Socio-economic impacts of the cultivation of genetic modified(GM) crops in China

Insect resistant *Bacillus thuringiensis*(Bt) cotton has been commercially planted since 1997 in China, the cultivated area increased from 0.03 million hectares to 2.8 million hectares in the last 21 years. The adoption rate of genetic modified (GM) cotton was 95% in 2017. GM papaya resistant to papaya ringspot virus (PRSV) disease and insect-resistant poplar have been approved for commercial planting in 2006 and in 2005. In 2017, disease-resistant GM papaya was planted on 7,130 hectares at 86% adoption rate (ISAAA 2017). To date, some researches on socio-economic impacts of GM crops such as cotton, maize, soybean, rice, papaya and sugarcane have been carried out in China. Methodologies of socio-economic considerations may be different depending on whether GM crops have been commercialized or not.

Here are case studies for GM cotton and maize.

(1)The effects and impact dynamics of Bt insect-resistant cotton adoption in China were extensively analyzed by using six unique waves of panel data collected between 1999 and 2007. The study revealed that the benefits of Bt cotton continue 10 years after it has been commercialized, albeit with evidence of a decline in the benefit since the early adoption period. Importantly, it show that the benefit has been shared by both Bt

and non‐Bt cotton adopters (Qiao *et al*., 2016). A 15-year study from 1997 to 2012 further explained the sustainability of Bt crops in the long run. The results revealed that pesticide use against bollworms has not increased significantly over time, indicating that the buildup of pest resistance is not a concern at the moment due to the existence of natural refuge areas. There was no outbreak of secondary pests during Bt adoption, and that both Bt and non-Bt adopters benefit from the widespread adoption of the technology, suppressing the density of the pest population regionally. The benefit of Bt cotton adoption continues 15 years after its introduction, albeit with evidence of a decline in the comparative advantage over non-Bt cotton in late adoption since pesticide use categorized were for controlling bollworms and for controlling secondary pests(Qiao, 2015).

(2)To examine the potential economic impacts of China's insect-resistant GM maize, researcher uses data drawn from the production trials of insect-resistant GM maize and expert interviews to determine the impacts of commercializing GM maize at farm level under three scenarios with varying severity of insect pest attacks in maize production. Economic impacts are simulated using a modified Global Trade Analysis Project model. The research findings showed that in farm terms, insect-resistant GM maize increases crop yield and reduces both pesticide and

labor inputs. In national terms, China can increase its GDP by USD8.6 billion and maize self-sufficiency by about 2 percent given normal insect pest attacks if China commercializes GM maize. Additional beneficiaries include consumers and the livestock industry. Non-maize crops can also benefit from land saving through GM maize commercialization. Chemical is a sector with the decrease in its output because demand for pesticides will fall (Xie *et al*., 2017).

(3)One study was performed to assess the impact of GM crops on the health of Chinese farmers. Pesticides used by farmers were recorded and classified as glyphosate, non-glyphosate herbicides, chemical lepidopteran insecticides, biological lepidopteran insecticides, non-lepidopteran insecticides and fungicides. The multivariate regression results show that none of the examined 35 health indicators was associated with glyphosate use, while the use of non-glyphosate herbicides was likely to induce renal dysfunction and decrease of serum folic acid. The use of chemical lepidopteran insecticides might be associated with hepatic dysfunction, serum glucose elevation, inflammation and even severe nerve damage. In this context, if GM crops are adopted, the alterations in pesticide use may benefit farmer health in China and globe, which has positive implications for the development of GM crops(Zhang *et al*., 2016).

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