



WHY PAKISTAN MUST EMBRACE GENETICALLY MODIFIED CROPS

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The introduction of genetically modified (GM) crops represents a substantial advancement in agricultural methods, especially for nations like Pakistan where the agricultural sector is confronting many difficulties. Although high-yielding varieties (HYV) and chemical fertilizers helped the Green Revolution increase agricultural yields in the past, its shortcomings in terms of sustainability and environmental effects are coming to light. Genetically modified crops (GM) provide a viable substitute, with the possibility of increased yield, less dependency on chemical fertilizers, and enhanced resistance to environmental challenges. However, there are several obstacles to Pakistan's switch to genetically modified crops, such as inadequate infrastructure, negative public image, and regulatory barriers. This article explores the scope, potential, and challenges of transitioning from the Green Revolution to the Gene Revolution in Pakistan with the help of genetically modified crops.

AGRICULTURE IN PAKISTAN

Since gaining its independence in 1947, Pakistan's economy has been based primarily on agriculture. At first, the industry was defined by conventional farming practices that involved little use of technology. The 1960s saw the start of the Green Revolution, which resulted in large improvements in crop yields, especially for wheat and rice, with the use of chemical fertilizers, HYVs, and vast irrigation systems (PBC, 2023).

Because of these developments, Pakistan was able to become self-sufficient in food grains by the 1980s. However, there were drawbacks to the Green Revolution as well, like degraded soil, scarce water supplies, and a greater dependency on chemical inputs, all of which had long-term effects on the environment and the economy (FAO, 2023).

The growth and productivity of the agriculture sector have fluctuated during the past few decades. The industry grew by more than 4% annually on average between the 1970s and 2000. But after 2000, a number of issues including outmoded farming methods, wasteful water use, and a lack of funding for agricultural R&D caused this increase to drop to less than 3% yearly (World Bank, 2023). Pakistan's agriculture industry currently confronts several difficulties, such as low production, a lack of water, and climate change susceptibility. According to USAID (2023), the agriculture industry faces several challenges, including low investment in research and development (R&D), weak market linkages, and poor infrastructure.

NEED FOR GENETICALLY MODIFIED CROPS IN PAKISTAN

Several studies have demonstrated that traditional farming practices, which mostly rely on chemical

fertilizers and inefficient irrigation systems, are to blame for Pakistan's agricultural sector's yield growth plateau. Although these techniques were successful at first, they have threatened the nation's long-term food security by degrading the soil, reducing biodiversity, and decreasing agricultural yield returns.

The adoption of genetically modified crops offers a workable approach. Genetically modified crops have been modified to increase their resilience to environmental stressors, diseases, and pests. This has increased agricultural yield and decreased reliance on chemical inputs. Significant yield increases have been revealed by a meta-analysis of the effects of GM crops worldwide, especially in underdeveloped nations with comparable agricultural practices to Pakistan. For example, the introduction of BT cotton, into India produced better economic results for smallholder farmers by increasing cotton yields by 50% and reducing pesticide usage by 39% (Klümper & Qaim, 2014).

Success examples from nations like India and others imply that Pakistan stands to gain just as much from switching to genetically modified crops. This shift is necessary to advance the agricultural economy as well as to ensure food security. The overwhelming weight of data indicates that Pakistan must adopt GM agriculture to overcome the drawbacks of conventional farming and ensure long-term, sustainable agricultural growth (Khush, 2012; Qaim & Kouser, 2013).

WHY GENE REVOLUTION: THE GLOBAL EVIDENCE

With differing effects on food security, the introduction of genetically modified (GM) crops has greatly increased agricultural production worldwide. It is found that genetically modified crops, such as insect-resistant (IR) maize and herbicide-tolerant (HT) soybeans, have been linked to higher yields and lower pesticide usage. For instance, yields of HT soybeans increased by 12% in the US, whereas yield benefits of 5% to 25% were observed in South Africa with IR maize compared to traditional crops. By expanding the availability of crops, these advancements not only increase food security but also promote environmental sustainability by lowering the need for chemical inputs (James, 2022).

The financial gains from genetically modified crops are also noteworthy. Farmers throughout the world have witnessed significant increases in income, with smallholder farmers in poorer nations benefiting the most. In underdeveloped nations, the use of genetically

modified crops has increased revenue by \$100 per hectare on average; larger improvements have been seen in areas such as Sub-Saharan Africa, where agriculture plays a vital role in sustaining lives. By increasing rural people's purchasing power and reducing poverty, this economic growth contributes to increased food security in these areas (Brookes & Barfoot, 2022).

A decrease in the amount of land used for agriculture has also been connected to the widespread acceptance of GM crops. Genetically modified agriculture (GM) technology helps to preserve natural ecosystems and lessen deforestation by boosting crop yields, which allows more food to be produced on the same or even less territory. This component is essential for reducing the negative effects of agriculture on the ecosystem, especially in areas with abundant biodiversity. It is predicted that between 1996 and 2018, GM crops avoided the conversion of 23.6 million hectares of land to agricultural use. This represents a considerable contribution to worldwide environmental conservation efforts (Brookes & Barfoot, 2022).

POTENTIAL BENEFITS

The Gene Revolution in Pakistan has a lot of potential advantages. First, the productivity of agriculture can rise significantly as a result of GM crops. Comparing conventional kinds with genetically modified crops, like BT cotton, can result in yield increases of up to 30% (Ahmad et al., 2023). Pakistan can attain food security and lessen its reliance on food imports with the help of this productivity boost. Second, GM crops may lessen the need for chemical fertilizers and pesticides, which could result in cheaper production costs and less contamination of the environment. This is especially crucial for Pakistan, as overuse of agrochemicals has contaminated water and degraded soil (PBC, 2023).

Furthermore, Pakistan's agriculture may become more resilient to climate change if GM crops are adopted. Farmers can better adapt to the negative consequences of climate change by using crops that are bred for heat resistance, salinity tolerance, and drought tolerance. This will ensure steady harvests even in difficult situations. The gene revolution has the potential to alleviate public health problems and malnutrition by enhancing the nutritional value of crops. For example, vitamin A-enriched biofortified foods like Golden Rice can be quite helpful in preventing nutritional deficits (Ahmad et al., 2023).

HURDLES IN THE ADOPTION OF GM CROPS

Notwithstanding the Gene Revolution's exciting promise, several issues must be resolved for it to be successfully implemented in Pakistan. The legal structure controlling the use of genetically modified crops is one of the main obstacles. The biotechnology regulatory landscape in Pakistan is presently undeveloped, with convoluted clearance procedures and a lack of clarity about biosafety standards. The biotechnology industry may see a decline in investment and innovation as a result of this regulatory uncertainty (PBC, 2023).

Significant obstacles also lie in how the public views and accepts genetically modified crops. Farmers and customers alike are mostly ignorant of biotechnology, which contributes to their rejection and distrust of genetically modified crops. Strong public awareness campaigns and educational initiatives are needed to allay these worries by educating stakeholders about the advantages and security of genetically modified crops (Ahmad et al., 2023).

The requirement for large investments in R&D and infrastructure is another significant obstacle. The creation and marketing of genetically modified crops demand substantial financial and technological resources. To spur innovation and technological developments, Pakistan's existing expenditure in agricultural R&D is inadequate, and increased cooperation between universities, public research institutes, and private sector organizations is required (PBC, 2023). Furthermore, the successful distribution and commercialization of genetically modified agriculture is impeded by the absence of contemporary infrastructure, such as cold storage facilities and effective supply networks (NEPRA, 2023).

WAY FORWARD

We need to implement a number of well-considered steps in order to exploit the potential of GM crops. First and foremost, a comprehensive and encouraging regulatory environment for biotechnology must be created. This entails expediting the approval procedures for genetically modified crops, guaranteeing the implementation of biosafety protocols, and offering inducements to private enterprises to invest in biotechnology (PBC, 2023). Second, it's critical to raise public knowledge and educate the public about GM crops. To carry out awareness campaigns, workshops, and training programs for farmers and consumers, government

agencies, research institutions, and civil society organizations should cooperate together.

Another essential element of this shift is funding R&D. To create genetically modified crops that are suited to a given region, the government ought to enhance its financial support for agricultural research and form alliances with global research institutions. Furthermore, bolstering the capabilities of research establishments and cultivating cooperation among scientists, policymakers, and industry participants can stimulate innovation and guarantee the flourishing commercialization of genetically modified crops (PBC, 2023).

Enhancing the infrastructure is also necessary to encourage the use of genetically modified crops. This entails making investments in cutting-edge cold storage facilities, irrigation systems, and effective transportation networks to minimize post-harvest losses and guarantee the prompt delivery of agricultural products to markets. Moreover, facilitating the adoption of GM crops and raising agricultural production can be accomplished by establishing an environment that encourages private sector involvement in agriculture. Examples of such environments include lending availability and technical assistance.

Pakistan has a great potential to upgrade its agriculture industry and achieve sustainable growth as the Green Revolution gives way to the Gene Revolution. Pakistan can effectively tackle issues of poor productivity, environmental degradation, and climate change, while also guaranteeing food security and economic feat, by harnessing the potential of genetically modified crops. But in order to fully realize this potential, all parties involved, the government, academic institutions, commercial industry, and civil society must work together. Pakistan may effectively traverse this transition and reap the full benefits of the Gene Revolution with the help of encouraging legislation, more R&D investment, improved infrastructure, and higher public awareness.

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