APP Thematic Feature No. 5

Intra-ACP Agriculture Policy Programme (APP) Caribbean Action, with funding by the European Union under the 10th European Development Fund (EDF)

Intra-ACP APP Caribbean Action

Responding to Climate Change in Caribbean Agriculture with Adaptation and Mitigation Strategies

Changing Climate, Changing Farming Systems

Traditionally, farmers around the world have been able to rely on predictable weather patterns and climate to know when they would be short on water and when they would get much anticipated rain. They would talk about rainy season and dry season, or planting season and harvest season. Today however, this isn't necessarily the case. Farmers who would have expected rain in May, are not seeing it until July, if at all. Instead of dry season, they are dealing with prolonged periods of devastating drought, and instead of rainy season, they are battling the effects of flooding and intensified damage from hurricanes

"Instinctively, farmers have said exactly what recent data analysis has told us when looking at information from the Caribbean for 2000 to 2009", said Dr. Lyle Barbara Graham, a Caribbean agriculture expert and consultant for the Caribbean Action under the Agricultural Policy Programme (APP). "There are later peaks, later flowering and longer droughts."

The devastating effects of drought in the Caribbean. (Photo: APP)

These factors are changing how farming must be carried out in the Caribbean in order to be successful. Higher temperatures, rising sea levels and intensified weather activity are also impacting usual traditional practices.

The cause of all these factors, though debated by some, is clearly climate change.

"Climate change is here; it has been and will continue to impact the Caribbean and the viability of farming systems in all countries in the Region", said H. Arlington D. Chesney, the former Executive Director of the Caribbean Agriculture Research and Development Institute (CARDI).

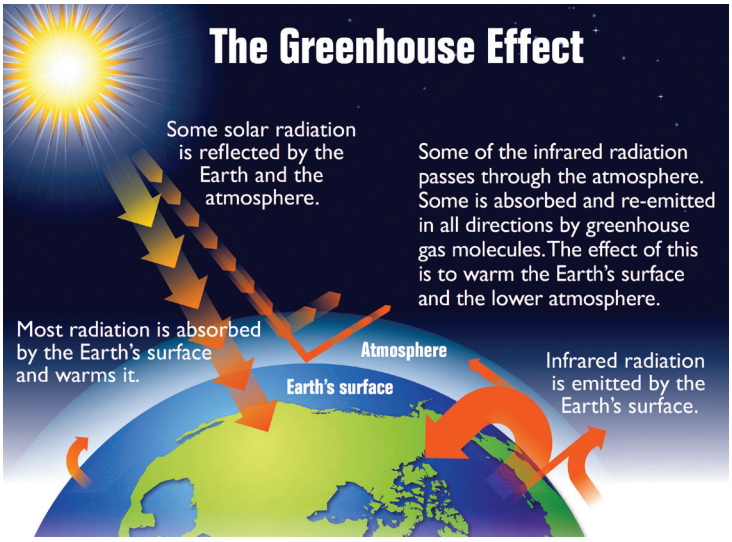
This feature highlights the already known causes and potential impacts of climate change, as well as the options for response in the Caribbean farming community. It also highlights initiatives that are being carried out under the Agricultural Policy Programme (APP), funded by the European Union (EU) under the 10th EDF, towards addressing these changes and resulting challenges. The main goal of the programme is to enhance the regional capabilities of the agricultural sector in eradicating poverty, and the specific objective is to do this through the support of smallholder agriculture. Addressing climate change impacts to agriculture is an absolute must in order to be truly helpful.

Understanding Climate Change

The temperature of the Earth is ultimately a balance between energy absorbed and energy lost. The sun's rays enter the atmosphere, warming up the Earth and then the warming planet returns heat energy, called infrared radiation, back to space. Some of this radiation gets trapped in the Earth's atmosphere and then reflects back down to earth causing the planet to be about 33 degrees warmer than it would be otherwise. This is

called the natural greenhouse effect, and without it we could not live on this planet. It would be much too cold.

The problem of climate change comes about however, with the 'enhanced' greenhouse effect. This occurs when too much carbon dioxide is emitted. It rises into the atmosphere thickening the natural greenhouse layer, trapping more of the sun's heat and warming the planet.



"The Greenhouse Effect" in: Introduction of US EPA (Dec 2012), "Climate Change Indicators in the United States: 2nd edition, Washington, DC. USA: US EPA http://www.epa.gov/climagechange/science/indicators/download.html

There are natural causes that lead to a warming planet such as changes in the Earth's orbit that disturb the radiation balance, changes in solar intensity and volcanic eruptions. However, since the industrial revolution in the 18th century, human activity has created much of the change. The burning of fossil fuels and biomass have emitted increased amounts of carbon dioxide and agriculture outputs have increased the emission of methane and nitrous oxide. All of these factors alter the composition of the earth's atmosphere and therefore trap more heat.

According to the 4th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), "There's a better than 90% probability that human-produced greenhouse gases, such as, carbon dioxides, methane and nitrous oxide, have cause much of the observed increase in the Earth's temperatures over the past 50 years."

Signs of Global Climate Change

As temperatures rise there are a variety of side-effects resulting in changes to weather around the world. As the air becomes warmer, increased amounts of moisture evaporate from land and water into the atmosphere. This causes more rain and snow and heavier downpours in some locations on the planet. Conversely, as more water evaporates from the earth and air and ocean currents shift taking the atmospheric moisture elsewhere, some places on earth are left with dried up land and limited access to fresh water.

Climate is the average weather conditions in given locations over longer periods of time, which may include average temperature, precipitation and wind patterns, as well as natural variability and extremes.

Climate variability refers to inherent or natural fluctuations within the climate system. These fluctuations can occur on a variety of time-scales, from seasonal and annual, to longer term fluctuations. Examples of seasonal fluctuations are the phenomena of the El Nino, characterized by unusually warm oceanic temperatures affecting weather in several parts of the world and El Nina, which brings unusually cool oceanic temperatures in the central and the eastern equatorial Pacific.

Climate change involves significant changes in the climate system over time.

Source: United States Department of Agriculture (USDA), Frequently Asked Questions about Climate and Climate Change

Also, as the earth warms so do the oceans. Hurricanes and other tropical storms get their energy from a warm ocean and so we are seeing these storms growing stronger, with heavier rains and increased wind speeds. As the oceans warm we are also seeing sea levels rise. Each drop of water expands just a little bit but over the vast expanse of the ocean this leads to a significant increase. Sea levels are also rising due to melting sea ice, glaciers and snow cover due to a warming earth.

According to a recent online National Geographic Article called 'Sea Level Rise', "Core samples, tide gauge readings, and most recently, satellite measurements tell us that over the past century, the Global Mean Sea Level (GMSL) has risen by 4 to 8 inches (10 to 20 centimetres). However, the annual rate of rise over the past 20 years has been 0.13 inches (3.2 millimetres) a year, roughly twice the average speed of the preceding 80 years."

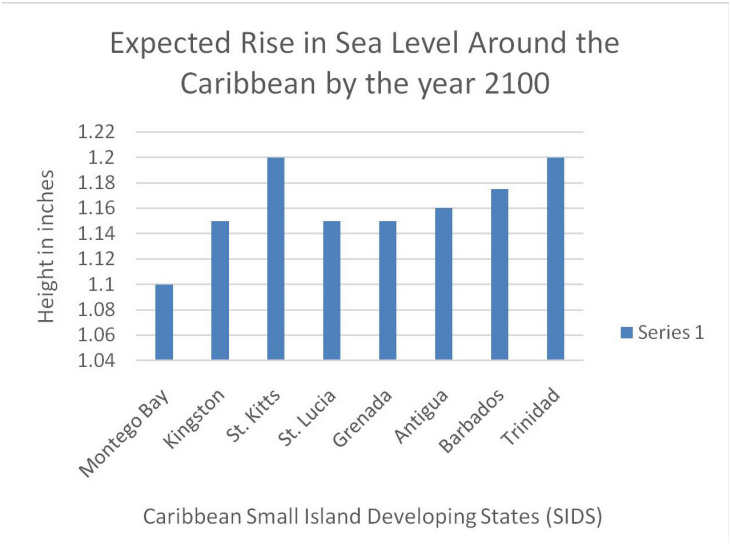
Rising sea levels lead to additional problems in the environment. Low-lying areas experience more frequent flooding. Storm surges during extreme weather events are higher and more powerful. Salt water from the sea is more susceptible to entering fresh water systems, further

limiting access to sufficient water for human consumption and agricultural use. And, rising sea levels cause increased coastal erosion, leading to loss of essential minerals in the soil and harm to important coastal ecosystems such as mangrove forests and coral reefs .

The aftermath of Hurricane Tomas in Saint Lucia, 2010. (Photo: APP)

The Caribbean and Climate Change

The Caribbean is particularly susceptible to the negative impacts from climate change. The Region is composed of mostly small island countries, with low-lying coastal zones that are essential to their socio-economic and environmental well-being.



Data Source: "Assessing the Vulnerability of Air and Sea Ports in Small Islands", Leonard A. Nurse, Faculty of Science and Technology, University of the West Indies, Cave Hill, 2015

They are highly dependent on rainfall for water resources, making them more vulnerable during droughts. They are also surrounded by the warming and rising oceans, exposing them to the increasingly intensified rains and high winds, coastal erosion and flooding. The already warm climate is getting hotter and there is noticeable climatic variability, both of which make farming in the Region more challenging.

A brief look back at the impact of hurricanes and other weather extremes in the Caribbean since 2000 illustrate an unnerving "new normal" for the Region. In 2004 Hurricane Ivan hit the Cayman Islands, Grenada, Jamaica, Saint Lucia and Saint Vincent and the Grenadines causing an estimated US $3.06 billion. Grenada alone suffered 100% destruction of its banana and vegetable crops. In 2008, Tropical Storms Fay, Gustav, Hanna and Ike affected 8% of Haiti's population, wiped out 70% of their crops and caused damages of over US $1 billion.

Most recently, Hurricane Matthew hit Haiti. It was the third strongest storm on record to make landfall in Haiti. It left over 500 people dead, tore out grapefruit, banana and avocado trees, damaged important root crops and killed livestock.

Devastation left by Hurricane Matthew in Haiti, 2016. (Source: IICA Haiti)

In terms of extreme weather, in 2011 intense rainfall in the normally dry season led to flooding and destruction of crops, livestock and infrastructure in St. Vincent and the Grenadines. A freak, unseasonal storm hit Dominica, Saint Lucia and St. Vincent and the Grenadines on Christmas Eve in 2013. It was said to have been 'like nothing ever seen in that part of the Caribbean, 'causing severe damage from torrential rains and strong winds.

In 2010 and again in 2015, significant droughts impacted countries across the Caribbean. Important crop losses resulted from the severe droughts, further straining this food-insecure Region.

Caribbean Agriculture and Climate Change

With the tenuous link between the climate, the weather and agriculture, it is obvious that climate change will impact food availability across the globe, and specifically in the Caribbean. If climate change issues are not tackled and mitigation practices are not put in place in the agriculture industry, the sector will be further weakened, food import bills will rise and poverty will increase.

Agriculture accounts for approximately 7% of the Region's total gross domestic product (GDP) and is the mainstay of the economies of Dominica, Guyana and Haiti. It creates employment in the range of almost 25% of the labour force in the Caribbean, earns export revenues and contributes to the development of rural economies.

Predictions of further drought and limited access to water in the Region will lead to new pests, diseases and weeds, not to mention the inability to water crops. Under these new conditions, many of the key crops traditionally cultivated in the Region could become impractical and uneconomical. Stronger winds, more rainfall and highly-salinized water are also very hard on crops. The traditional open-field agriculture practiced in the Caribbean is not ideal for these new conditions where crops are exposed to the effects of the weather.

Agriculture in the Caribbean is sensitive to climate variability and future change because it is:

- Dominated by a mix of small semi-commercial and medium sized commercial producers;
- Mostly undertaken in open fields, on hillsides and fully exposed to the vagaries of the weather;
- Predominantly rain-fed, with strong sensitivity to rainfall variability, which impacts water availability;
- Dependent on cultivation of a limited range of commercial crops, grown under specific environmental conditions and farming systems.

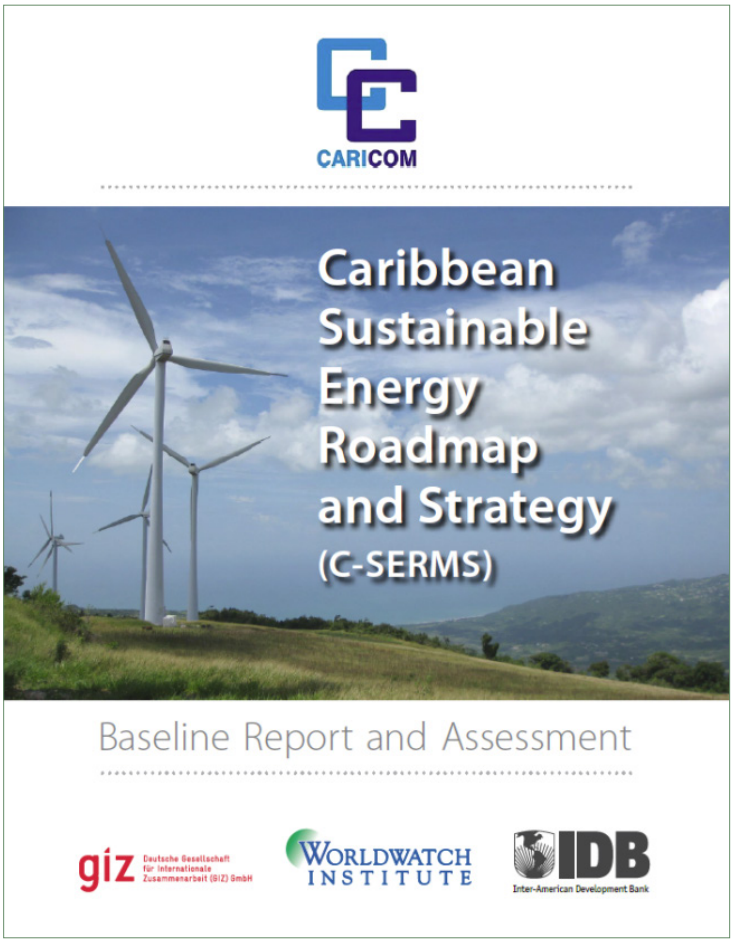
Responding to Climate Change in the Caribbean

Meeting these challenges to Caribbean agriculture, and in fact the Caribbean on the whole, will require a creative, united and scientific approach. The core responses must be Adaptation and Mitigation, supported by Science and Communication.

Adaptation accepts the reality that the climate is changing and takes action to deal with it. As noted in a 2007 article on vulnerability and adaptation in South Africa by the Department of Environment Affairs, the best adaptation scenarios include resilience strategies to address the immediate effects of climate change and acclimation-type strategies to deal with gradual changes.

Mitigation, on the other hand, recognizes the fact of climate change but seeks to do what it can to keep it from getting worse. It is about tackling the causes of climate change such as reducing our carbon foot print and carrying out environmentally friendly activities.

A key element to the success of adaptation and mitigation strategies is good science. In order to make informed decisions, guide appropriate responses and take effective action, quality data and expert knowledge must be available and applied. That is why investment



into the science of climate change adaptation and mitigation needs to be made a priority.

Communication is another key. It is essential to increase public awareness of the issue, including the resulting impacts. This will be the only way to change attitudes and consequently amend behaviours in order to lead individuals and groups to make more environmentally responsible decisions

The road to both effective adaptation and mitigation however, is not an easy one. Building climate resilient, low carbon economies in the Caribbean will required a transformational change by governments, regional organizations, development organizations, the private sector and the public. It will also require significant levels of financial and technical support.

CARICOM is responding. For example, they have created a regional framework for coping with climate change. Development institutions are working in agriculture to help advance and adopt new climate-smart technologies. The promotion of 'Green Economies' is being supported and many countries are pursuing low-carbon strategies.

Efforts to collect useful data for strategy creation are also underway. A Canadian-Caribbean partnership is working to create climate models for projection of future scenarios. The EU and the Caribbean Community Climate Change Centre (5Cs) are working to generate knowledge of likely location-specific impacts and hazards from climate change to guide policy and planning.

These are just a few of the ways that the Region as a whole is working to tackle climate change. One of the hardest hit industries though is agriculture. Those involved in this sector cannot afford to sit back and wait for external institutions to solve their specific challenges. The industry itself must take specific and definitive action to help themselves.

Getting Caribbean Agriculture Climate-Smart

It is clear that climate change and its resulting impacts will transform farming across the world. It must! When we understand what people are currently doing in agriculture and meld that information with new and innovative techniques to respond to climate change, we become climate smart. Climate-smart agriculture involves improving and adopting farming practices, policies, management, innovation technology and financing in order to increase productivity, enhance food and nutrition security and strengthen the public, production and business environments surrounding agriculture. Setting the policy framework also sets the stage for actions on climate-smart agriculture.

Under Component One of the APP, support provided to develop national agriculture policies and plans recognised the importance of building resilience to climate change as a top priority, particularly given the significant impacts on the availability of water for farming. Using an audit instrument developed under the APP, at least 5 countries in the Region have been assessed to determine if they are climate change ready. The Audit Instrument was applied to assess the extent to which the planning processes within a country's agriculture sector integrated disaster risk management considerations, including impacts from climate change.

The assessment process began with the identification of risks due to climate change and natural disasters. From that, ten key pillars for strengthening responses were determined and a tool to assess a countries readiness to respond was created. Once assessments were complete, countries identified gaps in their planning and now they are working to fortify their plans to prepare for, and protect and recover from, climate change and disaster events. (see TF #9)

Improved plant varieties in their plantlet stage. (Photo: CARDI)

Under Component Two, CARDI has been taking actions to contribute to building a climate resilient farming sector by:

Working with scientists, development organizations and farmers to cultivate and distribute more climate resistant food crop varieties: This is an essential element to climate change adaptation. Current plant varieties are struggling to survive under the heat stress and lack or

overabundance of water due to climate change. The new pests and diseases that have arisen as a result of climate change are also threatening the success of current plant varieties in the Caribbean. Technology is now available to build better, more resistant varieties of food crops that can withstand the fallout from these changes.

Providing hands-on training in germplasm improvement and direct support to farmers to produce and sustain their own quality planting material: Several propagation facilities and multiplication units in countries of the Region have been refurbished to almost double their capacity to produce and multiply improved germplasm.

Conducting climate smart crop evaluation trials for water stress to determine the crop varieties that are most tolerant to drought conditions including, sweet potato trials in Antigua & Barbuda and St.Vincent & the Grenadines, cassava trials in Trinidad & Tobago and corn in Belize.

Recycling run-off water in Jamaica. (Photo: CARDI)

Exploring the use of Green Intensive Farming Technologies (GIFTs) and practices aimed at optimizing production, reducing environmental impacts, addressing environmental changes and creating more sustainable farming systems in the Region: This includes Protected Agriculture (PA) systems, Irrigation, Hydroponics and Aquaponics. The focus of the APP has been on the construction of a Tropical Greenhouse in Trinidad and Tobago (see TF #7), and design and material improvements to an existing greenhouse in Tobago, both in collaboration with the Faculty of Food and Agriculture and Facility of Engineering, UWI. They are also carrying out experimentation with 'Guinea grass' as mulch to conserve soil water content for sweet potato production in St. Kitts and Nevis.

Evaluating the use of liquid fertilisers in the production of Taro (dasheen), with trials in Dominica for appropriate plant nutrition and method of application to enhance productivity in changing climatic conditions.

Using water more efficiently is an absolute necessity for farming systems in a changing climate. Since the majority of farming systems in the Region are open-field and rain-fed, the impact of climate change and its effect on water availability for agriculture is an issue that can't be ignored. Irrigation, including advances in rainwater harvesting, is both a farmer traditional knowledge and an innovative practice under the general chapeau of a 'GIFT'. In the broader context of climate change, innovation in water management systems for agriculture is being actively promoted to tackle the water for agriculture challenge. The aim is to ensure the most efficient use of all available sources, distribution methods and uptake of water by plants, whether grown in open-fields or in protected agriculture structures.

Large water retention pond on farm of Christoper Cox, Saint Lucia (front) behind him stands veteran PA farmer, Jervis Rowe of Abbey Garden Farms/ Jamaica (Photo: APP)

Rainwater harvesting and storage is an important aspect of farm water management and a source of water for irrigation. It involves collecting water from a prepared collection area and storing it in a tank or small reservoir for future use. The use of heavy duty pond liners in a man-made pond to collect rainwater is also an effective technique. Trickle irrigation can be used in conjunction with any of these water harvesting, collection and storage systems to make an efficient, environmentally friendly and climate resistant solution to water shortages.

Recycling runoff water is another way to use available water more efficiently. Run-off can occur due to

Water Management Practices under New Climatic Realities:

Water Management – Rain Harvesting

Roof top harvesting: Storage in plastic, cement or ferro cement tanks which allows for water supply during the dry season or droughts for crops, forages and livestock

Soil surface runoff: Storage in dams, natural ponds and rivers, or soil storage including bunds or pits which allows for water supply during the dry season or droughts for crops, forages and livestock

Community harvesting: Farmers on contiguous plots of land can share the cost and construction of catchment or runoff systems, along with the storage tanks to be used by the immediate community.

Check Dams: These dams can be built by a community of farmers to ensure that the farmer at the very end of the farming area still has access to water for his operations. Farmers would need to agree on an arrangement for distribution lines, maintenance and watering times.

Soil Management Practices under New Climatic Realities:

Soil Management – The Benefits of Mulch

Soil water content: Water is both trapped in the mulch and held in the soil for use during low rainfall or drought, allowing for continued crop growth when there is no access to irrigation

Soil protection: Minimizes soil loss during high winds, reduces the damaging impact of heavy rainfalls, which causes erosion, and deflects direct sunlight resulting in lower soil temperatures

Plant growth: Promotes germination from the moisture resulting from condensation, keeps roots much cooler and suppresses weed growth allowing for better crop establishment and nutrient uptake

Soil Management – Contouring

This is the practice of plowing and/or planting across a slope, following its contour lines. It is a viable option to conserve rainwater by forming a water break and reducing soil loss from surface erosion.

over-watering or poor soil and can happen with both natural rain water and during irrigation. Run-off water can be stored in separate ponds or ditches and channelled back to a field when it is required.

The benefit of saving water with this technique is obvious, however it also goes a long way in protecting the environment. Agricultural run-off generally contains large amounts of chemicals from fertilizer. These can seep into the groundwater and pollute local bodies of water.

Efficient water use not only greatly decreases the impact of drought but also enhances the efficiency of fertilizer application, or fertigation. Fertigation is the injection of fertilizers, soil amendments, and other water-soluble products into an irrigation system. Such targeted fertilizer use, similar to the taro experiment in Dominica, can greatly reduce costs and the adverse impacts of excessive agro-chemical use on the environment.

Agriculture Management Practices under New Climatic Realities:

Management of Plant Varieties and Cultivars

Farmers across the Region are already fully aware of what works best in their fields however they can also benefit from improved cultivars that are more resistant to pests, disease, heat and drought in this new climatic environment.

Protected Agriculture

Greenhouses, shade houses and tunnels are excellent options for controlling the environment in which plants are cultivated. They allow for protection against sun and heat and pests and diseases, as well as better control over water and fertigation elements.

Moving Forward Together

As part of the APP, partnerships have been strengthened and widened with a number of agencies working collaboratively towards the goal of a climate-smart agriculture. These agencies are coordinated under the Climate Change and Natural Resources Management (CCNRM) Thematic Group (TG), coordinated by the FAO and supported by the APP Caribbean Action. Meetings address issues and constraints related to the areas of Climate Change, Disaster Risk Management, and Natural Resources Management impacting the Regional Agricultural Sector.

In her opening remarks at a workshop to formulate a livelihoods resilience programme for Caribbean states, Dr. Lystra Fletcher-Paul of the FAO, and Coordinator of the CCNRM TG, shared some sobering information. "It has been estimated that in the Caribbean, changes in annual hurricane frequency and intensity could result in additional annual losses of US $446 million by 2080", she said. "The agriculture sector in particular, has been severely affected, by these weather related and seismic events. Consequently, the region's food and nutrition security has been impacted."

There is much that is being done, still much to be done and much more that can be done to fortify Caribbean agriculture to adjust to the new realities of climate change. Clearly, inaction is not an option. With the physical and economic well-being of the Region at stake, efforts to adapt to and mitigate the elements of climate change in farming systems are indispensable. That is why we must continue to move forward together, using the strengths of individuals, organizations and governments, to ensure that Caribbean agriculture has the best chance to survive, and even thrive.

In moving forward together, the Region needs to heed the call of Dr. Lystra-Fletcher to "enable the environment, watch and safeguard, apply prevention and mitigation measures and prepare to respond." These four thematic pillars are at the core of Disaster Risk reduction for Food and Nutrition Security.

See also:

TF#6: Are Farmers Still Planting by the Moon?

TF#7: 96° in the Shade: Cooling Things Down in Protected Agriculture Structures

TF#8: Farming Green - Using Natural Plant Material to Enhance Crop and Livestock Farming

This is the first of a 4-part series of Thematic Features with a focus on Innovation & Technologies for Sustainable Farming Systems produced under the Agricultural Policy Programme (APP) Caribbean Action highlighting work under Component 2 – Applied Research and Development and Innovation in Farming Systems. The APP is funded by the European Union (EU) under the 10th European Development Fund (EDF) with the Inter-American Institute for Cooperation on Agriculture (IICA) as Executing Agency and the CARICOM Secretariat (CCS) and the Caribbean Agricultural Research and Development Institute (CARDI) as Implementing Partners.

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