

Annex 3: Agriculture Sector Fact Sheet- Crop Diversification and New Varieties

Sector	Agriculture
Category	Land Management
Adaptation needs	Improve the resistance of plants to variety of stress that result from climate change. Reducing vulnerability to illness and enhance overall health due to additional nutritional content that new crop varieties provides. Enhance farmer resilience to climate variation which causes loss to crops due to shifts in rainfall. New varieties of crops are adapted to different weather conditions.
Technology Name	Crop Diversification and New Varieties
How this technology contributes to adaptation	Breeding new and improved crop varieties enhances the resistance of plants to a variety of stresses that could result from climate change. These potential stresses include water and heat stress, water salinity, water stress and the emergence of new pests. Varieties that are developed to resist these conditions will help to ensure that agricultural production can continue and even improve despite uncertainties about future impacts of climate change. Varieties with improved nutritional content can provide benefits for animals and humans alike, reducing vulnerability to illness and improving overall health. The aim of crop diversification is to increase crop portfolio so that farmers are not dependent on a single crop to generate their income. When farmers only cultivate one crop type they are exposed to high risks in the event of unforeseen climate events that could severely impact agricultural production, such as emergence of pests or drought. Introducing a greater range of varieties also leads to diversification of agricultural production which can increase natural biodiversity, strengthening the ability of the agro-ecosystem to respond to these stresses, reducing the risk of total crop failure and also providing producers with alternative means of generating income. With a diversified plot, the farmer increases his/her chances of dealing with the uncertainty and/or the changes created by climate change. This is because crops will respond to climate scenarios in different ways. Whereas the drought may affect one crop negatively, production in an alternative crop may increase.

Background/Notes, Short description of the technology option sourced from ClimateTechWiki, Seminars, etc	The introduction of new cultivated species and improved varieties of crop is a technology aimed at enhancing plant productivity, quality, health and nutritional value and/or building crop resilience to diseases, pest organisms and environmental stresses. Crop diversification refers to the addition of new crops or cropping systems to agricultural production on a particular farm taking into account the different returns from value-added crops with complementary marketing opportunities. Major driving forces for crop diversification include: • Increasing income on small farm holdings • Withstanding price fluctuation • Mitigating effects of increasing climate variability • Balancing food demand • Improving fodder for livestock animals • Conservation of natural resources • Minimizing environmental pollution • Reducing dependence on off-farm inputs • Depending on crop rotation, decreasing insect pests, diseases and weed problems • Increasing community food security. New and improved crop species can be introduced through two different processes: • Farmer experimentation with new varieties. Farmers have introduced new and improved species over centuries, mainly in regions that constitute world centers of cultivated crop diversification, such as Meso-America, the Andes, Africa and parts of Asia, in response to environmental stress conditions. There are many thousands of existing varieties of all of the important crops, with wide variation in their abilities to adapt to climatic conditions. Agricultural researchers and extension agents can help farmers identify new varieties that may be better adapted to changing climatic conditions, and facilitate farmers to compare these new varieties with those they already produce. In some cases farmers may participate in crossing select seeds from plant varieties that demonstrate the qualities they seek to propagate to develop new varieties with the characteristics they desire. • The introduction of new crop species to diversify the crop production systems needs to take into account the following inter-related categories: ○ Availability and quality of resources including irrigation, rainfall and soil fertility. ○ Access to technologies such as seed, fertilizer, water, marketing, storage and processing. ○ Household related factors covering food and fodder self-sufficiency requirement as well as investment capacity. ○ Price and market related factors including output and input prices
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Implementation assumptions, How the technology will be implemented and diffused across the subsector?	Plant breeding requires know-how and investment in terms of human and financial resources as well as time. There are already different varieties of crops suitable for different climate conditions, but Belize does not have the facilities to engage in this kind of research. The Belize Ministry of Natural Resources and Agriculture would have to select suitable varieties based on the projected climate conditions. The climate models project climate scenarios for Belize in which the average temperatures will have increased, while rainfall will have decreased and would be delivered more intensely over a shorter period of time. (Second National Communication, 2009). Before contemplating any introduction, a rigorous security assessment should be conducted. This involves compiling an inventory of varieties by crop, including varieties currently used by farmers, as well as new varieties not yet available to farmers for testing. It is important to get an overview of the strengths and weaknesses of current agricultural and seed systems and an in-depth understanding of the root causes of any current and potential stresses. Fundamentally, a decision to introduce new varieties needs to be founded on sufficient evidence that new varieties offer promising opportunities, and, equally, that their introduction will not expose farmers further to increased risk. The BAHA Biosafety Policy of 2009 provides the framework to protect the natural resources of Belize and the health of the residents from the adverse effects that may arise from the development and application of GMOs and its derived products by (i)Regulating, evaluating and monitoring the development and use of GMOs in Belize; (ii) Establishing criteria for assessing the risks associated with GMO use; (iii) Developing the capacity in Belize to effectively manage and mitigate such risks; (iv) Promoting the establishment of collaborative links with regional countries and institutions on biosafety; (v) Establishing mechanisms for assessing the benefits to be derived from GMO use; and (vi) Ensuring that public education, participation and consultation is critical in the implementation of this policy. It is important to monitor and evaluate (with farmer participation) the performance of new varieties, report results and recommend next steps and changes to improve processes. It is also important to provide detailed information on yields and production conditions. In 2013 the Grain Growers' Association tried to get permission to import GMO corn (The Organic Pepper, 2013) www.theorganicpepper.ca/trouble-in-paradise. Preliminary feasibility and market studies are recommended before crop diversification selection is implemented. In order to support farmer innovation, communities have to be linked to research programs and should have access to research products. Support for the decentralized selection by farmers of preferred varieties (as well as their production and marketing) should be seen as part of a wider set of interventions to decentralize service delivery to farmers. Opportunities for new and improved crop varieties arise where attractive native species can be developed for sale on national and international markets. By implementing market development strategies and integrating various
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Costs	Costs of farmer experimentation are generally low, but results may only have local applicability. Capital investment will relate to the purchase of new seed varieties (if not available ‘wild’ locally) and labor time. Where farmers are implementing a project initiated by an external agency, capital costs for training, technical experts, field staff, on farm trial equipment (an experimental plot may be established), and site visits may also be required. A five-year project involving around 1,000 farmers conducted in Mexico, had an estimated total costs of \$300,000 (Smale et al, 2003). Financial requirements of diversification revolve around the costs involved in researching the species to be planted and training in the management of diversified systems. Preliminary feasibility and market research need also to be considered in the financial requirements. Infrastructure (such as transport and storage) and marketing costs should also be considered.
Country social development priorities	<i>Horizon 2030- Part III: Growth and Sustainable Development Strategy 2014 – 2017</i> The Vision of Horizon 2030 is realized through a number of strategies, in this case “Economic resilience” derived from increasing agricultural production in a sustainable way and by increasing local values added through the development of agro-processing.

Country economic development priorities economic benefits	Food and Agriculture Policy 2002-2020 The process of farmer experimentation and the subsequent introduction of adapted and accepted varieties can potentially strengthen farmers' cropping systems by increasing yields, improving drought resilience, boosting resistance to pests and diseases and also by capturing new market opportunities. Crop diversification provides better conditions for food security and enables farmers to grow surplus products for sale at market and thus obtain increased income to meet other needs related to household well-being. Crop diversification can enable farmers to gain access to national and international markets with new products, food and medicinal plants. Diversifying from the monoculture of traditional staples can have important nutritional benefits for farmers in developing countries and can support a country to becoming more self-reliant in terms of food production. Diversification can also manage price risk, on the assumption that not all products will suffer low market prices at the same time. <i>The 2015 National Adaptation Strategy and Action Plan to address Climate Change</i> recognizes that Belize is very vulnerable to the adverse effects and the impacts of climate change and climate variability. The main export commodities, bananas, citrus, sugar and aquaculture, plus commodities accessing emerging markets and the local food crops are all vulnerable to the vagaries of the climate. Crop diversification is a means of building resilience against this vulnerability. Diversification of the Production Base and Food Security according to the <i>National Food & Agriculture Policy Framework 2002-2020</i> <i>The Agricultural Development Management and Operational Strategy</i> (ADMOS 2003) was a means to increasing the competitiveness of the agricultural commodity sector in order to reduce food insecurity and poverty, and promote dynamic processes of rural and agricultural development in Belize. The strategy was directed at facilitating the private sector to access value-added commodity opportunities through addressing
Country environmental development priorities --environmental	• Belize's National Environment Action Plan – 2015-2020 Conservation of natural resources, minimizing environmental pollution and depending on crop rotation, decreasing insect pests, diseases and weed problems.
Social benefits	Increase food security and balancing food demand. Generation of revenue.

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Other considerations and priorities (such as market potential)	Crop diversification can enable farmers to gain access to national and international markets with new products, food and medicinal plants. The climate change benefit is greater resilience and food security through cultivation of crops that are less susceptible to new climate conditions, hence securing the yields at acceptable levels. Crop diversification contributes to efficient land use, less tilling, thereby enhancing the function as a sink. Crop diversification is also an adaptation strategy because the new crops cultivated are selected to be suitable for the changed weather (rainfall and temperature) conditions.
Capital costs (per facility)	A five-year project involving around 1,000 farmers conducted in Mexico, had an estimated total costs of \$300,000 (Smale et al, 2003).Source: climatetecwiki.org
Operational and Maintenance costs (per facility)	Maintenance costs for farms can be low, but crop diversification requires higher than usual maintenance because of the different production periods of the crops. Treatment (fertilizer and weeding) has to be more careful. Estimated at 10 % of establishment cost. The establishment costs were those from Smale et al, 2003) climatetecwiki.org
Daily supply capacity per facility	This depends on the crops being cultivated. Production can be at subsistence levels or at commercial levels.
Up scaling potential	High. Farmers tend to use sections of their total farm land (10 to 20 %) leaving the balance to lie fallow for a few years. The section under cultivation can be increased easily depending on market projections.