All GM products are tested to see if they could trigger allergies or contain other substances that could possibly be dangerous to human and animal health. To date, no negative effects on human health have been shown as a result of the consumption of such foods by the general population in the countries where they have been approved. Continuous application of safety assessments based on the Codex Alimentarius Commission (an organisation which forms part of FAO and WHO) principles and, where appropriate, adequate post-market monitoring, forms the basis for evaluating the safety of GM foods. After around 20 years of consumption by billions of livestock, pets and humans, there have been no cases of allergy, cancer or death, or indication that GMOs are of any health concern. Likewise, to date GM crops have not been shown to cause environmental problems that differ from conventional agriculture. However, this does not obviate the need for each new GM crop to be closely examined to determine if negative impacts on the environment could occur. Regulators take into consideration the likelihood of harm resulting from any out-crossing (the spreading of novel genes), changes to biodiversity, susceptibility to non-target organisms (insect, spiders and other animals), and gene transfer to microorganisms, amongst others during the risk assessment process.

HOW CAN MY COUNTRY TAKE ADVANTAGE?

Based on national priorities and needs, countries can decide whether or not to take full advantage of modern biotechnology. However, should they wish to use GMOs, they are required to have a functional biosafety legal framework and also sufficient trained personnel that can implement it. Currently, project countries in the Caribbean do not yet have fully functioning biosafety legal frameworks in place to oversee the production nor release of GMOs, nor their commercialisation for food and feed uses. At the regional level, research institutions throughout the Caribbean have recognised that the production of GM products could lead to an increase in yields, and reduced use of water in agriculture. These institutions have identified several local products (e.g. sugarcane, cotton, rice, coconut, cocoa, coffee, peppers, and spices) that could be improved using modern biotechnology. Institutions leading the way include: the University of the West Indies (UWI), the Caribbean Agriculture and Development Institution (CARDI), the Caribbean Industrial Research Institute (CARIRI) in Trinidad and Tobago, and the National Agriculture Research Institute (NARI) in Guyana.

The Caribbean region is not yet developing animal genetic engineering nor cloning of animals. Although there has been some research in Barbados on Blackbelly sheep, the region is far from having the capability to engage in specific animal biotechnology projects. However, experts in the region believe that an expansion of animal breeding using conventional and new embryo techniques as well as DNA techniques to characterise regional species would be a positive development.

ARE THERE ANY DRAWBACKS TO USING GMOs?

Currently, the USA is the region's main supplier of food and agricultural products. The majority of all maize, soya bean, cotton and rapeseed products imported from the USA are derived from GM crops. However, as recognised above, none of the Caribbean project countries have a fully functioning biosafety legal framework in place to oversee the production or release of GMO, and/or commercialisation for food and feed. Therefore there is no administrative procedure in place to authorise the importation of such products. Similarly, the European Union is CARIFORUM's second largest trading partner after the USA. Some of the main exports from the Caribbean region to the EU are bananas and sugar. Should the region start cultivating GM versions of these crops, and should they also wish to continue this trade with the EU, they will have to acquire a *priori* authorisation to export the products to the EU – which could be a lengthy, expensive, and possibly ultimately unsuccessful process.

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UWI

BENEFITS AND RISKS of Genetically Modified Organisms

BENEFITS

Genetically modified organisms (GMOs) are created with a desired characteristic to exploit, such as resistance to an insect pest or improvement to the ripening process, in order to better meet a market need. Currently, commercial GM crops are being cultivated which have abiotic stress tolerance (e.g. water efficient maize), improved growth/yield, disease resistance, herbicide tolerance, insect resistance, improved product quality and pollination control system.

Moreover, future commercial GM crops are expected to help to:

- Reduce food waste. A new GM apple that doesn't turn brown when sliced could help reduce food waste;
- Provide essential vitamins. Golden Rice, a GM rice that contains beta-carotene, could help fight vitamin A deficiency, especially when consumed by children and pregnant women.
- Reduce food allergies. GM peanuts with modified allergens could reduce the risk of peanut-allergy reactions.

The annual global area of GM crop cultivation has consistently increased over the past 20 years, with recent increases occurring in the developing world (54 % of the total global GM crop cultivation is now in countries of Africa, Asia and Latin America). It has been demonstrated that both industrial-scale and resource-poor farmers can benefit from these biotechnology products. GM crops have had a positive impact on farm income worldwide due to enhanced productivity and efficiency gains. In 2012, direct global farm income benefit was in the order of US$18 billion.

During the 17 years from 1996-2012, global farm incomes are reported to have increased by US$116.6 billion. Since 1996, farmers planting GM crops have reduced pesticide inputs in their fields by 8.8 % or over 500 million kg, which has led to an overall reduction in the environmental footprint of GM crops by 18.7 %. The largest environmental gain has been with herbicide-tolerant GM soya bean, where agricultural practices associated with their cultivation have resulted in a decrease of some 200 million kg in applied herbicides, as well as allowing "no till" farming practices which significantly reduce agricultural soil erosion and loss. Farmers planting insect-resistant GM maize and GM cotton have also experienced similar significant reductions in pesticide loads.

EXPERIENCES OF INDUSTRIALISED AGRICULTURE WITH GM CROPS

The USA is the country with the most experience with GM crops to date, where farmers cultivating herbicide-tolerant GM soya bean received an estimated cost saving of US$71.3/ha in 2012 (almost three times higher than earlier years of GM crop cultivation). The annual total national farm income benefit from herbicide-tolerant soya rose dramatically from US$5 million in 1996 to nearly US$6.1 billion in 2012; also farmers in the USA have reportedly saved around US$140 million from reduced pesticide use associated with GM maize. Overall, GM crops have been estimated to have enhanced farm income by US$53 billion in the period from 1996 to 2012.

In Canada, the major GM crop, herbicide-tolerant oilseed rape, has boosted total rapeseed production by 11 % and farmers cultivating GM oilseed rape earned US$446 million in 2012. Canada is estimated to have enhanced farm income by $4.9 billion from the cultivation of GM crops during the period of 1996 to 2012. Likewise, farmers in Australia cultivating insect-resistant GM cotton had significant cost savings of about US$186 - 270/ha despite the high seed cost.

EXPERIENCES OF FARMERS CULTIVATING GM CROPS IN DEVELOPING COUNTRIES

Since resource-poor farmers in developing countries have demonstrated the greatest area of GM crop cultivation of late, it is useful to consider whether they also receive tangible economic benefits from modern biotechnology. In India, cotton is one of the most important crops, accounting for 30 % of its agricultural Gross Domestic Product (GDP). However, due to the high incidence of pests, especially cotton bollworm, Indian farmers often lost up to 50 - 60 % of their crop. However, since the commercialisation of insect-resistant (Bt) GM cotton in 2002, cyclic infestations of cotton bollworm have been suppressed. In 2013, India ranked first in GM cotton production worldwide (producing 10.8 million ha). Between 1998 to 2013, Indian cotton yields increased by around 30 % and insecticide spraying reduced by around 40 %, with an accompanying increase of 88 % in on-farm profits.

In the Philippines, the Asiatic corn borer causes losses of up to 80 % of maize production. Prior to the commercialisation of insect-resistant GM maize, yields in the country averaged only 2.8 tonnes/ha. Bt maize was approved in the Philippines for commercial release in 2003 with an initial planting of more than 10,000 ha. Together with other GM maize varieties, the total cultivated area in 2013 was 795,000 ha (45,000 ha more than in 2012). Some of the benefits from cultivating Bt maize in the Philippines include: yield advantages of about 1.1 tonne/ha or a 30 % yield increase over conventional maize hybrids; reductions of pesticide costs by 56 %, and; an increase in net profitability during wet (4 - 7 %) and dry (3 - 9 %) seasons.

In China, rice is the most important crop with the highest level (28 %) of global production. Insect damage in rice yields is estimated to cost at least several billion of US dollars worldwide. In 2009, insect-resistant (Bt) rice was approved in China for food, feed and cultivation. Small and poor farm households that cultivated Bt rice benefited economically from higher crop yields and lower pesticide usage.

RISKS

In over 20 years of cultivating GM crops, the vast majority of scientific and economic research has shown significant and consistent positive contributions of GM crops. Of course, there have been a few research outcomes that have presented negative contributions of GM crops, but the majority of them have either had demonstrable errors or design faults, been difficult to repeat, or their conclusions were attributable to the practices associated with the GM crop and not directly to the GM crop itself. This is not to say that the cultivation of GM crops or the use of GMOs is risk-free, just that they present similar (or lower) levels and types of risks associated with the cultivation of non-GM crops or the use of non-GMOs. Moreover, it is important to state that all of the GM products that are authorised for commercial activity are the result of very long, expensive and thorough scientifically-based evaluations by several independent and governmental regulatory agencies. Thus, all of the GM products that can be encountered on a daily basis have been approved not only by regulatory agencies within any single country but usually also by others around the world. In addition, the health and safety of GM crops has been endorsed by such societies as the American Association for the Advancement of Science, the American Medical Association, the International Society of African Scientists, the Royal Society of Medicine (UK) and the World Health Organization (WHO), to name a few. A 2013 review analysing the safety of GM crops over the past 10 years demonstrated not only the large amount of studies that have been done on GM crops, but also the lack of detectable hazards directly connected to their use.

Extensive and continuous studies on GMOs are being conducted to ensure their ongoing safety for consumption. Current foods on the market made from GM crops have been considered as safe as their non-GM counterparts otherwise they would not have been authorised by regulators.