Chapter 45
Reducing Vulnerability to Climate Change and Global Market Developments

Capacity Building and Knowledge Transfer for Smallholder Farmers in Small Island Developing States as One Means to Adapt to a Changing Environment: The Case of St Lucia

Franziska Mannke and Kathrin Rath

Abstract As many crops are sensitive to changes in temperature and precipitation, agriculture is especially vulnerable to climate events. This may prove critical in tropical regions where most agriculture is in rain-fed systems and climate change may have a potentially large influence on productivity. By adversely affecting food and water resources, climate change thus threatens progress and efforts made in poverty reduction, economic growth, and achievement of further Millennium Development Goals, such as ending hunger on our planet and achieving environmental sustainability.

The intensification of food production transformed formerly small-scale traditional systems to modern large-scale monocultures, e.g. in Latin America. However, banana monoculture production by smallholders is also found in many parts of the world, for example in countries such as St Lucia, which is a major banana-producing country in the Caribbean Windward Islands.

Mono-cropping farmers increasingly need to deal with the fact that modern intensive agricultural systems which are characterized by increased need for fertilizers and irrigation, i.e. nutrients and water, may become more sensitive to climate change in terms of lower productivity, higher vulnerability, and reduced sustainability in the future. Moreover, food systems in developing countries are currently experiencing enormous organizational changes, reflected in the ongoing reorganization of supply chains, ranging from farm to fork. Being at the end of the chain, particularly the small-scale producers have to cope with global consumers' demands, reflected in the necessity to deliver high-quality products on time and at competitive prices. These high requirements can represent a serious barrier to small farmers' participation in higher value chains, e.g. in the Caribbean Island of St Lucia. St. Lucia's farmers therefore need to diversify their production, e.g. by adopting fair trade production standards, and tap new domestic as well as niche markets by means of improved commercialization to sustain food security and poverty reduction endeavors.

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Considering that small island developing states like St Lucia, where agriculture still represents the backbone of a society increasingly have to face these two global challenges – globalized markets and climate change – and recognize their impacts already today, this paper will explore the future impacts of climate change on the Caribbean region, discuss the potential impacts of climate change for smallholder agriculture in St Lucia, and elaborate on the importance of information, training and capacity building, not only in terms of improved diversification and commercialization of agricultural produce, but also for raising the adaptive capacity of small-scale farmers in St Lucia by providing sustainable adaptation options for farm-level diversification in the light of climate change.

Keywords Adaptation strategy · Agriculture · Capacity building · Climate impacts · SIDS · St Lucia

Introduction

The impact of global warming can already be noticed in many parts of the world. According to the World Bank (2005: 16), given the extent of the impacts and the irreversible character of some of the climate change impacts, the Caribbean region needs to prioritize adaptation in its comprehensive climate strategy. Given that no adaptation takes place, the World Bank (2005: 23) estimates a potential economic impact of climate change on the Caribbean Community (CARICOM) countries[1] to range from US$1.4 to 9.02 billion. It is estimated that the largest category of impacts were loss of land, tourism infrastructure, housing, other buildings, and infrastructure due to sea level rise (Fig. 45.1).

Although the agriculture sector in the Caribbean region only contributes very little to the worldwide increase in greenhouse gases (GHG), agriculture as such is a major source of GHG and has fuelled climate change in many ways, e.g. through the conversion of forests to farmland and the release of greenhouse gases. According to expert opinion, agriculture contributes 14% of global emissions (UNFCCC 2009: 2). Seen from a different angle, climate change threatens to irreversibly damage natural resources on which agriculture depends. Some regions benefit in that moderate warming may slightly increase crop yields. Overall, however, negative impacts will most likely dominate: floods and droughts will become more frequent and severe. This is likely to seriously affect productivity on the farm level, impact the livelihoods of rural communities, as well as increase the risk of conflicts

[1]The Caribbean Community (CARICOM) comprises 15 Caribbean nations and dependencies. The organization promotes the economic integration and cooperation among its members and coordinates foreign policy.

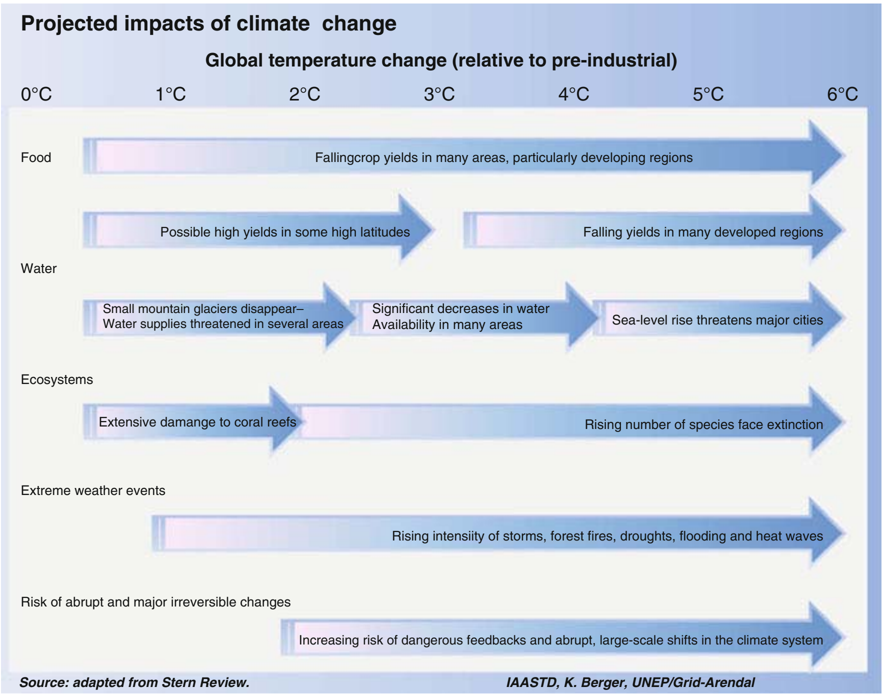

Fig. 45.1 Projected impact of climate change
Source: Stern (2005)

over land use and water resources. Furthermore, climate change contributes to the further spread of pests and invasive species and might contribute to increasing the geographical range of some diseases.

For the small island developing states (SIDS) of the Caribbean region, the impacts of climate change may lead to social impacts, as they are expected to affect all levels of rural poverty, trends in intra-national as well as international migration, the use of marginal lands, national food security, and foreign exchange earnings. As a vast majority of the Caribbean region's population relies on subsistence agriculture to at least a certain extent, the need to adapt to climate change becomes pressing, considering the impact of a changing climate regime on food production and supply (National Symposium on CC, p. 11).

The intensification of food production transformed formerly small-scale traditional systems to modern large-scale monocultures, e.g. in Latin America. However, banana monoculture production by smallholders is also found in many parts of the world, for example in countries such as St Lucia which is a major banana producing country in the Caribbean Windward Islands. In St Lucia as well as elsewhere in the world, mono-cropping farmers increasingly need to deal with the fact that modern intensive agricultural systems, characterized by increased need for fertilizers and irrigation, i.e. nutrients and water, may become more sensitive to climate change in terms of lower productivity, higher vulnerability, and reduced sustainability in the future.

Besides this, major structural changes in the worldwide agricultural industry, albeit mostly taking place in the developed countries, have far-reaching implications and may counteract efforts to develop the agricultural sector in less developed countries and, in particular, SIDS such as St Lucia. Food systems in developing countries are currently experiencing enormous organizational changes, reflected in the ongoing reorganization of supply chains, ranging from farm to fork. Being at the end of the chain, especially the small-scale producers have to cope with global consumers' demands, reflected in the necessity to deliver high-quality products on time and at competitive prices. These high requirements can represent a serious barrier to small farmers' participation in higher value chains, e.g. in St Lucia.

St Lucia's farmers therefore need to diversify their production, e.g. by adopting fair trade production standards, and tap new domestic as well as niche markets by means of improved commercialization to sustain food security and poverty reduction endeavors. In this respect, it is of key importance to consider the future impacts of climate change on agriculture and to develop adaptive capacity among the affected groups of society in order to enable them to cope with the challenges of climate change.

For purposes of this paper, adaptation will solely be viewed in terms of raising the adaptive capacity of social systems with particular attention paid to the agricultural sector. In this context, raising the adaptive capacity of small-scale farmers is therefore concerned with (a) an improved anticipation of future climatic changes, i.e. knowledge transfer and capacity building, and (b) the optimization of production systems to reduce exposure to loss of yields or to exploit new crop growing opportunities, e.g. agricultural diversification and improved commercialization.

Impacts of Climate Change in the Caribbean Region

The impact of global climate change is manifold: heat and droughts as results of global warming in parts of the world, changed rainfall patterns often combined with extreme weather events and natural disasters such as hurricanes and floods, as well as sea level rise due to the melting of polar caps. All regions worldwide are affected by climate change and have to more or less adapt to the situation.

Although only contributing very little to the global greenhouse gas emissions (GHG) which are responsible for global warming, particularly SIDS, such as the island states located in the Caribbean, have to struggle with the effects of climate change. SIDS in general only have a limited spatial size surrounded by large expansion of ocean, they only have limited natural resources as well as limited water resources. SIDS have already been facing high susceptibility to natural hazards and extreme events such as hurricanes and storm surges. The economies of small islands have the problem of extreme openness which makes them highly sensitive to external market shocks. Furthermore, SIDS have only limited financial and human resources (Nurse and Sem 2001: 845).

Due to these characteristics, SIDS, including all Caribbean islands, only have marginal adaptation capacities. This means, they have only little capacity to make "adjustments in (their) ecological, social or economic systems in response to actual or expected climate stimuli, their effects or impacts" (Nurse and Sem 2001, in Ministry of Physical Development Environment and Housing 2005: 11). In addition, they have less capability to recover from extreme events. SIDS are therefore highly vulnerable to the threats caused by the effects of climate change and sea level rise.

The climate in the Caribbean region is characterized by dry winters and wet summers with the dominate influence of the North Atlantic subtropical high (NAH). During winter, the NAH lies further south with strong easterly winds modulating the climate and weather in the region (UNFCCC 2005: 7). Temperatures in the total region vary in from 28°C in the hotter months (July–Aug) to around 24°C in the cooler months (Jan–Feb). The region, like other regions worldwide, faces a general warming. Actual temperature analysis for the Caribbean shows a warming ranging from 0 to 0.5°C per decade for the period from 1971 to 2004. Since the 1950s, the percentage of days having very warm maximum or minimum temperatures has increased considerably, while the percentage of days with cold temperatures has decreased (Mimura et al. 2007: 691). The table below shows the projected increase in air temperature (°C) relative to the 1961–1990 period. The analysis reaffirms previous IPCC projections and makes clear that a general warming up to 4.18°C more compared to temperatures in the last century is projected (Table 45.1).

With regard to precipitation, most of the Caribbean basin is supposed to become up to 25% drier in the annual mean by the 2080s (Taylor et al. 2007). The following table shows the projected change in precipitation (%) relative to the 1961–1990 periods. Regarding precipitation, the range of projections is still large, and even the direction of change is not clear. It is anticipated that similar to the changes reported from global analysis, the maximum number of consecutive dry days is decreasing while the rainfall intensity and the number of heavy rainfall events are increasing (Mimura et al. 2007: 691) (Table 45.2).

Table 45.1 Projected increase in air temperature (°C), relative to the 1961–1990 period (Mimura et al. 2007: 694)

Region	2010–2039	2040–2069	2070–2099
Caribbean	0.48–1.06	0.79–2.45	0.94–4.18

Table 45.2 Projected change in precipitation (%), relative to the 1961–1990 period (Mimura et al. 2007: 694)

Region	2010–2039	2040–2069	2070–2099
Caribbean	−14.2 to +13.7	−36.3 to +34.2	−49.3 to +28.9

Due to the generally projected decline in total rainfalls and the intensification of rainfall variability, most islands in the Caribbean are expected to be exposed to severe water stress in the future. As water resources are limited, these islands depend on surface water catchments for water supply. During the dry season, water shortages already often occur in many areas (Tulsie et al. 2001). With regard to the anticipated reduction in precipitation, it will be most likely that future water demand could not be met to serve all needs (Mimura et al. 2007).

Like other coastal areas, the Caribbean region will be seriously affected by sea level rise. According to the Caribbean Community Climate Change Center, the region experienced a sea level rise of 2 mm per year during the twentieth century (Caribbeannetnews, 19.01.2007). Although there will be regional variation, it is projected that sea level will rise as much as 5 mm per year over the next 100 years as result of GHG-induced global warming (Nurse and Sem 2001: 845). Due to the spatial limit of small islands and due to the fact that most economic activities, infrastructure, and settlements are along the coastlines, sea level rise will be one of the major challenges with the Caribbean nations will have to meet.

Another critical element of climate change, especially in the Caribbean region, is the increase in extreme climate events and natural disasters such as hurricanes and floods with regard to the danger and damage they cause. Impacts of natural hazards to the economies of small islands are disproportionally large. For example, hurricane Ivan hit the island of Grenada in 2004 and caused damages up to 200% of Grenada's GDP (Ratter 2009). One of the major threats of these natural disasters is the time it takes to recover from them. In future, due to more intense and/or more frequent extreme events, the affected islands could have less and less time to recover; the possibility exists that full recovery could never be completed. This may result in long-term deterioration of affected islands (Mimura et al. 2007: 693).

The described impact of climate change in the Caribbean region clearly underlines the vulnerability of SIDS and points to their limited adaptive capacity. Warmer temperatures, changing precipitation patterns, sea level rise, and additional and more severe extreme weather events in this region most likely mean irreversible environmental losses, decline of economies, deterioration of settlements and infrastructure, and danger and adverse health effects for human beings.

With regard to the agricultural sector, which plays a major role in the Caribbean economy, the implications of climate change amongst others are saltwater intrusion and worsening of soil conditions, loss of soil fertility and therefore lower productivity, erosion and land degradation, and an increased crop vulnerability to certain diseases due to higher temperatures and changed rainfall patterns. It is most likely that improved irrigation methods in many places are needed to solve the problem of seasonal water scarcity for water-intensive crop production. These impacts may in future threaten subsistence and commercial agriculture in the Caribbean.

The Impact of Climate Change on the Agricultural Sector: The Case of St Lucia

This chapter explores the effect of a changing climate regime on the agricultural sector of the Small Island Developing State of St Lucia and highlights the national adaptation strategies.

Impacts and Vulnerabilities

With regard to its current climate, accessible data for the island state is more or less in line with climate data for the total Caribbean region. Like agriculture in other Caribbean Islands, St Lucia's agricultural sector has shown a high vulnerability to the existing climate, e.g. to spatially and temporally unevenly distributed rainfall, and especially to some natural disasters which have affected the island during the last years (NN 2001).

To assess St Lucia's vulnerability to the impacts of climate change and in order to be able to develop adaptive strategies also for the island's agriculture sector, St Lucia's Ministry of Planning, Development, Environment, and Housing already started in 1999 to prepare St Lucia's initial national communication on climate change to the UNFCCC. As to the table mentioned below, six climate change scenarios for St Lucia have been developed, each showing a low, medium, and high case scenario with regard to GHG emissions (Table 45.3).

Table 45.3 Six climate change scenarios used in the National Climate Change Vulnerability and Adaptation Assessment

Factor	Period	Scenario	Change
Annual mean temperature change (°C) for 2050	Average	Low	+1.71
		Medium	+2.03
		High	+5.0
Annual mean precipitation change (%) for 2050	Average	Low	−1.3
		Medium	−5.2
		High	+20
Seasonal mean temperature change (°C) for 2050	Dec–Feb	Low	1.68
		High	2.00
	June–Aug	Low	1.71
		High	2.01
Seasonal mean precipitation change (%) for 2050	Dec–Feb	Low	3.4
		High	5.9
	June–Aug	Low	−14.4
		High	−6.9
Projections for sea level rise (cm) for 2050	Average	High emissions	50
		Medium emissions	39
		Low emissions	26
Tropical storms/hurricanes scenario	Average	High	+20
		Low	−20

Source: Tulsie et al. 2001: 43

Regarding the impacts of climate change, the above scenarios show an increase in the annual mean temperature, modifications in rainfall patterns especially in summer, more frequent hurricanes and tropical storms, and a sea level rise of at least 5 mm per year until 2050. Increased annual mean precipitation of 20% in the "high case scenario" and an increase of tropical storm events (+20 events) may lead to the assumption that although drought periods are extended, the surplus of precipitation will come as increased rain intensities. According the "low case scenario" the tropical storm decrease (−20 events) and the annual mean precipitation decrease by some 1.3% is tantamount to higher storm intensities (Reisdorff and Leal 2008: 6–7).

The implications of climate change to St Lucia's agricultural sector are manifold, and basically the same as what has been described for the total Caribbean region. Major challenges for St Lucia are linked to salinization and water shortages, soil erosion and loss of soil fertility, plant diseases, and tropical storm activities, which will lower St Lucia's agricultural productivity:

- *Salinity of coastal agricultural zones and loss of freshwater* due to saltwater intrusion as an impact of sea level rise will most likely destroy crops, ruin soils, or make them unsuitable for agriculture. Furthermore, a lack of freshwater for irrigation is anticipated. An increase in sea level can also result in total physical loss of agricultural lands and pasture for livestock (Tulsie et al. 2001).
- *Periods of low precipitation and extended dry periods* will result in water shortages for irrigation and therefore in a loss of soil moisture; they will weaken the crops prone to insect attack and diseases such as the Black Sigatoka disease; and will be responsible for an increase of agricultural pests due to the alteration of the soil microorganism balance on the one hand (Tulsie et al. 2001).
- *Increased concentrated precipitation due to heavy rainfall and storm surges* will lead to flooding of agricultural lands and to excessive soil erosion and loss of nutrients. Especially on St Lucia, the problem of soil erosion and leaching of nutrients may become a major problem as the banana cultivation was extended to upper catchment areas and steep slopes in recent years (Reisdorff and Leal 2008).
- *Rising intensity of extreme climate events* such as hurricanes may not only lead to the destruction of crops and livestock but also to the destruction or damage of agricultural infrastructure and to the loss of farm lands (Tulsie et al. 2001).

In Aug 2007, hurricane Dean hit St Lucia and caused severe damage to the total country, to the agricultural sector, and especially to the banana industry. Bananas are St Lucia's main cash crop product, and 85% of the banana fields in the Roseau valley and 70% of the fields in the Micoud region were damaged due to overthrown and ripped out banana trees. Furthermore, the Dennery valley was completely flooded. All in all, hurricane Dean caused estimated costs of 13,200,000 ECD to St Lucia's agriculture sector including fisheries (St Lucia National Emergency and Management Organisation 2007). The photo below illustrates the damages

Fig. 45.2 Damaged banana field
Source: IICA 2007: 3

hurricane Dean caused not taking into account the damages to other affected islands which laid in the passage of the hurricane (Fig. 45.2).

All the above mentioned implications underline the high vulnerability of St Lucia's agricultural sector to the impacts of climate change. The serious damage of the island's agriculture, which is crucial for St Lucia's inhabitants and the country's economy, may lead to loss of income, increased unemployed and poverty and it will endanger the country's food security.

Adapting to Climate Change: St Lucia's National Climate Adaptation Policy

The St Lucia National Climate Change Policy and Adaptation Plan points towards the climate-related features of the island: as St Lucia is located within the trade wind belt, winds approach the island from directions between the east–northeast and east–southeast. Stronger, more northerly winds occur from December to May. Average temperatures in St Lucia are around 27°C; the relative humidity is 75%, with little variation. A dry season from January to May and a wet season from June to December are characteristic for St Lucia's climate. During times of heavy rainfall, flooding often occurs in the low-lying areas. The island is vulnerable to tropical storms and hurricanes which occur in the Western Atlantic between the months of July and November each year, and has during the last decades suffered from a number of storms and hurricanes. The high concentration of infrastructure (hotels, ports, roads, settlements) located along the coast, often in low-lying reclaimed areas contributes to an increased vulnerability. In its national climate change policy, the government of St Lucia clearly states that climate change may impact agricultural production which is important for national food security, as well as for the generation of employment and foreign exchange. In the light of these aspects, and given St Lucia's geographic location within the hurricane belt, its small land size and the location of major settlements and infrastructure in low-lying coastal areas prone to flooding and storm damage, the island government regards St Lucia as highly vulnerable to climate change impacts (GOSL 2003: 1–11).

To cope with the threats of climate change, St Lucia is, on the one hand, contributing to several Caribbean-wide programmes and projects such as the Caribbean Planning for Adaptation to Climate Change Project (CPACC) and the Special Programme on Adaptation to Climate Change (SPACC). On the other hand, St Lucia's government has identified country-specific adaptation strategies within its initial national communication on climate change documentation. Adaptation options for agriculture in documentation vary from:

- Changing land topography to reduce water run-off and soil erosion
- The introduction of salt-, heat-, and drought-tolerant crops
- Improved irrigation systems
- Farm relocations and
- An improved pest and disease management

During the National Symposium on Climate Change and Food Production, held in the Cara Suite Hotel, St Lucia, on 21 July 2005, the following specific measures were suggested as options to the implications of climate change (GOSL 2005: 11):

- Production adjustments at the micro-levels
- Income diversification and insurance schemes at the market level
- Pricing policy adjustments
- Income stabilization options at the institutional level
- Development and promotion of new crop varieties at the technological level

Additionally, scientific work such as data collection and analysis and crop research is deemed to be necessary to support adaptive strategies. Major barriers to almost all adaptive options are related to limited technical and financial resources, limited stakeholder awareness and limited technical and institutional capabilities, as well as to existing market arrangements and market constraints (NN 2001).

Agricultural diversification in line with capacity building as one additional adaptive strategy in order to reduce St Lucia's agricultural vulnerability – and especially the vulnerability of banana production – to the impacts of climate change is also required by different stakeholders such as IICA (IICA 2008) and the Ministry of Planning, Development, Environment and Housing (Tulsie et al. 2001). The EU-funded AGIL-project "Banana commercialisation and Agricultural Diversification in St Lucia", which will be elaborated later, acts on this challenge.

The Transformation of Food Systems and the Consequences for Smallholder Banana Production in the Caribbean Region: The Case of St Lucia

The Caribbean island of St Lucia, belonging to the Lesser Antilles, has a population of more than 160,000 people. St Lucia belongs to the category of Small Island Developing State (SIDS) and is characterized by an open, developing economy with limited human and financial resources that is heavily dependent on tourism and agriculture (GOSL 2003: 2–11). The independent small island state is located between the Caribbean Sea and North Atlantic Ocean, north of Trinidad and Tobago. St Lucia is volcanic and mountainous with some broad, fertile valleys. The island is 43 km long and 22.5 km wide; settlements and activities are primarily located along the coasts and in the valleys. With a total land area of approximately 616 km^2, St Lucia has 158 km of coastline. According to the CIA World Fact Book (2009), only 6.45% of the total land is reported to be arable land, with permanent crops being cultivated on 22.58% of the area. In 2003, approximately 30% of the arable land was under irrigation. The major agricultural products grown are bananas, coconuts, vegetables, citrus, root crops, and cocoa. In line with this, its main export commodities are bananas (41%), clothing, cocoa, vegetables, fruits, and coconut oil. History and welfare in St Lucia are closely linked to commodity exports. Banana is still the main agricultural crop, but the banana industry is declining due to the loss of preferential trade regimes as a result of global trade liberalization policies. The economic and social consequences of these changes in the agricultural sector are said to be responsible for a substantial increase in poverty. According to the St Lucia Poverty Assessment (Kairi Consultants 2006: xvi), poverty by headcount increased to 28.8% in 2005; overall, the country is classified as a lower-middle income country.

For St Lucia, tourism and agriculture represent the two main pillars of its economy, with tourism being the island's most important source of foreign exchange. Today, the services industry accounts for almost 80% of the country's gross domestic product (GDP), with tourism contributing approximately 40% of the island's GDP; in contrast, the proportion of agriculture in the GDP fell from an average of 14% during the 1980s to 5.5% in 2004, down to 3% in 2008 (OECD 2006: 94; IMF 2006; WTTC 2008; SEDI 2008). However, in spite of its declining contribution to the small island's gross domestic product and corresponding total area of agricultural holdings, the agricultural sector still plays a significant role in the country's socio-economic development, in terms of food security, employment, and poverty reduction (MAFF/GOSL 2007: 13–15).

Concerning the transformation of food systems, global agriculture is struggling to keep pace with increasing demands for food as human population increases and food preferences alter. The global economic development has resulted in major global shifts in consumption, marketing, production, and trade. McCullough et al. (2008: 4) lists four key driving forces associated with economic development which drive the transformation of global food systems and impact producers in developing countries:

- Rising incomes
- Demographic shifts
- Technology for managing food chains
- Globalization

Moreover, through increasing integration of world markets resulting from multilateral trade liberalization and structural adjustment programmes especially in the developing world, farmers in the developing world are now, more than ever, linked to consumers and companies of the developed world.

The transformation of agricultural production systems can be observed as the level of organization in retail rises, the level of specialization of wholesale increases, and the scope of formalized procurement grows. This implies that production systems not only in developed, but also in developing countries, are becoming more commercialized. These commercialized systems show specialization at the farm level, greater dependence on purchased inputs, and more marketing of outputs (McCullough et al. 2008: 23). Being at the end of the chain, small-scale producers have to deal with global consumers' demands, reflected in the necessity to deliver high-quality products on time in a given volume at competitive prices. These high requirements can represent a serious barrier to small-scale farmers' participation in global food export and local markets, and higher food value chains in particular.

Challenges of Smallholder Windward Islands Banana Production

The specific banana production environment in the Windward Islands is characterized by a number of factors which prevent farmers achieving the high level of production and productivity common in other banana producing regions. In 2000, Reid estimated the total area under cultivation in the Windward Island region at over 30,000 acres, with most of the cultivated land under drought stress during the dry period (January to June). According to Reid (2000: 45), some of the key banana production problems include:

- The *rain-fed nature of banana production* characterized by severe water deficit in the dry season causing crop loss
- The *difficult production environment*, with particular reference to steep slopes and shallow soil depth, high level of soil acidity, and poor native soil fertility
- *Soil acidity* – farmers have to use large amounts of fertilizers and to apply limestone in an effort to ameliorate the adverse effects of the soil acidity
- A relatively *high level of field losses*, estimated at 20–30%, resulting mainly from the ravages of nematodes and the corn borer
- The *high cost of "high quality" inputs* to farmers, who may not be able to use these at the recommended rates

- The *high cost of controlling leaf spot disease* in the rugged terrain and highly variable agro ecological zones in the Windward Islands
- The *shortage and high cost of labour* in banana production (over 60% of the total cost of production)

These factors contribute to the relatively low average yields of 6–8 tonnes per acre obtained on most farms. This relatively low average yield is regarded as a major factor resulting in high unit cost of banana production. Labour is estimated to account for over 50% of the total cost of production, with material inputs representing approximately 30% and management and capital 20% (Reid 2000: 45).

The lower cost of production faced by other banana producers will enable them to operate profitably in a liberalized market for bananas. The relatively higher cost of production by the Windward Islands banana producers requires that they increase their productivity if they are to stay competitive in the banana market. Windward Islands producers are required to narrow the productivity gap between local production and that of other banana producers (Reid 2000: 45).

Growing evidence suggests that it is only access to the Fairtrade markets which allow farmers to receive a premium on top of the market price for their produce that is enabling the Windward Islands industry to survive: According to latest figures for banana shipments from the Windward Islands, the average proportion of Fairtrade bananas grew from 29% in 2005 to 72% in 2006 (Fairtrade, 20 June 2009).

Constraints and Opportunities of Banana Production in St Lucia

In 2007, more than one-fifth of the population lived on agricultural holdings located in rural areas, most of which are nowadays small-scale farms (MAFF 2007: 13).

Constraints

According to the 2007 St Lucia Census of Agriculture, the continuing decline in number and area of agricultural holdings in St Lucia is the most striking result of the overall transformation of food systems. Compared to 51,328 acres in 1996, the total land area in these holdings fell to 30,204 acres in 2007, representing a decline of 41.1%. The largest loss in the number of holdings and area was observed in the largest farms: more than 70% of farms with more than 100 acres disappeared in 2007. Small farms thus dominate St Lucia's agricultural sector (GOSL 2007: 4–6).

Table 45.4 Number of trees in St Lucian agricultural holdings 1986–2007.

Number of selected trees (1986–2007)			
	1986	1996	2007
Banana	11,839,400	11,376,220	5,042,412
Plantain	329,300	606,731	1,103,603
Coconut	846,200	560,880	280,001

Source: GOSL 2007: 12

Moreover, and in line with the decrease in the number of holdings, the dismantling of preferential trading agreements has resulted in the sharp decline in banana production and significant reductions on agricultural export earnings. The apparent abandonment of banana plots has contributed to the decrease in land used for permanent and medium term crops in total land holdings. The following table illustrates this decline of banana production by stating the decline in number of banana trees (Table 45.4).

Between 1992 and 2004, annual export volumes showed a considerable decline, from 135,000 tonnes down to 42,000 tonnes. Accordingly, banana export revenues declined from US$71m to US$31m. Simultaneously, the number of banana farmers fell from 10,000 in the early 1990s to 1,552 in 2007 (Fairtrade, 20 June 2009; AGIL 2009: 4).

In spite of this development, banana production remains central to the agricultural sector in St Lucia, although the impacts of globalization, multi-lateral liberalization and increasingly unfavourable banana trade regimes, especially for small-scale farmers, resulted in a major decline of exports and the number of farmers. Bananas still represent the dominant export crop of the island, contributing over 70% of total agricultural exports between 2002 and 2006 (GOSL/MAFF 2007: 1).

According to Polius (2000: 57), and in line with the problems of banana production mentioned before, the following factors contributed to the apparent movement away from bananas:

- Uncertainty about future market development
- Shortage of available labour
- High cost of production/labour
- High cost of inputs, e.g. fertilizers
- Yield losses due to drought, pests and diseases and
- Declining soil productivity

In St Lucia, banana has dominated performance in the agricultural sector. The fortune of the sector is seen as being closely tied to this commodity. Since the early 1990s, Caribbean banana exporting states such as St Lucia needed to adapt to changes to the banana import regime in Europe. Consequently, the production systems had to be adjusted to increased competition and lower prices. Within these adjustment processes, the government of St Lucia embarked on a strategy to diversify the agricultural sector, focusing on the fresh produce sector, in particular vegetables, fruits, root crops, and horticulture. Underscoring the need to adjust to major global shifts in consumption, marketing, production and trade, the government of St Lucia aims to diversify the agricultural sector, not only to tap new international as well as domestic markets, but also to enhance food security, raise additional foreign exchange earnings, and lower the food import bill (Polius 2000: 55–57).

Opportunities

The increase in land use for non-traditional crops suggests that the St Lucian agricultural diversification strategy had somewhat of an effect as the land use for temporary crops such as tomato, sweet pepper, etc. increased from 4.9% to 10.8% between 1996 and 2007. However, the findings of a recent survey of St Lucian banana farmers point toward some fundamental constraints that hinder diversification:

- Unpredictable, not yet established market for alternative crops
- Established market for bananas, predictable revenue streams
- Lack of land, time, and financial means
- Age level of banana farmers

With reference to the knowledge level of the farming community, Reid (2000: 45) stated that the typical farmer has a general knowledge of the recommended practices in banana production, however fewer than 50% have in-depth knowledge and understanding of the practices. The reluctance of the farmers to diversify becomes even clearer by the result that almost two-thirds of the farmers interviewed in 2008 state that they do neither have access to information about sustainable crop alternatives nor to information about latest technologies (AGIL 2009: 21–23).

That lack of knowledge can pose a serious barrier to diversification is underscored by the findings of a recent desktop study stating that “for the export based agro-economy of St Lucia the potential economic value of a crop is as vital as its ecological value, because the limitations in arable land forces people to grow crops with high cash yields per area” (Reisdorff and Leal 2008: 3).

Two cash crops were identified to play a potential key role with respect to both economic and ecological requirements: sweet potatoes and papaya. In terms of diversification, the study suggests that these cash crops may be considered as functional key elements for the early stages of agro-forestry systems which may be installed on former banana plantations. Furthermore, the study identified peach palm as one of the fruits with the highest economic potential for export and with certain ecologically valuable features. Peach palm can be used for fruit production; it can be consumed locally or be transformed into higher value goods, i.e. processed food for both local and export markets. Key recommendations of the analysis pointed out that export crop revenues may be increased by improvement of production systems, i.e. fair trade and organic certification (e.g. banana, pepper, ginger), by quality improvement (banana, cocoa) and/or by the development of a small local food industry fulfilling EU standards (Reisdorff and Leal 2008: 3).

Strengthening Adaptive Capacity of the Agricultural Sector in St Lucia: The AGIL Project

The Caribbean region, including St Lucia, shows the following general characteristics (GOSL 2006 – Report National Symposium on Climate Change and Food Production 2005, p. 8):

- Tropical and low-lying coastal states
- Very prone to extreme weather events
- Diverse cultures, environments, and food provision systems
- High reliance on imported foods
- Dependency on export crops, tourism, and other non-food sectors for foreign exchange revenues
- Loss of preferential export trade regimes
- Continuing dependency on preferential agricultural markets (bananas, sugar)
- Lack of regional-level institutional connectivity
- Non-traditional agricultural markets (rice, coffee, cocoa, root crops, and vegetables)

Adaptive Capacity Building in the Frame of National Adaptation

A range of limits and barriers exist which need to be addressed for effective adaptation to climate change:

- Physical and ecological limits
- Technological limits
- Financial barriers
- Informational and cognitive barriers
- Social and cultural barriers (Adger et al. 2007: 733–737)

Addressing these aspects relates to the assessment of the so-called adaptive capacity. The International Panel on Climate Change (IPCC) defines the adaptive capacity as "the ability or potential of a system to respond successfully to climate variability and change [including] adjustments in both behavior and in resources and technologies" (IPCC 2007: 21). Adaptive capacity is regarded as a prerequisite for the pursuit of effective adaptation strategies in order to mitigate the harmful impacts of climate change. A positive aspect of adaptive capacity is the fact that, according to the IPCC, it enables sectors and institutions at the same time to take advantage of opportunities and benefits from climate change, for instance longer growing seasons or increased potential for tourism (IPCC 2007: 21). According to the IPCC, the human and social capacities are viewed as key determinants of adaptive capacity on all scales. Furthermore, it is argued that these aspects had the same relevance as income levels and technological capacity (IPCC 2007: 27).

In St Lucia's National Climate Change Policy and Adaptation Plan, three main policy objectives comprise (1) the development of processes, plans, strategies, and approaches to mitigate climate change impacts; (2) the development of a climate-proof regulatory environment; and (3) the design of economic incentives to encourage public and private sector adaptation measures (GOSL 2003: 6). Correspondingly, a range of policy directives for the agricultural sector have been formulated, which also need to be taken into consideration to ensure the sustainability of agricultural projects that deal with knowledge and capacity building (GOSL 2003: 11–12):

1. *Development of a sound basis for decision-making*, by conducting further and more detailed research to assess, inter alia:
   - Risks posed by climate change to the productivity of agricultural crops, and to food security (specific attention placed on potential impacts on banana, cocoa, and other commercially important crops)
   - Impact on water availability for agriculture (specific attention on irrigation)
   - Impact of climate change on soil productivity and soil management (specific attention on salinization, erosion, etc.)
   - Impact of climate change on pest–crop interactions
2. *Development of a national adaptation strategy for the agricultural sector* to address impacts over the short, medium, and long term
3. *Incorporation* of the national agricultural adaptation strategy into national physical and spatial planning process
4. *Inclusion* of adaptation policies into the national policy formulation process
5. *Adoption of appropriate adaptation measures* to address areas of *immediate need* where this does not jeopardize or contradict the development of long-term, sustainable strategies for the agricultural sector. Such measures may include soil conservation measures and construction of water storage and irrigation facilities for crop production
6. *Formulation and implementation of any other such strategies and measures* which may help to ensure food security sustainable food production and sustainability of forest resources

The AGIL Project as a Means of Capacity and Knowledge Building for Human Adaptation

To the disadvantage of St Lucia's banana farmers, the banana exporters from the ACP region, e.g. Costa Rica, have increased their exports to the EU market as they can produce at lower cost (Mather 2008: 3). According to Reid (2000: 45), the relatively higher cost of production by the Windward Islands banana producers does require that they increase their productivity, i.e. build capacity in terms of production knowledge and application of new technology, if they are to successfully stay competitive in the market for bananas. Building this knowledge and capacity involves anticipating future climatic changes and their potential impacts on crop production.

To support the transition of the agricultural sector, St Lucia receives funds from the European Special Framework of Assistance (SFA), which was designed to facilitate economic adjustment and diversification of particularly those groups historically dependent on the banana business. In this respect, St Lucia's banana farmers obtain assistance to adapt to new market conditions and, furthermore, improve their competitiveness in terms of producing high-quality crops through raising the efficiency of production and building capacity for better commercialization, as well as supporting agricultural diversification.

In order to motivate the remaining farmers to remain in the banana industry, grow more competitive and adopt new approaches, the project "Banana Commercialization and Agricultural Diversification in St Lucia (AGIL)" is being conducted in the course of this SFA: the AGIL project aims to assist with the development of rural communities in the Caribbean island of St Lucia by undertaking a set of initiatives related to human resource development and training. The project duration is 1.1.2008 until 31.12.2010.

The set of actions envisaged as part of this project include consultancy, training workshops, and seminars on the one hand, complemented by coaching within businesses as well as a business-friendly system of advice on the other hand, which caters for the needs of small enterprises and the realities of small farmers. The partnership of the EU-funded project entails the Research and Transfer Centre "Applications of Life Sciences" at the Hamburg University of Applied Sciences, Germany (the European partner) and the Sir Arthur Lewis Community College (the St Lucian partner). There is also a network of national and international agencies involved in the project and taking part in its activities.

In methodological terms, the project is organized into five sets of activities:

1. *Project management* involves the overall project management, administration and reporting, as well as the coordination of the partners.
2. *Assessment of needs* entails an assessment of the current state-of-the-art with respect to training and information needs seen in the agricultural sector as a whole and in rural communities in particular, complemented by an overview of the elements that hinder investment and access to capital in the country.
3. *Capacity building* develops and implements a capacity-building programme which enhance the capacity of target beneficiaries (approximately 200 entrepreneurs, 20 agribusinesses, and around 20 agencies such as farmer and other rural organizations) and will involve training workshops and seminars around the island of St Lucia to achieve greater agricultural diversification, inform on technologies, and improve access to capital.
4. *Consultancy, coaching and on-site support* entails the undertaking of consultancy, advice, and coaching within agribusinesses to improve access to technology and the relevant capital, thus helping them in the areas of market strategies to improve domestic and international market penetration. Activity 4 also entails the provision of training to at least 20 agencies (e.g. farmer and rural organizations) for the

improvement of data management and dissemination systems, as well as to provide support to stakeholders in the application of data and information for effective decision-making.

5. *Networking, information and dissemination* is a complementary measure in the execution of the project; a network will be established, linking all relevant stakeholders. In addition, information about the project will be disseminated. By means of these measures, a lively network will be maintained and information about the project will be systematically disseminated.

As illustrated in Fig. 45.3, the project takes a participatory approach, involving multiple stakeholders and beneficiaries to maximize the impact of the activities: farmers and farm workers are at the heart of the capacity-building project. By means of a comprehensive assessment of needs, involving two hundred banana farmers and an additional two hundred non-banana farmers, specific training objectives could be defined. In the following, a capacity-building programme was set up which includes topics such as theory and practice of international trade; trade of perishable products; the adoption of production systems to meet domestic and international trade requirements and standards; awareness raising on aspects of product diversification, presentation, labelling, market packaging, and distribution systems (Fig. 45.4).

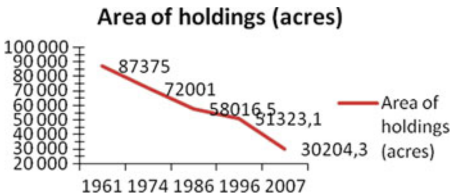

Fig. 45.3 Total area of holdings 1961–2007 (acres)
Source: GOSL 2007: 5

Fig. 45.4 Actors and beneficiaries of the AGIL project
Source: own visualization

A case study of a training session on improved pesticide management may serve as a concrete example of the knowledge and capacity-building activities of the AGIL project.

Case Study: AGIL/BMU Pesticide Training 2009

Rationale

The Musa species, which, besides banana, also includes plantain and highland banana, is prone to pests and diseases. A major constraint to Musa production in lowland tropical humid areas, e.g. in the valleys of St Lucia, is the Black Sigatoka disease. This disease can cause 40% yield loss due to incomplete finger filling. In spite of the still unknown impact of climate change on crop–pest relationships, and as temperature is likely to increase due to global warming, pests are expected to become more damaging.

In St Lucia's banana industry, farmers currently use fungicides to combat these pests; however, theoretical as well as hands on knowledge on appropriate techniques, types, and amounts of fungicides is often lacking or incomplete. With increasing rainfall due to climate change, this spraying strategy might become less effective as higher precipitation will result in greater runoff of the fungicide, requiring either better formulations or more frequent spraying which further reduces profitability of production (Nicholls et al. 2008: 9–11). Consequently, there is a pressing need for alternative control methods (Fig. 45.5).

Fig. 45.5 Pesticide spray worker in protective working outfit
Source: AGIL project

Scope

Within the frame of the AGIL project, a training module on the issue of pesticide management has been designed and implemented by means of a set of training workshops. The three key aims of the training module were:

- To assess and develop candidates in competence of spray operators to meet standards set by the certification authority
- To ensure that candidates are competent in their general knowledge of pesticides, crop protection, hazards, international standards for food production, and good agricultural practices
- To ensure that candidates have basic knowledge and competence in the safe use of pesticides used in commercial banana cultivation

The pesticide workshops were held at different locations of the island over a period of 2 months, since the needs assessment revealed that trainings should be conducted not only in Castries but also in the south and southeast of St Lucia, where most of the banana producers are located (AGIL 2009: 38).

Results

In close cooperation with the Banana Production Management Unit (BPMU) of the State Ministry of Agriculture, Fisheries, and Forestry, the AGIL project conducted a series of workshops for farm workers and spray operators. To reach the objectives of the envisaged training, the following topics were covered in a total of six 2-day training sessions:

- Health and safety management
- GAP/record keeping
- General sanitation on the farm
- Hygiene and safety for fruit farmers (GGP)
- Occupational health and safety
- Leaf spot disease
- Pesticides and other chemicals
- Pesticides and toxicological chemical legislation
- Principles of pest management

In these workshop sessions, a total of 254 farmers benefited from the training, with each training session comprising two full days of formal and informal learning, i.e. lectures were held in classroom and on the field (see pictures below) (Fig. 45.6).

In terms of project relevance, the BPMU training sets contributed to project objectives in the implementation of the capacity-building programme to enhance the capacity of farmers and spray operators to adopt sustainable technologies and skills required for continued compliance to local and global industry standards.

Fig. 45.6 BPMU workshop utilizing formal and informal learning methods
Source: AGIL project

Fig. 45.7 Award ceremony for successful participation in pesticide training
Source: AGIL project

As proof of having achieved the learning target, each participant received a certificate of competence for having been trained in the respective subject area at the end of the workshop. Concerning the further dissemination of key learnings, the training content as well as any other material and studies produced in the framework of the capacity-building project are accessible through the AGIL project website (www.st-lucia-project.eu), fulfilling EU visibility and dissemination criteria (Fig. 45.7).

Conclusion and Recommendations

Owing to limited endowments with land, labour, and capital, St Lucia's banana farmers cannot compete on price with the large-scale Latin American producers who can exploit economies of scale. Furthermore, consumers demand high quality produce throughout the year, posing additional challenges to smallholders who often lack efficient production methods and financial resources. The remaining options for staying in the agricultural business are twofold (a) St Lucia's farmers need to diversify their production, e.g. by adopting fair trade production standards that promise premium prices yet demand compliance to specific production standards as well; and (b) tap new domestic as well as niche markets by means of improved commercialization.

The current constraints St Lucia's banana farmers experience may worsen given the projected changes in climate, unless diversification activities take into account climate change impacts and adaptation options as well.

The coastal agricultural land will suffer from salinity and loss of freshwater due to sea level rise. Consequently, saltwater intrusion may destroy soils or even result in total loss of land and pasture for livestock. Farm relocation could be an adaptation option, if alternative suitable land were available.

The terrain for banana production, with approximately 50% of the area cultivated to bananas on slopes greater than 20°, does not allow for mechanical harvesting, posing not only a natural limit to the maximum productivity of banana production, but also increasing the risk of erosion. Increased concentrated precipitation may lead to flooding, soil erosion, and loss of nutrients. Reducing water runoff and soil erosion through technological means, e.g. wells or storage facilities, as well as agro-forestry measures, could foster the adaptation to this climate impact. However, this requires a certain investment and technological knowhow. At the same time, new ways of financing for agricultural investment should be designed by the government.

Most of the land is subject to drought stress during January to June. Periods of low precipitation and extended dry periods are expected to result in water shortages for irrigation and, consequently, loss of soil moisture. In addition, crops become more vulnerable to insect attack and diseases. Improving water management, e.g. by using irrigation and water storage technology, could prove an effective means of adaptation. However, this also requires a certain financial investment as well as technological expertise.

The current production of bananas in St Lucia is all based on a conventional system that involves a high input of synthetic pesticides and fertilizers. Raising temperatures and declining precipitation, coupled with the depletion of fossil fuels, i.e. anticipated rise oil price, may negatively impact small farmers in particular, who often lack financial resources to purchase additional pesticides and fertilizers to increase crop yields and combat plant diseases. Diversifying the agricultural production through switching production to new cash crops or species with higher heat and drought tolerance is an adaptation option. Correspondingly, more research in crop species should be funded and new ways of financing for agricultural investment should be designed by the government. To provide incentives for raising producers' knowledge level to ensure compliance with new production methods, these credit lines could require proof of adequate further education in sustainable production.

The AGIL project is viewed as a means of adapting sustainable agricultural technologies and efficient practices at a local level. Pretty and Hine (2000: 11) underscore that these arise from new configurations of social capital, e.g. new partnerships between institutional stakeholders, and human capital, e.g. management skills and knowledge. It is argued that agricultural systems that show a high level of social and human capital are able to innovate in the face of uncertainty.

As the impacts of climate change will most likely disadvantage SIDS due to their inherent constraints, more capacity-building projects focusing on climate change implications for the agricultural sector and further climate impact research is needed in this region to raise the adaptive capacity of small tropical islands like St Lucia and foster their sectoral and cross-sectoral mainstreaming of climate adaptation practices.

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