The Role of Biotechnology in Sustainable Agriculture

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Monsanto company has been active in developing technology for increasing maize production in the world. Aside from maize, Monsanto is also active in conducting research and developing technology for soybean, cotton, vegetables and herbicides. The company's headquarter is in Saint Louis, Missori, USA, employing 26,000 person and has activities in more than 500 locations around the world. With the net sale of around $13.7 billion in the fiscal year of 2012, Monsanto is a global company, with diverse in people, products and geographics.

As the world population has increased steadily, from 3.7 billion people in 1970 to 6.1 billion in 2000, and is expected to reach 9.3 billion people in 2050, meeting an anticipated demand for food is just one part of the challenge. Agriculture is certainly leading the central role in providing global food security, providing employment to the most part of the population and to facilitate their income growth, while at the same time, conserving ecosystem and anticipating climate changes in utilizing the available natural resources (Figure 1).

As a global company, Monsanto's commitment to sustainable agriculture is formulated in three integrated actions, namely : producing, conserving and improving lives (Figure 2). This actions have been implemented through (a) helping farmers to double the yield of maize, soybean, cotton and canola crops from 2000 to 2013, (b) decreasing resource use intensity by 33% in 2030 compared to 2000; (c) improving lives, including at least 5 million additional resource poor farmers by 2030.

Achieving the Yield Gains

Monsanto employs three pillars of technology to achieve the yield gains in agriculture, namely through conventional breeding, agronomics and biotechnolgy. Through plant breeding, scientist strategically breed plants to create new, more robust hybrid varieties which perform better in the fields. Agronomists use precision agriculture, plant density, better plant health assisted by plant protection (seed treatment, fungicide) and conserved tillage to make land more productive. The biotechnology research supplement plant breeding, to advance economic traits by adding beneficial genes to the plant varieties. Applying the three pillars in the fields, maize farmers select the best hybrids, learning best agronomic practices, sharing the

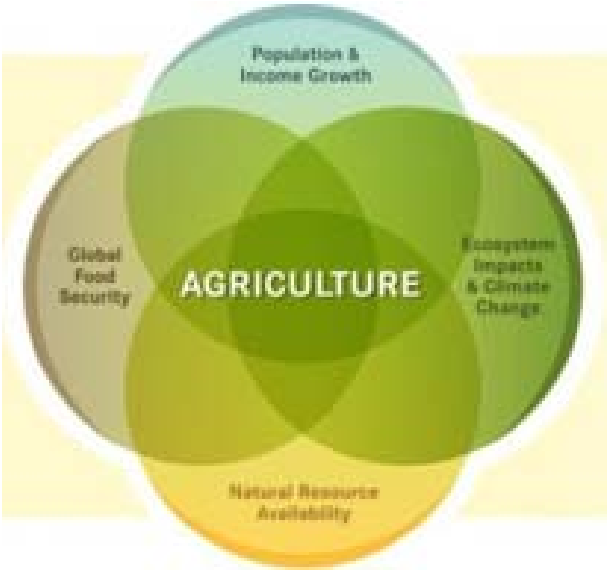

Figure 1. Sustainable Agricultural System to Provide Global Food Security, using the Available Natural resources.

Figure 2. Three actions to achieve sustainable agriculture.

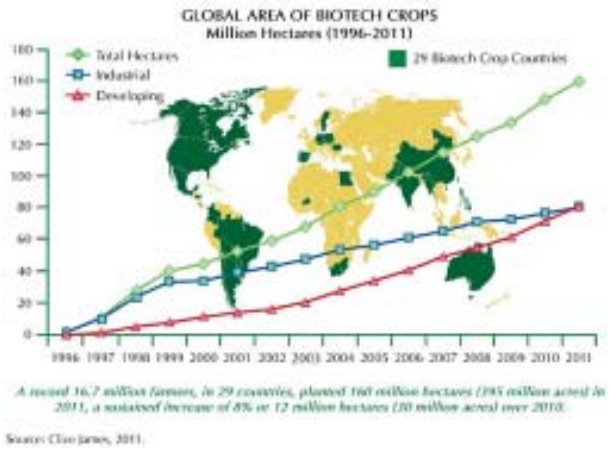

Figure 3. Global area of biotech crops.

technology from the expert, and sharing experience from the vegetable business.

The application of biotechnology in a form of the biotech-crops, the varieties developed through biotechnology have been grown in 29 countries, covering 160 million ha in 2011, involving 16.7 million farmers (Figure 3).

Countries which approved the cultivation of biotech crops and countries which approved import biotechnology crop produces are listed on Table 1.

What is in the pipe line of Biotech crop technology? The ultimate goal is for higher yield per ha with more efficient use of nitrogen, drought tolerance, and other beneficial traits (Figure 4).

By applying biotechnology, in the future, maize crop which presently utilities only 40% to 60% of the applied Nitrogen, may increase its efficiency, thereby reduces the amount of nitrogen fertilizer required. This in effect, reduces the N_2O gas derived from the N fertilizer and thus reduces more potent greenhouse gas N_2O. Increased N use efficiency by the maize crop also reduces the cost of maize production and at the same time reduces agriculture's overall impact on the environment. By inserting "drought gene", maize crop would have the drought tolerance character which provide protection against limited water resource.Maize crop containing the "drought gene" under drought stress in the field under the Nebraska (USA) field trial in 2007 was able to produce 94 bushel/acre (around 6 t/ha dry grain), as compared to an only 76 bushel/acre (around 4.9 t/ha) obtained from the regular hybrid.

South East Asian countries, including Indonesia, can drive a sustainable agriculture with biotechnology. As stated by the Australian Bureau of Agricultural and

Table 1. Countries approved biotech crops cultiviation and imports.

Cultivation	Import for food/feed
US	EU
Canada	Japan
Argentina	Australia/New Zealand
Brazil	Mexico
Colombia	Colombia
Egypt	Korea
Honduras	Taiwan
Mexico	China
Paraguay	Philippines
Uruguay	Sinagpore
Australia	Malaysia
India	Thailand
Philippines	Indonesia
South Africa	Russia
Burkina Baso	Switzerland
EU	India (oil only)
Bolivia	

Figure 4. Commercialized products and future products.

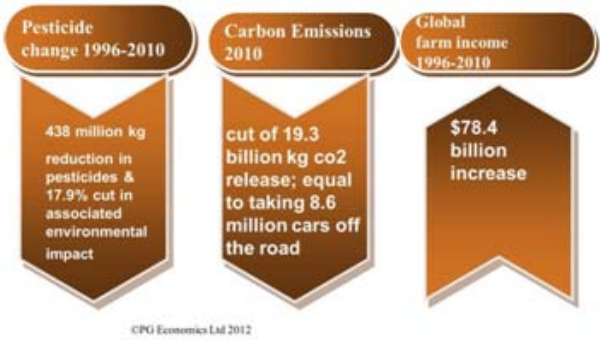

Figure 5. Key finding of the impact of the biotechnology cultivation.

Resource Economics (ABARE) in the Market Access Issues for GM Products (2007): "The report found that despite perception of consumer resistance and the range of market access conditions, GM-producing countries dominate world trade in maize, soybean, cotton seed and canola". Key findings of the impact of biotech crops cultivation could be summarized bellow (Figure 5).

Biotech-crop cultivation has reduced The use of pesticides, reduced greenhouse-gas, and increased farm income.