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Baseline Study on Existing Sustainable Practices, Models and Technologies used by farmers in Barbados and six countries of the Organization of Eastern Caribbean States (OECS)

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
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List of Acronyms

APUA	Antigua Public Utilities Authority
AR	Agricultural Region
BADMC	Barbados Agricultural Development and Marketing Corporation
BOD	Biochemical Oxygen Demand
CaFAN	Caribbean Farmers Network
CARDI	Caribbean Agricultural Research and Development Institute
CARICOM	Caribbean Community
CMC	Central Marketing Corporation
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
GAP	Good Agricultural Practices
GPS	Geographical Positioning System
HACCP	Hazard Analysis Critical Control Points
IICA	Inter American Institute for Cooperation on Agriculture
IPM	Integrated Pest Management
ISO	International Standards Organization
NAMA	Nationally Appropriate Mitigation Actions
NAPA	National Adaptation Programme of Action
NGO	Non-Governmental Organization
OECS	Organization of Eastern Caribbean States
OGCA	Organic Growers and Consumer Association
PROMIS	Production and Marketing Intelligence Service
PV	Photovoltaic
RDP	Rural Development Project
ROC	Republic of China
SCPI	Sustainable Crop Production Intensification
UK	United Kingdom
UNFCCC	United Nations Framework Convention on Climate Change
USVI	United States Virgin Islands
VINCYKLUS	St Vincent and The Grenadines Agro-Processors Cluster
WASCO	Water & Sewerage Company Incorporated
WINFA	Windward Islands Farmers' Association

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BASELINE STUDY

1. EXECUTIVE SUMMARY

This project sought to collate information on sustainable agricultural practices at the community level in Barbados, Antigua, Dominica, St. Kitts/Nevis, St. Vincent and the Grenadines, Grenada and St. Lucia. The United Nations Food and Agriculture Organization (FAO) is prepared to facilitate and promote the use of some of those tried and tested methods and make them available to the wider agricultural community in the Region. Those practices can easily be subsumed into the FAO new paradigm of sustainable crop production intensification (SCPI), which can be summed up in the words "save and grow". Sustainable intensification means a productive agriculture that conserves and enhances natural resources.

The determination of the current practices was achieved by on-farm/workplace observation and inquiry. Additionally, the marketing and legislative protocols were reviewed as they impact current practice. Sustainability in this context included **environmental, financial** and **socio-economic** elements. The on-farm data was captured through structured interviews conducted by trained, and experienced, Field Assessors. A standardized instrument was used to direct / guide the structured interview and capture qualitative data. The sanctioned concept and project approach was not to determine the prevalence or statistical significance of the employed practices but rather to seek out even isolated cases of sustainable operation.

The selected interviewees within each district reflected the range of product mixes, tenure patterns and marketing arrangements. Discussions with the producer groups (crop/livestock farmers, fisher-folk), district extension officers, and produce buyers/consignees; supplemented by the assessor's familiarity with the sector, directed the selection process. The actual methodology used aspects of Rapid Reconnaissance approaches that are locally relevant and accurate in "assessing the real situation," and useful in decreasing outsider bias. The responses/observations were recorded by question heading. This report covers the activities of over 2000 producers drawn from individual interviews, field inspections, Extension Officer

reviews and structured group sessions. The practices recorded were described in terms of environmental, financial and socio-economic aspects

Whilst several practices were seen to be endemic and common to all seven countries there were subtle inter- and intra-island differences. In all countries of reportage, sustainability was more commonly defined in terms of environmental aspects by way of soil and water conservation. The practices considered to be sustainable dealt with land clearing, erosion reduction and soil improvement. Additionally, water conservation as opposed to rainwater harvesting and storage was a central pursuit. The respondents understood that appropriate cropping patterns, fish culture and livestock rearing, were largely determined by geography. There is also a reasonable level of understanding of the benefits of biodiversity as they relate to sustainability.

However, there is less coherence with other aspects of sustainability, especially in the current era of anthropogenic climate change in terms of waste disposal, carbon footprint and standards-based marketing. With the exception of "manures," waste management did not feature prominently in the sustainability kit. Overt association or linking of land tenure and the social acceptability of the farming/fishing operation with long term sustainability was not commonly encountered. Several recommendations are presented based on the amalgam of practices recorded during the study. These recommendations are tabulated within the rubric of land use, soil quality, water use and reuse, environmental sustainability, and financial sustainability.

The current sustainable practices are still part of an *ad hoc* approach. This Study considered holdings/operations by Geographical Positioning System (GPS) survey, field visit, geography, agricultural district, and importance of the major crop/product, yet there were no examples of operations utilizing a full set of sustainable practices across environmental, financial and socio-economic spheres. One of the most important uses of this study could be the reintroduction of Good Agricultural Practices (GAP) with a focus on Climate-smart agriculture that could, in one fell swoop, ensure the viability of the sector in a comprehensive way.

2. RATIONALE

The objective of this baseline study is to gather information, from seven target countries, on existing sustainable agricultural practices including those, which traditionally fall outside of the purview of Ministries of Agriculture. The United Nations Food and Agriculture Organization (FAO) is seeking to facilitate and promote the use of some of these tried-and-tested methods. The project's genesis stems from several workshops and meetings wherein the Organization was asked to capture the existing practices, technologies and models of sustainability; and make them available to the wider agricultural community in the Region.

Those practices would be in keeping with the FAO new paradigm of sustainable crop production intensification (SCPI), which can be summed up in the words "save and grow". Sustainable intensification means a productive agriculture that conserves and enhances natural resources. To overcome the challenges inherent in feeding a growing world population there is no option but to intensify crop production. Given the constraints farmers face, in order to grow, agriculture must learn to save. This level of crop production intensification will be built on farming systems that offer a range of productivity, socio-economic and environmental benefits to producers and to society at large.

Agriculture must, literally, return to its roots by rediscovering the importance of healthy soil, drawing on natural sources of plant nutrition, and using mineral fertilizer wisely. A genetically diverse portfolio of improved crop varieties that are resilient to climate change and smarter, precision technologies for irrigation would also be needed. The FAO recognizes that to encourage smallholders to adopt sustainable crop production intensification, fundamental changes are needed in agricultural development policies and institutions.

Thus the goal of the project is to collate information on sustainable agricultural practices at the community level in Barbados, Antigua and Barbuda, Dominica, St. Kitts/Nevis, St. Vincent and the Grenadines, Grenada and St. Lucia. Farmers and producers in the Caribbean Region have long been practicing conservation

agriculture, and integrated farming systems, including both crop and pest management. Sustainable, as it refers to agriculture, involves more than the study of relationships between organisms and their environment. It has been defined as "an integrated system of plant and animal production practices having a site-specific application that will last over the long term whilst satisfying human needs, efficiently using natural resources, demonstrating financial viability and enhancing the quality of life for farmers and society as a whole." Sustainability in this context includes **environmental, financial** and **socio-economic** elements. It will, of necessity, be defined in the context of anthropogenic Climate Change.

3. CONCEPTUAL FRAMEWORK: FOR PROJECT EXECUTION

Definitions

To facilitate a common understanding of the project and its attendant goal, unambiguous definitions of the terms "baseline study," and "sustainable," were required. A baseline study is "an analysis of a current situation to identify the starting points for a program or project." Sustainable invariably means "meeting the needs of the present without compromising the ability of future generations to meet their own needs". Sustainable as it refers to agriculture involves more than the study of relationships between organisms and their environment. It has been defined as "an integrated system of plant and animal production practices having a site-specific application that will last over the long term whilst satisfying human needs, efficiently using natural resources, demonstrating financial viability and enhancing the quality of life for farmers/producers/fisherfolk and society as a whole." Sustainability in this context includes **environmental, financial** and **socio-economic** elements.

Questionnaires

What the Project seeks to accomplish is an analysis or determination of the practices, models and technologies, currently employed by producers, which fall within the rubric of sustainable agriculture. The determination of the current practices was achieved by on-farm/workplace observation and inquiry. Additionally, the marketing and legislative protocols were reviewed as they impact current practice.

The on-farm data was captured through structured interviews conducted by trained, and experienced, Field Assessors. A standardized instrument was used to direct the structured interview (see Appendix I). This Project is meant to capture qualitative data, in the sense that one wants to detect the tried-and-tested methods and technologies. The idea is not necessarily to determine the prevalence or statistical significance of the employed methods but rather to seek out even isolated cases.

Careful and appropriate sampling was guided by the project question viz. "what are the tried-and-tested practices, models and technologies used by producers in the seven countries?" By focusing on the answers to the project question, the focused inquiry has resulted in a more thorough "analysis of the current situation to identify the starting points for a program/project" or baseline study.

4. DEFINING THE SCOPE AND METHODOLOGY FOR THE INQUIRY

The on-farm/workplace observation and inquiry will revolve around the practices that reflect stewardship of the natural and human resources. Sustainability, as reflected in current practices, was defined in environmental, financial and socio-economic terms. Given the relative importance of the natural environment to sustainability issues, the farms/agribusinesses surveyed were initially categorized and representative by district. By covering all the districts, all geographic scenarios were captured. Further segregation was based on geographic features, in as much as they affect the likely conservation practices.

The selection process was guided by interviews with the Ministries of Agriculture, Producer organizations, NGOs, and Environmental Management officials. Meetings with focus groups were organized; the following was undertaken

- a review of the documented holdings/producers in the administrative district
- determination of the major types of potential/actual environmental degradation to which the area is prone with regard to
    - soil (quality/quantity)
    - water (quality/quantity)

- air-borne pollutants
- flora/fauna interaction (biodiversity)

- assessment of the economic importance of the major products emanating from the district – to select the success factors (financial sustainability)
- integration of the enterprise within the community

The seven Assessors all have over 20 years field experience within their respective countries of operation and augmented the data gathered during the selection process (Appendix II). Additionally, by traversing specific locations with "high risk" environmental issues (e.g. Riverine operations, steep slopes, watersheds), they determined the rationale for additional interviewees.

The selected interviewees within each district reflected the range of product mixes, tenure patterns and marketing arrangements. Discussions with the producer groups (crop/livestock farmers, fisher-folk), district extension officers, and produce buyers/consignees; supplemented by the assessor's familiarity with the sector, directed the selection process.

The actual methodology used aspects of Rapid Reconnaissance approaches that are cost efficient, timely, locally relevant, accurate in "assessing the real situation," and useful in decreasing outsider bias. The responses/observations were recorded by question heading, and the relevant practice, model or technology. A general overview of findings is provided consistent with the approved "Concept Note"

Conceptual framework: project relevance in 2011

Any discussion on sustainability in the context of Small Island Developing States in the Caribbean must be circumscribed by concerns about Climate Change. Any practice or approach deemed sustainable should be climate-smart as it refers to measures that will minimize agriculture's contribution to greenhouse gases or increase carbon sequestration. Transformation of agriculture to meet the growing demand for food provides opportunities to build synergies and manage trade-offs across the multiple objectives of food and nutrition security, and climate change adaptation and mitigation.

Documenting existing sustainability practices in the targeted Caribbean Islands can be the first step in the transition to developing a National Adaptation Programme of Action (NAPA) or Nationally Appropriate Mitigation Actions (NAMAs). Since the Cancun Conference, over 40 developing countries have submitted NAMAs to the United Nations Framework Convention on Climate Change (UNFCCC) and over half of these included agricultural mitigation policies or activities. NAMAs, which will benefit from technology transfer and financial support from developed countries, are expected to lead to large-scale emission reductions in developing countries. Many of the tried-and-tested sustainable practices, currently in use in the Caribbean will be the foundation for comprehensive, climate-smart agricultural strategies as part of NAPA.

The work of Climate Scientists in the Caribbean has reemphasized the importance of rainfall to regional agriculture. Island agriculture is totally rainfall driven; whether from recharged underground sources, surface-flows or direct precipitation. The expected variability in terms of rainfall quantity and intensity will increase the vulnerability of these small states and further threaten the viability of their agriculture. Sustainability models, incorporating water management as well as related soil management issues, will be the *sine qua non* of agriculture development strategies.

Globally, agriculture directly accounts for about 14 percent of greenhouse gas emissions (methane from animal digestion and nitrous oxide from agricultural soils, etc.), and indirectly for another 17 percent due to the fact that agriculture is a major driver of deforestation and land-use change. The sector holds a large mitigation potential, mainly through reduced deforestation, soil management and increased productivity.

5. CURRENT PRACTICES/MODELS

A field assessor in each of the seven countries alerted the respective Ministries of Agriculture and interacted with key Extension staff and Producer Organizations to launch the project. Discussions with the producer groups (crop/livestock farmers, fisher-folk), district extension officers, and produce buyers/consignees; supplemented

by the assessor's familiarity with the sector provided the following details. This report covers the activities of over 2000 producers drawn from individual interviews, field inspections, Extension Officer reviews and structured group sessions. The Assessors first established their bona fides and reassured many of the potential interviewees that the exercise would redound to their benefit. Caribbean producers, especially those on a sustainable trajectory, have been interviewed and studied *ad nauseam*.

This report introduces the reader to the multiplicity of practices that can be correctly deemed "sustainable" in the context of Caribbean agriculture. There were dozens of instances where the Assessors were sent to interview recommended producers or asked to include activities at "production sites" that did not meet the "sustainability criteria" agreed to by the team. Common examples involved instances of terracing or composting that were not technically correct and thus were not deemed to be sustainable.

5.1 ENVIRONMENTAL SUSTAINABILITY

There were several practices that are common throughout the seven countries constituting the baseline territories.

Soil Management

Soil management is a common feature on farms. Most of the farmers, Extension Officers and Ministry Officials equate sustainability with land quality and quantity, so there is a heavy concentration on soil conservation and improvement.

For the purposes of this study soil management was analyzed by way of eighteen interrelated criteria. These dimensions included original and seasonal land clearing methods, land preparation, soil protection, quality enhancement, and soil water management.

Unlike the threat of deforestation that hovers over the activities of continental CARICOM States and the larger islands, the Eastern Caribbean States are not engaged in significant farmland expansion. Hence the land-clearing techniques

considered were with respect to seasonal land clearing and not the expansion in to virgin or secondary forests. Even so, there were isolated instances of the unsustainable use of bulldozers and subsequent burning. In the seven countries, the land clearing methods ranged from the use of hand tools, grazing sheep, and selective thinning to motorized cutting machines. The multiplicity of methods was not only evident between countries but within them as well. In the case of St. Lucia, the land clearing techniques and estimated prevalence by agricultural region were as follows; Slash and burn less than 70% (Regions 8 and 4), Herbicide application up to 90% (Regions 5 and 2), Slash/cutting up to 50% (Regions 1, 6 and 8), Mechanization less than 40% (Regions 6 and 3)

The conservation practices included low soil exposure by selective tree cutting and understory slashing. Burning was avoided and the cut material windrowed. In Grenada and the mountainous Windward Islands there was selective thinning and the planting of spreading crops, green cover, windrowing and using the cut vegetation to reinforce contour-protective bunds.

PLATE 1 Use of plastic mulch in Antigua (weed control, soil water conservation)

Subsequently, the protection of cleared land included practices such as terracing, contour ploughing, crop cover and direct planting (Table 1). Contour ploughing and terracing have been listed as practices in St. Kitts and Barbados but there are

significant variations in terms of technical correctness and efficacy. Contour ploughing independent of bed preparation on the contours, and subsequent good crop cover, reduce the efficacy of the practice. In St Vincent, of the 35 producers with recordable soil sustainability features, 19 practised contour ploughing and planting. Soil management in the less mountainous islands was primarily about holding moisture, avoiding wind erosion and improving fertility. (PLATE 1)

Table I Sustainable practices involving soil management across seven countries

Sustainability feature SOIL MANAGEMENT (Soil quantity, quality)	Perceived Frequency[1]
1.1 Appropriate Land clearing technique used (to maintain biodiversity, conserve soil)	2
1.2 Appropriate Building site selection	1
1.3 Building layout	2
1.4 Terracing	1
1.5 Contour ploughing	1
1.6 Crop cover	2
1.7 Direct planting (reduced on slopes to reduce soil loss by erosion)	1
1.9 Drainage (soil conservation, reduced runoff rate)	1
1.10 Ameliorant/incorporate	0
1.12 Green manure	1
1.13 Nutrient recycling	1
1.14 Composting	2
1.15 Crop rotation	3
1.16 Appropriate tillage (minimum soil disturbance)	2
1.17 Vermiculture	0
1.18 Soil fauna/flora (increased soil micro flora and fauna)	0

Many of the contour beds were not properly drained and subsequently developed weak bunds that broke free long streams of muddy water. In St Kitts, experience has

[1] [1] Legend: perceived frequency of occurrence, **0** = absolutely no evidence of practice/technology, **1** = 1-25%, **2**= 26-50%, **3**=51-75%, **4** =76-100%

forced one farmer to adjust his contours to allow water flow to a nearby ghaut/ravine. As articulated by the farmer, heavy rains will fill the furrows and burst the banks causing water to rush down the middle of the field, washing away soil and crops. The adjustment will allow the water to flow in a specified direction rather than filling and breaking the banks during heavy rains. In Barbados contour planting and the use of fruit trees for soil stabilization was evident in the Scotland District (Plate 2) some of the initial work was done by the soil conservation unit.

Improved Drainage was a very common practice recorded. Apart from the traditional drainage procedures (box drains, furrows, trenches), some producers avoided the same wheel tract on unpaved roads; variable wheel tracts led to reduced channels that could lead to fast-flowing miniature streams. Soil loss through erosion by water was the most prevalent concern.

PLATE 2 Bawdens, Sedgepond (sloping) soil conservation

The soil protection methods were often augmented with soil quality improvement through the use of ameliorants. Green manures such as guinea grass were listed for producers in all countries. Nutrient recycling by incorporating animal and green manures has been extensively reported. Manure incorporation varies from on-farm collection and subsequent spreading to animal droppings whilst grazing. Field grazing by these animals is often used as a means of weed control as well.

PLATE 3 Sheep used for weed control/manure/green manure precursor

Composting has been listed as an activity but to date only a small percentage of the farmers claiming to do composting have shown proper technical execution. There has been deviation from the actual practice leading to the use of green manures and mulch from material that was listed as composted. The most comprehensive composting operations were recorded from Grenada where true compost (friable organic material that can be used as a soil amendment or as a medium to grow plants) and compost teas were prepared to nutrient-rich specifications.

PLATE 4a Compost making Grenada

PLATE 4b Compost making Grenada

Textbook crop rotations have been evident wherein crop choices reflected different nutrient uptake regimes, differing feeding depths and dissimilar pest profiles. The soil was measurably improved in some cases due to the fertility increases, lowered pest loads and improved friability. Table 1-A highlights typical rotations encountered on mainland St. Vincent.

Table 1-A Recorded Crop Rotations on selected farms in St Vincent

FARMER	***LOCATION***	***CROPS/SEQUENCE***
Val Samuel	Argyle	Melons → Peanuts → Ochroes
James Peters	Belmont	Carrots → String Beans → Cabbage
Ainsley Derby	Belle Isle	Tomatoes → Sweet Potatoes →Yams
Granville Slater	Buccament	Cucumbers → Tomatoes →Lettuce
Eva Slater	Vermont	Cucumbers→ Carrots → Eddoes → Cabbage
Granville Antoine	Tourama	Sweet Potatoes → Yams → Eddoes
Felix Toppin	Tourama	Sweet Potatoes → Tomatoes → Yams
Leniff Patterson	Spring Village	Yams & Eddoes → Tomatoes → Ginger
Reginald Jeffery	Spring Village	Tomatoes & Cabbage → Eddoes → Yams →Tannias
Clinton Harry	Belair	Sweet Potatoes → Yams → Eddoes,

However there was significant evidence in countries like St. Kitts/Nevis and St. Lucia that the rotations were based more on economic factors than on crop husbandry. Same family rotations were noted as a means to cash in on high value crops although the

"rotated" crops had similar pest/disease and nutrient profiles. Interviewed farmers glibly said that they practiced rotations because they were not doing successive crops, yet the expected agronomic and soil improvement gains were not necessarily obtained.

Table 1-B Recorded Crop Rotations on selected farms in Dominica

FARMER	***LOCATION***	***CROPS/SEQUENCE***
Rose Nelson	Southwest District	Carrots → String Beans → Cabbage
Harold Fevrier	Southern District	Dasheen → Ginger→Yam
Deles Warrington	Northeast District	Bananas → Tannia →Bananas
Dublin Prince	North	Ginger → Passion Fruit →Pineapple

Appropriate tillage varied from minimum, to dust mulches, and to sub-soiling. Tillage variations were often incorporated with other operations like deep planting, fallow and manual land clearing. Documented examples from Antigua and Barbuda indicated that two farms in the South West district (volcanic sandy loam soils) used minimum tillage as effected through ploughing every three years. In Barbados it was noted that most of the "organic" farmers routinely minimize tillage/compaction by using small hand-push tillers. Direct planting as a means of limiting soil disturbance and reduced tillage was in evidence in St Kitts/Nevis, St Lucia, Grenada and St Vincent and the Grenadines. The method was confined to appropriate crops such as cucurbits, papaya, roots and tubers, plantain, and banana.

Vermiculture, although a technology popularized by Cuban volunteers in the Region, was not a practice recorded outside of Antigua and Barbuda where an enterprising farmer had developed a product range including worm compost. The Antiguan Farmer had done trials with local species but found them inefficient. He imported the California red worm in 1992 and always raised them in bins. They have not been able to move beyond his compost bins. This recorded method of rearing is significant in light of the designation of the red worm as an invasive species. The Field Assessors noted that while the deliberate introduction or reintroduction of soil fauna/flora was not a recognizable feature, many producers avoided inorganic chemicals that were believed to reduce soil biodiversity.

Water Management

Under the rubric of environmental sustainability, water management was seen as one of the most important components. It is at the heart of island-based agricultural adaptation with respect to Climate Change. If mitigation is about greenhouse gases, adaptation is about water. Common water management practices include rainwater harvesting (e.g. the use of water directed from guttering on farm buildings with subsequent storage), water reuse, and conservation.

Table II Sustainable practices involving water management across seven countries

Sustainability feature WATER MANAGEMENT (Water quantity, quality)	Perceived Frequency[2]
2.1 On site water course protection (maintaining banks etc)	0
2.2 Deliberate Riverine stabilization (maintaining flow direction)	0
2.3 Harvesting	1
2.4 Collection from guttering	1
2.5 Direct Collection from rainfall	1
2.6 Adequate Drainage (to limit waterlogging/flooding)	1
2.7 Irrigation method (efficient use of water)	3
2.8 Mulch (protecting soil moisture)	2
2.9 Green cover	1
2.12 Dispensing to animals (efficient presentation, proper storage)	2
2.14 Reuse	0
2.15 Reduction (low flow taps)	0
2.17 Bio-cleansing (use of organisms to remove contaminants)	0
2.18 Water treatment/settling	0

The urgency or track record in rainwater harvesting varies across the countries of reportage. In Barbados, within development project areas, well water is supplied thereby reducing the urgency of water catchment at the farm level (Table II). In St Kitts, ponds and wells are the major water source in the St. Peters project and Mansion. Whilst in Antigua and Barbuda ponds and dams are the direct concerns of many producers. In St. Lucia watercourse protection has been given greater prominence post Hurricane Tomas, whilst water-harvesting initiatives are on stream

[2] Legend: perceived frequency of occurrence, **0** = absolutely no evidence of practice/technology, **1** = 1-25%, **2**= 26-50%, **3**=51-75%, **4** =76-100%

in Region 3. On-farm ponds are replenished directly from rainfall or indirectly through springs/artesian sources.

How the available water in Island States eventually gets in to irrigation systems varies between and within islands. The breakdown in St Lucia was as follows; about 80% of the farms in Regions 7 and 8 are Rainfed; in most regions 10% of the holdings source gravity flow water from a stream/river, 15% use drip and 80% of protected agriculture structures use overhead systems. The European Union - Government of Saint Lucia irrigation project in the community of Delcer provides water for Region 6. This project provides water to the community and the environs especially during the dry period of the year.

The irrigation method provides an opportunity to conserve water with most producers in Barbados using drip systems. The rare occasion when sprinkler systems were deemed to be sustainable was highlighted by the account of an Antiguan farmer who swore that the system improved pest and disease management. This affirmation referred to control of the Diamond Back Moth on cabbage. The sprinklers were used in the evening, when the farmer contends the moth would be visiting; he observed that the water disrupted them from settling on the crop.

The plausibility of that system would be dependent on the augmenting of the irrigation water with a pesticide and the creation of a more humid microclimate against diseases like powdery mildew. Sprinklers can be sustainably used in pasture management especially when the pumps utilized are solar powered.

A noticeable feature of farms in the seven countries under review was the general absence of farm buildings except in the case of poultry and pig enterprises. Many of the cropping activities are removed from the producer's place of abode. Collection of rainwater in containers directly or from guttering is not a major activity. Interestingly, in Dominica rainwater is still considered a very important resource and is collected or harvested from rooftops of farmhouses using traditional bamboos and the storage drums are protected with a fabric covering. The water is used for domestic and agricultural purposes.

Dispensing of water to animals and the use of water for cleaning was observed to be at acceptable standards in terms of efficiency. Many producers reused water used for pen cleaning as part of overall irrigation water and "fertigated".

Mulch as a means of conserving water is widespread and includes the use of plastic. In Barbados mulching is used to varying degrees. There are a few growers who cover almost the whole cultivated area whilst others just use strips. Inorganic, mainly fabric or plastic mulches are common, however, some "organic" growers are using organic mulches such as coconut fibre and green waste from the solid waste plant in Barbados.

Apart from the conservation of water, there were a number of practices that improve the quality of the water that is either utilized in situ or runs off. In all the countries there was acknowledgement of the links between land-based operations and fish culture. Pollutants generated on land eventually reach the sea and can cause irreparable damage.

Cropping Pattern

Combined soil and water management involved the use of green covers and judicious cropping patterns. Generally crops were selected based on an understanding of the soil type and nutrient status. Trees were used as borders between plots and as windbreaks. Fruit trees were intercropped with short-term crops such as pumpkin and squash. For example, in Antigua and Barbuda, carrots and beets are grown in sandy loam soils best suited to the physical requirements of the crop.

On sloping land in Grenada, good coverage was provided, large plants (fruit trees) were used on steeper areas, and a good mix of annuals and perennials (different families and root depths, etc) were planted. In all of the countries there were examples of appropriate crop selection (Table V). In Dominica, within and outside of the Carib Territory, the planting of crops on specific areas is done based on their ability to reduce erosion, maintain soil nutrient balance and keep the soil intact.

PLATE 5 Crop mix to achieve good ground cover, Grenada

Table V Sustainable practices involving cropping patterns across seven countries

Sustainability feature **CROPPING PATTERN**	Perceived Frequency[3]
3.1 Crop appropriate for area/slope	2
3.2 Proper plant growth habit	2
3.3 Crop rotation	3

BIODIVERSITY

Very few of the farmers interviewed on the basis of the sustainable practices on their farm had monocultures. In most farms bees, butterflies and wasps were observed. The borders around and beyond the farms had endemic mixes of plants and weeds. The biodiversity displayed on, and proximal to, farms was indicative of a strategy through

[3] Legend: perceived frequency of occurrence, **0** = absolutely no evidence of practice/technology, **1** = 1-25%, **2**= 26-50%, **3**=51-75%, **4** =76-100%

which a wide mix of products is used to hold customers and as a means of financial security. Some of the diversity was deliberately organized to explore synergies. A pineapple farm boasted no less than 20 different fruits trees and a range of crops, including sorrel, cucurbits and beans. That farm also had bee hives \ pollinators, which were sometimes rented to other farmers.

Table VI Sustainable practices involving biodiversity across seven countries

Sustainability feature **BIODIVERSITY**	Perceived Frequency[4]
4.1 Land clearing method (retaining flora and fauna)	2
4.2 Avoidance of monogenic strains/lines	0
4.3 Product mix (complex agro-ecological zone)	1
4.4 Bio/cultural pest management	1

One farm with banana as the main crop had it intercropped with cassava; additionally there were rows of corn and sweet potato, interspersed with pineapple and yams. Many farmers used biological insecticides and a few used limited organophosphate pesticides only at planting time. Most farmers depended on a mix of cultural practices to control pests, including crop rotation and intercropping (Table VI). In Dominica, many of the farmers used biological control methods based on plant extracts grown on the farm. Testimony to the low use of inorganic pesticides was the observed abundance of beneficial insects and pollinators. In Dominica as well was the one documented case of small-scale sericulture. None of the documented instances of land clearing by producers included mangroves. Mangrove trees are specially adapted to being submerged in saltwater and thus provide detritus needed to fuel the important food chain of the mangrove ecosystem.

Producers and fisher-folk operating in its environs understood the coastal stabilizing role played by mangrove.

CARBON FOOTPRINT

[4] Legend: perceived frequency of occurrence, **0** = absolutely no evidence of practice/technology, **1** = 1-25%, **2**= 26-50%, **3**=51-75%, **4** =76-100%

All farmers and fisher-folk interviewed used fossil fuels for pumps, tractors, engines etc. The area of energy efficiency and renewable systems appears to be off the radar of many Regional producers. One farm with an integrated aquaculture-hydroponics system used electricity to pump recycled water from the tilapia fishpond to vegetable beds and back to the fishpond. The owner reported that government policy did not allow use of co-generated solar powered equipment.

Table VI Sustainable practices involving carbon footprint across seven countries

Sustainability feature **CARBON FOOTPRINT**	Perceived Frequency[5]
5.1 Reduced Fossil fuel use	0
5.2 Reduced Electricity use	0
5.3 Renewable energy use	1
5.4 Solar	1
5.5 Wind (energy generation)	1
5.6 Waste reduction/less landfill use	0

The Field Assessor verified the letter and intent of the relevant legislation. With regards to renewable energy use, the major limiting factor was a piece of legislation that permitted only the Antigua Public Utilities Authority (APUA) to produce power (The Public Utilities Act CAP 359, PART II, Section 5 to 8). However, Grenada reports cases of solar and wind powered generators being used for honey extraction, water pumping, refrigeration, lighting and produce grinding/processing.

Worldwide, post-Kyoto reaction suggests that sustainability of production will be linked to climate-neutral technologies. Already, key exports of Fairtrade bananas require the use of environment-friendly techniques, particularly with regard to the use of agrichemicals derived from petroleum products. In Barbados, where solar water heating is commonplace, there is minimal use of alternative energy on farms, many of the respondents noted they were weighing the cost of the investment.

[5] Legend: perceived frequency of occurrence, **0** = absolutely no evidence of practice/technology, **1** = 1-25%, **2**= 26-50%, **3**=51-75%, **4** =76-100%

PLATE 6 Energy generation, Grenada

WASTE DISPOSAL

For the crop farmers, waste is not a major issue. Generally the crop residue is ploughed back in or it is used to feed pigs on farm, or by other pig producers (Table VII). Crop wastes (including carrot tops) are also used as mulch. Some farmers gathered the crop residues into a heap let it dry and then burnt it. This they reported was to reduce pest problems, in two instances sweet potato was the crop of concern. These findings reinforce the observation that composting is one of the most misunderstood operations on Caribbean farms. An appropriate composting process must be used in order to ensure that pests and pathogens that are harmful to humans and plants are destroyed, The process depends on the composting conditions (temperature, aeration etc.) as well as duration of survival of pathogens and pests.

Instead of drying and burning to reduce contamination, the material could have been composted. In one organoponics farm, fish waste was used to fertilize on land crops as part of the overall system of growing plants in composted organic material. Livestock farmers generally viewed daily-generated waste as manure. Offal, skins and rendered materials were often generated off farm in Government abattoirs. Manure is often collected (gratis) and taken off farm to be used by crop farmers.

Although increasingly farmers said they sell manure if they are not growing any crops themselves.

Table VII Sustainable practices involving waste disposal across seven countries

Sustainability feature **WASTE DISPOSAL**	Perceived Frequency[6]
6.1 Use of crop residue/waste/entrails	3
6.2 Composting	2
6.3 Scrap metal/building material	0
6.4 Waste water	1

PLATE 7 Organoponic Systems, Antigua

[6] Legend: perceived frequency of occurrence, **0** = absolutely no evidence of practice/technology, **1** = 1-25%, **2**= 26-50%, **3**=51-75%, **4** =76-100%

Several farmers recognized the threat to their operations posed by waste originating from inputs such as plastic containers and packaging. Apart from the impact of leached material on soil and water quality they recognized the potential health risk.

Inorganic waste disposal presents more of a challenge in the region. The absence of plastic recycling facilities makes disposal of containers and issue. Outside of Grenada there were no documented cases of the current reuse of spent oils/fuel.

5.2 FINANCIAL SUSTAINABILITY

Most farmers were GAP trained if not GAP certified. The relationship between GAP and sustainability was very evident. GAP training increases the likelihood that sustainable practices will be part of the farmer's routine. The inter-island differences in the quality or strength of marketing arrangements were noticeable. Cooperative membership in some cases was linked directly to market access, with particular reference to supplying the hospitality industry. Common to the countries was the fact that often there is no formal contract arrangement; rather informal arrangements are in place with Marketing Boards, supermarkets and hotels.

A few interviewees were members of farmers groups, but these were found to be ineffective in arranging markets for the crops with the exception of Windward Islands Farmers' Association (WINFA) and Caribbean Farmers Network (CaFAN). WINFA banana farmers have access to the Fairtrade market. Apart from the impact on financial sustainability that Fairtrade brings, there is the emphasis on ethical, environment-friendly production. Fairtrade has a direct impact on environmental sustainability and socio-economic soundness (Table VIII). The social premium earned by Fairtrade farmers redounds to the benefit of entire communities. In all islands, farmers reported having verbal contracts with hotels, restaurants, supermarkets and hucksters.

Very few farmers supplied government institutions with vegetables on a continuous basis. A few interviewees were retailers as well as producers and had stalls at public markets. Farmers still report dissatisfaction with the inordinate delays in payment by

corporate buyers and retail chains. Their financial sustainability rests with the cash turnover associated with farm-gate sales to hucksters. There were a few instances of entrepreneurial creativity. One farmer sold his vegetables to persons in his community, even dropping off vegetables to members who were confined to their homes.

Table VIII Sustainable practices involving marketing arrangements across seven countries

Sustainability feature **MARKETING ARRANGEMENTS**	Perceived Frequency
7.1 Contract sales	0
7.2 Listed consumers	2
7.3 Cooperatives	1
7.4 Value chain involvement	1
7.5 GAP certification	0
7.6 Standards driven production (Fairtrade etc)	1

The greatest threat to the sustainability of production in all the islands was in the sphere of finance. Legislative and incentive mixed-signals, less stratified markets to reward environmentally sound production, and weak financing arrangements all conspire to reduce producer efficacy.

TENURE

Security of tenure is one of the root determinants of sustainability in all the countries in which the present baseline study was conducted. Willingness to shepherd the natural resources that fall within the purview of agriculture is directly proportional to the vested interest in the farm or holding. Farmers without secure title find it difficult to make long-term choices; there is always the temptation to take the short-term gain (Table IX). Long-term leases, freehold, and well-monitored rental agreements are the bedrock of sustainable agribusiness models.

A significant number of farmers rented lands from the government, whilst there were those with freehold interest and others in various stages of regularization. Because of the focused nature of this study, the producers interviewed were those utilizing sustainable practices, hence the high levels of freehold and secure tenure encountered. The general farming populations in the countries of interest have less secure tenure.

Table IX Sustainable practices involving tenure across seven countries

Sustainability feature **TENURE**	Perceived Frequency[7]
8.1 Freehold	2
8.2 Leasehold	2
8.3 Rental	1
8.4 None	1

Table X St Lucia Census results (86,96,07) re. Land tenure structure

LAND TENURE STRUCTURE (1986-2007)			
Forms of Tenure	**1986**	**1996**	**2007**
Total Area of Holdings	**100.0%**	**100.0%**	**100.0%**
Owned	60.2%	52.1%	39.7%
Family Land	24.4%	29.8%	41.9%
Rented/Leased Private	6.7%	8.6%	10.4%
Rented/Leased Government	1.8%	4.9%	3.1%
Squatting Private	2.0%	1.4%	1.5%
Squatting Government	1.6%	1.5%	2.2%
Other	3.3%	1.8%	1.1%

If St. Lucia is taken as an example (Table X), there is a trend towards increase in family-owned lands and more private rental/lease agreements. The lack of clear title has implications for access to/availability of financial resources (e.g. bank loans) to capitalize operations.

5.3 SOCIOECONOMIC SUSTAINABILITY

[7] Legend: perceived frequency of occurrence, **0** = absolutely no evidence of practice/technology, **1** = 1-25%, **2**= 26-50%, **3**=51-75%, **4** =76-100%

The interviewed farmers and fisher-folk were all recognizable members of the various communities and involved in farmers groups, village councils, sporting groups, etc. One farmer in South Central District of Antigua and Barbuda reported that the farmers with contiguous plots help each other at planting and harvesting. Other less structured community-based groups did not necessarily echo this level of cooperation. Only four out of the initial round of two hundred and forty-five direct interviewees stated that a number of persons in their respective communities assisted with short-term labour, when extra hands were needed. Although the majority of producers are well-entrenched in their communities, financial viability is still based on satisfying demand generated elsewhere. In other words the major market for their produce is located outside of their local community.

Table X Sustainable practices involving social impact across seven countries

Sustainability feature **SOCIAL IMPACT**	Perceived Frequency[8]
9.1 Integration into neighbourhood	2
9.2 Community involvement	2

The overall sustainability of activities in the sector is circumscribed by State-wide support through legislation, incentives and disincentives. The possible amalgam of policies can be exemplified with reference to St Kitts and Nevis. Support services to the farming community come primarily from the Department of Agriculture and allied Institutions such as CARDI, IICA, Taiwanese Agricultural Technical mission of the ROC. The more recent policies to be amended in support of Sustainable Agriculture include the Land Development Act of 1991 (provides a contract of tenancy under the Agricultural Small Holdings Act Chap. 87 of the Laws of St. Christopher and Nevis), the National Conservation and Environment Protection (Amendment) Act, 1996 and the National Conservation and Environmental Conservation Act (1987).

[8] Legend: perceived frequency of occurrence, **0** = absolutely no evidence of practice/technology, **1** = 1-25%, **2**= 26-50%, **3**=51-75%, **4** =76-100%

The group interview phase of project implementation unearthed no instances of overt social incompatibility with the exception of the growing of illegal crops notably *Cannabis* spp. The sustainability of production whether land-based, aquatic or marine does not appear to be threatened by adverse community reaction. The integration of fishing activities and shared beachfront access with the Tourism industry points to a lessened degree of inter-sectoral conflict.

6. SUSTAINABILITY MATRIX

The "AgroMatrix" policy framework, that has been postulated by the Inter American Institute for Cooperation on Agriculture to move Caribbean agriculture forward, fits into the hemispheric aspirations as laid out in the AgroPlan 2015 and the truly global Millennium Development Goals (Table XI). The AgroMatrix incorporates a systemic, as opposed to simply systematic, analysis of agriculture and the rural milieu. It defines sustainable development in terms of the economic, ecological, social and political dimensions necessary to achieve competitiveness, sustainability, equity and governance respectively.

Table XI Agromatrix Framework

The AgroMatrix Conceptual Framework				
Systemic Concept / Sustainable Development Approach	Rural Territories	Agri-Food Value Chain	Policy System	Strategic Objectives
Economic (Production & Trade)	I. Promote Competitive Rural Enterprises	II. Forge Linkages, Integrate Chains & Enhance Productivity	III. Build an Enabling Business Environment	Competitiveness
Ecological (Environmental)	IV. Promote good environmental practices	V. Promote Integrated Environmental Management	VI. Build a Pro-Eco Institutional Framework	Sustainability
Social (Cultural & Human)	VII Facilitate Improved Quality of Life and Access to Services	VIII. Develop Capabilities, Expertise and Innovation	IX. Promote Policies to Improve Lives and Livelihoods	Equity
Political (Institutional)	X. Strengthen Public and Private Sector Partnerships	XI. Strengthen Dialogue, Inter-relationships and Commitments	XII. Promote national policies and external cooperation	Governance
Strategic objectives	Rural Prosperity + Food Security + Positioning			Sustainable Development of Agriculture and Rural Life

The Agro Matrix addresses these four major inter-dependent elements and defines the spheres of actions based on three levels: rural operations, the agri-chain and policy. In other words it is a framework that gets to the core issues of competitiveness, sustainability, equity, and governance by defining what each means at the farm, agri-chain and overarching policy level.

This study on sustainable practices in Barbados and six OECS countries can easily fit in to the overall milieu. The Matrix is premised on a "sustainable development approach" that culminates in "sustained development of agriculture and rural life". The documented practices that focus on environmental factors are consistent with box IV of the Agromatrix and align with the sustainability strategic objective. The financial aspects of sustainability as described herein anticipated marketing arrangements that linked producers to strong value chains in accordance with boxes I and II. Those factors would lead to the realization of the competitiveness strategic objective. To the extent that issues of tenure and social impact were considered in this study, box VII would impact on the equity strategic objective. The political significance of legislation affecting socio-economic sustainability has already been mentioned and would speak to the governance issue.

The recorded sustainable practices were listed as per the concept note within the context of their verified existence. Additionally the Field Assessors were asked to document the perceived frequency of their occurrence. The individual country reports are provided at Annex 1-6, and the following is a tabulation of the modal average for the seven countries (Table XII). The three Appendices are as follows:

Appendix 1: Baseline Survey template

Appendix 2: Useful information collected on Marine environment

Appendix 3: List of Assessors from the seven countries that were surveyed

Table XII Modal average of sustainability features, based on perceived frequency

Sustainability feature	Perceived Frequency[9]

[9] [9] Legend: perceived frequency of occurrence, **0** = absolutely no evidence of practice/technology, **1** = 1-25%, **2**= 26-50%, **3**=51-75%, **4** =76-100%

SOIL MANAGEMENT (Soil quantity, quality)	
1.1 Appropriate Land clearing technique used	2
1.2 Appropriate Building site selection	1
1.3 Building layout	2
1.4 Terracing	1
1.5 Contour ploughing	1
1.6 Crop cover	2
1.7 Direct planting	1
1.9 Drainage	1
1.10 Ameliorant/incorporate	0
1.12 Green manure	1
1.13 Nutrient recycling	1
1.14 Composting	2
1.15 Crop rotation	3
1.16 Appropriate tillage	2
1.17 Vermiculture	0
1.18 Soil fauna/flora	0

Sustainability feature **WATER MANAGEMENT** (Water quantity, quality)	Perceived Frequency
2.1 On site water course protection	0
2.2 Riverine protection/stabilization	0
2.3 Harvesting	1
2.4 Collection from guttering	0
2.5 Direct Collection from rainfall	0
2.6 Adequate Drainage	1
2.7 Irrigation method	3
2.8 Mulch	2
2.9 Green cover	0
2.12 Dispensing to animals	2
2.14 Reuse	0

Sustainability feature **WATER MANAGEMENT** (Water quantity, quality)	Perceived Frequency
2.15 Reduction (low flow taps)	0
2.17 Bio-cleansing	0
2.18 Water treatment/settling	0

Sustainability feature **CROPPING PATTERN**	Perceived Frequency[10]
3.1 Crop appropriate for area/slope	2
3.2 Proper plant growth habit	2
3.3 Crop rotation	3
BIODIVERSITY	
4.1 Land clearing method	2
4.2 Monogenic strains/lines	
4.3 Product mix	1
4.4 Bio/cultural pest management	1
CARBON FOOTPRINT	
5.1 reduced Fossil fuel use	0
5.2 reduced Electricity use	0
5.3 Renewable energy use	0
5.4 Solar	0
5.5 Wind	0
5.6 Waste reduction/less landfill use	0
WASTE DISPOSAL	
6.1 Use of crop residue/waste/entrails	3
6.2 Composting	2
6.3 Scrap metal/building material	0
6.4 Waste water	1

[10] Legend: perceived frequency of occurrence, **0** = absolutely no evidence of practice/technology, **1** = 1-25%, **2**= 26-50%, **3**=51-75%, **4** =76-100%

Sustainability feature **MARKETING ARRANGEMENTS**	Perceived Frequency
7.1 Contract sales	0
7.2 Listed consumers	2
7.3 Cooperatives	0
7.4 Value chain involvement	0
7.5 GAP certification	0
7.6 Standards driven production (Fairtrade etc)	0
TENURE	
8.1 Freehold	2
8.2 Leasehold	2
8.3 Rental	1
8.4 None	1
SOCIAL IMPACT	
9.1 Integration into neighbourhood	2
9.2 Community involvement	2

7. CONCLUSIONS/RECOMMENDATIONS

This baseline study was in sync with the five pillars of sustainability viz. Increased productivity, Reduced risk, Conservation of resources, Viability, and Social acceptability The utility of this snapshot of current sustainable practices is in its capacity to point to areas for intervention or strengthening of existing efforts. As a baseline, it provides information on what practices are used in which islands with an overview approximation of the frequency of occurrence from on-island assessors.

Some conclusions and recommendations are provided in the Table XIII.

The current sustainable practices are still part of an *ad hoc* approach. This Study considered close to two thousand holdings/operations by GPS survey, geography, agricultural district, and importance of the major crop/product, yet there were no

examples of operations utilizing a full set of sustainable practices across environmental, financial and socio-economic spheres. *One of the most important uses of this study could be the reintroduction of Good Agricultural Practices with a focus on Climate-smart agriculture that could, in one fell swoop, ensure the viability of the sector in a comprehensive way.*

Table XIII. Conclusions and Recommendations

Conclusions	Recommendations	Remarks
The reported practices can be the first step in the transition to developing a National Adaptation Programme of Action (NAPA) or Nationally Appropriate Mitigation Actions (NAMA).	Use the current tried-and-tested sustainable practices as the foundation for comprehensive, climate-smart agricultural strategies as part of NAPA	The Ministries of Agriculture in the targeted countries have not comprehensively addressed adaptation or mitigation issues with regard to Climate Change
Land: With regard to the environmental dimension of sustainability across all the Islands - land clearing is approached with knowledge of the consequences of soil loss and the need for soil protection. The requisite soil cover, avoidance of steep exposed slopes, minimum tillage and direct planting of appropriate crops are well-understood	- Site preparation should be conducted with minimum soil disturbance/loss - Cut vegetation should be windrowed and/or composted - Properly constructed terraces on slopes of <15% - Direct planting of fruit trees on sloping land - Contour drainage - maintain appropriate green cover during fallow	Flexibility by the State, with regard to the interpretation of land zoning regulations, has exacerbated inappropriate slope management.
Soil quality: Improvement of soil quality appears to be lagging behind, although green manures are used and nutrients recycled. Composting remains a largely misunderstood concept and some of the acclaimed crop rotations are based solely on financial considerations, and not agronomic reality.	- Use of green manures - Crop rotations that involve less closely related plants that proportionately utilize different nutrients and have different pest complexes e.g. Cucumbers-tomato-lettuce - Appropriate/Minimum tillage - Effective composting	Soil/growth media improvement is a linchpin of sustainable agriculture and will be key to water and nutrient availability.
Water use: Water harvesting / conservation are limited to using low flow irrigation techniques. Several instances of the use of potable water directly from State mains were recorded. If water availability is going to be a limiting factor in the near future then those	- On-farm storage of rainwater - Effective use of low flow emitters, drip irrigation - Use of green/artificial mulch - Practical soil moisture tests (e.g. “feel tests” with an auger) - Fixed receptacles for animal watering	The consensus of the University of the West Indies’ Climate Studies Group, as at the end of 2011, is that rainfall will be a significant variable as the climate changes, thereby

Conclusions	Recommendations	Remarks
practices will be difficult to sustain. When State-managed water sources were used (as in ponds, dams and other catchments), on-farm conservation was often lacking. There was evidence of head-end leaks in drip irrigation systems that negated the conservation gains of using a low flow technique. Absence of a reliable method of determining plant water needs can result in over-watering when using drip systems. Poor choice of emitter, mismatched pumps, long lateral lines and lack of compensation for uneven terrain suggest the need for remedial interventions in a number of cases.	- Low flow taps for washing equipment/produce/machinery - Adequate drainage to avoid water-logging - Solar-powered sprinkler systems for pastures or soiling grasses.	impacting water availability.
Water reuse / recycling: Four islands listed water reuse/recycling of water especially in livestock rearing operations, yet there was room for improvement. Poultry and Pig operations were often better organized than ruminant rearing. Sustainability concerns should be assessed prior to farm building construction to facilitate aspects such as directed runoff and storage from guttering.	- Farm buildings constructed to direct and store water from guttering. - Reuse of water in livestock operations (e.g. use of grey water for pasture irrigation)	The increase in protected agriculture structures (such as row covers, shade-houses and enclosed greenhouses) provides new opportunities for recycling water use even in non-hydroponic systems
Environmental sustainability: Only Grenada had a comprehensive planned approach to a green economy that included legislation and stated commitment to reduce carbon footprint. Dominica had some farm-based	- Ministries of Agriculture promote and incentivize climate-smart agriculture via sustainable practices as mentioned herein - refocus on Good Agricultural Practices (GAP) as a mechanism for livelihood protection and nutrition	As part of nationwide environmental sustainability initiatives, the role of agriculture as a significant steward of the natural

Conclusions	Recommendations	Remarks
alternative energy systems. Waste reduction and the consequent relief on landfills was not a feature identified during the study	security as opposed to an imposition for international trade	environment should be prominently projected
Financial sustainability: Examples of environmentally-sound, sustainable practices were seen, but financial sustainability aspects were less evident. The apparent exclusion of producers from a number of value-chains is cause for concern. With the exception of producers belonging to a handful of farmers' organizations and the cooperatives, the others depended on very loose verbal agreements at best. Formal, structured arrangements for the marketing of non-traditional vegetables and fruits still pose a problem. Bananas in the Windward Islands and onion in Barbados are two of the more developed value chains. The incorporation of VINCYKLUS, the agri-business cluster in St Vincent and the Grenadines is a potential source of improvement.	- Continued promotion of the Value Chain approach with a concentration on looped value chains to include by-product and end-product utilization - Proper Record Keeping as part of a regimen of business monitoring - maintain a customer database - keep the community informed about production and sustainability issues	A major feature of financial sustainability is proper accounting for the resources utilized. Proper agricultural records incorporate more than just financial information, all major decisions can be traced through accurate and timely entries. Decision-making is thus better informed, including decisions on contractual arrangements.

8. ANNEXES

ANNEX 1 Antigua and Barbuda
Tabulated results and Assessor notes
Antigua and Barbuda

General findings

Each crop farmer interviewed had at least six sustainable practices. All persons had a concept of sustainable farming/fishing and made an effort to practice the same.
With regards to renewable energy use, the major limiting factor was a legislation which permitted only the Antigua Public Utilities Authority (APUA) to produce power (The Public Utilities Act CAP 359, PART II, Section 5 to 8). The act also gives APUA rights over all water in the country, and in times of drought, farmers find the pipe borne water to their farms being restricted, priority being given to homes, the city and the hospitality sector. Nevertheless, persons may write to the Authority for permission to generate power. The Authority permits the use of ponds, dams and rainwater harvesting, in the agriculture sector, since for the most part they are unable to meet all the demand for water by the various sectors.

Rain water harvesting, either by water catchment in dams, ponds, wells, or guttering on buildings, was practised by all but four producers. Antigua and Barbuda are normally prone to drought and access to water is critical for production. As a result, rain water harvesting is a norm for crop and livestock producers. There are also high costs associated with using APUA water for farming, even with special rates for farmers. So drip irrigation use was widely practised by crop producers. Two farmers, who use sprinkler irrigation, use it for specific crops (cabbage) as a pest control measure-disrupting the insect pests (Diamond back moth).

Sustainability feature SOIL MANAGEMENT (Soil quantity, quality)	Notes	Perceived Frequency[11]
1.1 What type of Land clearing technique was used?	Brush cut and plough Plough twice Minimum tillage	2 1 1
1.2 Check Building site selection	There were hardly any buildings on the farms. But the few were situated on higher elevations than the farms	1
1.3 Check Building layout	The livestock pens were well constructed and laid out. Mostly pig and poultry producers	3
1.4 Terracing?	This was unique. Bench terracing	1
1.5 Contour ploughing?	This practice is not as widespread as it should be < 10%	1
1.6 Crop cover?	This was minor practice	1
1.7 Direct planting?	This was minor practice	1
1.8 Other?	Aquaponics (2 farms)	1
1.9 Drainage?	In most areas this was not a practice	1
1.10 Ameliorant/incorporate?		0
1.12 Green manure?	Ploughing in grass or legumes was practised by a least 20%	1
1.13 Nutrient recycling?	In some form about 30%	2
1.14 Composting?	Only a small percent did this and it was done in a heap, not a pit < 5%	1
1.15 Crop rotation?	Practised by most crop farmers >80%	4
1.16 Appropriate tillage?		4
1.17 Vermiculture?	This was unique. This farmer has Developed products along with the	1

[11] Legend: perceived frequency of occurrence, **0** = absolutely no evidence of practice/technology, **1** = 1-25%, **2**= 26-50%, **3**=51-75%, **4** =76-100%

Sustainability feature SOIL MANAGEMENT (Soil quantity, quality)	Notes	Perceived Frequency[11]
	worm compost. He used a small wind powered system to generate power to irrigate his crops, from rainwater collected in tanks. He used micro-sprinklers for maximum water efficiency. He used old shipping pallets to construct beds for the crops. He makes a worm compost "tea" for pest control. His crops are organic	
1.18 Soil fauna/flora?		0
1.19 Other?	Plastic or grass mulch <1%	1

Sustainability feature WATER MANAGEMENT (Water quantity, quality)	Notes	Perceived Frequency[12]
2.1 On site water course protection?		0
2.2 Riverine protection/stabilization?		0
2.3 Harvesting?	Pond or dam or well Over 80% practice	4
2.4 Collection from guttering?	About 10% practice	1
2.5 Collection from rainfall?	In some way or another maybe	2
2.6 Drainage?		4
2.7 Irrigation method?	Drip	4

[12] Legend: perceived frequency of occurrence, **0** = absolutely no evidence of practice/technology, **1** = 1-25%, **2**= 26-50%, **3**=51-75%, **4** =76-100%

Sustainability feature WATER MANAGEMENT (Water quantity, quality)	Notes	Perceived Frequency[12]
	Sprinkler (used as part of pest mgt?)	1
2.8 Mulch?		1
2.9 Green cover?		2
2.10 Other?	APUA water-public utility. Up to 75% of farmers use this. Some only for spraying and postharvest washes.	4
2.11 Washing/cleaning?		4
2.12 Dispensing to animals?	Used by all livestock farmers	4
2.13 Conservation?		0
2.14 Reuse?	Aquaponics system	1
2.15 Reduction (low flow taps)?		0
2.16 Outbound pollutants/leachates?		0
2.17 Bio-cleansing?		0
2.18 Water treatment/settling?	(livestock sump pond) Mainly used by pig producers, about 40%	2

Sustainability feature **CROPPING PATTERN**	Notes	Perceived Frequency[13]
3.1 Crop appropriate for area/slope?	General practice Over 80%	4
3.2 Proper plant growth habit?	Over 80%	4
3.3 Crop rotation?	Over 80%	4

[13] Legend: perceived frequency of occurrence, **0** = absolutely no evidence of practice/technology, **1** = 1-25%, **2**= 26-50%, **3**=51-75%, **4** =76-100%

Sustainability feature **CROPPING PATTERN**	Notes	Perceived Frequency[13]
3.4 Other?	Pasture rotation	4
BIODIVERSITY		
4.1 Land clearing method?		1
4.2 Monogenic strains/lines?		1
4.3 Product mix?		4
4.4 Other?	Presence of bees, wasps, butterflies	4
CARBON FOOTPRINT		
5.1 Fossil fuel use?		4
5.2 Electricity use?		1
5.3 Renewable energy use?		0
5.4 Solar?		0
5.5 Wind?		1
5.6 Waste reduction/less landfill use?		1
5.7 Other?	(poultry waste buried in pits)	1
WASTE DISPOSAL		
6.1 Use of crop residue/waste/entrails?		4
6.2 Composting?		1
6.3 Scrap metal/building material?	For fences and animal pens about 10%	1
6.4 Waste water?		0
6.5 Other?	Burning ….Crop waste burnt to reduce pest about 10%	1

Sustainability feature **MARKETING ARRANGEMENTS**	Notes	Perceived Frequency[14]
7.1 Contract farming?		0
7.2 Listed consumers?	No written contracts/verbal agreement	2
7.3 Cooperatives?	Farmers may register with an organisation but they tend not to be very involved in its functioning	3
7.4 Value chain involvement?		1
7.5 GAP certification?	Trained but not certified	4
7.6 Standards driven production (Fairtrade etc)?		0
TENURE		
8.1 Freehold?		1
8.2 Leasehold?		1
8.3 Rental?		4
8.4 None?		0
SOCIAL IMPACT		
9.1 Integration into neighbourhood?		1
9.2 Community involvement?		1

Policy and legislative framework for crop and livestock production

The Ministry of Agriculture, Lands, Housing and the Environment has passed a few legislation in the last five years that helps to promote sustainable farming practice: Pesticides and Toxic Chemical Control Act, Fisheries Act, The Dog Control Act. In

[14] Legend: perceived frequency of occurrence, **0** = absolutely no evidence of practice/technology, **1** = 1-25%, **2**= 26-50%, **3**=51-75%, **4** =76-100%

draft are: Bio-safety Protocol, Plant Health Act and Animal Health Act, to be passed soon.

The Ministry holds each year, in collaboration with regional agricultural organizations, a Pesticide Awareness Week the last week in September each year. This year's theme was "Save lives! Read and Understand Pesticide Labels" and included a seminar on "Effective Regulatory Management of Pesticides and Toxic Chemicals". Over the last ten years the ministry has also being involved in a regional project to inventory obsolete or banned pesticide stocks and to seek ways to dispose of them safely.

In 2009, the Minister of Agriculture sought to bring back the Environment Division under the Ministry of Agriculture. It was then at the Ministry of Tourism. This was an effort to better integrate programmes for sustainable use of the land and water resources.

The Ministry is currently developing an Agriculture Land Use Policy, which will form part of a National Physical Plan for Antigua and Barbuda. A National Agriculture Policy is also being developed. Included in this will be Good Agricultural Practices for crop and livestock, as well as safe pesticide use. The later will also include an incentive for farmer certification whereby compliant farmers will have greater market access. Both documents are not yet at a stage to be disseminated.

Other ongoing programmes to support sustainable farming practices include:

- Disaster preparedness toolkit: "Saving animals, securing fishers and farmers from disaster", which outlines actions for pre-, during and post-disaster.
- Launched in October 2011, a "Buy Local" campaign to promote local produce, services and products
- Make adjustments to the National Food Plan to change focus from production to storage and marketing. To this end, the Ministry acquired a packhouse and is seeking to increase chillroom storage.
- Upgrade Central Marketing Corporation (CMC) to market local produce and eggs, while seeking export markets in the USVI. To support this, the Ministry

has re-activated the Production and Marketing Intelligence Service (PROMIS) Unit-responsible for production data and marketing intelligence

- A FAO funded project to construct mini-dams to provide 230 million gallons of water for the agriculture sector
- Plans are in process to launch a pilot project in biogas digestion on one pig farm
- The ministry also launched a youth programme- The Pares Youth Project, where 40 young farmers will have access to 20 acres of land for farming. Government will put in fencing, water and other infrastructure for the project. The farmers will be assisted by a management team to guide production for import substitution and identifying niche markets for export in selected commodities (onion and carrots).
- The Ministry, under the FAO Initiative on Soaring Food Prices in 2008 has constructed a few miles of farm access roads and improved a few mini-dams.

ANNEX 2

Report on baseline study on sustainable production practices in Barbados

Background

In Barbados, agricultural production holdings may be broadly (arbitrarily) classified as follows:

- Plantations- mainly sugar cane and root crops/cotton. Only a few of these have diversified to vegetable/livestock production
- Farms on larger holdings of 2 to 8 Ha- livestock and or vegetable production
- Farms on smaller holdings 0.2 to 1.6 Ha- livestock and or vegetable production
- Backyard efforts- livestock and or vegetable production

There are about 4,600 registered "farmers". Out of these, about 1000 fall on plantations and smaller/larger holdings. The remainder of production is from much smaller "kitchen garden" efforts, but traditionally these have made a strong, consistent contribution in supplying hotels and supermarkets. Therefore they cannot be ignored with regard to production.

Most of the farms in larger/smaller holdings are found in rural development programs or in clusters in certain areas. Table 1 below shows some of the main areas where farms are concentrated.

There are at least 15 protected cultivation efforts scattered over the island. The largest is about 4 acres of coverage. The significance of these would/should be reduced use pesticides (herbicides especially)/fertiliser and seepage of chemicals into groundwater.

Some technologies that are standard:

- Plantation- sugar cane cultivation rotated with root crops. Very routine, with no special measures
- Livestock- poultry, pigs dairy are vertically integrated and use a routine technology. Similar exists for sheep, though not as vertically integrated. Few examples that differ in terms of practices
- General farms. Drip irrigation is often the only sustainable practice that is found.

Areas that are specifically at risk and other risk issues:

- The Scotland district- Bawdens, Greenland, Sedgepond, Bath, parts of Lammings, Newcastle fall on this area soil erosion issues (steep slopes)

Fig 1 Bawdens, Sedgepond (sloping)

Fig 2 Greenland (flatter section of Scotland district)

Fig 3 Newcastle area

Fig. 4 Lammings Area

- Areas falling in Zone 1 of the groundwater protection zones. Leakage of pesticides/fertilisers into groundwater. Some producing areas fall on or very close to such areas e.g. Belle, Trents.
- Soil erosion in runoff from plantations in the flatter part of the island just after cultivation (soil fertility conservation).

Methodology

The strategy to cover all the major agricultural areas in the island, has been a combination of the following:

- Using the list of registered farmers (4546 approx), From this list a smaller group (about 65) of farmers who have recently invested in "new technology" was extracted for follow up.

- Use of Google Earth imagery to identify focus areas,

- Suggestions from Extension officers, farmer groups etc

- Farm reconnaissance trips for detailed observation. All farms in the rural development areas and clusters in many areas were visited and observed to check for the presence of indicators such as tanks, windmills/panels, mulch etc. the features of these farms are completely visible from the road. Some farmers were questioned on site.

- A shortened version of the farmers list (selections from about 1000) was used in combination with Google earth images. Calls (to those in areas with intense agricultural activity) were done to "mine" for other examples. This was done to cover farms (including livestock operations) outside of the rural development projects.

Table 1 Listing of areas where small and larger agricultural holdings are concentrated in Barbados (excluding plantations)

N.B ***Plantations are spread over all parishes***

Among the **plantations,** a small group has led the crop diversification effort:

- Claybury- vegetables, pawpaw and other fruit, root crops (pasture for hay more recently)
- Brighton- onions and other vegetable greenhouses
- Hopewell- vegetables and fruit crops
- Mount Wilton- vegetables, root crops, pawpaw and other fruits
- Warleigh- root crops and vegetables under BAMC management
- Springhall-root crops and vegetables under BAMC management

Farmers groups:

Barbados Agricultural Society, Association of Women in Agriculture. St George Farmers Coop. Bawdens Land-lease Farmers coop. National Union of Farmers. Organic Growers and Consumers Association.

Results/findings

Many of the best examples of sustainability were not found within the typical farming areas. Results were summarised in table 2.

1 Soil management

(quantity)

1.4, 1.5, 1.6 Terracing and contour ploughing were prevalent in the Scotland district. In this area, terracing is generally done initially by the Soil Conservation Unit. Ploughing was done on the contour.

On plantations, khus khus grass is planted on the periphery to reduce soil runoff from fields. Effort is made to maintain crop cover during the rainy season. On other Larger/smaller holdings weeds were left in place to provide a cover during the rainy season

(quality)

1.10

There was a strong tendency among farmers to use chicken and sheep manure in fields. This is driven by a corresponding need for chicken and sheep growers to manage waste effectively.

Some organic farmers place crop residues in rough compost heaps. There has also been limited usage of residues from plant nursery for those who propagate their own plants.

Organic growers and a few small farmers were very keen on minimum tillage using small hand pushed tillers occasionally.

Quite a few farmers used chicken and sheep manure in the fertigation system. The manure was placed in a 55 gal drum and fertigated on to the field. This practice was widespread.

2 Water management

2.1 and 2.2 are relevant mainly in the Scotland District. There are various structures such as gabion weirs which protect watercourses.

2.3 there is a strong trend towards water harvesting and collection. A number of persons have installed tanks or structures for collecting water. The largest of these was collecting over 100,000 gallons of water at one site.

It was noted that in most of the Rural Development projects (RDP) projects irrigation water was provided from wells. This did not seem to encourage farmers to turn to harvesting water. Some respondents felt they could not do catchment because of this arrangement.

In a few chicken farms rain water was collected and used for washing egg crates and general washdown. One leading pig farm also used rainwater for washdown.

Drip irrigation was integral to most farms and is being used increasingly. Mulching with fabric mulch is also prevalent, but usually only for small section or for specific crops such as herbs. A few farms have been seen to use mulch extensively.

There was one interesting observation where the farmer designed the beds to focus water towards the middle of the beds and was able to capture rainfall better.

At least one livestock (dairy) farmer used a pool and a solids separator to recycle wash-down water.

Generally poultry and other livestock use water dispensers which use nipples or other interactive mechanisms to reduce the total water used.

Quality: One measure that was seen to reduce leachate was the use of a greenhouse/hydroponic system. The system uses leach trays that eliminate the seepage of fertiliser in the ground

In some livestock farms (pigs/dairy the effluent is spread on pastures, thus reducing the amount of nutrients that escape through the soil profile.

The use of mulch also reduces the levels of herbicide leachate entering groundwater.

The leading chicken processor was practicing rendering to reduce the B.O.D and generally remove solids/oils. The solids and fats are dried and pelletized for animal feed.

3. Cropping pattern

Not many recordings in this area. Some of the organic farmers noted the attention to crop rotation and crop combinations.

It was only in the steeper parts of the Scotland district that fruit crops were chosen for the advantage of stabilising slopes.

4 Biodiversity

It is mainly the organic growers that have paid any attention to biodiversity and follow practices such as minimal clearing and encouragement of non crop plants on the farm.

Some organic growers tended to use heirloom varieties and traditional landraces.

5 Carbon footprint

5.1to 5.5 Most farms are still strongly dependent on fossil fuels

There are some outstanding examples where people are utilising alternative energy, in at least 3 cases, virtually 100%. Some leading farmers are contemplating the investment in solar/ wind energy. The initial cost seems to be a hindrance for most persons.

Two livestock farms had facilities for biogas generation.

Some individuals were using gravity to avoid or reduce the electricity usage. In one case the washdown water for a dairy and another was a special hydroponic system.

5.6 For the poultry industry there was a tendency to provide the waste to crop farmers or to the newly operating solid waste recycling plant.

6.1 For the poultry industry there was a tendency to provide the waste to crop farmers or to the newly-operating solid waste recycling plant. One dairy farmer has installed a separator to remove the solid part from waste-water and use as fertiliser. The liquid part was also applied to fields after reusing a number of times.

The leading chicken processor was practicing rendering to reduce the B.O.D and generally remove oils. The solids and fats are dried and pelletized for animal feed.

One Chicken hatchery mixed waste with crop residue to make a rough compost

Three farms generated biogas

Waste water from wash-down was recycled by at least one dairy.

7 Marketing arrangements

Several farmers spoke of "contracts" with supermarkets. However these arrangements were usually just verbal.

The organic farmers had a system of listed customers where they maintained a database and did deliveries based on requests. There was also a weekly farmers market for organic produce. BADMC occasionally held farmers markets for RDP farmers.

A few farmers were involved in a value chain program for onions

At least one poultry business had HACCP and ISO 9001 certification.

Only one crop farmer was encountered as having tried for HACCP certification. This exercise had not been successfully completed and the farmer was at the time handling produce in the way that all other farmers tend to do. The cost of the process was stated as a deterent.

8. Tenure

Many of the farms (1/3 of total) were owned by the producer. The greater amount were leased or rented.

9. Social impact

Thus aspect was difficult to assess. Those who stated that they have programs for the community preferred not to give details (preferred to do it silently).

The organic farmers have been doing programs for diabetic and disabled persons. They were also more closely linked into the national nutrition/ health programs

Table 1 Summary of practices recorded

Analysis of observations

Some outstanding models/practices

1 Greenhouse/ sheep under citrus effort at Trents

- Operates fully on solar PV energy (electrical fencing mostly)
- Greenhouse operates completely from rainwater
- Gravity fed hydroponic system

- No leaching of fertiliser into ground

2 Greenhouse, poultry and fruit crop operation at Warleigh

Greenhouse operation using strongly organic/IPM principles

Also has orchards and does free range poultry/ eggs

Water recycling, compost making

3 Goat farm at Morgan Lewis (Hoad)

Goat farm produces biogas for house, makes compost/fertiliser from goat manure

4 Organic farmers (OGCA)

Minimum tillage

Compost making

Heirloom seed

Organic and other mulches

Crop rotations and mixes

Well structured in coop (have a farmers market and listed consumers)

5 Goat, poultry farm at Bawdens (Brouillet)

Completely Solar (PV) powered (house and solar fencing

6 Dairy at Bright Hall

Gravity used for washing down

Recycling system for water

Separation of waste and solid part used for crop fertiliser

Liquid part goes for fertiliser for pastures

7 Nursery (Phillips

Wind and solar energy powers the whole operation

8 Claybury

Water catchment in dam

Use of fabric mulch

9 Chickmont foods (Montrose and other farms in group)

Rendering of water waste, removal of solids and oils to reduced B.O.D

10 Cole pig production

Water catchment, production of biogas, use of liquid waste on pastures

11 Forde at Lammings

Mulch/soil erosion Almost the whole farm covered by mulch. This mulch also assists in reducing erosion since the area is at risk for erosion

ANNEX 3

Focus group notes Dominica

Introduction

The economy of the Commonwealth of Dominica was founded primarily on an agricultural base historically concentrated on banana production. It was noted that Agriculture was the most dominant sector of the economy in the late 1980 and 1990s contributing approximately 25% to the gross domestic product. By 2000 the production of bananas declined from approximately 70,000 metric tons to under 30,000 tons in 2000. Further decline was experienced due to trade liberalization which reduced unfettered access of Caribbean banana to the UK market. The production system attracted use of large expanse of small holdings, with a high concentration of inputs for banana crops suitable for the UK market based on the parties' agreement.

There were some aspects of sustainable practices models and technologies practised but such practices became more prevalent with the focus on a diversified economy; conservation agriculture and integrated farming systems including both crop and pest management.

The four focus group discussions held in October/November give an insight into such tried and tested methods which are sustainable in nature. In some of the regions, the farming population was on average sixty persons. Those involved in the focus group discussion formed a sample of the farmers in that farming region.

Farmers Responses

In the east region which is the Carib territory, Castle Bruce farming continues to be the way of life, especially for the indigenous people who still have an affinity to the land even though this may be for historic and cultural reasons. Rain Water a very important resource is collected or harvested from roof tops of farm houses using traditional bamboos and the drums are protected with a covering. The water is used for domestic and agricultural purpose. In this region three farmers focused to a large extent on what they said were organic farming practices. They are involved in production of vegetables and poultry utilizing the waste for the production of compost which is used on the farm. They try as hard as possible to reduce,

reuse and recycle, engage in good agricultural practices and produce healthy crops. Their crops are produced in that manner fetch a higher price and their model farm is usually targeted by Ministry of Agriculture and schools in the area as a point for learning about some aspect of sustainable practices.

Grass barriers and bamboos are used on gently sloping areas to reduce soil erosion. Crops planted on specific areas are done based on their ability to reduce erosion, depleting soil nutrients and keep the soil intact. Composting is popular in that area and is being encouraged by the Fair-trade Group. The group also collects all of the blue plastics used to cover and protect the bananas and disposed it in a manner r which does not affect the environment. Irrigation system utilizing waterways/nearby rivers is available and used by some farmers. One particular farmer uses biological pest management systems for control of insects.
A combination of flowers and plants tried and tested as natural insect/pest repellant is widely used.

In the southern region farmers spoke of crop rotation practices which give a good yield as well as enriches the soil. Mix farming is done including banana production on a smaller scale. One farmer, who also grows flowers, uses flowers and specialized crops and grass to hold the edge of slope. Her water source comes from a small ravine which is carefully constructed to guide the water away from her farm. Rain Water is also harvested from the roof top and used for agricultural purposes... Green house production of vegetables and flowers and production of seedlings are done using on-farm produced compost.

Biological pest control utilizing a range of flowers and crops which have insect repellent properties as well as using proper crop rotation practices as practised in this region. Sericulture is practised by one farmer but not on a large scale. The Dominica Organic Movement facilitated session as well as a team of Cuban Agronomists did biological pest control sessions with farmers. Good Environment practices ensures that nothing goes to waste. Farmers with pigs and poultry use vegetables not good enough for sale to feed the animals; and the animal waste is used to produce compost for the farm. In order to suppress the growth of weeds and better control and manage them, farmers reported the use of black plastic cover especially for the production of pineapples. Crop rotation is used widely as a means of maintenance of soil nutrients, productivity and in some cases to control erosion. In this region, mixed farming and animal rearing are done and managed so that as close as

possible Good Agricultural Practices are observed. The presence of butterflies and earth-worms may be an indication of biological pest control methods or use of organic manure.

In the northern region some levels of banana production continues with a great focus on Good Agricultural Practices, proper drainage, water harvested from roof top as well as proper management of pasture land for large animals such as cows. Crop rotation practices are done among a wide selection of crops. Some farmers target several markets for different crops based on the volumes.

Proper drainage systems control the volume of water onto farms and drainage of inputs into rivers or waterways close by. Some farmers have built systems to tap water from nearby ravines for agricultural and domestic purposes. Wind breaks such as large trees are grown or used in areas prone to heavy winds and proper drainage and soil erosion practices are done in areas prone to soil erosion by planting of special grass which holds the soil together.

In the eastern region, the use of black plastic covers (plastic mulch) to control the weed is popular. The rearing of goats, poultry and other green material to make compost is also popular. The design of the animal pen allows for proper space to feed, clean and picking up of material for the compost. Rainwater is harvested from roof tops and used for cleaning and fed to animals.

ANNEX 4 Grenada

Sustainable Projects noted include:

1. Organic cocoa production and certification
2. Organic Chocolate manufacturing
3. 1/3 Solar powered factory processing- net metering + backup stand alone system + diesel co-generation system
4. Inter island water transportation service using sails instead of engine propulsion
5. Sustainable goat dairy operation
6. Goat cheese manufacturing
7. Highly efficient composting procedure-for on farm processing
8. Sustainable and efficient design of animal houses and processing houses
9. Remote pastoral perimeter solar fence
10. Grey water recycling operation.
11. High yield milking goats breeding and recording operation.
12. Protein from farm waste.
13. Research opportunity for potential Gliricidia farming option-Alternative crop (Lucaena, Gliricidia, banana, breadfruit, green cane hull) in support of sustainable livestock production.
14. Network for recycling old engine oil to fuel feed boiler in the manufacturing of feed for poultry and small ruminant.
15. Networking or governments fisheries department (fish markets/vending stalls) to provide protein source(fish waste) to be used in manufacturing feed.
16. Networking waste from malt factory to be used in manufacturing feed.
17. Farmers run and owned cooperatives
18. Rain water for crop irrigation system
19. Natural pest control application from locally available plant compounds for verora mite farm management in bee-keeping .
20. Sustainable Boat building techniques that reduces the harvesting of locally grown trees (cedar).

ANNEX 5 St. Kitts/Nevis

St Kitts Nevis

Sustainability feature SOIL MANAGEMENT (Soil quantity, quality)	Notes	Perceived Frequency[15]
1.1 What type of Land clearing technique was used?	Bulldozed and ploughed Disc harrow and plough Herbicide Minimum tillage	1 3 1 1
1.2 Check Building site selection		
1.3 Check Building layout		
1.4 Terracing?		0
1.5 Contour ploughing?	Common practice on crop farms	3
1.6 Crop cover?	Fallow	3
1.7 Direct planting?	Selected crops, melons, papaw, etc	2
1.8 Other?	Use of speedling trays	2
1.9 Drainage?	Maintain banks & roadway	1
1.10 Ameliorant/incorporate?		
1.12 Green manure?		2
1.13 Nutrient recycling?		
1.14 Composting?		
1.15 Crop rotation?		3
1.16 Appropriate tillage?		2
1.17 Vermiculture?		
1.18 Soil fauna/flora?		
1.19 Other?		

[15] Legend: perceived frequency of occurrence, **0** = absolutely no evidence of practice/technology, **1** = 1-25%, **2**= 26-50%, **3**=51-75%, **4** =76-100%

Sustainability feature WATER MANAGEMENT (Water quantity, quality)	Notes	Perceived Frequency[16]
2.1 On site water course protection?		
2.2 Riverine protection/stabilization?		
2.3 Harvesting?	Pond/dam or well St. Peters project & Mansion	1
2.4 Collection from guttering?	For watering seedlings, etc	1
2.5 Collection from rainfall?	For emergency use	3
2.6 Drainage?		
2.7 Irrigation method?	Drip	2
2.8 Mulch?	plastic	2
2.9 Green cover?		
2.10 Other?		
2.11 Washing/cleaning?	Mostly of farm	2
2.12 Dispensing to animals?	troughs	2
2.13 Conservation?		
2.14 Reuse?		
2.15 Reduction (low flow taps)?		
2.16 Outbound pollutants/leachates?		
2.17 Bio-cleansing?		
2.18 Water treatment/settling?		

Sustainability feature **CROPPING PATTERN**	Notes	Perceived Frequency[17]

[16] Legend: perceived frequency of occurrence, **0** = absolutely no evidence of practice/technology, **1** = 1-25%, **2**= 26-50%, **3**=51-75%, **4** =76-100%

Sustainability feature **CROPPING PATTERN**	Notes	Perceived Frequency[17]
3.1 Crop appropriate for area/slope?	Observed, no adverse condition	3
3.2 Proper plant growth habit?		2
3.3 Crop rotation?		3
3.4 Other?		
BIODIVERSITY		
4.1 Land clearing method?	Disc harrow, chemical, Manual	3
4.2 Monogenic strains/lines?		
4.3 Product mix?		
4.4 Other?		
CARBON FOOTPRINT		
5.1 Fossil fuel use?		3
5.2 Electricity use?		1
5.3 Renewable energy use?		
5.4 Solar?		
5.5 Wind?		
5.6 Waste reduction/less landfill use?		
5.7 Other?		
WASTE DISPOSAL		
6.1 Use of crop residue/waste/entrails?		3
6.2 Composting?		
6.3 Scrap metal/building material?		
6.4 Waste water?	Not a real issue	1
6.5 Other?		

[17] Legend: perceived frequency of occurrence, **0** = absolutely no evidence of practice/technology, **1** = 1-25%, **2**= 26-50%, **3**=51-75%, **4** =76-100%

Sustainability feature **CROPPING PATTERN**	Notes	Perceived Frequency[17]

Sustainability feature **MARKETING ARRANGEMENTS**	Notes	Perceived Frequency[18]
7.1 Contract farming?		
7.2 Listed consumers?		
7.3 Cooperatives?	Eg. Sandy Point Agri. Co-op Society	1
7.4 Value chain involvement?		
7.5 GAP certification?	Training Certification	2
7.6 Standards driven production (Fairtrade etc)?		
TENURE		
8.1 Freehold?		2
8.2 Leasehold?		1
8.3 Rental?		
8.4 None?		
SOCIAL IMPACT		
9.1 Integration into neighbourhood?		2
9.2 Community involvement?		2

[18] Legend: perceived frequency of occurrence, **0** = absolutely no evidence of practice/technology, **1** = 1-25%, **2**= 26-50%, **3**=51-75%, **4** =76-100%

ANNEX 6 St Lucia

Sustainability feature SOIL MANAGEMENT (Soil quantity, quality)	Notes	Perceived Frequency[19]
1.1 What type of Land clearing technique was used?	• Slash and burn 70% and less (Region 8 and 4) • Spraying up to 90% (Region 5 and 2) • Slash/cutting up to 50% (Region 1, 6 and 8) • Mechanization 40% and less (Region 6 and 3)	
1.2 Check Building site selection		
1.3 Check Building layout		
1.4 Terracing?	Insignificant use, almost not recommended	
1.5 Contour ploughing?	not recommended using machinery, however is widely use for vegetable production especially in Region 2	
1.6 Crop cover?	frequently use in most AR's especially with sweet potato.	
1.7 Direct planting?	mostly use for roots and tubers, plantain and banana	
1.8 Other?		
1.9 Drainage?	Most farms have drainage though can be improved	
1.10 Ameliorant/incorporate?	widely use on banana and plantain (musa species) farms (Region 3, 8)	
1.12 Green manure?	not widely use but presently being introduced (Region 7).	
1.13 Nutrient recycling?	widely use in Region 8	

[19] Legend: perceived frequency of occurrence, **0** = absolutely no evidence of practice/technology, **1** = 1-25%, **2**= 26-50%, **3**=51-75%, **4** =76-100%

Sustainability feature SOIL MANAGEMENT (Soil quantity, quality)	Notes	Perceived Frequency[19]
1.14 Composting?	Highly recommended throughout the island with ongoing FAO/EU project	
1.15 Crop rotation?	highly recommended; island wide (60%). In most instances farmers are moved by possible high sales (ej tomatoes) and likely to repeat crop production.	
1.16 Appropriate tillage?		
1.17 Vermiculture?		
1.18 Soil fauna/flora?		
1.19 Other?	The use of manure (poultry waste) is practised by many farmers if not directly from their farm, from other source within the community	

Sustainability feature WATER MANAGEMENT (Water quantity, quality)	Notes	Perceived Frequency[20]
2.1 On site water course protection?	where required is available and where damaged after hurricane Tomas is down for repair – 80%.	
2.2 Riverine protection/stabilization?		
2.3 Harvesting?	not a common practice. A water harvesting project is presently being implemented in Region 3	

[20] Legend: perceived frequency of occurrence, **0** = absolutely no evidence of practice/technology, **1** = 1-25%, **2**= 26-50%, **3**=51-75%, **4** =76-100%

Sustainability feature WATER MANAGEMENT (Water quantity, quality)	Notes	Perceived Frequency[20]
2.4 Collection from guttering?	insignificant and if so, for washing of agricultural tools, boots and produce	
2.5 Collection from rainfall?	insignificant and if so, for washing of agricultural tools, boots and produce	
2.6 Drainage?	available on most farms – 80%.	
2.7 Irrigation method?	Rainfed (region 7, 8) – 80%; stream/river source in most regions with gravity (10%) and drip and overhead sprinklers (green house) in all other regions (15% & 80% respectively). Region 6 is fed through the government Delcer Irrigation System.	
2.8 Mulch?	not a common practice however is being introduced by the Ministry of Agriculture for specific crops (plastic covering) – 30%.	
2.9 Green cover?		
2.10 Other?		
2.11 Washing/cleaning?	washing of produce is mostly done from WASCO and cleaning from collected rain water or stream/river water.	
2.12 Dispensing to animals?		
2.13 Conservation?		
2.14 Reuse?		
2.15 Reduction (low flow taps)?		
2.16 Outbound pollutants/leachates?	not a common problem/issue	
2.17 Bio-cleansing?		
2.18 Water treatment/settling?		

Sustainability feature **CROPPING PATTERN**	Notes	Perceived Frequency[21]
3.1 Crop appropriate for area/slope?	80% applicable	
3.2 Proper plant growth habit?	90%	
3.3 Crop rotation?	This practice is influence by sales	
3.4 Other?	Intercropping is a widely used practice Eg. Musa species with citrus; mix vegetables; etc	
BIODIVERSITY		
4.1 Land clearing method?	Land clearing methods used in most cases have had a significant negative impact on biodiversity. Almost all Agricultural Regions (AR) indicated the use of chemicals especially in spraying contributed to the impact.	
4.2 Monogenic strains/lines?	A significant reduction of the presence of the same in non livestock production. Efforts to improve the same through IPM are recommended by ministry officials	
4.3 Product mix?		
4.4 Other?		
CARBON FOOTPRINT		
5.1 Fossil fuel use?	Fossil fuel is used on all farms (over 90%) for the different activities where applicable, example small implements for land preparation, irrigation, etc	
5.2 Electricity use?	not widely use except where livestock (poultry) is part of farm production activity.	

[21] Legend: perceived frequency of occurrence, **0** = absolutely no evidence of practice/technology, **1** = 1-25%, **2**= 26-50%, **3**=51-75%, **4** =76-100%

Sustainability feature **CROPPING PATTERN**	Notes	Perceived Frequency[21]
5.3 Renewable energy use?	Solar energy is used for small agro processing activity by Rural Women Network groups in different AR's (Region 4, 1)	
5.4 Solar?		
5.5 Wind?		
5.6 Waste reduction/less landfill use?		
5.7 Other?	Use of water, presently by 1 farmer (Region 4).	
WASTE DISPOSAL		
6.1 Use of crop residue/waste/entrails?	Use of crop residue is use for composting and in some cases as animal feed. In the case of the livestock farmers entrails are disposed of.	
6.2 Composting?	Technique is not widely used by most farmers but highly recommended by Ministry officials	
6.3 Scrap metal/building material?		
6.4 Waste water?		
6.5 Other?	Biogas practice is presently being recommended on livestock farms (piggery) as part of IICA/Ministy of Agriculture initiative – 20% where piggery is located.	

Sustainability feature **MARKETING ARRANGEMENTS**	Notes	Perceived Frequency[22]
7.1 Contract farming?	There is no formal contract arrangement; rather an informal arrangement is in place with Marketing Board, supermarket and hotels.	
7.2 Listed consumers?	Listed consumers for markets is the most widely use practice – 90%	
7.3 Cooperatives?	Cooperative membership (60%) is available in Regions 4, 5 & 6. – Eastern Farmers Cooperative, Black Bay Farmers Cooperative and Belle Vue Farmers cooperative	
7.4 Value chain involvement?	Value chain involvement is with Regions 5 & 6 (Fruit bowl salad).	
7.5 GAP certification?	Majority of farmers are GAP certified by the Ministry of Agriculture	
7.6 Standards driven production (Fairtrade etc)?	The banana farmers interviewed were Fairtrade certified farmers (90%). Efforts towards certifying for non banana crops are being pursued as part of diversification of Fairtrade production for export	
TENURE		
8.1 Freehold?	The majority of farm land under cultivation is family own (60%);	
8.2 Leasehold?	Leasing (30%) Eg. Black Bay Farmers Cooperative	
8.3 Rental?		

[22] Legend: perceived frequency of occurrence, **0** = absolutely no evidence of practice/technology, **1** = 1-25%, **2**= 26-50%, **3**=51-75%, **4** =76-100%

Sustainability feature **MARKETING ARRANGEMENTS**	Notes	Perceived Frequency[22]
8.4 None?	Squatting on government lands (10%).	
SOCIAL IMPACT		
9.1 Integration into neighbourhood?	There is integration into the respective neighborhoods and clearly seen during cultural activities	
9.2 Community involvement?	Community involvement is widely seen in AR's where there is the presence of a strong Agricultural Cooperative	

ANNEX 7 St Vincent and the Grenadines

St Vincent and the Grenadines

Sustainability feature SOIL MANAGEMENT (Soil quantity, quality)	Notes	Perceived Frequency[23]
1.1 What type of Land clearing technique was used?		3
1.2 Check Building site selection		
1.3 Check Building layout		
1.4 Terracing?		3
1.5 Contour ploughing?		1
1.6 Crop cover?		1
1.7 Direct planting?		1
1.8 Other?		
1.9 Drainage?	Contour drains (box) drains are present	1
1.10 Ameliorant/incorporate?		
1.12 Green manure?		1
1.13 Nutrient recycling?		
1.14 Composting?		2
1.15 Crop rotation?		3
1.16 Appropriate tillage?		1
1.17 Vermiculture?		
1.18 Soil fauna/flora?		
1.19 Other?		

Sustainability feature WATER MANAGEMENT (Water quantity, quality)	Notes	Perceived Frequency[24]

[23] Legend: perceived frequency of occurrence, **0** = absolutely no evidence of practice/technology, **1** = 1-25%, **2**= 26-50%, **3**=51-75%, **4** =76-100%

Sustainability feature WATER MANAGEMENT (Water quantity, quality)	Notes	Perceived Frequency[24]
2.1 On site water course protection?		1
2.2 Riverine protection/stabilization?		
2.3 Harvesting?		2
2.4 Collection from guttering?		1
2.5 Collection from rainfall?		3
2.6 Drainage?		
2.7 Irrigation method?	Drip and other low flow methods	1
2.8 Mulch?		2
2.9 Green cover?		
2.10 Other?		
2.11 Washing/cleaning?		
2.12 Dispensing to animals?		
2.13 Conservation?		
2.14 Reuse?		
2.15 Reduction (low flow taps)?		
2.16 Outbound pollutants/leachates?		
2.17 Bio-cleansing?		
2.18 Water treatment/settling?		

Sustainability feature **CROPPING PATTERN**	Notes	Perceived Frequency[25]

[24] Legend: perceived frequency of occurrence, **0** = absolutely no evidence of practice/technology, **1** = 1-25%, **2**= 26-50%, **3**=51-75%, **4** =76-100%

[25] Legend: perceived frequency of occurrence, **0** = absolutely no evidence of practice/technology, **1** = 1-25%, **2**= 26-50%, **3**=51-75%, **4** =76-100%

Sustainability feature **CROPPING PATTERN**	Notes	Perceived Frequency[25]
3.1 Crop appropriate for area/slope?		2
3.2 Proper plant growth habit?		
3.3 Crop rotation?		2
3.4 Other?		
BIODIVERSITY		
4.1 Land clearing method?		
4.2 Monogenic strains/lines?		
4.3 Product mix?		
4.4 Other?		
CARBON FOOTPRINT		
5.1 Fossil fuel use?		
5.2 Electricity use?		
5.3 Renewable energy use?		
5.4 Solar?		
5.5 Wind?		
5.6 Waste reduction/less landfill use?		
5.7 Other?		
WASTE DISPOSAL		
6.1 Use of crop residue/waste/entrails?		2
6.2 Composting?		2
6.3 Scrap metal/building material?		
6.4 Waste water?		
6.5 Other?		

Sustainability feature **MARKETING ARRANGEMENTS**	Notes	Perceived Frequency[26]
7.1 Contract farming?		1
7.2 Listed consumers?		2
7.3 Cooperatives?		
7.4 Value chain involvement?		1
7.5 GAP certification?		2
7.6 Standards driven production (Fairtrade etc)?		1
TENURE		
8.1 Freehold?		3
8.2 Leasehold?		1
8.3 Rental?		1
8.4 None?		1
SOCIAL IMPACT		
9.1 Integration into neighbourhood?		1
9.2 Community involvement?		1

[26] Legend: perceived frequency of occurrence, **0** = absolutely no evidence of practice/technology, **1** = 1-25%, **2**= 26-50%, **3**=51-75%, **4** =76-100%

9. APPENDICES

APPENDIX I

Baseline Study

Producer Questionnaire/Inquiry form

Note on the Data sheet

Country District

Full Name

Enterprise location (specific for ease of verification)

Enterprise (product mix)

Recordable practices

1) SOIL MANAGEMENT

1.1 What type of Land clearing technique was used?

1.2 Check Building site selection

1.3 Check Building layout

Soil management (quantity)

1.4 Terracing?

1.5 Contour ploughing?

1.6 Crop cover?

1.7 Direct planting?

1.8 Other?

Soil management (quality)

1.9 Drainage?

1.10 Ameliorant/incorporate?

1.12 Green manure?

1.13 Nutrient recycling?

1.14 Composting?

1.15 Crop rotation?

1.16 Appropriate tillage?

1.17 Vermiculture?

1.18 Soil fauna/flora?

1.19 Other?

2) **WATER MANAGEMENT**

2.1 On site water course protection?

2.2 Riverine protection/stabilization?

Water (quantity)

2.3 Harvesting?

2.4 Collection from guttering?

2.5 Collection from rainfall?

2.6 Drainage?

2.7 Irrigation method?

2.8 Mulch?

2.9 Green cover?

2.10 Other?

2.11 Washing/cleaning?

2.12 Dispensing to animals?

2.13 Conservation?

2.14 Reuse?

2.15 Reduction (low flow taps)?

Water (quality)

2.16 Outbound pollutants/leachates?

2.17 Bio-cleansing?

2.18 Water treatment/settling?

3) **CROPPING PATTERN**

3.1 Crop appropriate for area/slope?
3.2 Proper plant growth habit?
3.3 Crop rotation?
3.4 Other?

4) **BIODIVERSITY**

4.1 Land clearing method?
4.2 Monogenic strains/lines?
4.3 Product mix?
4.4 Other?

5) **CARBON FOOTPRINT**

5.1 Fossil fuel use?
5.2 Electricity use?
5.3 Renewable energy use?
5.4 Solar?
5.5 Wind?
5.6 Waste reduction/less landfill use?
5.7 Other?

6) **WASTE DISPOSAL**

6.1 Use of crop residue/waste/entrails?
6.2 Composting?
6.3 Scrap metal/building material?
6.4 Waste water?
6.5 Other?

7) **MARKETING ARRANGEMENTS**

7.1 Contract farming?

7.2 Listed consumers?

7.3 Cooperatives?

7.4 Value chain involvement?

7.5 GAP certification?

7.6 Standards driven production (Fairtrade etc)?

8) **TENURE**

8.1 Freehold?

8.2 Leasehold?

8.3 Rental?

8.4 None?

9) **SOCIAL IMPACT**

9.1 Integration into neighbourhood?

9.2 Community involvement?

APPENDIX II

Marine Environment

The marine environment was considered during the review of sustainable practices in its own right and as a consequence of land-based operations. The following table (Table A) was developed by the Caribbean Network of Fisherfolk Organisation and shows the impact on the environment of various fishing methods. Table B shows the number of registered fishers and the fishing methods employed in Antigua and Barbuda. Most fishers use more than one method.

Table A. Impact of various Fishing Methods on the Ecosystem.

SEVERE IMPACTS	MODERATE IMPACTS	MINIMAL IMPACTS
Bottom trawls	Fish traps/pots	Hand-held spears
Trammel nets	Bottom longline	Free-dive harvesting
Bottom gillnets	Midwater nets	Hook and line
Explosives (dynamite)	Pelagic longlines	Vertical longlines
Chemicals (Chlorine etc)	Purse seines	Rod and reel

Table B. Primary Fishing Methods/Percent of Active Fishers Employing Methods.

Primary Fishing Method	ANTIGUA		BARBUDA		Total Active Fishers	% of Fishing Method
	Active Vessels	Active Fishers	Active Vessels	Active Fishers		
Trapping	126	330	10	19	340	36.4
Gill Netting	50	98	9	9	107	11.4
Hand Lining	69	191	0	0	191	20.4
Free Diving	3	9	4	5	14	1.5
SCUBA Diving	19	72	6	14	86	9.2
Troll Lining	84	170	2	4	174	18.6
Vertical Long Lining	5	10	0	0	10	1.1
Beach Seining	1	13	0	0	13	1.4
TOTALS	**357**	**893**	**31**	**51**	**935**	

Except for the trapping (fish traps/pots), most of the other methods practised by Antiguan and Barbudan fishers fall within the methods with minimum environmental impacts (Table B). In Grenada a fisheries-based adaptation initiative was reinforced and consolidated. It involved an intervention by the Fishery Authority to provide an alternative fishing opportunity for a community of fishers targeting shelf fish for an export market. The shelf stock was depleting while the market share in the export market was decreasing also; fishers were then introduced to an alternative oceanic long-line fishery through skills training. Uptake of the alternative fishing opportunity was immediate and as a result, this new oceanic long-line fishing community is now responsible for the bulk of national higher value-added fish production.

Concern for the Marine Environment includes sustainably sound disposal methods for inorganic lubricants etc., all of the fisherfolk interviewed desisted from discarding refuse at sea or on beaches. Grenada has a nascent network recycling old engine oil to fuel the manufacture of feed for poultry and small ruminants. The return of inadvertently caught juveniles and mangrove protection is discussed in the section on biodiversity. The various Fisheries Divisions attempt to monitor the fishing industry, within the confines of their resources. They also conduct training workshops on sustainable fishing methods and ensure registered fishers use the right gear, including right size gill nets and fish-pot wire.

Coastal zone management and respect for the role that mangrove plays in fisheries was also noted. It was reported that integrated efforts at sustainability were recognized through the use of boatbuilding techniques that reduced the harvesting of locally grown trees.

APPENDIX III

Field Assessors:

Country	Assessor	Background
Antigua	Julie Ann Laudat	Crop Protection Specialist, first Female Extension Officer, Manager, extensive national experience
Barbados	Stevenson Skeete	Agronomist, Field Officer, Ministry of Agriculture, 30 years experience
Dominica	Josephine Dublin Prince	WINFA Board member, former Senator, extensive national experience
Grenada	Earl Roberts	Tertiary level Lecturer. Farmer, Consultant, Farmers' Organizations Representative
St Lucia	Eustace Vitalis	Agronomist, former Purchasing Manager Sandals Inc, extensive national experience
St Vincent	Clarence Paddy Thomas	WINFA Trustee, farmer, Field Manager, 35 years experience
St. Kitts/Nevis	Stephen Duggins	Agronomist, Agricultural Officer, extensive national experience