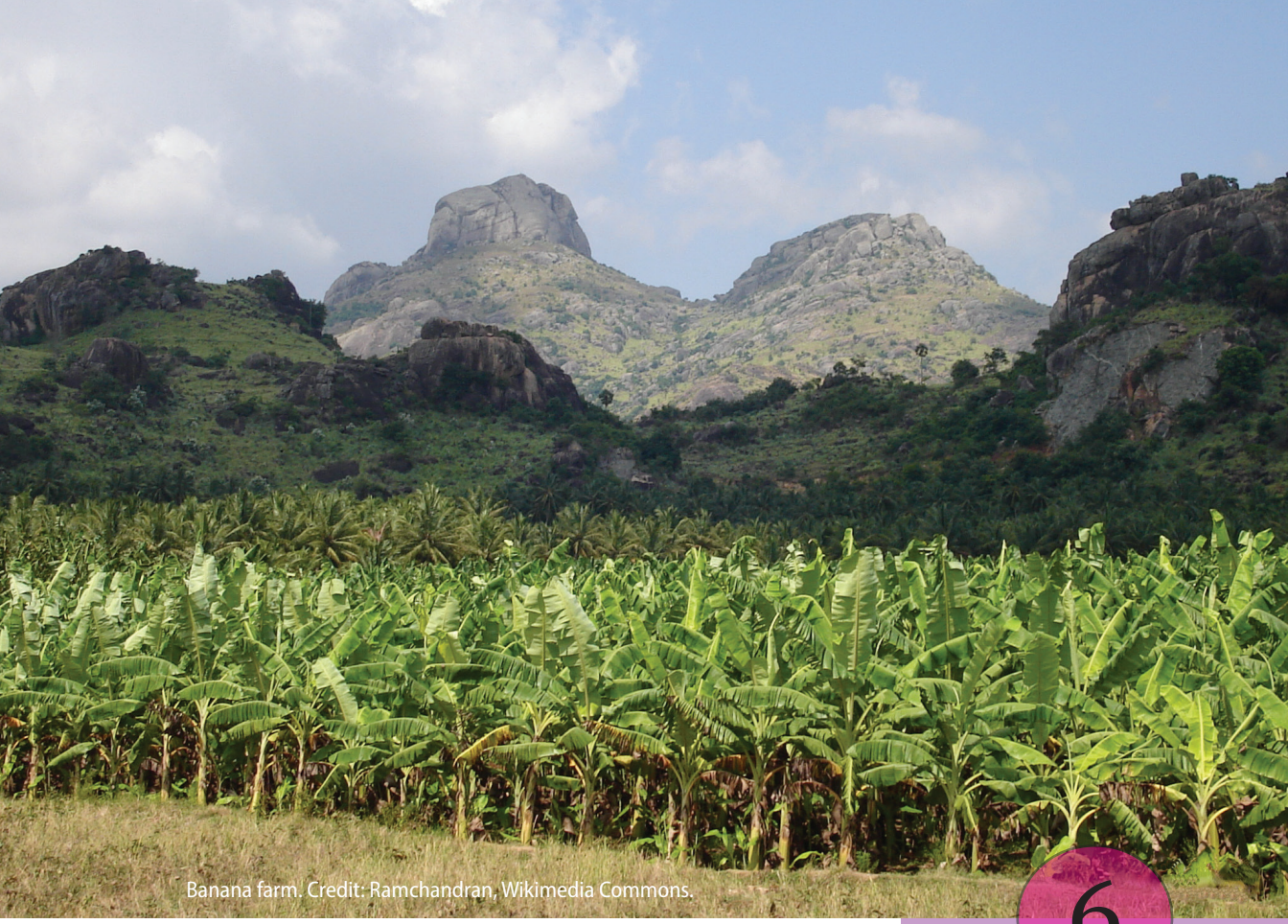

Banana farm. Credit: Ramchandran, Wikimedia Commons.

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Perspectives and prospects for tropical island agriculture: The Anglophone Caribbean

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ABSTRACT

This chapter provides perspective on the parallel development pathways of Anglophone Caribbean SIDS from a ground-level vantage point. The antecedents that have determined the current ownership structure and focus of island agriculture are

reviewed in terms of plantations, post-independence agriculture, and the forays into foreign exchange earnings through commercial, export-oriented agriculture. The issues associated with island agriculture and its ability to feed residents and visitors are discussed in the context of commercial versus subsistence designations. The climate change era and its impacts on agriculture are traced from the Barbados Programme of Action through to the Caribbean Community Climate Change Centre's involvement. Efforts to separate agriculture from the Agriculture, Forestry, and Other Land Uses (AFOLU) designation, and the Paris Climate Agreement serve as a precursor to note the climate-determined future of agriculture. This chapter concludes with the prospects for island agriculture and the case for optimism.

INTRODUCTION: PERSPECTIVE, PARALLEL PATHWAYS, PLANTATIONS, POLITICS, PROSPECTS

Perspective is invariably dependent on the vantage point. The views and recollections of the observer or chronicler will be skewed or biased by their vantage point. The perspectives offered in this chapter come from ground-level involvement in Anglophone Caribbean island agriculture. As such, they are decidedly skewed from the inside looking out to the wider world. There are shared parallel underdevelopment pathways that unite and typify these islands that lend themselves to collective assessment. The major islands range in size from Jamaica (11,188 km^2) to Nevis (93 km^2) and national population densities from Barbados (659 per km^2) to The Bahamas (37 per km^2) (Maximay, 2015). These are interrelated statistics that predetermine much of the very nature of island agriculture.

These islands were regarded as colonies for exploitation and not for expansion of the realm (Bardoe, 2019; Meneketti, 2021). Consequently, agricultural raw materials were the primary resources exploited, leading to the prominence of plantations as a means of organizing island agriculture up to the 1960s. The initial absentee landlord arrangements were superseded by multinational corporations (Johnston, 2016). Anglophone Caribbean agriculture was dominated by raw material production (sugar, bananas, cotton, cocoa, coffee) on plantations that invariably occupied the most suitable arable land (Gumbs, 1981). Given their small size and population densities, non-plantation agriculture was often relegated to less-than-optimal landscapes (ECLAC, 2004; Canterbury, 2007).

The late 1950s and early 1960s marked an era of political activism, colonial de-shackling, and moves towards independence from Britain that literally changed island agricultural landscapes (Khan, 2007). Workers' Rights, as more than a *cause celebre* kindled in the extractive industries during the 1930s, became an issue for plantation workers and their political leaders (Harris, 2002). Labour-focused politics highlighted the exploitative nature of several plantation operations and accelerated

calls for change in ownership patterns of prime arable lands (Canterbury, 2007). Post-Independence plantation-styled operations had a profound impact on island agriculture and provide a segue to considerations of its prospects.

Despite its chequered past, Anglophone Caribbean island agriculture has endured. The agricultural sector has survived crises of political, medical, economic, and environmental ilk (Barker, 2012; Canterbury, 2007; Caribeean Development Bank [CDB] & Food and Agriculture Association [FAO], 2019). The prospects for the future are promising given the global recognition of island vulnerability, the United Nations Declaration on the Decade of Family Farming (2019–2028), the centrality of agriculture in adaptation and mitigation strategies, enhancement of island ecosystem services, and the advocacy of organizations such as the Global Island Partnership (GLISPA).

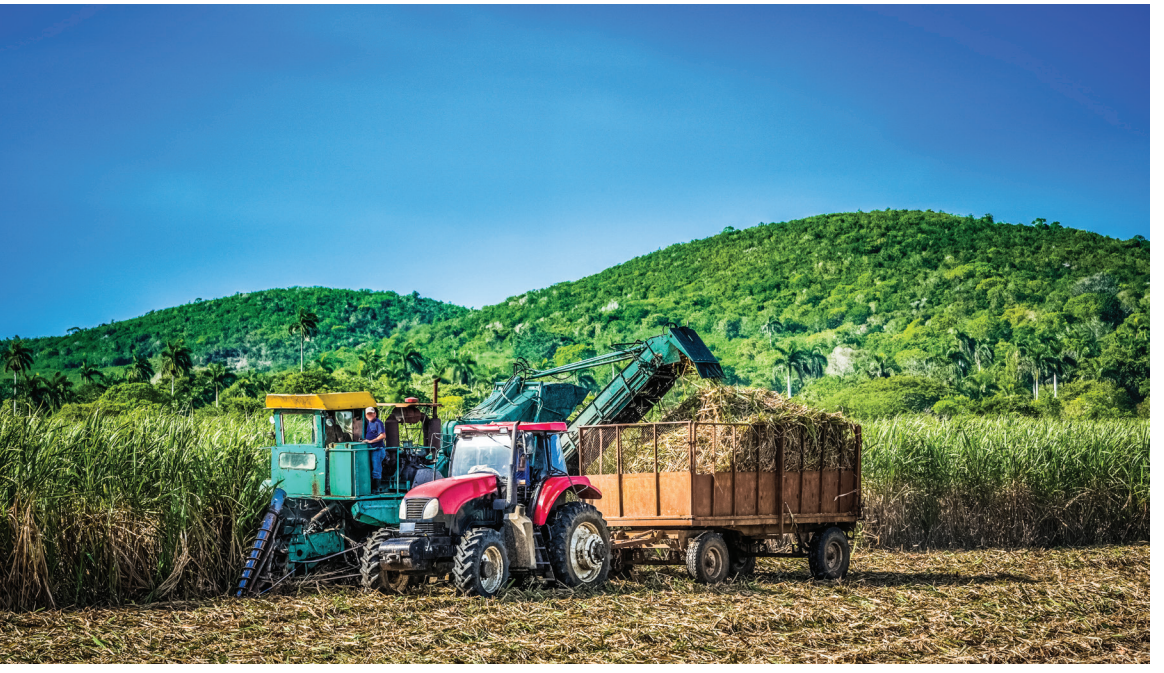
PLANTATION ERA AGRICULTURE

Twentieth-century Anglophone Caribbean island agriculture was dominated by export crop plantations. The plantation had a significant hold on the socio-economic, cultural, and environmental landscape (Mintz, 1965; Horowitz, 1971). Apart from the foreign (or locally privileged) ownership, there were commonalities with respect to labour and task-based work, field and post-harvest technologies, limited sharecropping, off-season land use by estate workers, and a heavy dependence on imported food (Mintz, 1965). A brief review of the plantation is necessary to appreciate the endemic issues that circumscribe island agriculture in the Anglophone Caribbean.

The development and maturation of island societies and economies in the Anglophone Caribbean have been fundamentally determined by the plantation era and the inequalities and inequities created by slavery and colonialism. A process that had its roots post-emancipation gave rise to modified rural land use patterns and agrarian structures that reflected different though still unjust social arrangements (Potter et al., 2004). In the Caribbean of the post-emancipation period, there emerged a local peasantry made up of ex-slaves who left the sugar plantations and established independent communities, called free villages, with economies based on small-scale agriculture and other informal activities such as small-scale retailing, fishing, and charcoal burning (Beckford & Campbell, 2013).

With export agriculture based on sugar still dominant, there developed in the twentieth century a two-tiered agricultural system. This system featured a large-scale export-oriented sector based on traditional plantation crops like sugarcane and banana juxtaposed with a small-scale farming sector focusing on domestic food crops (Beckford & Campbell, 2013). These food crops were the staples in local diets and local cuisine and were the markers for what is now deemed food sovereignty (Thompson, 2019).

Prior to the labour rights activism mentioned earlier, post-slavery plantations



Harvesting sugarcane in Santa Clara, Cuba. Source: Mabofoto, Adobe Stock.

were feudal arrangements. Some plantations or estates had their own 'police service' primarily for property protection but who would often adjudicate on infractions within the boundaries of the estate. Although individual islands were relatively small, the plantations were organized for large-scale commercial production of an export crop. Monocropping as the major business activity inculcated a pest control mindset that promoted chemical-based solutions to eradicate the threat (ECLAC, 2004). It would be several decades before island agriculture accepted pest management as opposed to pest eradication (Donovan & Poole, 2008; CDB & FAO, 2019).

The plantations were created to supply a distant market with a highly specialized product, at first mainly sugar but later others, like coffee or cotton. The plantation often grew food to feed its own workers, but at times the entire output of the estate was exported. This meant that the society was dependent on long-distance trade to carry off the crop and to bring in supplies and food. When this happened, more of its total consumption and production was carried by long-distance traders than in any other part of the world economy of the time (Kendall & Petracco, 2009).

This pattern of dependence on imported food reflects less of a failure of local small farmers to produce, as it does of the power dynamic and political might of plantation owners. Any discussion on the unique nature of Caribbean island agriculture must be tempered by an understanding of the ownership, operating ethos, and profit-maximizing focus that characterized plantations.

The typical post-slavery plantation was a type of commercial farming where a single

crop is grown in a large area. The following are some noteworthy characteristics of plantations that still raise discordant notes with national agricultural policy and aspirations in 2023. Plantations demanded very large areas (in relative terms for small islands). Capital-intensive inputs were routinely used; contiguous villages or population enclaves provided the labour force; and all the produce was used as raw material in respective industries. The development of plantations is the result of a well-maintained network of transport and communication, connecting plantations to markets, often with the intended consequence of constraining the other production tier. This duality has persisted and characterizes agriculture in some of the islands where the transition to post-independence agriculture has been incomplete (Beckford & Campbell, 2013).

POST-INDEPENDENCE AGRICULTURE

Independence, variations of full internal self-governance, and anti-colonial sentiments presented an amalgam of forces that shifted land ownership from the earlier foreign (or locally privileged) controlled plantations to state or locally owned large farms (Jainarain, 1975). Historically, agriculture played a central role in the Caribbean economies. Large plantations of especially sugar and bananas produced agricultural commodities for export (Beckford & Campbell, 2013), thus representing an important sector of the economy. Anglophone Caribbean island agriculture is more diversified than in the latter days of traditional plantation production (FAO & CDB, 2019).

The terms of trade for traditional commodities, following successful challenges at the World Trade Organization, reduced the extent and quantum of preferential treatment protocols (Clegg, 2005). Reforms of the EU agricultural policies had a dramatic effect on export demand for sugar and bananas and stimulated a restructuring of farming systems and a shift of exports from raw materials (agricultural products) to processed food products (FAO & CDB, 2019).

Prior to independence, all agricultural efforts were geared towards maximizing raw material production. Local small farmers were operating at subsistence levels whilst the emphasis of the state agricultural entities was on export crops (Hope, 1981). With independence and varying degrees of internal self-government in the Anglophone islands, there were concerted efforts to create a commercial small farmer class (Williams & Smith, 2008). Ministries of Agriculture, complete with Extension Divisions, were given the mandate to boost local production. Resident experts, trained for plantation-scale operations, were asked to provide farm management and business development services. The significant small farmer populations were encouraged to modernize their operations with the promise of yield and quality increases over traditional techniques (Donovan & Poole, 2008). The Green Revolution initiated the concepts of high-yielding varieties that required a regimen of crop production that

consumed substantial agrichemical inputs (Singh, 2000). It became quite clear that factor productivity was a key determinant of success. Thus land, capital, cultivar, labour, and technology were paramount.

The introduced technologies included hybrid seeds which disrupted common practices like partial retention of yield for subsequent crops (Curry, 2022). Uniform yield and quality were not guaranteed from these second-generation seeds. The 'tech packs' of bundled technological practices were actively promoted by the state, private sector, and academic institutions (e.g., IPS Cuba, 2021; Muthie, 2023).

INTRODUCED TECHNOLOGIES included hybrid seeds which disrupted common practices like partial retention of yield for subsequent crops (Curry, 2022). Uniform yield and quality were not guaranteed from these second-generation seeds.

Within the farming communities on the islands, the early adopters were viewed as progressive and modern. The returns on investment for this agrichemical-based production encouraged the development of cadres of strictly commercial farmers (Allard, 2012). Decision-making was inextricably linked to technical feasibility and economic viability. Choice of crops was now primarily based on projected returns and documented yields from other jurisdictions, especially those countries providing hybrid seeds and high-yielding varieties (Allard, 2012).

The shifts towards commercialization were not accomplished uniformly throughout the Anglophone islands. Those countries with a high percentage of early adopters soon added marketing and storage as Public Sector services (e.g., National Agricultural Marketing and Development Corporation Trinidad and Tobago; Barbados Agricultural Development and Marketing Corporation; Guyana Marketing Corporation). In some countries, (e.g., Guyana, Jamaica, and Trinidad and Tobago) production based on prevailing prices led to scarcity-glut cycles. Thus, the state got involved as a buyer of last resort, with the expectation of leveling the production peaks and troughs (Demas, 1987; Canterbury, 2007). Given the freedom to produce the crops of their choice, the majority of the decisions went the way of higher net returns.

Prior to the 1970s oil and energy crises, this heavy dependence on agrichemicals primarily sourced from petrochemicals afforded notable increases in factor productivity in keeping with the commercial aspirations of farmers. Those islands, such as Barbados, St. Vincent, and Trinidad, where traditional exports were still a major feature of smallholder production did relatively well. The oil crisis heralded a period of price increases for petrochemicals-based agrichemicals as well as for national and international transportation. With the notable exception of the twin island Republic of Trinidad and Tobago which boasted a mature petroleum sector, island economies struggled (Dippel & Khadan, 2018). Smallholder commercial farming was negatively impacted. Those farmers who were heavily indebted ran the risk of losing their holdings.

Jamaican coffee farmer in the Blue Mountains. Source: Paul Dober, Wikimedia Commons.

By the 1980s, the stratification within the Anglophone islands was firmly established; there was a cadre of local commercial farmers duly recognized by the state. One of the limiting factors in this agricultural technology-driven operation was water management. As small islands, there were few natural surface stores like lakes. The recharge of groundwater depends on catchments and watersheds. Historically, most of the prime arable lands would have been incorporated into plantations. Independence and self-government meant significant changes in patterns of land ownership, with the state becoming a major landowner (CDB & FAO, 2019). In many instances, private speculators pitted potential purchasers against one another with respect to residential, commercial, industrial, or agricultural interests (IICA, ECLAC & FAO, 2012).

This post-independence cadre of commercial farmers was primarily involved in vegetable and fruit production involving imported and improved seed, targeting their evolving local markets. This era of commercial production was accompanied by shifts in agricultural education (Pemberton, 2005). The sole island-based regional university added what was the Imperial College of Tropical Agriculture to its Jamaica Campus. The Faculty of Agriculture at the St. Augustine, Trinidad campus had the mandate to train agricultural scientists with a focus on national agricultural development in the former colonies. Its predecessor was a world-famous training institution for scientists working throughout the tropical British Empire.

The existing post-secondary island-based institutions included the Jamaica School of Agriculture and the Eastern Caribbean Institute of Agriculture and Forestry. Anglophone Caribbean nationals also attended the Guyana School of Agriculture on the South American mainland. These institutions were already making adjustments in curricula and focus to cater to national agricultural efforts that extended beyond the traditional export crops and providing raw materials.

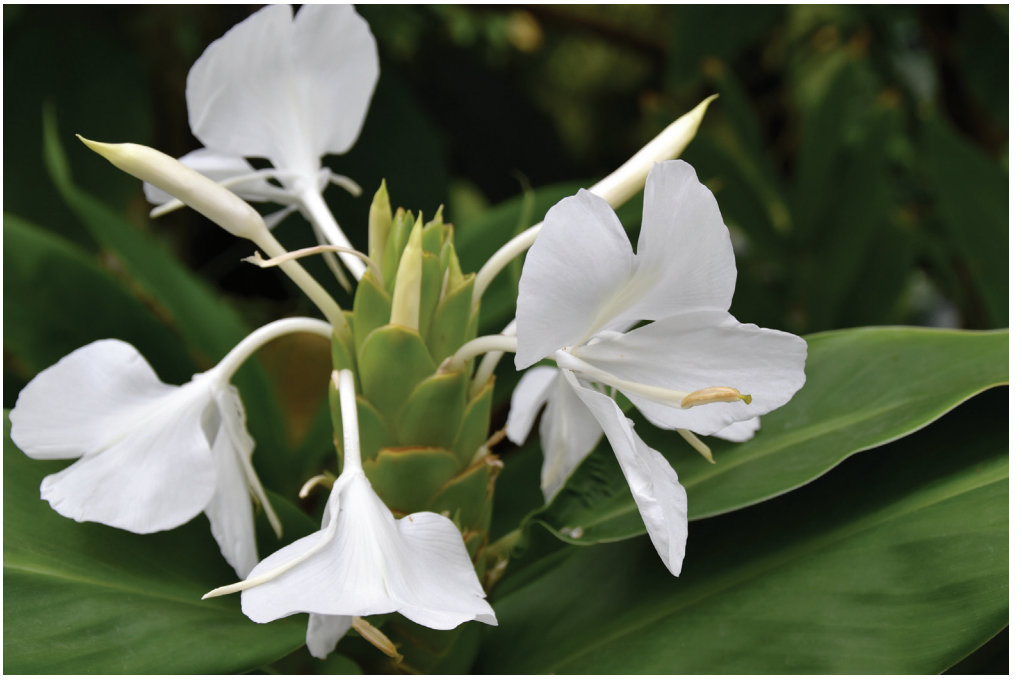
Commercial agriculture, by definition, is market focused. Most of the islands under consideration have minuscule domestic markets. The realities of island agriculture based on imported inputs and technologies necessitated access to foreign exchange at the personal and state levels. These island countries had fledgling new currencies

that were not traded globally, hence the need for foreign exchange to settle accounts. Whether operations were state or private sector financed, there was always the need for internationally traded currencies. Island commercial agriculture is increasingly focused on exports and earning foreign exchange (CDB & FAO, 2019).

EXPORTS, FOREIGN EXCHANGE, AND SERVICES

Given the small domestic markets and the imperatives of earning foreign exchange to sustain Anglophone island agriculture, concerted efforts were made to export non-traditional crops (Clarendon, 1994; Donovan and Poole, 2008). This wave of so-called diversification efforts provided a rational path to the complementary development advocated by Sir Arthur Lewis. His "Industrialization by Invitation" model was premised on the complementary development of the local agricultural sector (Downes, 2004).

Various islands approached diversification differently, from a knee-jerk reaction to the collapse of traditional exports (e.g., Trinidad and Tobago and Jamaica) to economy-wide linkages with industry and tourism (e.g., Belize and Barbados). One of the more comprehensive efforts was the Agricultural Diversification Coordinating Unit, headquartered in Dominica but serving the Eastern Caribbean States. Export protocols, grades and standards, market information systems, and producer training were all part of the mandate. The choice of crops for the diversification programs included non-traditional food crops and non-food products like anthuriums and ginger lilies.



Ginger lilies. Source: Nasser Halaweh, Wikimedia Commons.

By the late 1980s, Anglophone Caribbean islands still had examples of agricultural sectors that were characterized by over-dependence on a small number of export crops, mainly sugar and bananas. Sugar in Barbados, St. Kitts, and Nevis, Jamaica, and Trinidad and Tobago where exports represented between 54% and 95% of total agricultural exports, while in Dominica, Grenada, St. Lucia, and St. Vincent and the Grenadines, banana exports accounted for between 22% and 82% of total agricultural exports (Demas, 1987). The diversification efforts were stymied by an admixture of cultural, socio-economic, and political overlays (Barker, 2012).

The intricacies embedded in these attempts at diversification within the agricultural sector were comprehensively articulated during a 1987 address to the Board of Governors by the then President of the Caribbean Development Bank (CDB), Mr. William Demas. He made eight observations at that time that are still relevant 36 years later:

1. The complexity of the agricultural diversification process demands that countries take a holistic view. Attempting to deal with any single factor such as credit availability, marketing, technology, land distribution and tenure systems, macro-economic policies or infrastructure, without simultaneously dealing with the others is likely to be unsuccessful.

2. The far-reaching effect that macro-economic policies have on the agricultural development process. He was particularly concerned that the regional governments recognize the central role that prices play in the process.

3. Inadequacies in agricultural marketing systems and methods act as a serious constraint to the increase of food production for local and regional consumption.

4. Both regional and national efforts should go hand in hand in the transformation and diversification of Anglophone Caribbean agriculture.

5. An all-out effort by regional governments should be made to rationalize and coordinate agricultural research work being carried out by national bodies and by regional institutions.

6. CDB should intensify its role in lending and providing technical assistance for agricultural diversification; and more effectively coordinate and rationalize all the many forms of financial and technical support available from multilateral and bilateral sources of support.

7. A brighter future for Caribbean agriculture depends crucially on the entry of younger and reasonably well-educated people into full-time agricultural activity

organized along business lines.

8. The West Indian public will have to accept that a greater degree of local and regional import substitution and replacement in food and agriculture will most likely entail in some cases somewhat higher prices for the food they consume, since so much of the food which is imported is highly subsidized by the developed country exporters (Demas, 1987).

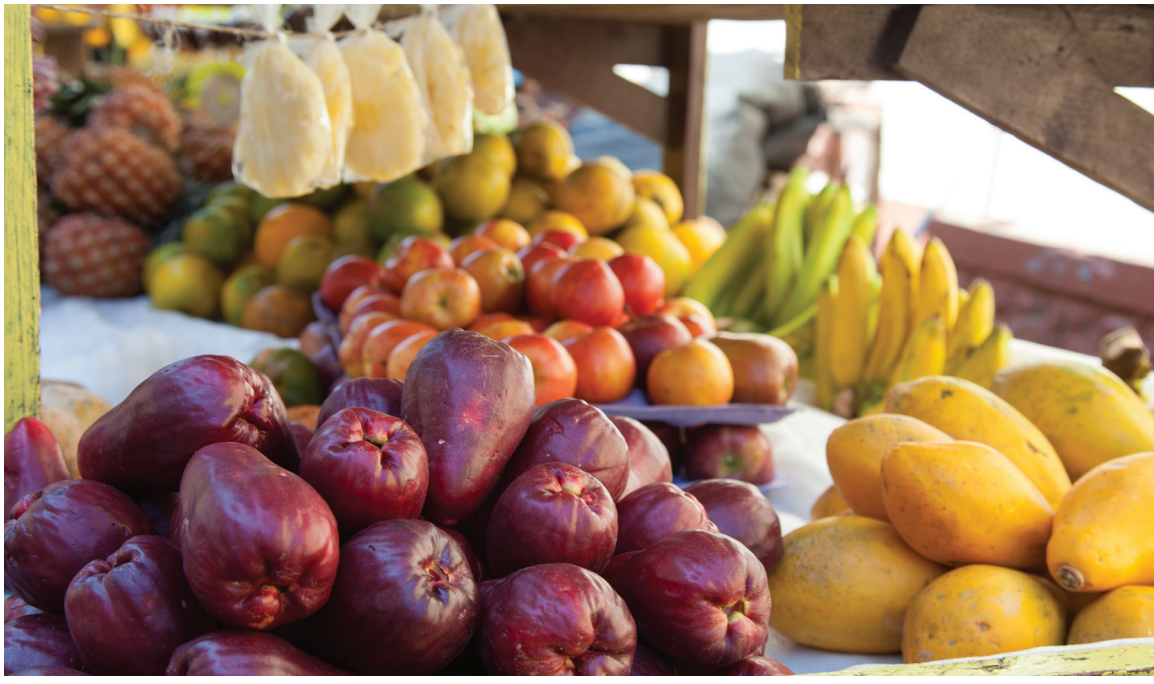
The islands of the Anglophone Caribbean have continued to wrestle with these issues especially that "a greater degree of local and regional import substitution and replacement in food and agriculture will most likely entail in some cases somewhat higher prices for the food they consume" (Demas, 1987). That issue has prompted a longstanding debate on the mechanisms and policy mixes that should be employed to feed island populations.

FEEDING ISLAND POPULATIONS

Feeding island populations involves more than the provision of the daily calorific requirement per person. Nutrition insecurity is bad for everyone, but even more so for the poorest (Siddiqui et al., 2020). The first thing families with low income do during food deficits is switch to cheaper food that fills stomachs but is usually less nutritious (Harrington et al., 2009). When nutritional needs are not met, people have lower productivity and inadequate nutrition has irreversible effects on children's physical and mental development (Burunciuc, 2022). The islands of the Anglophone Caribbean are not immune to these concerns and repercussions. Agriculture has not always been equated with food production on those islands; export earnings previously assured the means and wherewithal to import the needed food (Kendall and Petracco, 2009). Given its orientation to the use of imported inputs and demands on foreign exchange earnings, commercial agriculture was never really conceived as the major source of local food (Kendall & Petracco, 2009).

The 2007–2008 world food crisis heralded another round of enthusiastic attempts to address the ongoing disconnect between on-island food production and total dependence on imports (CDB & FAO, 2019). There was an acknowledged inability of small islands to be totally self-sufficient with respect to the provision of food (Demas, 1987). However, total dependence could be avoided by boosting local production in nutritionally focused areas. If a major carbohydrate source was ascertained through root crops, breadfruit, or banana/plantain cultivation; dependence could be limited to the other prominent food groups (CDB & FAO, 2019).

Official island policy ranged from acknowledging near-total dependence to aggressively promoting import substitution (Kendall & Petracco, 2009). The twin island



Local fruit for sale by the street in Falmouth, Jamaica. Source: Alison Toon, Adobe Stock.

Republic of Trinidad and Tobago exemplifies the former approach. Policy was dictated by what the government and Central Bank deemed "Months of Import Cover" which translated to the national cash holdings divided by the modal food monthly import bill. Thus, when the Government said the country has "11 months cover," all things being equal if the country did not earn an additional penny, they could safely import food for another 11 months. A statement on 2 September 2022 entitled "The Domestic Economy (2019–2022) and Short-term Outlook" by Dr. Dorian M. Noel, Deputy Governor, Central Bank of Trinidad and Tobago included this quote: "On the external front, Trinidad and Tobago continued to record healthy current account surpluses (4.4 percent of GDP in 2019) and net official reserves was roughly US$7 billion (7.7 months of import cover)."

Predictably during the 2008–2009 crisis, it mattered precious little; if the money was available, the food wasn't. Countries that were traditional food exporters restricted or curtailed exports (Deuss, 2017; Pisanto, 2017). The lessons not learned then would place the islands in a similar position when the COVID-19 pandemic limited world trade for two years in 2020–2021.

Over the years, island governments and policymakers have been urged to jumpstart agricultural production (Demas, 1987; Jainarain, 1975; Kendall and Petracco, 2009). Following exposure to natural hazards that damage food systems, it is critical for governments to provide short-term relief to prevent loss of life and livelihood while laying the foundations for long-term economic growth. Larger islands in the

region (Jamaica, Trinidad, Dominica) have the potential to develop and strengthen competitive value chains for niche and high-value products, for example, fruit and vegetables of nutraceutical significance, seafood, and spices. To reduce post-harvest losses and boost export revenues, islands could also benefit from investment in agro-processing, smart contracts, and logistic services.

Prior to the pandemic, local producers in the Eastern Caribbean islands produced approximately one-third of the demand from the hospitality and tourism industry; global estimates for tourism arrivals in the Caribbean suggest modest increases beyond 2023, hence there is a larger unrealized potential (Burunciuc, 2022). International financial institutions active in the Caribbean (e.g., World Bank and International Monetary Fund) have suggested that with financial support and investments in upgrading production systems, agro logistics, and marketing, domestic farmers could consistently supply fresh and minimally processed food all year round and receive better prices, reemphasizing the earlier prescriptions that assumed the availability of foreign exchange would assure food availability.

By far the most comprehensive approach involves Climate-Smart Agriculture solutions that could include the use of high-yielding crop varieties and animal breeds resilient to heat, drought, pests, and diseases, coupled with climate-proof irrigation and drainage infrastructure, as well as sustainable land management. If adopted, these solutions have the potential to transform the Caribbean's agri-food systems (Simpson, 2012; UWI & IICA, 2019). The University of the West Indies (UWI) and the Caribbean Agricultural Research and Development Institute (CARDI) have actively promoted the comprehensive Climate-Smart Agriculture Compliant (C-SAC®) tool, mobile app, and branding standard as one route to achieving comprehensive CSA benefits. A free use version of the app can be found at https://csac.uwiclimatetools.tech/

THE CLIMATE CHANGE ERA

Any examination of island agriculture in the Anglophone Caribbean could be segregated into pre- and post-independence/colonialism, subsistence and commercial, or pre- and post-climate change awareness. The climate change era in the Anglophone Caribbean unofficially started in 1998 when an agriculture representative from The UWI Faculty of Agriculture began liaising with the Caribbean Planning for Adaptation to Climate Change (CPACC).

In 1994, Barbados hosted the Global Conference on the Sustainable Development of Small Island Developing States. The resulting Barbados Programme of Action (BPoA) focused on sustainable development through adaptation to climate change impacts. In response to the BPoA, The Organization of American States (OAS) and islands of the Caribbean Community (CARICOM) jointly organized a series of national and regional workshops to facilitate maximum stakeholder consultation on climate

change issues. The result was a proposal for the Caribbean Planning for Adaptation to Climate Change (CPACC) project (1997–2001). The goal of the CPACC project was to build capacity in the Caribbean region for adaptation to climate change impacts.

The CPACC achieved a series of goals that heralded the region's official and structured response to climate change (Maximay, 2015). A major achievement was the articulation of national climate change adaptation policies and implementation plans in 11 participating countries. The absence of comparable data across individual CARICOM states was an impediment that CPACC was able to highlight and began to reduce, through improved access and availability of data. An integrated database for the monitoring of climate change effects and the institutionalization of coral reef monitoring made systematic analysis a new possibility. The Inventory for Coastal Resources provided useful information on the links between land-based agriculture and marine ecosystems. A total of 18 sea level and climate monitoring systems were installed in 12 countries. The sea level rise data provided the means to investigate the salinization of aquifers and its eventual impact on crop production and animal husbandry. The very first workshop reviewing the impacts on agriculture and the water sector was convened in Trinidad in 2002.

ANY EXAMINATION OF ISLAND agriculture in the Anglophone Caribbean could be segregated into pre- and post-independence/colonialism, subsistence and commercial, or pre- and post-Climate Change awareness.

There was a period from 2002 to 2010 when climate change issues were not seen as of critical significance. However, in 2010, Dr. Michael Taylor coined the Taylor truths at the Caribbean Week of Agriculture in Grenada: "Climate Has Changed. Climate Will Change. Climate Demands Change." Reviews of climate change and agriculture were featured in the subsequent years of 2011, 2012, and 2013 on specific themes. In 2011, there was an Anglophone Caribbean island scientist at the 17th United Nations Framework Convention on Climate Change (UNFCCC) Conference of the Parties (COP17) in Durban as part of The Food, Agriculture and Natural Resources Policy Analysis Network (FANRPAN)-led lobby to have agriculture considered in the negotiations as an item on its own, unlike previous meetings that involved AFOLU.

The Paris Climate Agreement and subsequent Green Climate Fund (GCF) programs have ensured a well-documented commitment to Climate-Smart Agriculture (CSA) by all the islands. Yet, there is no unanimity as to what a comprehensive CSA project or operating protocol should entail. There has been no shortage of CSA-themed projects in all the islands whether organized or delivered by local entities like Ministries of Agriculture or Non-Governmental Organizations (NGOs); regional institutions like CARDI; or international like the International Fund for Agricultural Development (IFAD), The Food and Agriculture Organization of the United Nations (FAO), The InterAmerican Institute for Cooperation on Agriculture (IICA), and the European Union

Jamaican farm worker in outdoor agricultural field watering lettuce garden. Source: Debbie Ann Powell, Adobe.

Development Funds (ERDF).

Climate-Smart Agriculture (CSA) has been repeatedly described by the FAO (FAO 2014, 2018, 2021, 2023) as a systematic approach to agricultural development intended to address the related issues of food security and climate change from multiple perspectives, ranging from field operations to national policy. Climate-Smart Agriculture is meant to (1) improve food security and agricultural productivity and (2) increase the resilience of farming systems to climate change through adaptation, whilst (3) capturing potential mitigation co-benefits.

Global attention continues to focus on CSA as one of the approaches to mitigate, or adapt to, climate change. The proliferation of projects claiming to fit the CSA designation has led to a degree of skepticism in some quarters (e.g., Dinesh et al., 2015; Chandra et al., 2018; Newell & Taylor, 2018; Taylor 2018), not least amongst them being the GCF. In the absence of a truly comprehensive Climate-Smart Agriculture that incorporates an auditing and certification scheme, skepticism remains rife. One adaptation or mitigation feature may not be enough to qualify an agricultural operation as being Climate-Smart. Consequently, a more holistic perspective can lead to a determination of the level of compliance with respect to Climate-Smart Agriculture.

Increased competition and comparative intensity of needs will make a rational assessment of proposed and ongoing projects exceedingly difficult. The Climate-Smart Agriculture Compliant (C-SAC) designation is a trademarked mechanism for determining the degree of Climate-Smart Agriculture compliance, with respect to proj-

ects, processes, and products. This certification and auditing scheme can be used to compare projects, processes, and products to justify the applicability and quantum of Climate Change Funding (grant and/or loan).

This scheme is structured with due cognizance of concerns about how the Global Climate Change funds will be disbursed. The C-SAC designation is meant to be a prioritizing tool with a holistic interpretation of the perceived benefits of Climate-Smart Agriculture. It can be used as a preliminary filter to sort through the number of "greenwashing" projects that may get funded under the rubric of climate-smart agriculture—all in a bid to access the millions of dollars that should go to help small and genuinely progressive farmers operating from tropical islands such as those in the Anglophone Caribbean. The C-SAC designation provides bankers and project managers with an easy-to-use tool to ensure funded projects really comply with a broad interpretation of Climate-Smart Agriculture.

Increasingly, the agriculture policymakers in the islands of the Anglophone Caribbean are accepting the reality of a climate-determined future. Production, trade, processing, utilization, and disposal of agricultural products all must be viewed through a climate change and emissions reduction lens.

THE CLIMATE-DETERMINED FUTURE OF AGRICULTURE

Every aspect of agriculture will continue to be determined by climate. At the farm and productive unit level, climate will dictate what can be profitably grown, and where, when, and how it can be raised. The range of climate impacts already experienced has moved all stakeholders in the Anglophone islands closer to the observed reality of a climate-determined future.

It took Hurricane Ivan in 2004, which was responsible for an estimated $101 million Eastern Caribbean dollars' worth of damage (Maximay, 2015) to the agricultural sector in Grenada, to bring extreme weather events to the fore of regional attention. The direct involvement of international agricultural organizations such as FAO and IICA augmented the efforts of CARDI and the CPACC follow-up project. The political, environmental, and scientific communities were beginning to take note, so much so that the University of the West Indies increased its research remit and offerings of study programs specifically linked to climate change.

For any crop, the effects of increased temperature will depend on the crop's optimal temperature for growth and reproduction. Whilst most tropical crops tend to grow faster in warmer conditions, there are compensatory shifts from vegetative to reproductive growth that can affect the yield of the marketable product (Driedonks et al., 2016; Sthapit et al., 2012). By investigating the agronomic and organoleptic results from germplasm accessions originating in climate analogs (Dwivedi et al., 2017), adaptive strategies were initiated. Many weeds, insect pests, and fungi were expected

to thrive under warmer temperatures, wetter climates, and increased CO2 levels (Kocmánková, et al., 2009). These caused new problems for farmers on crops previously unexposed to those threats. Moreover, increased use of pesticides and fungicides was not recommended considering their impact on human and environmental health (Sarkar, 2021).

Livestock husbandry involving ruminant animals showed a shift in preferred stock from cattle to sheep and goats as the Caribbean warms up (Maximay, 2015). Even small changes in temperature will be sufficient to have a relatively large effect on beef cattle operations (Joy et al., 2020). Smaller farmers are expected to be more resilient because they can shift to goats and sheep that can tolerate, to some extent, upward temperature shifts (Maximay, 2015).

WHILST MOST TROPICAL crops tend to grow faster in warmer conditions, there are compensatory shifts from vegetative to reproductive growth that can affect the yield of the marketable product (Driedonks et al., 2016; Sthapit et al., 2012).

In dairy animals, heat stress reduces the amount of milk produced, reduces milk fat and protein content, and decreases reproduction rates. High-producing dairy cows are the most susceptible to increases in the temperature-humidity index (THI), the scale used to measure heat stress (Liu et al., 2019). Other intensively housed livestock animals such as chickens and pigs are susceptible to heat stress. Observed responses include reduced feed intake, reduced egg laying, and reduced fertility levels (Lara, 2013).

Intensive pig and poultry industries in the Caribbean islands rely heavily on cereal grains from temperate countries as their principal feed type (Maximay, 2015). Climate changes have affected the traditional grain industries, which will put pressure on the pig and poultry industries in terms of feed availability and price (Zhang et al., 2022).

Marine and aquatic fisheries will continue to be affected by long-term global climate change caused by a combination of natural processes and human impacts, such as the emission of greenhouse gases. Climate change impacts are likely to amplify natural variations and exacerbate existing stresses on marine fish stocks, notably fishing pressure, diminishing wetlands and nursery areas, pollution, and UV-B radiation. In the oceans, climate change is expected to continue to result in increases in sea surface temperature, global sea level rise, decreases in sea-ice cover, and changes in salinity, wave conditions, and ocean circulation (IPCC, 2021).

International fisheries can be characterized on a global scale as being fully utilized, so much so that there are sharp conflicts between fleets and among competing uses of marine ecosystems (Spijkers, 2020). On land, climate change will affect the availability of water, rates of river flows, the size of man-made and natural lakes, and the demand for water in other activities competing with fisheries. These changes in turn will have an impact on the biological productivity of aquatic ecosystems and on

fisheries. The consequences of El Niño type of phenomena that sets off cyclical warming of surface waters off the South American coast will be more detrimental to inland aquatic resources (IPCC, 2021).

Climate change impacts are also being recorded on key types of agriculture-related infrastructure such as roads, bridges, irrigation channels, sluice gates, telecommunication and water lines, and purpose-built buildings (IPCC, 2021). The major threat posed would be that of severe weather events that could flatten buildings, destroy roofs, and undermine foundations. The higher frequency of droughts and severe precipitation events will increase the risk of flooding and erosion. When coupled with more severe storms, the use of impervious surfaces amplifies flooding risks by diverting stormwater into concentrated flows. Flooding and erosion continue to damage transportation infrastructure, interfere with traffic, and cause severe economic disruption. More frequent flooding also poses numerous public health concerns that require further investments in infrastructure to avoid cesspit overflows, stagnant mosquito breeding sites, and translocation of vermin.

The articulation of the climate change impacts by scientists, activists, and representatives (elected and self-appointed) who are citizens and residents of the Anglophone Caribbean islands are the subject of this ground-level perspective. Their knowledge provides the platform to recognize the prospects for the region.

PROSPECTS: THE CASE FOR OPTIMISM

In 2023, there is a pervading sense of recognition that there will be a 'Just Transition' within the agricultural sector in the Anglophone Caribbean islands. The UNFCCC, during the COP27 meeting in Egypt in 2022, agreed to place the long-sought issue of 'Loss and Damage' on the agenda, and there was some traction on the value of this topic.

The islands of the Caribbean Community (CARICOM) are no strangers to transitions, especially those that have been decidedly unjust. These Small Island Developing States (SIDS) have had to make political transitions from colonialism to independence, economic transitions from plantations to private farms, and Industrialization by Invitation (Bennett, 1973; Caldentey, 2007). The more recent transition is environmentally driven around issues of climate change. The concept of a 'Just Transition' with respect to climate change implies that all those citizens disadvantaged by adaptation and mitigation actions will be buffered through socio-economic programmers that protect livelihoods.

The international discourse on 'Just Transitions' has been focused on the energy sector, and in that respect, CARICOM is still fossil fuel dependent. The transition from fossil fuels to renewables is on the agenda of every state. The transitions being considered internationally tend to be mitigation-based and will involve reducing the carbon

footprint of all the sectors of economic importance. The situation in SIDS (like those in the Caribbean) is more dire; agricultural production will continue to be negatively impacted by climate change (Ortiz, et al., 2021), leading to forced adaptation-driven transitions. These transitions also need to be addressed in a 'just' manner because the nutrition security of these nations will be significantly compromised.

The optimistic outlook stems from cascading interventions, conventions, and adequately funded projects. Land and soil have always been the bedrock of agricultural production, and the impacts of climate change alluded to earlier in this chapter pose serious challenges to the sustained utilization of both, whether within the agricultural sector or without. Land degradation has implications for infrastructure and the built environment as well as agricultural production. The Anglophone Caribbean islands have been recognized as pioneers under the United Nations Convention to Combat Desertification (UNCCD).

All the Caribbean Small Island Developing States (CSIDS) are parties to the UNCCD and UNFCCC, participating actively in the COPs and the activities of both conventions. Under UNCCD, CSIDS are actively engaged in the Land Degradation Neutrality (LDN) Programme of the Global Mechanism. These islands are at the forefront of the Partnership Initiative for Sustainable Land Management (PISLM). The following is an excerpt from a 2021 meeting on "Advancing the Design of a LDN Transformative Project/Programme in Caribbean SIDS for Climate Change Mitigation and Adaptation."

> Representatives of the GCF secretariat, the UNFCCC Regional Collaboration Centre (RCC) at St. George's and the Global Mechanism of the UNCCD provided an overview of:
>
> GCF financial modalities and ongoing support provided for relevant initiatives in the region, including guidance to formulate multi-country funding proposals.
>
> Current climate change mitigation and adaptation priorities set by CSIDS in their Nationally Determined Contributions (NDCs) and National Action Plans (NAPs) highlighting the relevance of the AFOLU sector and land-based interventions.
>
> The status of the LDN target-setting process in CSIDS and related implementation efforts that require support. The country delegates shared information on the national priorities for climate change mitigation and adaptation, LDN targets and GCF financing.
>
> (United Nations Convention to Combat Desertification, 2021)

Optimism is vested in the realization that the governments and publics at large of these small islands understand the enormity of the task and are prepared to meet the challenge. The Managing Director of the GM highlighted that the CSIDS have always

understood the real importance of safeguarding land capital, since for small island states every hectare of healthy land is a precious resource.

The Caribbean is being effectively served by the Caribbean Community Climate Change Centre (CCCCC). Through its role as a Centre of Excellence, the CCCCC supports the people of the Caribbean as they address the impact of climate variability and change on all aspects of economic development.

Tropical island agriculture received another fillip stimulus when the UN declared 2019–2028 the Decade of Family Farming. A number of projects in keeping with that declaration are being implemented by the FAO, the UN agency with responsibility for agriculture. There are significant opportunities for the strengthening of farmers' organizations and the policy and other support for family farms. The Farmers' Organizations for African, Caribbean, and Pacific (FO4ACP) project is one such example. The project includes services for capacity building and selected training for farmers' organizations.

THE CARIBBEAN SMALL Island Developing States have always understood the real importance of safeguarding land capital, since for small island states every hectare of healthy land is a precious resource.

Agencies like IFAD have been promoting and supporting smallholder development in the Anglophone CSIDS. The Climate Smart Agriculture and Rural Enterprise Programme (SAEP) is a six year programme (2018–2024) funded by IFAD, the Caribbean Development Bank (CDB), and the Government of Grenada. It is focused on assisting beneficiaries to improve their livelihoods through skills training, investments in agriculture, teaching Climate-Smart practices, and providing business skills training and technical services to rural enterprises in the rural communities throughout the state of Grenada. That programme produced the first CSA manual for 4H students in SIDS, providing guidance for the next generation of agricultural producers.

The Anglophone Caribbean also has access to a disproportionately large per capita resident pool of expertise in climate change and agriculture at the University of the West Indies (augmented by mainland Universities in Guyana and Suriname), at CARDI, CCCCC, several island-based tertiary level institutions, and consulting firms. By way of example, the UWI launched its internationally endorsed "Global Institute for Climate-Smart and Resilient Development." Professor Michael Taylor, a lead author on the Intergovernmental Panel on Climate Change (IPCC) heads the renowned Climate Studies Group Mona (CSGM) with several breakthrough reports and tools to its credit. Dr. Dale Rankine, also of the CSGM, is an internationally recognized developer of climate models that can potentially revolutionize island agriculture.

The nexus between agriculture and health has been reemphasized on the heels of the climate crisis and the COVID-19 pandemic. Yale University in collaboration with regional institutions hosted a "Conference on Climate Change and Health in Small

Island Developing States: Focus on the Caribbean." There was a dedicated session addressing climate change, agriculture, and health. Apart from another round of talks about the reduction of the islands' food import bill, there are indicators that the 2022 announcement of "25 by 2025" will be more than just a slogan. The Heads of Government within CARICOM have declared their intention to reduce the regional food import bill by 25% by the year 2025. The call for an upsurge in region-wide climate-smart agriculture has been sounded. This too augurs well for smallholders in the islands.

Prospects for the future of Anglophone Caribbean Island Agriculture are skewed towards optimism, given the interlocking initiatives, the history of resilience (in the truest sense of the word), the engaged stance at the global level, repositories of tested and proven expertise, and global leadership of an Anglophone Caribbean Islander as Executive Secretary of the United Nations Framework Convention on Climate Change.

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