USDA CARIBBEAN CLIMATE HUB

Greenhouse Gas Mitigation & Adaptation Workshop | Summary Report

USDA Building Blocks for Climate Smart Agriculture and Forestry

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INTERNATIONAL INSTITUTE OF TROPICAL FORESTRY

USDA CARIBBEAN CLIMATE HUB for Tropical Forestry and Agriculture

FLMM Fundación Luis Muñoz Marín

USDA United States Department of Agriculture

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Overview

The USDA Caribbean Climate Hub hosted a workshop in San Juan, Puerto Rico on September 22-23, 2015 to communicate the United States Department of Agriculture (USDA) strategies for greenhouse gas (GHG) mitigation and explore how these strategies interact with regional activities and partner agencies. The workshop served as a platform to discuss what tools and techniques are currently proving effective in communicating climate science and adaptive practices within Caribbean working lands.

Caribbean Climate Hub

The USDA **Caribbean Climate Hub** (CCH) is located in Río Piedras, Puerto Rico, and is one of the ten Hubs nationwide. This **network of Climate Hubs** works with USDA agencies and other partners to deliver science based knowledge and practical information to farmers, ranchers, and forest landowners in order to help them adapt to climate change and weather variability by coordinating with local and regional partners in federal and state agencies, universities, and the public. The CCH is focused on tropical forestry and agriculture. It is the mission of the CCH to provide:

- Technical support for agricultural land and forest managers to respond to drought, heat stress, floods, pests, and changes in growing season in Puerto Rico and the US Virgin Islands.
- Outreach and education to farmers, ranchers, forest managers and advisors on ways to build resilience to extreme weather events and thrive despite change.

The **Mission** of the CCH is to assist the US Caribbean in sustaining and improving the viability of forest and agricultural production, the availability and quality of soil and water resources, the viability and quality of rural lifestyles, and increase food security in light of climate change. The Goal of the CCH is to develop and deliver information related to climate, agriculture, and forestry for better planning and implementation of actions related to the mitigation of and adaptation to climate change in the tropical working lands and oceans in the Caribbean.

The **Vision** of the CCH is agencies, organizations, producers, managers, and decision-makers working collaboratively to promote sustainable and best management practices that ensure food, water, and other vital resources are available in the US Caribbean by sustaining and strengthening the services provided by natural land and seascapes, working lands and rural communities in the face of changing climate.

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Objectives for the workshop and participation

The GHG mitigation and adaptation workshop was attended in person by 59 participants, with an additional 10-13 participating online. Attendees represented students and faculty from the University of Puerto Rico, Agricultural Extension agents, government representatives from municipal authorities, the Puerto Rico Department of Natural and Environmental Resources, the Puerto Rico Department of Agriculture, the Virgin Islands Department of Agriculture, private businesses, growers and USDA personnel from the Office of the Chief Economist, Natural Resources Conservation Service and US Forest Service.

1) Communicating findings & strategies of USDA Building Block Teams to local USDA agencies and partners

2) Facilitating information sharing and partnerships among Hub network cooperators

3) Fostering and expanding cooperative stakeholder networks

4) Sharing climate science communication strategies

5) Hearing from local and federal partners what adaptation andmitigation efforts are underway, and sharing information regarding tools and resources that are currently being employed to overcome barriers

6) Gathering input regarding what climate related tools, information, and/or technology may be developed to facilitate regionally specific adaptive practices among local advisors and producers

The broad range of stakeholders reflects a deliberate effort on the part of the CCH to provide a platform for information sharing across departmental and agency divides. Highlights of the workshop were participation from the Puerto Rican Secretaries of Agriculture and Natural and Environmental Resources, the Assistant Commissioner of Agriculture for the US Virgin Islands, the NRCS Caribbean Area Director and a range of researchers, advisors and practitioners.

The workshop also greatly benefited by presentations from the International Institute of Tropical Forestry (IITF) Director and the IITF Project Leader, the Northern Forest Hub Leader and the USDA Director of Climate Change Program Office.

Background

This section of the report provides context by introducing the concept of greenhouse gases, how they affect the atmosphere, and how that in turn affects agriculture.

Greenhouse Gases

Greenhouse gases (GHGs) are gases that absorb long-wave infrared radiation emanating from earth. They include naturally occurring substances such as methane and carbon dioxide and even water vapor. Changes in the atmospheric concentrations of GHGs can alter the balance of energy transfers between the atmosphere, space, land, and the oceans. A gauge of these changes is called radiative forcing, which is a simple measure of changes in the energy available to the Earth-atmosphere system (IPCC, 2001). Holding everything else constant, increases in GHG concentrations in the atmosphere will produce positive radiative forcing (i.e., a net increase in the absorption of energy by the Earth).

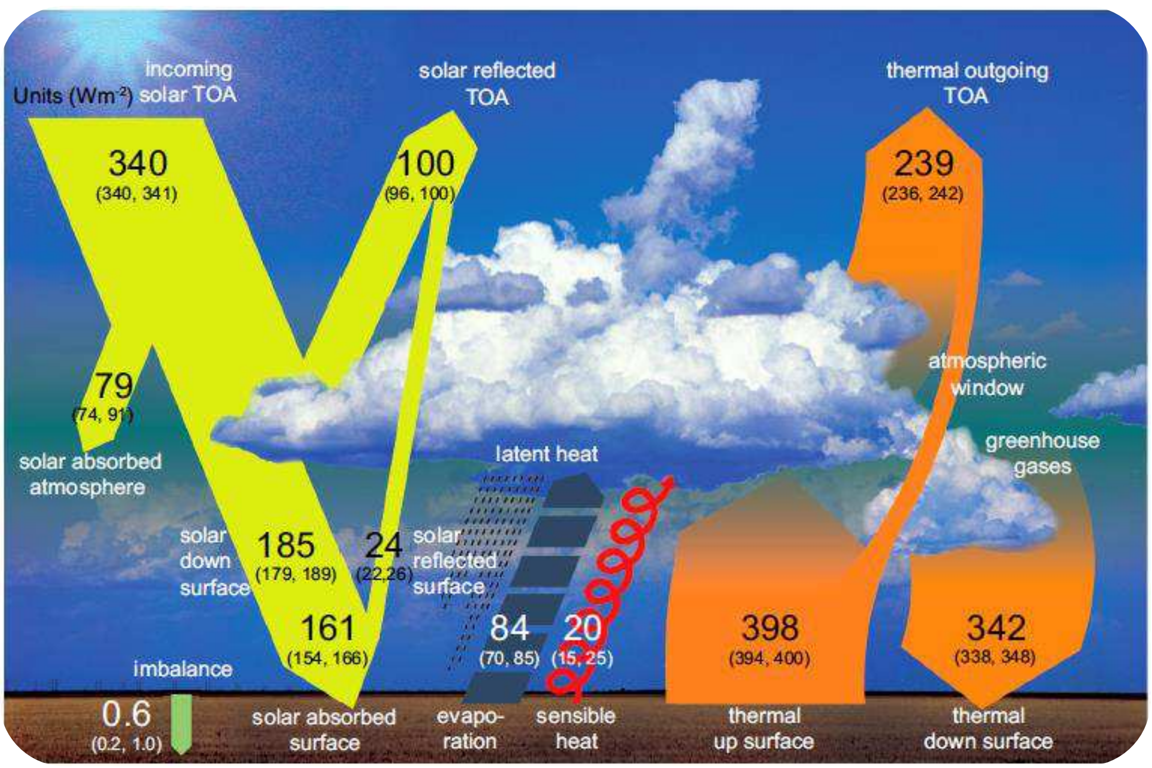


Figure 1: Global energy balance measured in watts/ square meter. source: IPCC 2001

The United States Environmental Protection Agency (EPA) recognizes four major types of greenhouse gases, Carbon dioxide (CO_2), Methane (CH_4), Nitrous oxide (N_2O), and high-global warming potential gases, which are, Hydrofluorocarbons (HFCs), Perfluocarbons (PFCs), Sulfur hexafluoride (SF_6). Of these, CO_2 is the most prevalent. For this reason and for ease of measurement, all GHGs are measured in terms of their global warming potential (GWP) in relation to CO_2 and expressed in terms of carbon dioxide equivalents (CO_2e). Global warming potential is a factor of radiative forcing (the ability of a gas to ‘absorb’ or ‘hold’ solar radiative energy) and how long the gas persists in the atmosphere. Atmospheric concentrations of CO_2 are reaching global averages of ~400ppm as compared to pre-industrial levels of an estimated 278ppm (IPCC, 2014). Of the total amount of GHGs emitted by the U.S. in 2013, about 84% were energy related and 92% of those energy-related gases were CO_2 emissions from the combustion of fossil fuels (EPA, 2014). As of 2013, the United States was the second-largest contributor of energy-related CO_2 emissions, after China, and was followed by Russia, India, Japan, and Germany. The primary drivers of these emissions were fossil fuel combustions and land use change (IPCC, 2014).

While pinpointing specific regional effects of increasing concentrations of atmospheric GHGs remains difficult, climate and atmospheric scientists have reached consensus on several important issues: atmospheric concentrations of GHGs have increased dramatically since the industrial revolution, human combustion of fossil fuels is the primary driver of this increase, GHGs have a positive radiative forcing effect on the global atmosphere resulting in increasing global average temperatures (IPCC, 2014). Rising global temperature averages are affecting and will continue to affect almost every facet of human and non-human life, but particularly those activities and industries that are directly dependent on climate such as agriculture and forestry.

Agriculture and Forestry

Agriculture and forestry are activities that both contribute to and are affected by increased levels of GHGs in the atmosphere. Following the combustion of fossil fuels for energy production- agriculture, forestry, and other land uses (AFOLU) are the leading cause of atmospheric GHG emissions globally. Much of this terrestrial carbon loss is through tropical deforestation that is the result of unsustainable logging practices, land clearing for agriculture, and development (IPCC, 2014).

In the immediate future, the effects of climate change on agriculture and forestry are expected to be mixed globally as some regions may benefit from an increase in length of growing season and CO_2 fertilization. These potential benefits will be predominantly experienced in northern latitudes and may be offset by increasing instances of drought, wildfire, and pest and disease outbreak. In the tropics, where many crops are already being grown at the fringes of their climatic parameters, small changes in temperature and rainfall patterns are expected to have a more immediately negative affect on yields and food security (Brown et al., 2015; IPCC, 2014; Walthall et al., 2012; Zhao et al., 2005). The extent to which climate change impacts will affect agricultural and forestry systems in the second half of the 21st century is largely dependent on existing social-ecological vulnerabilities and near-term mitigation and adaptation efforts (Walthall et al., 2012).

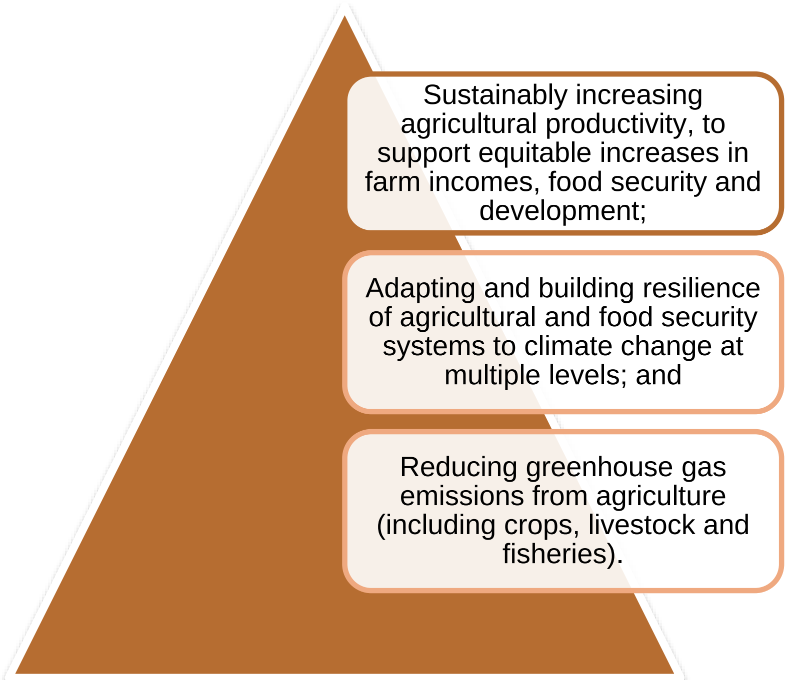
The Caribbean exhibits a high level of climate vulnerability for a variety of reasons that range from geographic and biophysical to political and economic (Mimura et al., 2007). Like much of the Latin American and Caribbean region (LAC), agricultural production in Puerto Rico and the US Virgin Islands is marked by small-holder, limited resource producers operating on slim economic margins and with minimal technological improvements (USDA NASS, 2012; Gould et al., 2015; Maharaj & Singh-Ackbarali, 2014; Mimura et al., 2007). Small holding farmers using traditional, agro-ecological practices that include crop diversification, maintaining local genetic diversity, animal integration, soil organic management, water conservation and harvesting, etc., may be more resilient to some climate change impacts such as pest and disease outbreak and isolated extreme events (Altieri et al., 2015); however, a high dependence on rain-fed systems as well as limited access to capital and assistance programs may leave such producers vulnerable to prolonged and repeated exposure to extreme climatic events such as hurricanes, prolonged droughts, and extreme rainfall events (Zhao et al., 2005). For a more in depth discussion on the history and current state of agriculture in the US Caribbean, please refer to the Caribbean Sub Hub's recently published Vulnerability Assessment.

Climate Change and Food Security

The UN Food and Agriculture Organization (FAO) estimates that global human population may reach 9 billion by 2050. They further estimate that global food production will need to increase by 70% to ensure adequate food supplies worldwide, with the bulk of this increase coming in the developing world (FAO, 2009). These gains must be made despite the increasing challenges of climate change and continuing geo-political instability. In 2015, the USDA released a report articulating how climate change is expected to affect food security both domestically and abroad (Brown et al., 2015). The emphasis on food security as opposed to food production is an important distinction. Food security has four components: availability, access, utilization, and stability (Brown et al., 2015). These components acknowledge that widely agreed upon global food security goals articulated within the United Nations Sustainable Development Goals for 2030, can only be achieved through integrated efforts that address not only technologies and techniques to improve average crop yields, but also the economic, trade, and transportation systems that play a vital role in the stability and vulnerability of global food systems. Centralized agro-industrial systems that rely on mass mono-cropping, global transportation networks, and long supply-chains have been cited as being vulnerable to disruptions from climate change as well as significantly contributing to carbon emission totals (Altieri et al., 2015; Comas, 2009). Globally linked food systems will likely continue to play a vital role in ensuring access to adequate food supplies during regional climate disruptions such as drought or hurricane damage; however, mechanisms must be found that prevent such global trade from inhibiting local production, particularly in the LAC where small-scale, high cost production and distribution difficulties can disadvantage local producers and result in high import dependence (Gould et al 2015).

Agroecological systems may offer a low carbon form of farming that can also work to increase food security and the resilience of food systems (Altieri et al., 2015). Observations of agricultural performance after extreme climate events like those experienced in and projected for the US Caribbean (hurricanes and droughts) demonstrate that resilience to such occurrences is closely linked to increased levels of biodiversity. Mijatovic et al. (2013) reviewed 172 case studies and project reports from around the world and found that agricultural biodiversity contributed to resilience through a number of, often combined, strategies: the protection and restoration of ecosystems, the sustainable use of soil and water resources, agro-forestry, diversification of farming systems (inter-cropping, etc.), various adjustments in cultivation practices (no-till, etc.) and the use of stress-tolerant crops and crop improvement. Such practices are inline with a climate smart agricultural approach that seeks to improve yields using ecologically sustainable methods that work to minimize a systems carbon footprint.

The FAO defines Climate Smart Agriculture as seeking to secure three main objectives:



Researching, developing, and promoting ecologically sound practices in food production could be an important step in building resilience into the largely small-scale farms of the US Caribbean. These methods may require more labor input as opposed to fertilizer, pesticide, and herbicide inputs. Chemical inputs must be imported at an increasing cost to local farmers and represent one of the largest growing costs to Caribbean producers. At the same time the islands suffer from some of the highest unemployment rates in the US (USDA NASS, 2012).

Efforts to shift agriculture toward a climate-smart, agroecological paradigm could have many environmental and socio-economic benefits, but challenges in land availability to young farmers, consistent access to affordable labor, and global competition must be addressed from many angles by both public and private interests. Achieving food security while meeting the challenges of mitigating and adapting to climate change will require a comprehensive effort to empower local, place-based innovation and production.

U.S. Emission Goals and USDA Strategies

The United States intends to reduce its greenhouse gas (GHG) emissions by up to 28 percent below 2005 levels by 2025. This economy-wide commitment comprises the US contribution to the global effort to combat climate change and will form a cornerstone of a new post-2020 international climate agreement ratified at the 2015 Paris Conference of Parties (COP).

The agricultural and conservation communities have an important role to play in helping the US achieve its emission reduction goals. Globally, agricultural production accounts for 17% of GHG emissions. In the US, agriculture accounts for 8% with domestic totals reaching 565 million metric tons of CO_2 equivalent ($MMTCO_2e$) in 2013 (see figure 2). While this number alone is significant, it does not take into account GHGs that are produced supplying producer energy demands, nor those produced in the processing and transporting of agricultural products. A FAO study found that globally, emissions from production activities accounted for only ~65% of the agricultural sectors' carbon footprint, with distribution, transportation, and food preparation providing the remaining 35% (FAO, 2011). These figure are estimates of global averages that reflect relatively low carbon intensity food systems as compared to those of the US and US Caribbean.

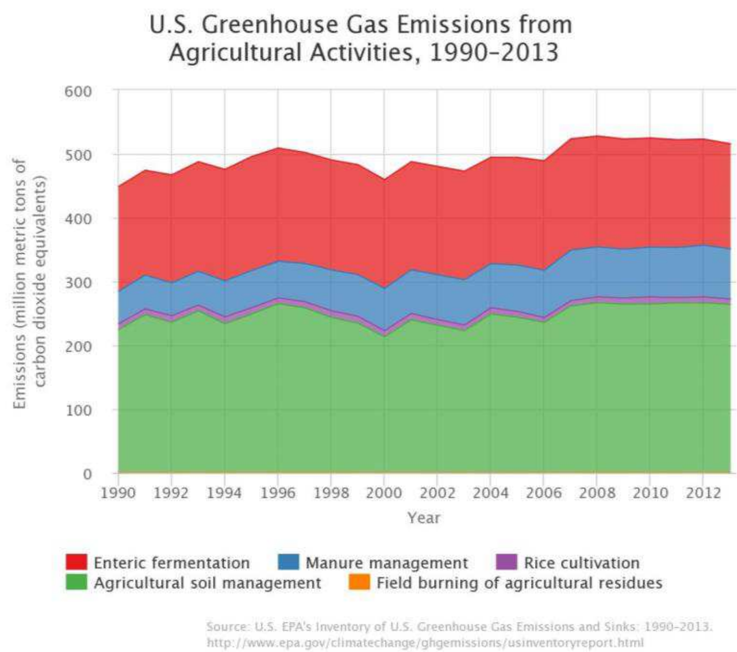


Figure 2: US GHG Emissions from Agricultural Activities. Source: US EPA's Inventory of US GHG Emissions and Sinks 1990-2013

Through its conservation, agricultural, forestry, and energy programs, the USDA is uniquely positioned to assist in helping the country achieve its GHG mitigation objectives. In 2014 the USDA formed ten Building Block Teams tasked with developing detailed options for implementing GHG mitigation technologies and practices. These teams include representatives from the Natural Resources and Environment; Farm and Foreign Agricultural Services; Rural Development; and Research, Education, and Economics mission areas. The teams reviewed potential technologies and practices, program authorities, and their potential to reduce GHG emissions and increase carbon sequestration. Based on their estimates, USDA actions could reduce net GHG emissions by 120 million metric tons of CO_2 equivalent ($MMTCO_2e$) by 2025.

Achieving significant reductions in greenhouse gas emissions and increases in carbon sequestration in forest and agricultural systems will require transforming the ways that crops and forest products are produced. In addition to net GHG reductions, achieving this transformation can create environmental and economic co-benefits. A broad array of voluntary USDA led conservation and energy programs are available to help improve agricultural and forest productivity, and provide economic benefits to landowners. Specifically, the Natural Resources Conservation Service (NRCS) and Farm Services Agency (FSA) provide technical support and financial assistance to encourage conservation practices and easements. Rural Development (RD) and the Rural Utilities Service (RUS) offer grants and loan guarantees to improve energy efficiency and build small- and large-scale power plants. The Forest Service administers several programs to improve forest health on both public and private lands.

Finally, agencies that focus on research, education, and extension are developing GHG mitigation technologies and encouraging their use by farmers and forest owners. The Building Block Teams provided detailed recommendations on how to use these and other existing programs and authorities to incentivize greenhouse gas mitigation practices. The objectives of this workshop were centered on sharing these recommendations with local USDA cooperators and other key partners such as territorial government offices and agricultural extension personnel.

By bringing together a diverse range of stakeholders at the workshop, the CCH hoped to create a productive arena in which to integrate national USDA mitigation strategies with local efforts currently underway. Territorial and private partners were able to learn what resources and capabilities the USDA has available to facilitate adaptation and mitigation practices, as well as gain knowledge and share information about other innovative programs within the region.

Workshop proceedings

The workshop and its presentations were organized along four general themes with many presentations covering several or all of the following:

- Overview of federal and territorial programs and strategies
- Communication and outreach strategies and tools
- Region specific climate science and adaptation tool development
- Field based mitigation/adaptation efforts

Each topic was addressed by four to five speakers followed by a panel discussion in which attendees could question the previous speakers as well as discuss potential space for collaboration. These panels were followed up by participatory exercises designed to gather information and facilitate discussion among collaborators. The CCH feels it is important to provide ample space for participation and information sharing that allows Hub staff to capture key ideas to fully capitalize on local knowledge and expertise.

USDA 10 Building Blocks

USDA Director of Climate Change Program Office William Hohenstein presented the findings and recommendations of the 10 Building Block teams and conveyed the high priority that these strategies have within the USDA administration. Director Hohenstein also stressed the importance of a climate-smart agricultural approach which seeks to optimize three outcomes: **promoting an increase in productivity, building greater climate resilience into agricultural systems, and reducing and/or removing GHG emissions associated with agricultural activities and production**. He stressed the point that while producers are capable of, and indeed have been adapting to climate variations for many years, without the proper information and tools, these adaptive practices may be largely reactive as opposed to proactive. Such an approach may not be sufficient to keep pace with the increasing rapidity of climate shifts and variability projected for the coming decades.

The USDA's GHG mitigation strategy is made of the following 10 building blocks:

Building block	Description
Soil Health	• Improve soil resilience and increase productivity by promoting conservation tillage and no-till systems, planting cover crops, planting perennial forages, managing organic inputs and compost application, and alleviating compaction. USDA aims to increase no-till implementation from the current 67 million acres to over 100 million acres by 2025.
Nitrogen Stewardship	• Focus on the right timing, type, placement and quantity of nutrients to reduce nitrous oxide emissions and provide cost savings through efficient application.
Livestock Partnerships	• Encourage broader deployment of anaerobic digesters, lagoon covers, composting, and solids separators to reduce methane emissions from cattle, dairy, and swine operations. USDA plans to support 500 new digesters over the next 10 years, as well as expand the use of covers on 10 percent of anaerobic lagoons used in dairy cattle and hog operations.
Conservation of Sensitive Lands	• Use the Conservation Reserve Program (CRP) and the Agricultural Conservation Easement Program (ACEP) to reduce GHG emissions through riparian buffers, tree planting, and the conservation of wetlands and organic soils. By 2025, USDA aims to enroll 400,000 acres of CRP lands with high greenhouse gas benefits, protect 40,000 acres through easements, and gain additional benefits by transferring expiring CRP acres to permanent easements.
Grazing and Pasture Lands	• Support rotational grazing management, avoiding soil carbon loss through improved management of forage, soils and grazing livestock. By 2025, USDA plans to support improved grazing management on an additional 4 million acres, for a total of 20 million acres.
Private Forest Growth and Retention	• Through the Forest Legacy Program and the Community Forest and Open Space Conservation Program, protect almost 1 million additional acres of working landscapes. Employ the Forest Stewardship Program to cover an average of 2.1 million acres annually (new or revised plans), in addition to the 26 million acres covered by active plans.
Stewardship of Federal Forests	• Reforest areas damaged by wildfire, insects, or disease, and restore forests to increase their resilience to those disturbances. USDA plans to reforest 5,000 additional post-disturbance acres by 2025.
Promotion of Wood Products	• Increase the use of wood as a building material, to store additional carbon in buildings while offsetting the use of energy from fossil fuel. USDA plans to expand the number of wood building projects supported through cooperative agreements with partners and technical assistance, in addition to research and market promotion for new, innovative wood building products.
Urban Forests	• Encourage tree planting in urban areas to reduce energy costs, storm water runoff, and urban heat island effects while increasing carbon sequestration, curb appeal, and property values. Working with partners, USDA plans to plant an average of 9,000 additional trees in urban areas per year through 2025.
Energy Generation and Efficiency	• Promote renewable energy technologies and improve energy efficiency. Through the Energy Efficiency and Conservation Loan Program, work with utilities to improve the efficiency of equipment and appliances. Using the Rural Energy for America Program and others, develop additional renewable energy, bioenergy and biofuel opportunities. Support the National On-Farm Energy Initiative to improve farm energy efficiency through cost-sharing and energy audits.

Many of these strategies, such as expanding the production and use of wood products, present unique opportunities for developing local industries in the US Caribbean. Puerto Rico has many distinctive and exceptional indigenous tree species that are particularly suited for use in furniture, musical instruments, flooring, and many other uses. If harvesting is conducted using sustainable practices, developing the islands wood products industry could offer many socio-ecological co-benefits by creating jobs, incentivizing the conservation of private forest lands, sequestering carbon in long-life wood products, and potentially offsetting the use of high-carbon source construction supplies such as concrete.

Director Hohenstein also presented the following potential next steps for Puerto Rico and the US Virgin Islands:
• Detailed GHG inventory of farms and forestlands within the region;
• Set priorities in alignment with broader regional conservation goals;
• Identify current rates of adoption of key conservation and GHG beneficial practices;
• Coordinate with USDA research in the region to improve understanding of practices and metrics;
• Consider partnerships – identify potential partners;
• Share insight and approaches with other countries in the region.

The CCH and its partners are currently engaged in many of these activities.

Adaptation Tools

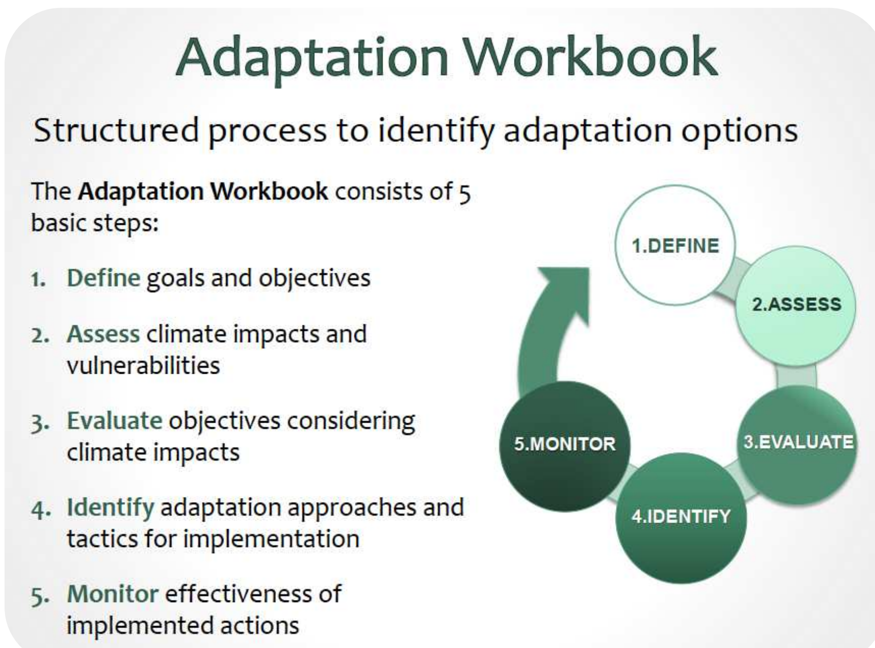


Figure 3: The Adaptation Workbook process enables working lands managers to consider climate impacts and vulnerabilities alongside their personal values and goals.

USDA Northern Forest Climate Hub Leader Chris Swanston presented the newly developed Forest Adaptation Workbook as one tool that has been developed to help forest managers and advisors plan and manage for region specific climate change impacts. The web-based tool draws upon local vulnerability assessments and climate projections to provide managers and producers with the knowledge and context from which to make climate-smart decisions that align with their personal values and objectives (Figure 3). Dr. Swanston stressed the importance of any decision-making process being transparent, participatory, and voluntary. This approach facilitates a 'bottom-up' process through which land-managers come to their own conclusions based upon a combination of sound scientific information and local knowledge. Having thus made the actual management decisions themselves, practitioners have greater ownership and understanding of the process and any subsequent actions.

The national USDA Regional Climate Hub website provides a list of some of the adaptation planning tools that are available to land managers. The tools range from specialized calculators to maps, models and datasets estimating a variety of outputs (e.g., crop production, greenhouse gas flux, and species distribution). Certain tools may be more relevant to land managers to aid in year-to-year decision-making, while others are more useful for researchers studying agriculture and climate change.

The Climate Hubs Tool Shed provides information on tools from across the country that can assist agricultural and forest land managers in adapting to climate variability and change. The database includes tools that are directly relevant to climate variability and change, as well as tools that assist in managing factors that interact with climate variability and change, such as drought, pests, and extreme weather. The target audience is extension and consultants, but the database could also be useful for land managers, land owners, and researchers. Both resources are available at http://climatehubs.oce.usda.gov/content/tools-and-data .

Puerto Rico

The workshop enjoyed participation from many key members of the Puerto Rican government including Secretary of Agriculture, the Hon. Myrna Comas and Secretary of Natural and Environmental resources Carmen Guerrero. Their departments have been working to integrate climate change into their planning and projects and have been important partners in forming and guiding the efforts of the Puerto Rico Climate Change Council (PRCCC). The PRCCC was formed in 2010 and has since grown to 157 members and partners covering a wide range of scientific and professional fields. The council reports that concerns around increased storm frequency, rising sea levels, floods, and coastal erosion are part of Puerto Ricans climate change awareness, however, the general public is less aware of the potential impacts on human health, food production, water supply, and biodiversity. The PRCCC provides a brief history of climate change efforts in the island on its website.

Puerto Rico Secretary of the Department of Agriculture, Myrna Comas, presented information on the current scenario in Puerto Rico and highlighted the need to understand and address trade and transportation issues, and appropriate economic incentives in addition to agricultural practices, in order to reduce risk and address vulnerabilities related to climate change and food security. The Department of Agriculture has been executing a four-part plan to develop adaptation strategies in the agricultural sector which include, mapping, analyzing risks, and identifying and developing adaptation strategies.

Puerto Rico Secretary of the Department of Natural and Environmental Resources, Carmen Guerrero, highlighted the current understanding of GHG emissions in the island and the government's efforts to address climate vulnerability, mitigation and adaptation in numerous sectors.

Both Secretaries would like to see an increase in the areas under protection and agricultural designation-
Secretary Guerrero would like to the percentage of the island that is protected increased from its current 8.7%, to 16% in 2020 and 30% in 2030. In November of 2014 the Puerto Rican government passed the 'Ley del Bosque Modelo de Puerto Rico' (Model Forest

Act of Puerto Rice) to structure the governance of the Model Forest created around Adjuntas. The law states, "This vision of sustainability, essentially intends to move towards a different relationship between the economy, environment and society."[1]
The act allows for and encourages sustainable agriculture within the model forest areas recognizing the potential for integrating ecological friendly agricultural practices with the preservation of biodiversity and water quality.

Ley 6-2014 – Establece una reserva mínima de 600,000 cuerdas de terrenos agrícolas en el Plan de Usos de Terreno

Ley 228-2003 – Establece la política pública de fomentar la agricultura orgánica por los beneficios al medio ambiente, el suelo, el agua y demás recursos naturales y a la salud de nuestro pueblo.

US Virgin Islands

The Assistant Commissioner of Agriculture for the US Virgin Islands, Errol Chichester spoke about the impacts drought is having on producers, and spoke to the capacity needs of the US Virgin Islands to address disaster, reduce vulnerability and increase food security.

USDA Natural Resources Conservation Service Caribbean Area Director, Edwin Almodovar presented the programs and capacity of his agency to reduce risk and vulnerability to climate change among area producers.

Next Steps for the US Caribbean

Large-scale agriculture within the US and other mass-producing countries such as Russia and Brazil is a significant contributor to GHG emissions worldwide. Methane from cattle production accounts for a large portion of that, as does carbon loss in soils from decomposing organic material. Likewise, the decomposition of agricultural residue and waste produces a significant amount of methane when considered on a global scale. Methane is a much stronger (GWP) GHG than is carbon, but persists for a shorter amount of time in the atmosphere.

While agriculture in the islands is not significantly contributing to global GHG totals, the island economies have a significantly higher carbon intensity than the mainland, and are significant consumers of electricity and fossil fuels. A strategy for reconciling these issues is considering ways in which the islands could begin to minimize their carbon footprint while increasing agricultural production. In many places, these objectives would seem to be at odds, but in the US Caribbean there is an opportunity to achieve both goals. For instance, the dairy industry in Puerto Rico is a significant contributor to the economy, and has long prevented the islands from the necessity of having to import milk. So, to understand the true 'carbon footprint' of the dairy industry, one cannot look

[1] Quote translated from original text: "Esta visión de sustentabilidad, pretende esencialmente "avanzar hacia una relación diferente entre la economía, el ambiente y la sociedad."

merely at the GHG's produced on-site at a dairy operation, although that is important to consider, one must also consider what alternatives sources are available. Assuming that there is no drop in demand for milk, and assuming that market mechanism will be in place to help supply that demand, then the levels GHGs produced per unit of milk will remain roughly the same, just in another location- most likely the mainland US. This would require milk and other dairy products to be shipped to the islands at a much higher carbon cost than if they were originally produced locally. While this analogy is anecdotal, stimulating local, climate smart production negates much of the need for carbon intensive storage and transport. Increasing local production may limit the islands' carbon footprint in the food cycle. This could be contingent on many things such as land use changes affected for that increased production, but by employing more agro-ecological production methods, the US Caribbean could increase local food production while simultaneously reducing their carbon footprint.

Initial outcomes

Important outcomes from the workshop included:

- Key knowledge and information sharing across organizational divides, including:
    - Strategies
    - Resources and tools
    - Common challenges
- Expanding the Caribbean Climate Hub's network of partner stakeholders to include additional:
    - Farmers
    - Extension personnel
    - University faculty
    - NGOs
    - Private agro-business
- Continuing to raise awareness of the Regional Hubs' network, mission, and capabilities
- Sharing and promoting the USDA's 10 building blocks of climate change mitigation,
- Gaining a better understanding of what skills, technology and information are needed to construct an effective array of applicable adaptation tools for the region, for example:
    - Incorporate more input from farmers
    - Building a platform for information sharing between various producers/organizations
    - Website for rapid assessments and summary of adaptive options available

Coming next

We will be compiling and synthesizing all the workshop comments and share those with participants. We will post all those talks that speakers would like to make public on the CCH website. We will also keep in contact as we develop new information to share, new ways of sharing information, and best mechanisms to help partners reduce risk related to climate change and implement mitigation and adaptation practices.

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