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Genetically Modified Organisms: Promising or Problematic for Food Security? A Review of Major Developments in Selected Industrialized Countries Part I

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Executive Summary

Building on decades of biochemistry research, bioengineers have successfully transferred genes across species to produce living organisms (plants and animals, including fish) with desired traits. Unlike traditional breeding practiced over 10,000 years, this process takes years not centuries from initial conception to field testing and commercialization. Given its precision and range of application, biotechnology has even been compared to 'playing God'.

Since the mid-1990s, major genetically modified crops, including alfalfa, corn (maize), soybeans, sugar beet, and cotton, have been commercialized in the United States. Data from 2018 shows that GMOs are grown throughout the world but primarily in the Americas, not much in Europe, and none at all in Russia. The highest GMO acreage in the USA is no accident. The legal and regulatory framework in the USA for food, agriculture, and the environment is supportive of GMOs, whereas the equivalent European Union framework

is not. In the U.S., the process of bioengineering itself is not regulated whereas it is in the EU. The EU adopts the precautionary principle (PP) in regulating GMOs, considering the scientific evidence on their impact to be uncertain. Indeed, in the EU, the cultivation and import of GMOs are subject to a law requiring prior authorization and the labelling and traceability system is mandatory. In the United States, mandatory labeling of GMOs will only start on 1 January 2022.

Both legal approaches have been criticized: the U.S. for being too pro-business; the EU for being too anti-innovation.

Perceptions of GMOs fall broadly into two opposing camps, although repeated surveys of consumers in both the U.S. and the EU show that the majority do not know much about GMOs. The pro-GMO camp sees in bioengineering the promise of agriculture that can improve food security including through higher yields, greater resistance to pests, more resilience to weather extremes like drought, and even better nutrition. They point to the fact that there has been no evidence of harm either to consumers or to the environment. The anti-GMO camp dismisses such support as biased, often without evidence for such bias. They assert that GMOs are bad for consumers, bad for biodiversity and bad for the environment. They see the control of bioengineered seeds by a handful of multinationals as a major threat to the livelihoods of millions of farmers, in particular smallholders, and the food security of nations dependent on these seeds.

Introduction

One would think that in a world still burdened with extensive poverty and hunger, bioengineering that can increase yields, among other things, would be welcomed by all. But it is not. Despite their tremendous promise, bioengineered crops, commonly referred to as genetically modified organisms (GMOs), biotech or GM products, are very controversial.

This is the first of two papers on major developments in the field of GMOs. The fundamental question these papers address is: do GMOs offer the promise of a more productive and sustainable agri-food system as its proponents say, or do they constitute a threat to food security by undermining consumer health, biodiversity, and the environment? Part I focusses on the situation in the industrialized world by looking at the United States and the European Union. Part II will focus on the situation in the developing world where agriculture still constitutes a major portion of the economy (around 10% of GDP or more), and where poverty is still extensive. The main question Part II will address is: given the situation in these major industrialized countries, and given the situation in their own countries with respect to agriculture, poverty, and hunger, what should developing countries consider as key in their adoption or non-adoption of GMOs?

Origins and Spread

Genetically altering plants to obtain desired traits started in the early twentieth century.[1] Biochemists Boyer and Cohen bioengineered the first organism (1973).[2] The Asilomar Conference (1975) on Recombinant DNA established guidelines for the safe conduct of biochemical research. Because of the many practical applications of DNA technology, funding for the research came more from the private than the public sector in the 1980s, thus expanding the U.S. biotechnology industry. Biochemists can transfer a specific gene from one plant of one species to another plant of another species to obtain a desired trait such as higher yield, greater insect and herbicide resistance, improved drought and heat tolerance, and better flavor, nutritional benefit and shelf life.

The precision of the bioengineering process makes it a powerful method of modifying plants (and other

1. Food and Drug Administration (FDA) of the United States government: A Timeline of key developments in GMO technology. https://www.fda.gov/media/135276/download
One can pinpoint the start of development of biotechnology to the nineteenth century, from Charles Darwin (1809-82) and Gregor Mendel (1822-84).

2.Herbert Boyer of the University of California at San Francisco and Stanley Cohen at Stanford University built on the work of Paul Berg in 1972; both winners of the 1980 Albert Lasker Award for Basic Medical Research.

living organisms) to acquire desired traits. It is more powerful than traditional breeding, which humanity has practiced for more than 10,000 years. As a result of such selective breeding over centuries, most of the plants and domesticated animals we have today bear little resemblance to their wild origins. To produce a GMO or GM product, once the gene transfer has been done in a laboratory environment, the plant must be cultivated in a greenhouse and then undergo field trials. The process of bringing a transgenic plant to market takes years, but the period is short compared to traditional breeding.

It was not until the mid 1990s however, that the first bioengineered crops were commercialized: herbicide-tolerant alfalfa, insect-resistant Bt[3] potato and Bt corn (maize), improved oil and herbicide-tolerant canola, herbicide-tolerant sugar beet, and glyphosate-tolerant[4] soybeans.[5] Fruits and vegetables include non-browning apples, pest-resistant sweet corn[6], reduced black spot-bruising potato, virus-resistant squash, Hawaiian papaya, and late ripening tomato. By 2015, more than 90% of major crops including corn, soybeans, canola, and cotton, produced in the U.S. were GMOs. GMO salmon was also approved in 2015. As of 2018, the United States is the country with the highest acreage under GMOs, some 75 million hectares (m ha), followed by Brazil at 51.3 m ha.

As is evident, GMOs are widespread among the major crops in the Americas, North and South, and in Asia, for cotton in India and China. They are minor in the EU, and totally absent (planting and importation) in Russia. The table in the Annex sets out the Global Area of Biotech Crops (2018) and the figure in the Annex sets out the Global Status of Commercial Biotech GM Crop (2018).

GMOs in the European Union

The limited spread of GMOs in the EU is largely a result of the regulatory regime. In the EU, only the transgenic maize MON810 has been currently authorized for cultivation (since 1998). The authorization to cultivate MON810 maize is currently being renewed[7]. Five GM maize varieties are also awaiting authorization for cultivation (1507, 59022, 1507 x59022, Bt11, and GA21 maize).

Between 2012 and 2018, the area cultivated with MON810 maize in the EU decreased from more than 129,000 hectares to approximately 111,845 hectares, a decrease of 11%. At the beginning of this period, five countries cultivated this transgenic maize: Spain, Portugal, Czech Republic, Slovakia, and Romania. Currently only Spain and Portugal continue to cultivate MON810 maize.

Evolution of the areas cultivated by MON810 transgenic maize in Europe (in hectares)

	2012	2013	2014	2015	2016	2017	2018	2019
Spain	116,306	136,962	131,538	107,749	129,081	124,227	115,246	107,127
Portugal	9,278	8,171	8,542	8,017	7,070	6,344	5,733	4,718
Czech Republic	3,050	2,560	1,754	997	75	0	0	0
Slovakia	189	100	411	104	112	0	0	0
Romania	217	835	771	2	0	0	0	0

Source: Inf'OGM, 2020

3. Bt is Bacillus Thuringensis, a common soil bacterium.

4. Glyphosate is a herbicide. Spraying glyphosate over soybeans to kill weeds does not harm the GM soybean.

5. It is interesting to note that although Monsanto developed a GM wheat (MON71800) in the early 2000s, and received approval from the Food and Drug Administration (FDA) for its use, it was never marketed.

6. Corn is a versatile crop used as cereal, vegetable, and even for alcohol.

7. European Commission. MON-00810-6. Under the authorization expiration dates, it indicates that "No expiration date as long as the renewal application is pending: MON 810 seeds for cultivation." http://ec.europa.eu/food/dyna/gm_register/gm_register_auth.cfm?pr_id=11

Between 2012 and 2014, the EU imported over 30 million tons of GM soybean (which represents about 85% of total soybean imported into the EU), between 0.5 million tons and 3 million tons of GM maize, and between 0.15 million tons and 0.60 million tons of GM corn gluten feed (European Commission, 2016). GMO imports are mainly intended to feed livestock. Other imported GMOs are used in the textile (cotton) or agro-fuel (rapeseed or corn) industries, or end up in human dishes (spreads, soups, etc.).

Key Features of the Legal and Regulatory Framework for GMOs in the United States

GMOs are regulated under the Coordinated Framework for Regulation of Biotechnology (1986). Three agencies operate within this framework:

1. The United States Department of Agriculture's Animal and Plant Health Inspection Service (APHIS) is responsible for transgenic plants. It regulates the planting, importation, and transport of GM plants;
2. The Environmental Protection Agency (EPA) is responsible for pesticidal plants and genetically engineered microbial pesticides. It regulates the manufacture, sale, and use of pesticides under the Federal Insecticide, Fungicide, and Rodenticide Act (FIRFA);
3. The Food and Drug Administration (FDA) is responsible for biotechnologically-derived food and medical products. It regulates the safety of all human and animal products (other than meat, poultry, and eggs), as well as drugs and biological products.

In 1980, the U.S. Supreme Court legalized the patenting of GE organisms (Plumer, 2015), but in 2013, it invalidated the patenting of human genes.[8]

The objectives of agriculture and food regulation in the U.S. are threefold: to protect the safety of food supplies, consumer health, and environmental sustainability. Regulation is based on risk assessment. The focus of the regulation is on the product rather than the process by which they are produced.[9] The USDA requires food manufacturers to use the labels 'bio-engineered' or 'Derived from Bioengineering' if their products contain bioengineered ingredients. The disclosure requirement was to take effect as of Jan. 1, 2020, although it will be mandatory only as of Jan. 1, 2022. However, the regulation does not apply to refined oils and sugar made from GMOs, the reasoning being that they do not contain detectable amounts of modified genes (Hogue, 2018).

It is noteworthy that as of March 2020, the United States had signed but not ratified the international treaty on biodiversity, which signals it does not want to be bound by the treaty. The Convention on Biological Diversity (commonly called Biological Convention or CBD) is a multilateral treaty with three goals: (i) the conservation of biological diversity; (ii) the sustainable use of its components; and (iii) fair and equitable sharing of the benefits arising from genetic resources. This treaty became effective on December 29, 1993. As of March 2020, it had been ratified by 196 parties, including 195 parties and the EU.

The U.S. also did not sign the Cartagena Protocol (2000). As of July 2020, 172 parties had ratified the treaty, including the EU.[10] The Cartagena Protocol seeks to enhance biosafety regulation and propagate the precautionary principle over the 'sound science principle' defended by the United States. In its simplest form, the precautionary principle states that "When an activity raises threats of harm to human health or the environment, precautionary measures must be taken even if some cause-and-effect relationships are not fully established scientifically".[11] This principle puts the burden of proof of safety on the proponent of the GMO, rather than on the authorities to demonstrate risk. Unsurprisingly, the pros and cons of the PP are hotly debated, as is what constitutes 'sound

8. NIH. U.S. National Library of Medicine. Medline. "Can genes be patented?" (Accessed oct 19, 2020) https://medlineplus.gov/genetics/understanding/testing/genepatents/#:~:text=The%20Supreme%20Court's%20decision%20invalidated,are%20not%20found%20in%20nature.

9. The National Research Council concluded that the "product of genetic modification and selection constitutes the primary basis for decisions and not the process by which the product was obtained". https://cdn.cfr.org/sites/default/files/book_pdf/The%20Regulation%20of%20GMOs%20in%20Europe%20and%20the%20United%20States.pdf

10. United Nations Decade of Biodiversity 2011-2020. 23 March, 2020. Press Release. https://www.cbd.int/doc/press/2020/pr-2020-03-23-meetings-en.pdf

11. National Center for Biotechnology Information. National Library of Medicine. "The Precautionary Principle" https://pubmed.ncbi.nlm.nih.gov/15968832/#:~:text=The%20Precautionary%20Principle%20in%20its,are%20not%20fully%20established%20scientifically%22.

science'. It has been pointed out that what is labelled 'sound' is not equated to scientifically rigorous and objective evidence. In fact, critics of GMOs point out that the term is typically used to defend ideological positions favoring private industry.

Key Features of EU Legislation on GMOs: The Precautionary Principle

In the EU, GMOs are strictly regulated, much more so than in the U.S. The texts governing the use and cultivation of GMOs on European soil are multiple and complex. EU legislation on GMOs regulates all GMO technology, from start of production and laboratory use to their voluntary introduction into the environment (field trials, cultivation and marketing). These texts also provide for post-marketing surveillance and monitoring of GMOs. Whenever there is scientific uncertainty with regards to impact of a technology, the precautionary principle applies. Thus: "Recourse to the precautionary principle presupposes that potentially dangerous effects … have been identified and that scientific evaluation does not allow the risk to be determined with sufficient certainty" (European Commission, 2017). In addition, all GMOs are to be assessed on a case-by-case basis.

The overall objectives are to: (i) Protect health and the environment; and (ii) Ensure the free movement of safe and healthy genetically modified products in the European Union.

The Directive 2001/18 (which replaced the first Directive 90/220) covers all major aspects of the deliberate release of genetically modified organisms into the environment. It requires an environmental assessment and it provides for a progressive authorization of the release of the GMOs. At the same time, it does not cover agri-food products derived from the processing of GMOs (Karky and Perry, 2019).

The risk assessment takes into account three elements:

- Modalities of development of the genetically modified plant or organism, including the source of the introduced genes and detailed molecular analysis.
- The risk associated with genetic products in the plant, mainly proteins.
- Examination of the possibility that the inserted gene could be transferred to bacteria. This is particularly important for the possibility of antibiotic resistance gene transfer.

The approval process: Approval for a new GMO to be introduced into the EU follows the authorization process dictated by Regulation 1829/2003. It has two distinct phases. The first phase is technical and consists of a rigorous safety assessment that covers the three elements mentioned above. Applicants may request authorization by submitting a regulatory dossier with experimental data to the European Food Safety Authority (EFSA), which then evaluates the safety for human and animal health and the environment. EFSA entrusts the dossier to its scientific committee composed of independent experts, who carry out the risk assessment according to the three criteria. The second phase is that of political decision-making. During this phase, the member states and the European Commission take into account EFSA's scientific report, along with other considerations (called other legitimate factors) to decide on authorizations for the marketing of products containing GMOs. Authorizations last for ten years (Europabio, 2011).

Labeling and traceability: Labeling and traceability requirements apply to all products if they contain more than 0.9% GMO per ingredient (the threshold is to be taken into account ingredient by ingredient). In 2010, it was estimated that only about thirty products were actually concerned by labeling, mainly imported products (notably from the United States). However, the labelling obligation includes important exclusions and does not concern, among others, food products from animals fed with GMOs (meat, milk, eggs) (European Commission, 2013).

Consumer Perceptions of GMOs in the United States

The American public has both positive and negative perceptions of GMOs. On the positive side, they believe that GMOs will increase the world food supply and contribute to more affordably priced food. On the negative side, GMOs will lead to problems for both the environment and human health (Pew Research, Dec. 2016).

By the 2010s, around 70%-80% of foods contained GMOs in the U.S. (according to the Grocery Manufacturers Association), from breakfast cereals to cooking oils

and corn chips. Yet consumer non-acceptance of GMOs seems to have increased over the last decade or so. Non-acceptance has increased from 15% (2007) to 46% (2018). This is despite the fact that 90% of the members of the American Association for the Advancement of Science (AAAS) believe GMO foods are safe to eat. Consumer concerns were primarily about the possible health impact (70%), followed by the desire for transparency (40%), and concern for the environment (34%) (Versolato, 2019).

The skepticism within the consumer group is mirrored by the split in attitudes even within the scientific community. Those who researched the safety of GMOs were evenly split between those who thought they were completely safe and those who asserted that each individual GMO should be subjected to rigorous epidemiological studies on the effects of GMO consumption (Wunderlich and Gatto, 2015).

Several surveys stretched over time however noted that most consumers knew little or were misinformed about GMOs. The importance of this finding was reinforced by the fact that it was similar to other surveys (e.g., 2012, 2013, 2014) of non-US consumers, including Japanese, Italian, Latvian, Polish, and Turkish). The main sources of information about GMOs for consumers are the media (internet, television, newspapers, and magazines), and relatives and friends. Scientific papers are not generally a source of information for consumers. However, it was the trust that consumers had in their sources of information, and the level of their own understanding of GMOs that were the important variables. Thus, consumers tended to trust scientific sources (though this trust was not 100%)[12] (Pew Research Center, 2016) more than other sources, which included advocacy groups, industry, and government. Furthermore, there is a positive correlation between higher levels of education and scientific literacy, and positive perceptions of the legitimacy of the bioengineering process and GMOs.

Consumer Perceptions of GMOs in the EU

Generally speaking, the EU public is much more anti-GMOs than the U.S. public. However, pro- and anti-perceptions seem to vary significantly by country. Perceptions are highly negative in France, Luxembourg, Greece, and Austria, but much more positive in the Netherlands, Belgium, Finland, and Sweden. According to successive surveys undertaken by Eurobarometer, anti-GMO perceptions first appeared in the late 1990s and early 2000s (Bonny, 2003). Though the EU is more anti-GMO than the U.S., there are similarities in public perception/preferences:

- Consumers did not know much about GMOs;
- Whether for or against GMOs, most consumers wanted to exercise choice guided by product labelling and transparency;
- As sources of information, there was much distrust of government, industry, and even of scientists although the latter were held in higher regard;
- Opinions became more radicalized once NGOs and environmentalist groups such as Greenpeace and Friends of the Earth publicized their staunch opposition to GMOs; and
- The enormous market power which a few multinationals hold, including through GMO patents, was considered excessive, an important manifestation of negative globalization.

It seems that anti-GMO voices were considered more legitimate sources of information than even the French Academy of Sciences and the French Academy of Medicine, which issued reports supporting GMOs (December 2002). Furthermore, although the majority of scientists working in molecular biology and plant breeding "express our support for the use of recombinant DNA as a potent tool for the achievement of a productive and sustainable agricultural system" (AgBioWorld, 2020), they either talked to too-small an audience of specialized journals, or their voices were largely drowned out by the clear anti-GMO messages ('GMOs are dangerous. We must ban them'). In fact, by 2020, 19 out of the 27 members of the EU had chosen to partially or completely ban GMOs (European Commission, 2020). However, a 2019 Eurobarometer survey indicated that the level of concern about GMO food in Europe has declined dramatically from 67% in 2010 to 27% in 2019 (EFSA, 2019). So, is the EU opposition to GMOs softening and if so, why? This surprising development should be monitored.

12. A minority (3 in 10) suspected the motives of research scientists, whose research findings they believed were influenced by industry.

Anti-GMO Camps Not Convinced by Positive Scientific Assessment

Since the Asilomar Conference of 1975, public concern about bioengineering has remained vocal. Over this 45-year period, the concerns have persisted, ranging from religious or philosophical to social, environmental, and health concerns. This wide range of controversies is in sharp contrast to the fact that the global scientific community still has not found any evidence that GMOs are more dangerous than traditional foods. This scientific consensus notwithstanding, the controversies seem to intensify between the two camps, with those who are pro-GMO and those who are anti finding no common ground.

The religious or philosophical argument objects to bioengineering 'playing God' because biochemists/bioengineers can rewrite the code of life itself, whether human, animal, or plant (Dabrock, 2009). Added to this concern about the inordinate power of biotechnology, is the great imbalance in market power of a few multinationals. As of 2018, the 'Big six' have consolidated into the 'Big four' which control more than 60% of the proprietary seed market (Hubbarb, 2019)[13]. For countries whose priority is food sovereignty, this concentration in the hands of a few foreign multinationals is a major concern. With so much market power and research capacity in a few private companies, the concern is that this will limit public research and bias evaluations from the scientific community.

For the anti-GMO camp, e.g. Greenpeace, Green America, GMOs are bad for the environment, bad for biodiversity, and bad for the health of consumers. GMOs are an important component of industrial agriculture which uses fertilizers, pesticides, and herbicides.

Industrial agriculture is unsustainable and should be replaced by regenerative agriculture, by which is meant agriculture that "allows actors across the current food system to use their skill, assets and determination to drive the transformation of a system which today is mostly geared towards efficiency and profit maximization for a few, to one that is driven by a goal to maximize access to nutrition for all, while also putting more back in to the environment and society than it takes out. Regenerative agricultural practices are already here, particularly in the United States"[14]. Glyphosate, most commonly used in the herbicide Roundup used on GMOs, has been found by the World Health Organization (WHO) to be a probable carcinogen. Declines in pollinator bees and monarch butterflies are attributed to the heavy use of these herbicides. Moreover, these chemicals pollute and poison the soil, waterways, and humans who come into contact with them. From this point of view, GMOs have no place in a sustainable agricultural system.[15]

In June 2016, 107 Nobel laureates signed an open letter urging Greenpeace to end its opposition to GMOs. The letter stated: "Scientific and regulatory agencies around the world have repeatedly and consistently found crops and foods improved through biotechnology to be as safe if not safer than those derived from any other method of production" (Achenbach, 2016). Greenpeace rejected the criticism. The response from another NGO, ETC Group was that this letter was more of "a propaganda tirade from transgenics companies than scientists presenting a position" (ETC Group, 2016). It is clear that the perceptions are black and white between the two GMO camps. There is no common ground between them.

13. The Big Four are: Bayer which merged with Monsanto; Corteva which is a merger between Dow and Dupont; ChemChina which merged with Syngenta, and BASF.

14. Forum for the Future. "Growing our Future: Scaling Regenerative Agriculture in the United States." https://www.forumforthefuture.org/scaling-regenerative-agriculture-in-the-us?gclid=CjOKCQjw8rT8BRCbARIsALWiOvQ2M9OrVi97Jv8hlhZ9IccHWYXaAnB2Gdr-BjV_SzYMELX6hrgqrRgaAuQ8EALw_wcB

15. Green America. "Genetic Engineering". https://greenamerica.org/gmo-inside

Conclusion

GMOs are here to stay, despite seemingly irreconcilable approaches between the two industrial powers (the U.S. and the EU); and substantial suspicion among consumers. There is no general consensus on the use and regulation of GMOs, even in developed countries. The approach adopted by the EU is said to be too restrictive, based on the precautionary principle, which limits the use and release of GMOs on European soil. On the other hand, the U.S. approach is said to be too business-like, promoting the profits of the industry. If GMOs are controversial in developed countries, what about developing countries? Do developing counties where agricultural transformation is still necessary need to decide whether to embrace or reject biotechnology or is there a third way? The decision is made more difficult since many developing countries also want to trade with the 27-member strong European Union and with the United States. For Africa for which agricultural transformation is critical, addressing this question as a continent on the eve of implementing the Africa Continental Free Trade Area (AfCFTA) is urgent if Africa does not want to become a patchwork of uncoordinated responses. For this could mean getting the worst of all possible worlds: not tapping into the promise, but suffering the alleged problems of this powerful biotechnology. Finding the best way to exploit the power of this modern technology while managing risks is an enormous challenge, as the experiences of both the U.S. and the EU clearly show.

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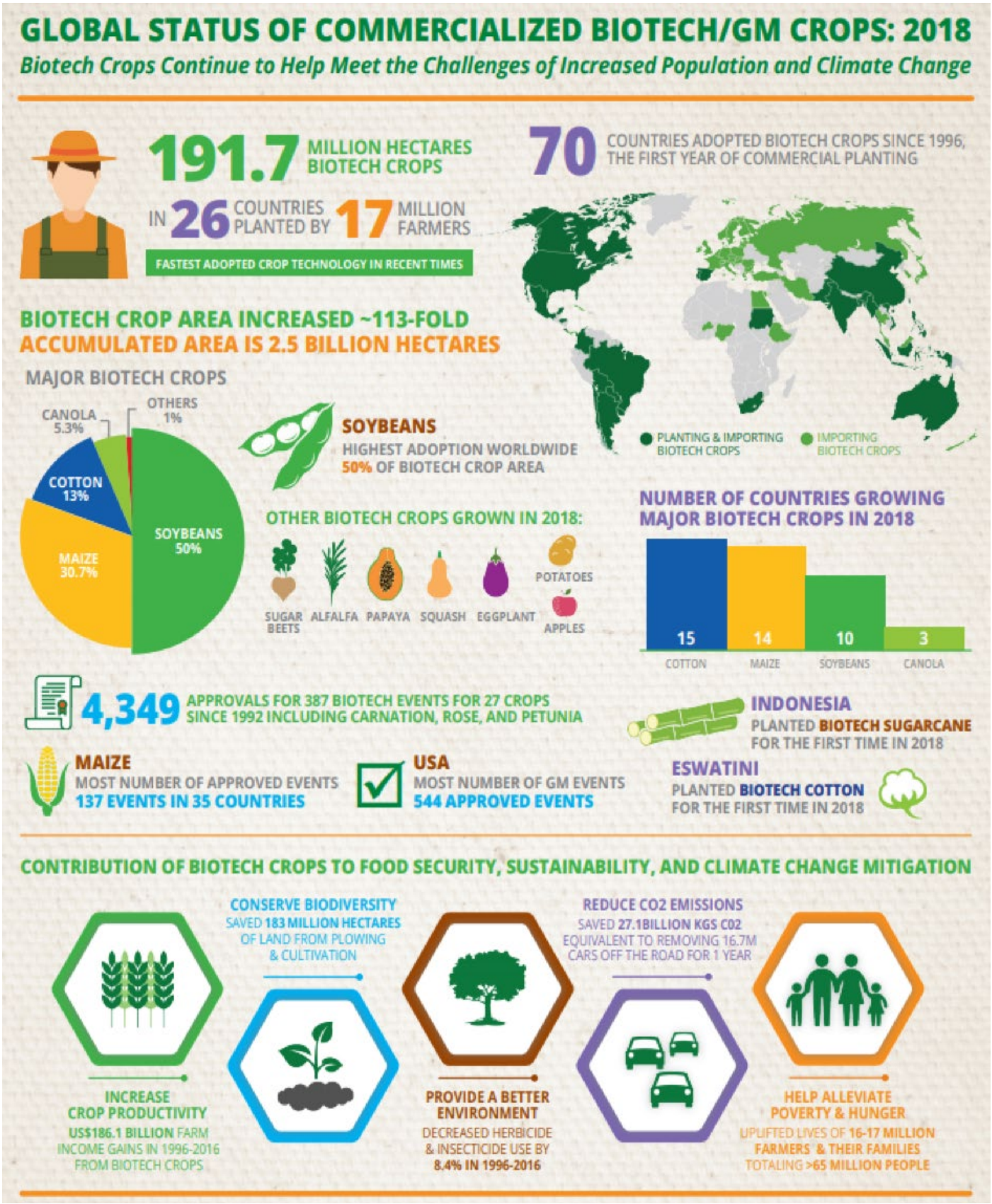
Annex Tab: Global Area of Biotech Crops in 2018: by Country (Million Hectares) **

rank	Country	Area (Million Hectares)	Biotech Crops
1	USA*	75.0	**Maize, soybeans, cotton, canola, sugar beets, alfalfa, papaya, squash, potatoes, apples**
2	Brazil*	51.3	**Soybeans, maize, cotton, sugarcane**
3	Argentina*	23.9	**Soybeans, maize, cotton**
4	Canada*	12.7	**Canola, maize, soybeans, sugar beets, alfalfa, potatoes**
5	India*	11.6	**Cotton**
6	Paraguay*	3.8	**Soybeans, maize, cotton**
7	China*	2.9	**Cotton, papaya**
8	Pakistan*	2.8	**Cotton**
9	South Africa*	2.7	**Maize, soybeans, cotton**
10	Uruguay*	1.3	**Soybeans, maize**
11	Bolivia*	1.3	**Soybeans**
12	Australia*	0.8	**Cotton, canola**
13	Philippines*	0.6	**Maize**
14	Myanmar*	0.3	**Cotton**
15	Sudan*	0.2	**Cotton**
16	Mexico*	0.2	**Cotton**
17	Spain*	0.1	**Maize**
18	Colombia*	0.1	**Cotton, maize**
19	Vietnam	<0.1	**Maize**
20	Honduras	<0.1	**Maize**
21	Chile	<0.1	**Maize, soybeans, canola**
22	Portugal	<0.1	**Maize**
23	Bangladesh	<0.1	**Brinjal/Eggplant**
24	Costa Rica	<0.1	**Cotton, soybeans**
25	Indonesia	<0.1	**Sugarcane**
26	Eswatini	<0.1	**Cotton**
	total	**191.7**	

*18 biotech mega-countries growing 50,000 hectares, or more, of biotech crops
**Rounded-off to the nearest hundred thousand.
Source: International Service for the Acquisition of Agri-Biotech Applications (ISAAA) 2018



Source: ISAAA, 2019

About the authors

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Isabelle Tsakok is an adjunct professor at SIPA and a Senior Fellow at the Policy Center for the New South, previously known as OCP Policy Center, who focuses on rural development, agricultural economics, policy analysis, food security and poverty reduction. She holds a PhD in Economics. Dr. Tsakok has worked on development issues for over twenty-five years, first as World Bank staff and since retirement as a consultant. She has specialized in policy analysis, program and project formulation and evaluation, research and training activities in agriculture, agro-business, rural development and poverty reduction. She has worked in most regions of the developing world: Africa, Asia - South, Southeast and East, North Africa and the Middle East and Latin America.

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Fatima Ezzahra Mengoub is an economist at the Policy Center for the News South. She specializes in agricultural economics and works on several issues related to agricultural growth analysis, economic structural change, inter and intra-regional agricultural trade, natural resource management and food security. She has published various articles on the role of agricultural investment, agricultural value chains, productivity and technological change in agriculture and water management. She has also taught macroeconomics and microeconomics at the Hassan II Institute of Agronomy and Veterinary Sciences (IAV) and the School of Governance and Economics (EGE). She holds an engineering degree in agricultural economics from the Hassan II Institute of Agronomy and Veterinary Sciences and is preparing a doctoral thesis on the impact of technological changes induced by irrigation on agricultural growth in Morocco.

About the Policy Center for the New South

The Policy Center for the New South: A public good for strengthening public policy. The Policy Center for the New South (PCNS) is a Moroccan think tank tasked with the mission of contributing to the improvement of international, economic and social public policies that challenge Morocco and Africa as integral parts of the Global South.

The PCNS advocates the concept of an open, responsible and proactive « new South »; a South that defines its own narratives, as well as the mental maps around the Mediterranean and South Atlantic basins, within the framework of an open relationship with the rest of the world. Through its work, the think tank aims to support the development of public policies in Africa and to give experts from the South a voice in the geopolitical developments that concern them. This positioning, based on dialogue and partnerships, consists in cultivating African expertise and excellence, capable of contributing to the diagnosis and solutions to African challenges.

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