

CARIBBEAN AGRICULTURE IN A PERIOD OF GLOBAL CHANGE: VULNERABILITIES AND OPPORTUNITIES

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ABSTRACT

Agricultural trends in the insular Caribbean are increasingly shaped by global change. Global change is characterized by two components, globalization and environmental change. Specifically, we can identify stresses and shocks associated both by economic trade liberalization, and the impacts of environmental hazards. In the latter case, an apparent increase in extreme weather conditions (notably unpredictable periods of prolonged drought and of intense rainfall) are possible harbingers of climate change. These forces have impacted both export agriculture and domestic food production throughout the region. In this paper, we document the performance of the agricultural sector in the context of these external forces. One focus of attention is the ability of small-scale farming systems to cope with, and adapt to, external change, drawing on their traditional knowledge. Opportunities for Caribbean agriculture are also evident through overseas niche markets and alternative trading networks like fair trade.

Keywords: global change, vulnerability, hurricane impacts, export agriculture, small-scale farming

RESUMEN

Las tendencias en el desarrollo agrícola en el Caribe insular están cada vez más sujetas a los cambios globales. Estos cambios globales se componen de dos elementos, globalización y cambios ambientales. Podemos identificar concretamente las tensiones y los impactos que conllevan la liberalización del comercio y los impactos de peligros ambientales. En lo referente al último caso, el aparente aumento de las condiciones climatológicas extremas (en especial períodos impredecibles de sequía prolongada y lluvias intensas) representa un posible presagio de cambios climáticos. Estos factores han repercutido en toda la región tanto en la agricultura para la exportación como en la producción doméstica de alimentos. En este artículo documentamos el rendimiento del sector agrícola en el contexto de estos factores externos. Uno de los focos de atención gira alrededor de la capacidad de los sistemas agrícolas a pequeña escala de adaptarse y enfrentar el cambio externo haciendo uso de los conocimientos tradicionales. Además, hay

oportunidades evidentes para la agricultura caribeña a través de nichos de mercados en el extranjero y redes comerciales alternativas como el comercio justo.

Palabras clave: cambio global, vulnerabilidad, impactos de huracanes, agricultura de exportación, agricultura de pequeña escala

RÉSUMÉ

Les tendances, en matière de développement agricole dans les îles de la Caraïbe, sont de plus en plus relatives aux changements globaux. Ces changements globaux se composent de deux paramètres: la globalisation et les changements environnementaux. Nous pouvons identifier de façon particulière les tensions ainsi que les impacts liés à de la libéralisation du commerce et les aux risques environnementaux. En ce qui a trait à ces derniers, l'augmentation apparente des conditions météorologiques extrêmes (précisément lors des périodes spéciales de sécheresse prolongée et de pluies intenses) représente de possible présages de changements climatiques. Ces facteurs ont eu des répercussions sur toute la région, spécialement sur l'agriculture d'exportation ainsi que sur la production locale alimentaire. Dans cet article, nous présentons des informations sur le rendement du secteur agricole en prenant en compte ces facteurs externes. Une attention particulière a été accordée à la capacité des micro-exploitations agricoles de s'adapter et de faire face aux les changements externes, en utilisant des connaissances traditionnelles. En outre, il y a des opportunités évidentes pour l'agriculture caribéenne à travers des niches de marchés à l'étranger et des réseaux commerciaux alternatifs, comme le commerce équitable.

Mots-clés : changement global, vulnérabilité, impacts des ouragans, agriculture d'exportation, micro exploitation agricole

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Environmental and Economic Vulnerability

The historical vulnerability of Caribbean agriculture due to the region's legacy of colonialism and plantation economy is well established. Under colonialism, new agricultural landscapes were created, but rampant soil erosion and land degradation were unintended side effects which undermined the agricultural resource base and eventually had negative impacts on sugar production (Watts 1987) and smallholder agriculture (Richardson 1992). Vulnerability resulting from colonial dependence on overseas metropolitan markets is dramatically illustrated by the region's economic malaise in the second half of the

nineteenth century, when world sugar prices collapsed due to the withdrawal of tariff protection for West Indian sugar and the promotion of European sugar beet, among other things (Richardson 1992). Over the last two decades, agriculture has entered a new era of vulnerability which has affected export crops and domestic agriculture alike. The forces driving these contemporary vulnerabilities are both *economic* and *environmental*. Economic vulnerability arises from policies of neo-liberalism and trade liberalization, the globalizing world economy and, more recently, world recession. Heightened environmental vulnerabilities are the result of a series of extreme meteorological events that have impacted the region's agriculture and may be the harbingers of climate change.

We use the term *global change* to characterize these dual forces which are rooted in macroeconomic and global environmental processes. Global change can occur in the form of *shocks* and *stresses*. Shocks are fast onset, abrupt events while stresses are more gradual conditions that develop over a longer period of time. Examples of environmental shocks are a hurricane strike and an earthquake, while erosion and land degradation or shifts in seasonal rainfall patterns are examples of environmental stresses. Examples of economic shocks include currency devaluations and sudden changes in world commodity prices, while persistent rural out-migration and poor marketing and infrastructure are illustrations of economic stresses.

Drawing on an analogy taken from photography, O'Brien and Leichenko (2000) use the term "double exposure" to refer to situations where "exposure units"—individuals and households, social groups and communities, places and regions—can be impacted by environmental change and by economic globalization. These double impacts result in both winners and losers (O'Brien and Leichenko 2000, 2003). Losers are exposure units that experience the negative effects of environmental change and simultaneously experience the negative effects of globalization. Winners emerge when there are simultaneous positive impacts that arise from the interplay of economic change and environmental change. Taken together positive and negative impacts can increase and polarize social and economic inequalities between individuals, social groups and places, or regions.

One definition of vulnerability is "the degree to which an exposure unit is susceptible to harm due to exposure to a perturbation or stress, and the ability of the exposure unit to cope, recover, or fundamentally adapt" (Kasperson and Kasperson 2001). Chambers (1989) argued that vulnerability has an external and an internal component. The external component comprises the stresses and shocks outlined above. Thus agricultural vulnerability is a condition that occurs after environmental shocks like impact of hurricanes or storms, which destroy crops and

damage livelihood assets. An economic shock like a sharp increase in fertiliser prices or a collapse in market prices also will have negative impacts on crop production and livelihoods. Stress-related agricultural vulnerability arises from more long-term conditions such as drought and land degradation, or rural poverty and farmers' lack of access to land or credit. On the other hand, Chambers (1989) characterises the internal component of vulnerability as the lack of means to cope with shocks and stresses without incurring damaging losses, including economic and social impoverishment and dependency. The lack of means to cope reflects the capacity of the exposure unit to respond, and this, in turn, may be analyzed using concepts such as resilience, coping strategies and adaptive capacity (Adger, Arnell and Tompkins 2005). Thus, as Leichenko and O'Brien (2008:10) argue, environmental change and economic globalization can influence both exposure to shocks and stresses and the capacity to respond to them.

Exposure to shocks and stresses and the resultant agricultural vulnerability has another analytical dimension; it can be examined at different geographical scales. At the regional scale, agricultural vulnerability can apply to the entire Caribbean region as a geopolitical entity, for example in discussion about regional food security. It can apply to single country or a sub-regional grouping such as the Organization of Eastern Caribbean States (OECS). At this geographical scale, vulnerability issues may focus on national economic development, social welfare, and the generation of foreign exchange. Finally, vulnerability has relevance at the scale of local communities and households within a country. At this scale, impacts may be disproportionately worse (or better) than for the country at large because global change can lead to differential spatial and social impacts even within in the context of a geographically small island or territory.

In this paper, we examine the environmental and developmental impacts of climate change and economic globalization on Caribbean agriculture, at the national and the local scales of analysis. Highlighting the shocks and stresses which have increased vulnerability and responses to these external forces, selected examples illustrate both negative and positive impacts of global change and capacities to respond. In the majority of cases, vulnerability to global change has resulted in negative impacts. However, a few examples document positive responses (especially to new marketing opportunities) despite persistent negative shocks and stresses from hurricane strikes and drought. The examples reported here are compiled from several sources: agency reports and current academic literature on Caribbean agriculture; interpretation of data largely derived from the FAOSTAT data base; and recent empirical research undertaken by the author in collaboration with other scholars.

Contemporary Change in the Caribbean Agricultural Sector

Potter *et al.* (2004) highlight the structural transformation of Caribbean economies in the second half of the twentieth century. Economies formerly dependent on export crops such as sugar and bananas developed mass tourism in the post-Independence period, and economic bases shifted from agriculture to the service sector. The long-term regional decline of agriculture is epitomized by the retreat from sugar. Today, Cuba remains the dominant producer of sugar cane. But even in Cuba, tourism overtook sugar as the main foreign exchange earner in the 1990s. There was a further contraction in output between 1999 and 2009, from 34 million to 11.9 million tonnes. The second and third ranked sugar producers, Dominican Republic and Guyana, maintained production levels over this period; but Jamaica and Haiti, fourth and fifth ranked sugar producers, also experienced declines. Of more symbolic significance, the governments of St. Kitts and Nevis, and Trinidad and Tobago joined the list of Caribbean countries which have disengaged from sugar since Independence. St. Kitts closed its sugar industry in 2005 after a 300-year history, while Trinidad finally said farewell to sugar in 2007, having closed the main Caroni sugar factory in 2003. The European Union (EU) had imposed a huge cut in sugar subsidies for Trinidad and other African, Caribbean and Pacific (ACP) producers which hastened the demise. The critical factor underpinning the regional demise of sugar has been economic globalization and the dismantling of protective international trade. Basically, relatively high cost Caribbean producers are unable to compete effectively with large scale producers like Brazil (Ahmed 2004).

A consequence of the decline of agriculture is that its relative contribution to Gross Domestic Product (GDP) has declined in all Caribbean countries over the past 20 years (Table 1). It is noteworthy however that agricultural employment remains proportionately more important to most Caribbean economies than its contribution to GDP, although Barbados and Bahamas, with relatively small agricultural labor forces, are exceptions. In the year 2000, Cuba and Haiti still had more than 2 million people working in agriculture; in Haiti's case, this represented more than 60% of total employment. In the Dominican Republic and Jamaica there are another 600,000 and 260,000 people working in agriculture, representing around 15% and 20% of their respective labor forces. Once family members of farmers and agricultural workers are included, the number of people directly dependent on agriculture in the Caribbean region clearly exceeds 10 million, more than a quarter of the region's population.

Though agriculture has been in decline, the proportion of total land area devoted to agriculture has not changed significantly during the period 1987-2007 for most Caribbean countries (Table 1). There are

Table 1. Summary statistics relating to changes in Caribbean agriculture

Country	%GDP agriculture 1990	% GDP agriculture 1997	% GDP agriculture 2006	% employed agriculture 2000***	Agricultural land as % of land area 1987****	Agricultural land as % of land area 2007****
Antigua & Barbuda	4.2	4.1	3.3	25.0	29.5	29.5
Aruba					11.1	11.1
Bahamas	2.3	2.7	1.6	3.8	1.2	1.4
Barbados	5.4	5.3	3.4	4.1	44.2	44.2
Belize	20.0	17.6	14.0	30.1	4.9	6.7
Cuba		6.2 *	3.8*	20.0	61.2	60.3
Dominica	25.0	19.4	17.6	22.9	25.3	30.7
Dominican Republic		12.4 *	11.2 *	16.7	54.6	52.1
Guyana	38.1	35.4	31.8	17.6	8.8	8.5
Grenada	13.4	8.0	6.0	24.3	38.2	38.2
Haiti		29.0 *	24.8*	62.3	58.1	61.3
Jamaica	6.5	7.4	5.0	20.6	44.0	47.4
Montserrat	2.6	1.1	1.2			
Netherlands Antilles					10.0	10.0
Puerto Rico	1.4	1.0	1.0		52.1	21.3
St. Kitts & Nevis	6.5	5.5	2.6	21.1	46.2	19.2
St. Lucia	14.6	6.9	4.0	23.4	34.4	18.0
St. Vincent & Grenadines	21.1	10.1	7.7	24.0	33.3	35.9
Suriname	10.8	15.1	6.1	18.9	0.6	0.5
Trinidad & Tobago	2.5	1.8	0.4	8.7	13.8	10.5

Sources: CARICOM selected statistical indicators, 1997, 2002-2006.

* FAOSTAT,

** FAOSTAT 2002-2006,

*** FAOSTAT (Reported in Deep Ford & Rawlings),

**** World Bank Development Indicators.

a few exceptions, for example Belize and Dominica have experienced small increases in cultivated area while several countries have recorded significant declines in the amount of agricultural land. Puerto Rico, for example, experienced a 50% reduction in agricultural land. This process began in the 1950s as the economy shifted to an industrial and service base (Monk and Alexander 1985; López, Aide and Thomlinson 2001) while, in recent times, suburban development has given added impetus to the abandonment of agricultural land (Parés-Ramos, Gould and Aide 2008). The steep decline in agricultural land in St. Kitts reflects the closure of its sugar industry while the decline in St. Lucia is probably the result of declines in banana cultivation, though similar declines are not evident in St. Vincent or Dominica (Table 1).

Vulnerability of the Caribbean Agricultural Sector

The Caribbean region of small island developing states (SIDS) and their fragile agricultural sectors are especially vulnerable to global change (Deep-Ford and Rawlins 2007). Most of the region's small, open economies are highly dependent on international trade, food imports and export agriculture, all of which contribute to economic vulnerability. Their geographical location in a region prone to natural hazards like hurricanes and floods contributes to environmental vulnerability. Further, economic and environmental vulnerabilities interact in ways which amplify the associated risks for agriculture, partly because they impact on countries with relatively small land areas, high population densities, very limited amounts of good arable land, and fragile agroecosystems. Land degradation is widespread and, as indicated above, is an environmental stress that contributes to environmental vulnerability. Degraded hillside farming areas are especially susceptible to flood rains which cause further extensive soil erosion, landslides and other forms of mass movement (McGregor 1995). In Jamaica, 17 of 26 watersheds are classified as critically degraded (Potter *et al.* 2004). Haiti is the most extreme case of agricultural vulnerability resulting from land degradation. In the Greater Antilles, these vulnerable degraded upland farming regions are also the main areas of rural poverty (Barker 1993) yet make significant contributions to domestic food production and to export crops like yams and coffee.

Notwithstanding the significance land degradation, climate change is the new face of environmental vulnerability for Caribbean agriculture. The scientific literature has identified two emerging trends with regard to climate change in the region. The first is that the region's climate has measurably changed since the 1960s, with a rise in surface air temperatures and declining rainfall (Gamble 2009). Chen and Taylor (2002)

have suggested that early season increases in rainfall and drought events may be related to global El Niño/La Niña events. Generally, the climate is projected to become warmer and drier (Gamble 2009) but trends in temperature and rainfall change are not geographically uniform across the islands in the region. The second trend regarding regional climate change appears to be an increase in the intensity and severity of hurricanes, linked to the rise in sea surface temperatures. Mimura *et al.* (2007) note that the frequency of hurricanes has increased since 1995, and the year 2005 was the most active Atlantic hurricane season on record.

Both the changes in rainfall regimes and the impacts of hurricanes will affect domestic and export agriculture. For example, the amount of water available to food crops is likely to be reduced with increases in temperature because of increased evapotranspiration (McGregor, Barker and Campbell 2009). Campbell, Barker and McGregor (2011) argue that the increasing incidence of extreme weather conditions, the increasing temperatures and decreasing precipitation, and possible shifts in seasonal rainfall patterns, all point to an increasingly unpredictable and risky climate for farmers and the agricultural sector. Further, the likely impacts of climate change may vary significantly between the eastern, central, and western parts of the Caribbean Basin (see discussion in Gamble 2009).

Another aspect of the discourse on climate change is sea-level rise. In the Guianas, prime coastal locations are utilized for export crops like sugar cane and rice, and so are vulnerable to the longer-term prospect of rising sea levels and enhanced threats of inundation by swollen rivers in flood events. A portend may be the January 2005 floods in Guyana, which were the worst in that country's history (UNDP 2005) causing extensive damage to the rice and sugar crop.

There are new economic vulnerabilities too, rooted in the globalizing world economy and trade liberalization which have affected domestic food production as well as export agriculture. These impacts began to be felt with the onset of Structural Adjustment Programs (Dodman and Newstead 2008) and the progressive dismantling of protective trade barriers from the early 1990s. Caribbean countries traditionally have high food imports levels, especially of cereals, but trade liberalization ushered in a flood of cheap fresh food imports from North America. Many items in this new wave of food imports, like onions, red beans, and potatoes, are items produced by small farmers. Not surprisingly, trade liberalization had negative impact on local domestic food production and food security as well as export agriculture (Weis 2004). Data for Jamaica illustrate aptly the impacts of trade liberalization on domestic food production. Figure 1 illustrates the decline of domestic food production and food exports between 1996 and 2005. Domestic food production declined by

25% in 1997 due to severe drought, and has never climbed back to its 1996 peak. Significant year-on-year declines occurred in 2000, 2002, and in 2004. These declines were the result of lethal combinations of drought and hurricane events (McGregor, Barker and Campbell 2009), but the bounce-back from these events was never sufficient to bring domestic food production back to the levels of the mid-1990s.

Figure 1. Jamaican Agricultural Production Index, 1996-2005.



Source: Ministry of Agriculture, Jamaica.

Impacts of Tropical Storms and Hurricanes

There is some debate as to whether climate change will increase hurricane frequency and magnitude (Gamble 2009) but storm activity across the Caribbean basin has been particularly active over the last decade or so. National economic assessments of damage to agriculture following a hurricane or tropical storm provide ample evidence of their debilitating impact on national development and the potential threat of heightened cyclonic activity in the future. A single storm (depending on its path) can inflict considerable economic damage to several countries. This was the case in 1998 when Hurricane Georges destroyed 90% of the agricultural sector in the Dominican Republic and Haiti, 95% of Puerto Rico’s banana crop and 50% of St. Kitts’ sugar crop. Another example was Hurricane Ivan in 2008 which devastated the Cayman Islands and

caused J\$8.5 billion damage to Jamaica's agricultural sector. But it was Grenada that suffered the most severe economic losses and social dislocation from Ivan, with damage equivalent to 2x the annual GDP, 89% of the housing stock destroyed (OECS 2004) and damage to agriculture of some EC\$45 million.

Nutmeg is Grenada's leading agricultural export and the island is the world's second largest exporter after Indonesia. Before Ivan, there were some 6,500 nutmeg farmers and more than 30,000 people (out of a population of 110,000) who relied on nutmeg as an income source. The hurricane damaged 90% of nutmeg trees and the cultivated area of nutmeg was reduced by 29%, while national production declined by more than 60%. Cocoa is Grenada's second largest agricultural export and that was also badly damaged. Cocoa is often grown as an understory crop, in combination with nutmeg, an environmentally and economically sustainable agro-forestry system. Unlike bananas (which can fully mature in less than 12 months if replanting is undertaken quickly after a hurricane strike), both nutmeg and cocoa take several years to recover from severe wind damage. Thus, it took three years for nutmeg acreage and production to recover to pre-Ivan 2004 levels. Given that Grenada's banana exports never recovered from the declines of the 1990s, recent policy is directed towards rehabilitation of the nutmeg sector where there are currently only 2,500 active nutmeg farmers (International Trade Centre 2010).

While Caribbean agriculture always has been disrupted by tropical storms, 2005 was the most active hurricane season on record. Further, in the last decade, several very active hurricane seasons have occurred within a relatively short space of time. Another active season was 2008, when Haiti was hit by an unprecedented series of four slow-moving, high rainfall tropical storms, Fay and Hannah, Ike and Gustav. They caused estimated damage of US\$900m, equivalent to 15% of GDP, and around 70% of the country's crops were destroyed. There was widespread flooding and loss of life in Gonaives in northern Haiti (World Bank 2009). At the time (two years before the 2010 earthquake) these events constituted Haiti's worst natural disaster. It is also significant that in April of 2008, before these calamitous storm events, world food prices spiked at levels never seen before and caused food riots in Port-au-Prince; in sum, a disastrous illustration of double exposure and the negative consequences of environmental and economic vulnerability.

Export Agriculture and Agricultural Vulnerability

The economic vulnerabilities of Caribbean export agriculture arising from the vicissitudes of the world economy are best illustrated by the

demise of export bananas in the Windward Islands (Klak *et al.* 2011). For a period after the Lomé Convention in 1975, Caribbean bananas enjoyed preferential access into the UK and were so lucrative they were known as “Green Gold”. Banana production peaked in 1990 but thereafter, as a result of the “banana wars”, production declined as the strictures of the World Trade Organization (WTO) gradually led to the dismantling of preferential entry into the region’s principal overseas market, the EU. Declines in production were matched by equally dramatic declines in the number of banana farmers. In 1994 for example, there were 23,100 banana farmers in the Windward Islands; by 2007 there were only about 4,000 banana farmers left.

Another example of “double exposure” to a combination of trade liberalization and tropical storms is the case of Jamaican export bananas. As in the Eastern Caribbean, the removal of preferential access to the EU market was eroding the competitiveness of Jamaican banana exports, but a sequence of three hurricane strikes in five years finally persuaded Jamaican Producers, the island’s principal exporter, to withdraw from the overseas market in 2008. Its two large banana estates in the eastern parishes of St. Thomas and St. Mary were wiped out by Hurricane Ivan in 2004, Hurricane Dean in 2007, and then Tropical Storm Gustav in 2008. In 2000 Jamaica exported only one-third of its annual crop compared to 99% for St. Vincent, 89% for Dominica, and 66% for St. Lucia, so Jamaica was less dependent on banana exports. But faced with huge economic losses of J\$2.6 billion (some incurred by a loss-making UK subsidiary selling fruit juices and smoothies), the company restructured its operations. Today it focuses on selling fresh bananas to the Jamaican domestic market, and has expanded into agro-processing in an emerging and lucrative Caribbean snacks market for banana, plantain, cassava, and sweet potato chips.

Adaptation to Global Change: Fair Trade and Niche Markets

An example of adaption to global change is the response of the Windward Islands to the plummeting banana production in the 1990s. Governments and agricultural institutions in the Windward Islands have tried to lock into new export opportunities offered by fair trade, to maintain a presence in their traditional UK market. Fair trade is an alternative international trading and marketing system based on alliances between consumer organizations in developed countries and producer associations in developing countries (Raynolds and Long 2007). It provides guaranteed prices for farmers in developing countries and includes a social premium which is paid through local farmers’ groups and invested in social, cultural, and environmental community development projects.

The first shipment of fair trade bananas to the UK left Dominica in the year 2000. Fair trade bananas seemed to offer new opportunities for export bananas that would protect the livelihoods of the small farmers and maintain foreign exchange inflows. By 2005, it was decided that all future banana exports from the Windward Islands would be fair trade (Momsen 2008) and a series of important institutional changes to the organization of banana production and export marketing were implemented to embrace fair trade. Thus, the Windward Islands Banana Development and Exporting Company (WIBDECO) was designated the regional marketer and distributor while the Windward Islands Farmers Association (WINFA) became the regional organization responsible for certifying farmers groups in each of the four islands. Each island has an umbrella organization which co-ordinates the activities of its respective island fair trade farmers groups. Table 2 shows that the number of fair trade groups in the Windward Islands increased over a 10 year period to 48.

Table 2. WINFA Banana Fair Trade Groups in 2007

Country	Membership (Number of farmers)	Numbers of groups
Dominica	858	17
Grenada	31	1
St. Lucia	1,300	13
St. Vincent & Grenadines	1,191	17
TOTAL	3,347	48

Source: WINFA.

Despite the early promise of fair trade, Table 3 illustrates that banana exports from the Windward Islands remain problematic. St. Lucia export volumes declined by about 17% between 2000 and 2008, whereas export production for St. Vincent and the Grenadines halved and for Dominica were reduced to one-third of the 2000 total. The value of banana exports for St. Lucia over the same period were unchanged at US\$21m, but export values declined from US\$18m to US\$8m for St. Vincent and the Grenadines and from US\$13m to US\$6m for Dominica. Tropical storms and hurricane threats remain omnipresent sources of vulnerability for banana exports, and in 2007 Hurricane Dean had a significant negative impact on the banana crop in the Windward Islands.

While at the national level, the shift to fair trade has not restored production and foreign exchange inflows to the levels prior to the onset of trade liberalization, a survey of 32 fair trade farmers in St. Lucia suggested that some benefits accrue at the community level through

improved farm incomes and the use of the social premium to implement community development and environmental programs (Fingall 2008). As part of a broad review of the fortunes of Windward Island banana production since trade liberalization (Klak *et al.* 2011) conducted surveys of 155 banana farmers in Dominica and St. Lucia (of whom 38 were fair trade farmers). They found considerable gaps between the development policy priorities of farmers and the impacts of these policies at the grassroots level. They also found evidence of diversification of income sources at the household level. Interestingly, attitudes of banana farmers still reflected the belief that central government should play a central role in banana production and many farmers held their own governments responsible for their deteriorating social and economic conditions (Klak *et al.* 2011:58).

Notwithstanding the fair trade initiatives of the Windward Islands, the response of the agricultural sector in the Dominican Republic to new opportunities in niche markets for banana exports as a result of economic globalization suggests that positive impacts (winners) can emerge, even in the context of double exposure. Table 3 shows that between 2001 and 2008 Dominican Republic banana exports volumes were fairly stable, around 40,000 metric tonnes, yet the value of banana exports more than doubled. This compares to a much smaller value increase for St. Lucia and declines in St. Vincent and Dominica. The reason is that the Dominican Republic has partially adjusted to trade liberalization by repositioning its agricultural exports. Not only has the Dominican Republic engaged with fair trade bananas, but more significantly, from the early 1990s it has been producing high value organic bananas, and has become the world’s largest supplier, accounting for 60% of the world market (Raynolds 2008).

Table 3. Caribbean Banana Exports

Country	2000		2008	
	Production (tonnes)	Value (1000 US\$)	Production (tonnes)	Value (1000 US\$)
Dominican Republic	79,004	19,755	192,363	71,152
Dominica	30,611	13,522	10,934	6,322
St. Lucia	50,072	21,836	41,215	21,770
St. Vincent & Grenadines	43,400	18,300	21,432	8,290
Grenada	705	221	0	0
Jamaica	40,900	21,200	40	37

Source: FAOSTAT.

Moreover, while fair trade is restricted to bananas in the Anglophone Caribbean, farmers and producer associations in the Dominican Republic are involved in a broader product range in fair trade and organic produce. Federación de Caficultores de la Región Sur (FEDECARES), for example, is a small holder association of 6,000 coffee growers founded after Hurricane David in 1979. Despite damage to coffee caused by Hurricanes Georges in 1998, and Hurricanes Noel and Tropical Storm Olga in 2007, the organization has forged a successful partnership with the UK fair trade organization Café Direct (CafeDirect.co.uk). The Confederación Nacional de Cacaocultores Dominicanos (CONACADO) is a co-operative of 182 fair trade cocoa producer associations, with 10,000 cocoa farmers (Fairtrade.org.co.uk). The Dominican Republic accounts for about two-thirds of the world's organic cocoa market. Moreover, the focus on organic cocoa has meant that production has encouraged a shift from low grade to high grade cocoa. This, in turn, is more environmentally sustainable because organic field practices require cocoa to be grown under the shade canopy of tall forest trees or food trees. It also contributes to livelihood diversification because it provides an additional source of income to cocoa farmers. Generally, the Dominican Republic has 14,000 organic growers and devotes 2% of its agricultural land to organic production (Raynolds 2008), a small but growing contribution to more sustainable farming in the region.

Local Farming Systems and Agricultural Vulnerability: Examples from Jamaica

Vulnerability scenarios for Caribbean agriculture are becoming increasingly complex. Drought appears to be a new source of vulnerability. The Caribbean region with its tropical maritime climate has two dry seasons, but there is evidence that the length, timing and duration of the main dry season is becoming more unpredictable, and the mid-summer drought (MSD) more severe (Gamble 2009). Moreover, over the last decade, an active hurricane season often has been preceded by, or in some cases, followed by a long period of drought. We noted above the four storm strikes on Haiti in 2008. These were followed by a lengthy drought which lasted into 2009. Jamaica suffered from the same drought, one of a number to have affected the island over the last ten years. Many of these droughts have occurred in the same year as a storm event which caused floods and wind damage (McGregor, Barker and Campbell 2009). Further, when domestic food production is affected by meteorological hazard, there is an inevitable upsurge in food imports to compensate ("double exposure" again), compounding the problem created by the onset of trade liberalization. Thus in Jamaica, following drought and

flood rains, food imports peaked at an all time high in 2008.

At the national level, there is generally an absence of data on the impact of drought on agricultural production (unlike the aftermath of a hurricane or tropical storm where national damage assessments are routinely conducted and compiled). However, there is new research at the community level in the Caribbean which has begun to document the impacts of drought. For example, Campbell, Barker and McGregor (2011) and McGregor, Barker and Campbell (2009) have documented the impacts of drought on farming systems in the southern section of the parish of St. Elizabeth, one of Jamaica's principal areas for domestic food production. Farmers sell produce in all the island's urban markets and major tourist resorts (Rhiney 2009). Yet it is also a rain shadow region, with average annual rainfall range between 650 and 800mm. and a main dry season lasting 4 to 6 months. Despite low rainfall, it is a major vegetable farming area because farming systems are finely-tuned to the environment. Farmers have adapted to these marginal environmental conditions by the ubiquitous use of guinea grass mulch and improvised irrigation systems.

But what happens to farmers and livelihoods when the farming environment, whose agricultural resource base is finely-balanced with few margins for error, is exposed to increasingly variable and unpredictable climate and weather conditions? Southern St. Elizabeth experienced a drought in the early months of 2004 followed by Hurricanes Charley and Ivan, both of which tracked just south of the island. Another extended seven month drought in late 2004 went into 2005 and resulted in serious bush fires and attendant crop damage, another source of vulnerability for this particular local area. Later in 2005, the area suffered the effects of Hurricanes Dennis and Emily and Tropical Storm Wilma. In 2007 the area felt the impact of Hurricane Dean followed by another drought, then Hurricane Gustav in 2008. An even deeper drought began in late 2008 and continued into 2009 and in 2010 the area was affected by one of the highest rainfall events ever recorded in Jamaica, associated with a weather system which developed into Tropical Storm Nicole.

Campbell (2011) has analyzed the differential impacts of hurricane and drought hazard on rural livelihoods in southern St. Elizabeth and how farmers there have tried to cope and adapt. Drought vulnerability is a more insidious external source of stress to farmers than the shock of a hurricane, but damaging losses are incurred from both. Some of the following examples are taken from a series of farm surveys and illustrate hazard impacts (McGregor, Barker and Campbell 2009; Gamble *et al.* 2010; Campbell, Barker and McGregor 2011). In one survey, farmers reported all crops were affected by the storm events of 2004 and 2005, but identified tomatoes, scallion, melons, and carrots as those most

affected. The list of crops most affected by drought was similar, though carrots were less affected and melons more so. In another survey of 282 farmers, 80% of the sample claimed they lost all their crops in Hurricane Ivan, but more than half of the same sample reported they lost all their crops again in the drought immediately after Ivan (Campbell 2011). In a survey conducted soon after Hurricane Dean, 72% of farmers lost more than 50% of their crops (McGregor, Barker and Campbell 2009). In the drought of 2007-2008 the majority lost over 50% of their produce, and melons and tomatoes were particularly badly affected (Campbell, Barker and McGregor 2011). Recovery from these disasters was problematic. Just over half of farmers said it took up to 6 months to recover from the events of 2004 and 2005, while another third said recovery took more than a year.

Farmers' knowledge and skills underpin livelihood strategies even though their financial resources are extremely limited. A key aspect of farming systems in southern St. Elizabeth is the use of mulching techniques, an adaptation to dry conditions which helps conserve soil moisture by reducing evapotranspiration, among other things. Mulching is central to farmers' traditional knowledge, skills and resourcefulness in coping with hazard vulnerability. Indeed, traditional knowledge has allowed Caribbean farmers to survive and adapt to change and adversity throughout the region's turbulent past and problematic present (Barker and Beckford 2006; Beckford and Barker 2007).

Though farmers are vulnerable, they are not passive in the face of adversity; they try to adapt and cope with changing conditions; they experiment and improvise, though not always successfully. In an effort to understand best farming practices during storm hazards, Campbell hunkered down with farmers during Hurricane Dean, and recorded what they did on the farm immediately before and after the storm (Campbell and Beckford 2009). Farmers' experiences and efforts to cope with drought also reflect limited options, so not surprisingly minimizing risk is the norm. Scaling back on production is a common adaptive response after a hurricane and also during a drought. Scaling back involves a reduction in the number and variety of crops grown and in the size of the cultivated area, by as much as 25% in a drought. Another strategy is to plant drought-tolerant crops (like scallion or sweet potato) in the dry season. Some farmers use a thicker layer of mulch. In the 2008 drought, more than 63% of farmers shared water with family or friends during the 2008 drought, a form of social capital (Campbell, Barker and McGregor 2011).

This Jamaican research clearly demonstrates the importance of indigenous knowledge in coping with climate change, a point emphasized in the latest IPCC report (IPCC 2007). When confronted by a hurricane

or a drought, Jamaican farmers rely on their traditional knowledge to help them try to cope with the event. Indigenous knowledge is incorporated into livelihoods strategies to reduce vulnerability to drought, and is used to guide their adjustments to planting methods, in utilizing moisture reducing strategies, and in scaling down production.

At the community level, farmers' personal resourcefulness, ingenuity and resilience help them to cope with the risk and uncertainty of natural disasters. However, when such events are compounded by uncertainties imposed by external economic conditions, such as price increase for agricultural inputs or competition from imported foodstuffs, then farmers' abilities to draw on local knowledge and experience to pull them through adversity becomes much more problematic. Southern St. Elizabeth, for example, was particularly badly affected by the flood of cheap food imports such as onions, carrots and red peas; onions are no longer grown in the area, so trade liberalization compromised the area's competitive position for some domestic food crops (Beckford and Bailey 2009).

Belatedly, several policy initiatives in Jamaica since 2007 have laid important foundations for domestic food security. These initiatives have lessons for other Caribbean countries. For example, there has been a concerted effort to create a more level playing field with respect to stemming the flow of imported food items which can be grown successfully in Jamaica. World Trade Organization rules allow for the identification and protection of vulnerable agricultural sectors, like domestic food crops produced by small farmers (Tufton 2009), so critical agricultural sectors have been ringfenced to try to protect them from food imports. Jamaica has renewed efforts to promote the consumption of local foodstuffs with an "eat what we grow and grow what we eat" campaign, a policy reminiscent of the self-reliance initiatives of the 1970s. Another strategy to promote nationwide farmers' markets is achieving early successes. Together, these policy initiatives seem to be paying dividends, at least in the short term, because the island's food import bill has fallen in value and volume since its 2008 peak, despite the continued unpredictable onslaught by adverse weather conditions.

Conclusion

Over the last 25 years, climate change and economic liberalization have emerged as significant global processes which have impacted agriculture in both developed and developing regions alike. In the Caribbean region, high-magnitude meteorological events and increasingly unpredictable weather patterns, together with market deregulation have disrupted agricultural development. Increased climate variability due to global warming and processes such as trade liberalization are the

external drivers of far-reaching changes in people's livelihoods, natural and human landscapes, and national economic development. Their causes are rooted in the impacts of a resource-hungry world economy on the natural environment but they combine in ways which amplify their impacts, especially in small island developing regions like the Caribbean.

This paper has illustrated how global change has doubly exposed Caribbean agriculture to new vulnerabilities by reviewing, through selected examples at the national level and the community level, the impacts of recent shocks and stresses on agricultural development and rural livelihoods. We also examined responses and adaptations to these processes in terms of national policy and local community initiatives and coping strategies. It was argued that, as the Jamaican case studies illustrate, farmers have only limited capacities to deal with heightened vulnerabilities, despite drawing on their local knowledge and skills to help them adjust to change. In the Dominican Republic and the Eastern Caribbean, institutions and farmers groups are seeking to take advantage of new opportunities in niche markets overseas to sustain agricultural exports and enhance rural livelihoods, through initiatives such as fair trade and organic produce. In Jamaica, there appears to be greater recognition of the need to increase domestic food production as way of achieving greater food security. However, in the Caribbean generally, the resourcefulness of farmers has not proven thus far sufficient to maintain sustainable livelihoods. Further policy interventions will be needed to buffer the impacts of global change.

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