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Report Highlights:

Singapore has no major import barriers on products containing GE ingredients or those derived from GE crops. In July 2016, Singapore's Genetic Modification Advisory Committee (GMAC) endorsed a document on stacked genes as a separate annex on the GMAC website (yet to be uploaded). The document was prepared by GMAC's "Subcommittee on Release of Agriculture-related GMOs."

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SECTION I. EXECUTIVE SUMMARY

Singapore imports 90 percent of its food supply. Malaysia, Indonesia, Australia, China, and the United States are key suppliers of agricultural products. U.S. exports of agricultural products to Singapore in 2015 were \$718.1 million, a decline of 13.28% from \$828.2 million in 2014. The fall may be attributed to several factors, including economic downturn, increased competition and severe High Pathogen Avian Influenza (HPAI) outbreaks in 2015. Leading categories included horticultural products, livestock / meats and dairy products.

Singapore's overall imports of GE material in bulk commodities continue to be negligible. The country does not import U.S. corn and only minimal amounts of soybeans. Thus, any imports of GE products would mostly be soy or corn based ingredients contained in further processed products.

Singapore does not produce any agricultural-related GE plants or animals. GE related activities concern confined laboratory research related to pharmaceuticals although in recent years there have been more applications and interest in innovative biotechnologies, such as CRISPR, etc.

The multi-agency Genetic Modification Advisory Committee (GMAC) was established under the country's Ministry of Trade and Industry in 1999 to oversee and provide science based advice on R&D, production, release, use and handling of GE matter. As an advisory committee, GMAC works closely with other national bodies/regulatory agencies, particularly Singapore's Agri-Food and Veterinary Authority (AVA) and Ministry of Health (MOH). GMAC formulated *Guidelines on the Release of Agriculture-Related GMOS* (1999) and *Biosafety Guidelines for Research on GMOs* (2006, revised in 2008 and January 2013).

However, as a non-regulatory committee, GMAC's guidelines are not legally binding. AVA gives final approvals. In 2016, GMAC endorsed the Stacked Gene document as a separate Annex on the GMAC website. The document was prepared by GMAC's "Subcommittee on Release of Agriculture-related GMOs."

Singapore focuses on promoting R&D in agro-technology via agro-technology parks. It wants become a regional hub for agricultural consultancy and for research on seed technology and agro-technology in tropical agriculture and aquaculture.

Singapore has also developed an agri-biotechnology park as a center of excellence in tropical agro-technology services. The activities include R&D in fish vaccines, food safety and animal/plant health testing, and post-harvest technology. However, the country's primary focus is still the biomedical industry, gene therapy, biologics and diagnostics.

Imported foods must be determined safe by the exporting countries' national regulatory bodies, and they must comply with international safety standards established by Codex Alimentarius.

SECTION II: PLANT AND ANIMAL BIOTECHNOLOGY

CHAPTER 1: PLANT BIOTECHNOLOGY

PART A: PRODUCTION AND TRADE

a) Product Development

b) Commercial Production

c) Exports: Singapore does not cultivate, produce, or export any GE crops.

d) Imports: Singapore imports hardly any GE agricultural products in bulk form. However, it does import a significant quantity of processed foods that contain ingredients (e.g., corn syrup and soybean oil) that were derived from GE grains.

e) Food Aid: Singapore does not need and does not receive humanitarian food aid.

f). Trade Barriers: In general, there are no barriers for imports of U.S. GE products, as long as they have been approved by U.S. federal agencies. Importers applying to import GE products must first prove that these GEs are considered safe for public consumption in their countries of origin before they are allowed entry into Singapore. Food producers must perform tests on the quality, allergenicity, toxicity, composition and nutritional values of food derived from GEs before these foods may enter. Foods containing new substances as a result of genetic modification must undergo additional tests.

PART B: POLICY

a) Regulatory Framework: GMAC published the *Guidelines for the Release of Agriculture-Related GE Products* in 1999 to ensure “the safe import, release and use in Singapore of agriculture-related organisms that have been genetically modified.” They provide a common framework to assess risks of agriculture-related GE products to human health and environment and approval mechanisms for their release.

Under the Guidelines, a proposal has to be submitted to GMAC; then to its Subcommittee on the Release of Agriculture-Related GE products that will review the application, including examining the GE’s origin, the experimental procedures used in development and the methods used to prove they are safe for consumption. Following recommendations of the Subcommittee, GMAC decides whether to endorse the application. GMAC’s decision is then forwarded to AVA, which determines final regulatory approval.

GMAC Committee and Subcommittees: The GMAC Main Committee is chaired by an official from the National Institute of Education (NIE), with members from 12 agencies, including AVA, National University of Singapore, Ministry of Health, Consumer Association of Singapore, Institute of Molecular and Cell Biology, Temasek Life Sciences Laboratory, and National Parks Board.

Please click [here](#) for the list of current members of the GMAC Main committee and for information on the Committee.

In addition to the main Committee, GMAC has four subcommittees as follows:

- Subcommittee for Release of Agriculture –Related GMOs: please click [here](#) for the details.
- Subcommittee for Research on GMOs: please click [here](#) for the details.
- Subcommittee for Labeling of GMOs: please click [here](#) for the details.
- Subcommittee for Public Awareness: please click [here](#) for the details.
- Please click [here](#) for a copy of the flowchart for evaluation, approval and registration of agricultural GE in Singapore. (Source: GMAC)

GE Regulatory system in Singapore

- GMAC Guidelines
 - Please click [here](#) for a copy of the Singapore Biosafety Guidelines for Research on GMOs (revised January 2013). (Source: GMAC)
 - The Guidelines aim to ensure safe containment, handling and transport of GEs used in research; and a common framework for assessment/notification of research on GEs.
 - Please click [here](#) for a copy of the Singapore Guidelines on the Release of Agriculture-related Genetically Modified Organisms (GMOs). (Source: GMAC)
 - The Guidelines’ aim to ensure the safe import, release and use of agriculture – related organisms that have been genetically modified. GMAC refers to agriculture-related organisms as “animals (including fish and invertebrates), plants, micro-organisms and vaccines used in cultivation, farming, agronomy, husbandry and horticulture”.
- Regulatory Authority for Food
 - Importation and sale of food, including GE Foods: for the application of import of GE foods, a proposal needs to be submitted to GMAC for it to evaluate their safety. After GMAC completes its evaluation, AVA takes into consideration GMAC’s recommendations and conducts further safety evaluations based on Codex’s *Guideline for the Conduct of Food Safety Assessment of Foods Derived from Recombinant-DNA Plants* – please click [here](#) for the details.
 - As a general policy on food safety reviews, Singapore regulatory bodies adopt the concept of “substantial equivalence” – i.e., if a new food or food component is found to be substantially equivalent to an existing food or food component, it can be treated to be as safe as the conventional food or food component.

b) Approvals: Please click [here](#) for the list of approved agricultural GE crops for use as food or food ingredients in Singapore (Source: AVA).

Latest approval updates: Singapore approved maize events MON87427 (HT) and 59122 (HT + IR) for food use.

c) Stacked or Pyramided Event Approvals: In July 2016, GMAC endorsed a document on stacked gene

that was prepared by the Subcommittee on Release of Agriculture-related GMOs and had agreed to include the stacked gene document as a separate Annex on GMAC website – at this time of writing, the document has not been uploaded due to some technical difficulties.

According to GMAC, the stacked gene document was prepared to address assessment requirements for stacked events; and simplifying the existing submission/review process.

d) Field Testing: AVA has approved JOil (S) Pte Ltd, a local company, for a small scale field trial for GE *Jatropha curcas* (Lines X8#34 and X8#291) with high seed oleic acid contents on Semakau Island, Singapore used for biofuel production. The GMO is not to be introduced (planted) in any other parts of Singapore's environment, and it is also not to be used for propagation in the country.

e) Innovative Biotechnologies: Singapore has been deliberating on regulatory and ethical issues arising from innovative biotechnologies that border between GE technology and innovative biotechnology. Thus, regulators struggle to agree on a harmonized regulatory framework for emerging technologies. For example, there are differing views on process-based vs. product-based approach. There are also concerns on detection issues with products that are developed by innovative biotechnology in the absence of transgene/s.

f) Coexistence: Since Singapore grows no GE crops, and scarcely has any field production of conventional crops; it has no policy on coexistence.

g) Labeling: There is no specific legislation/guidelines on labeling of GE foods. GMAC subcommittee on labeling was created to consider the issue of labeling of GE products. Labeling is receiving increased public attention and is becoming more contentious. However, in recognition that it is a complex issue with no internationally agreed upon threshold on GE material in food, Singapore has no plans to draft guidelines on labeling soon.

h) Monitoring and Testing: AVA monitors for presence of GE foods in the market, which includes taking samples and testing in AVA laboratories. AVA's laboratory can detect five specific types of GE events and can quantify GE content in certain food products.

i) Low Level Presence (LLP) Policy: Singapore does not have a threshold established or a policy per se, but has demonstrated sensitivity to instances of inadvertent release of unapproved events. LLP is connected to Singapore's policy on labeling. With no internationally agreed upon threshold on GE material in food, Singapore has no plans to draft guidelines on labeling soon.

j) Additional Regulatory Requirements: None at this time. Reportedly, authorities have been taking a considerably longer time to review proposals, conceivably, towards conducting environmental risk assessment of agriculture-related GEs.

k) Intellectual Property Rights (IPR): In Singapore, the onus is on importers to obtain patents for their GE products to ensure protection of their IPRs.

l) Cartagena Protocol Ratification: Singapore is not a party to the Cartagena Protocol on Biosafety.

m) International Treaties/Fora: Singapore is a member of Asia-Pacific Economic Cooperation (APEC),

Codex and one of the 12 countries negotiating the Trans Pacific Partnership (TPP). Biotechnology constitutes an important part of the overall discussion on food and agricultural matters in APEC. The country is also a member of the International Union for the Protection of New Varieties of Plants (UPOV).

n) Related Issues: Singapore has a multi-pronged strategy to promote food security, with research and development using modern agriculture technologies playing a key role. For example, the National Research Foundation recently awarded an \$8.2 million grant to a joint project between the National University of Singapore, the Temasek Life Sciences Laboratory and the International Rice Research Institute to address food security concerns, including the development of rice strains that can adapt to climate change. In addition, Economic Development Board (www.edb.gov.sg) encourages companies to establish centers for research, and several life science companies are working on crop varieties adapted for regional tropical growing conditions.

PART C: MARKETING

a) Public/Private Opinions: Complaints or cautionary letters in public forums have increased, and anti-GE food groups have become more vocal in recent years. Also, there has been more netizens calling for a more stringent rule on GE labeling. However, overall the opposition is still insignificant, and there is no major opposition to GE foods in Singapore.

GE Labeling

Singapore's position on GE labeling is in tandem with international trends and practices. This includes not making it mandatory to label GE foods. However, GE foods – also other food products - must meet existing food labeling requirements in regards to ingredient listing and information in order to facilitate tracing and recall. Companies can voluntarily label food as “GMO” or “non-GMO.” AVA's fundamental principle is that any labeling must be “practical, scientifically-driven and effectively implementable across countries”.

AVA and GMAC are expected to continue monitoring international developments closely; and Singapore is also working with the Codex Committee on Food Labeling to develop acceptable guidelines on labelling of GE food.

b) Market Acceptance/Studies: No significant barriers exist for importing or marketing GE foods in Singapore. In response to a public query on the safe consumption of GE food in Singapore, AVA stated in a 2012 letter that it wanted to assure the public that “all GM commercially available in Singapore have undergone safety assessments by both GMAC and AVA based on Codex's principles established by the Food and Agriculture Organization (FAO) and the World Health Organization (WHO)”.

CHAPTER 2: ANIMAL BIOTECHNOLOGY

PART D: PRODUCTION AND TRADE

a) Product Development: Singapore's animal biotechnology can be described as minimal at best and constitutes only R&D activities. One of AVA's technical and R&D centers is the Marine Aquaculture Center (MAC) located at St. John's Island. The MAC has undertaken several R&D activities to develop large-scale hatchery technology, including fish biotechnology and other upstream molecular applications – i.e., genetic selection to facilitate fish breeding, and development of fish vaccines and

diagnostic kits.

b) Commercial Production

c) Exports

d) Imports

e) Trade Barriers: There is no commercial production/exports/ or imports of GE animals or animal products in Singapore; so trade barriers are not applicable in this case.

PART E: POLICY

a) Regulatory Framework

b) Innovative Biotechnologies

c) Labeling and Traceability

d) Intellectual Property Rights (IPR)

e) International Treaties/for A,

f) Related Issues: There is no commercial production/export/or import of GE animal or animal products, and thus matters listed under “Part E: Policy” are not applicable.

PART F: MARKETING

a) Public/Private Opinions

b) Market Acceptance Studies: As there is no commercial production of animal biotechnology, public private opinions and market acceptance studies are not applicable in this case. Something remotely connected to animal biotechnology in Singapore is the FDA approved GE salmon (approved in 2015) that was created by Singapore’s Emeritus Professor Hew Choy Leong from the National University of Singapore.

However, there aren’t any known official studies on public reactions/opinions as it would probably take a few more years for the salmon to reach consumers’ plates. In addition, the developer of the GE salmon would have to apply for a safety assessment first before the product could be sold in Singapore.

END OF REPORT.