



Smallholders in the Global Arena: The Socio-Economic Impact of Genetically Modified Organism
Crop Adoption in Indonesia and Beyond

Post-Monitoring Insights on Genetically Modified Organism Crop Adoption in Indonesia

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BACKGROUND

- After release and distribution, GM may still have potential impacts on the environment, human health, and animal health.
- Therefore, continuous post-release monitoring and control are required.
- Monitoring aims to ensure that GM are used in accordance with permits, the safety conditions already assessed, and applicable regulations.

OBJECTIVES OF POST-RELEASE MONITORING

- Detect adverse effects of genetically engineered products on the environment, human health, and animal health at an early stage.
- Ensure that GM seeds and products are distributed in accordance with release and distribution permits.
- Control the spread of transgenes and genetically engineered plants beyond designated areas.
- Take corrective action, including control measures or withdrawal of GM, if adverse effects are identified.

LEGAL FRAMEWORK

Regulation	Main Provisions
Government Regulation No. 21 of 2005	Regulates the biosafety of genetically engineered products (GM), including the monitoring and control of GM that are distributed and used in Indonesia.
Presidential Regulation No. 39 of 2010	Regulates the Biosafety Commission for Genetically Engineered Products (KKH PRG), including its role in impact monitoring, risk management, GM withdrawal, and oversight of GM utilization.
Minister of Agriculture Regulation No. 50 of 2020	Regulates the monitoring and control of agricultural GM crop varieties distributed within the territory of the Republic of Indonesia.
Minister of Agriculture Regulation No. 35 of 2023	Amends Minister of Agriculture Regulation No. 50 of 2020 regarding the monitoring and control of GM crop varieties.

What Regulation 50/2020 requires

3

consecutive years of routine
monitoring after release

- ✓ Run by an independent survey agency or a university
- ✓ Farmer questionnaires, scientific papers and agricultural environment data
- ✓ Focus on effects on livestock health and the environment
- ✓ Permit holder pays; adverse findings can lead to recall from circulation

GLOBAL SCALE OF ADOPTION

Global adoption: hundreds of millions of hectares

189.8

million hectares, 2017

Global planted area, up from
185.1 million ha in 2016.

53%

share of developing countries

Including India, Pakistan, Brazil,
Vietnam, and Bangladesh.

90%

**of adopting farmers are
smallholders**

About 13 of 14 million adopting
farmers in 2009.

Figures come from ISAAA, an organization that supports agricultural biotechnology. Read them as a picture of scale, not proof of impact.

AVERAGE EVIDENCE

A meta-analysis of 147 farm-level studies

–37%

chemical pesticide use

+22%

crop yields

+68%

farmer profits

These are averages: results vary across studies, gains are larger for insect-resistant traits than herbicide-tolerant ones, and larger in developing countries.

WHERE INDONESIA STANDS

GM crops are now in Indonesian fields. The question has shifted from approval to performance.

Three crops have been cleared for cultivation: sugarcane, potato and corn.

INDONESIA

Indonesia has long consumed imported GM products, but its farmers are only beginning to plant them.

A National Food Agency official said most tempeh and tofu are made from imported GM soybeans.

What global evidence says about smallholders

Carpenter review, 2013

In some countries, smaller farms gain more from GM crops than large farms do.

Carpenter review, 2013

Household income rose more among lower-income farmers in studies that measured it.

Systematic review, 2026

Effects vary widely by region and depend on regulation and access to technology.

INDONESIA

**We found no public
smallholder-level
monitoring results yet.**

ADOPTION FOOTPRINT

A small but real footprint

19

events cleared for cultivation by 2026: one sugarcane, one potato, seventeen corn

15,000 ha

of GM corn planted in the first season, 2022

1,600 ha

of GM sugarcane estimated by PTPN XI for 2021

242

events holding food, feed and environment safety certificates by 2026

Industry and USDA attaché estimates, not official area statistics.

Sources: USDA FAS GAIN 2023, 2024; AgBioInvestor 2023; PTPN XI via Wikipedia · 05

Three crops cleared for cultivation

Crop	Trait	Developers and status
Sugarcane (NXI-4T)	Drought tolerance (betaine gene)	PTPN XI, Univ. of Jember, Ajinomoto. First crop to clear every safety review, 2018
Corn	Herbicide tolerance (NK603, GA21); insect resistance (Bt11)	Bayer and Syngenta traits. Eight events cleared by 2023
Potato	Late blight resistance	Approved for release, July 2021

EARLY EVIDENCE

What early evidence shows

Peer-reviewed study

Sugarcane under drought

NXI-4T held steadier water content and less leaf rolling than other varieties under drought.

University trial

Herbicide-tolerant corn

GM lines showed no herbicide burn-down in a West Java trial and out-yielded conventional lines.

Company-reported

Farmer returns

30% higher yield in five-province trials, from output and input savings.

Industry-linked study

Non-target insects

Predatory mites kept thriving in Bt corn fields in Sumatra; two new species were described.

None of these is a Regulation 50/2020 monitoring report.

Indonesia: approvals exist, adoption is limited

Limited

GM sugarcane (NXI-4T)

Three drought-tolerant events cleared BPOM; only NXI-4T is in use, on PTPN XI land and nearby farms.

Released

GM maize

Eight biotech varieties released as of 2023; a demonstration harvest was held in Lamongan, East Java.

Discussed

Soybean and cotton

Government pushed GM soybean (2022). Bt cotton in the early 2000s is said to have fallen short.

Three-gate approval: KLHK (environment), Ministry of Agriculture (feed), and BPOM (food).

GM maize in East Java: early field claims

Demonstration harvest, Banyubang, Lamongan

15–20% higher yield (village head's claim)

Rp20–25 m average profit per hectare

10 / 200 ha GM maize out of the village's potential area

Read with care

Harvest event run by BPJPH with CropLife and farmer groups.

Figures from a village head

seed and input costs not itemized.

SYNTHESIS

Socio-economic impact: opportunities and risks

Opportunities

On average: pesticide -37%, yield +22%, profit +68%.

Spillover: non-Bt farmers also cut pesticide use (India).

Household consumption of Indian Bt cotton farmers rose 18%.

Risks

High seed prices and dependence on seed companies.

Uneven benefits: small farmers who intercrop.

Quality, market, and legal risk

Conditions for smallholders to share the gains

Affordable seed

Seed price oversight

Local varieties

Traits bred into locally adapted varieties

Market and quality

Test quality and market fit before wide adoption (Burkina Faso).

Independent evidence

Multi-site trials and impact studies by independent institutions.

Clear regulation

A clear approval path

Support services

Extension, credit, and post-harvest storage and drying.

CONCLUSION

Messages

- 1 Post-release monitoring is an essential component of genetically engineered product (GEP) governance to ensure environmental, human, and animal safety.
 - 2 On average, evidence shows benefits for smallholders, especially from insect-resistant traits.
 - 3 Benefits are not automatic: seed price, quality, markets, and regulation
 - 4 Indonesia is at an early stage: approvals exist, adoption is limited, independent local evidence is thin.
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THANK YOU



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