PQNK KNOWLEDGE PAPER

GMO Maize and the Question Pakistan Has Not Yet Asked

Before Engineering the Plant, Should We Restore the Biological System That Protects It?

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Abstract

Pakistan is considering the commercialisation of genetically modified maize while its emerging domestic hybrid-seed industry warns that pollen-mediated gene flow could compromise non-GM seed production and create difficult-to-reverse consequences. The concern deserves scientific examination. Maize is cross-pollinated, and the Business Recorder article correctly raises questions extending beyond the performance of an individual GM hybrid to seed sovereignty, coexistence and the long-term structure of Pakistan's maize industry.

PQNK, however, introduces a question that lies beneath the GMO-versus-non-GMO debate: **why are we modifying the plant before restoring the biological production system in which the plant evolved to function?**

This distinction becomes particularly important with Bt technology. *Bacillus thuringiensis* (Bt), from which insecticidal genes used in Bt crops originate, is not an invention of genetic engineering. It is a naturally occurring bacterium associated with soil and other environmental niches, and particular strains produce proteins active against particular insect groups. Genetic engineering takes selected genes encoding such insecticidal proteins and enables the crop itself to express them.

PQNK approaches the problem from the other direction. Rather than isolating one biological mechanism and transferring it into the plant, PQNK seeks to restore the **entire soil-plant biological system**: undisturbed soil architecture, roots, organic cover, bacteria, fungi, mycorrhizae, predators, parasitoids, pathogens and the wider food web.

The scientific proposition that follows is testable. Before Pakistan concludes that genetic modification is necessary to solve maize production problems, GM maize should be compared not only with conventionally managed non-GM maize, but with high-performing Pakistani hybrids grown under a fully restored PQNK biological production system.

1. Pakistan's GMO Debate Is Important, but Incomplete

The Business Recorder article raises a legitimate national concern. Pakistan has developed an increasingly productive hybrid-maize industry, while stakeholders fear that commercial GM maize could introduce transgenes into non-GM maize through pollen movement and thereby complicate preservation of non-GM seed stocks and breeding programmes.

The Government of Pakistan itself has not treated the matter as settled. In July 2026, the Prime Minister's Committee on Genetically Modified Corn began what the government describes as an objective, science-based and evidence-driven examination of the scientific, economic and policy evidence surrounding commercialisation.

That is the correct approach.

But the evidence base should include **production-system alternatives**, not merely competing seed technologies.

The current discussion effectively asks:

Should Pakistan grow GM maize or continue with non-GM hybrid maize?

PQNK adds a third possibility:

What happens when Pakistan's best maize genetics are grown in a biologically restored production ecosystem rather than an input-dependent degraded one?

Without that comparison, the country may be evaluating two types of seed while leaving the production environment itself unquestioned.

2. Bt Did Not Begin in a Biotechnology Laboratory

This point is fundamental.

Bt is biological before it is biotechnological.

Bacillus thuringiensis is a naturally occurring bacterium historically associated particularly with soil, although it also occurs in other environmental niches. The US Environmental Protection Agency describes Bt directly as a naturally occurring soil bacterium that produces proteins active against certain insects.

Different Bt strains can produce different insecticidal proteins with activity against particular insect groups. This biological characteristic eventually became commercially useful first through microbial Bt insecticides and later through genetic engineering.

In Bt maize, scientists do not introduce the whole bacterium or reconstruct the soil ecosystem inside the plant. Selected Bt genes are inserted so that plant tissues produce particular insecticidal proteins.

That is an extraordinary achievement of molecular biology.

But it is important to understand exactly what has been achieved:

science has extracted one function from a much larger biological world and installed that function in the crop.

PQNK asks why the larger biological world was lost in the first place.

3. PQNK Does Not "Add Bt." It Restores the Conditions for Biology

This distinction should be explicit because otherwise the PQNK argument can easily be misunderstood.

PQNK does **not** propose that farmers inoculate their fields with Bt and thereby reproduce Bt maize biologically.

Nor should we claim that simply adopting PQNK guarantees a particular concentration of Bt organisms or a predetermined level of control of every target pest. The ecology of naturally occurring Bt is considerably more complex. Research indicates that soil can serve as a reservoir, while multiplication and persistence depend upon ecological conditions and interactions with insects, organic substrates and other organisms.

The PQNK proposition is broader.

Industrial agriculture progressively alters the habitat in which biological regulation operates through combinations of:

tillage and soil disturbance; loss of organic cover; simplified crop ecosystems; disrupted root systems; chemical interventions; excessive or inappropriate irrigation; loss of soil architecture; and reduction of above- and below-ground biodiversity.

PQNK reverses these conditions.

Hardpan is broken so the upper and lower soil profile reconnect.

The soil is thereafter left undisturbed.

Flooding/inundation is stopped.

The surface remains permanently protected by organic material.

Living roots are maintained for as much of the year as possible.

Biodiversity is encouraged rather than systematically eliminated.

Water is managed to maintain a moist **and aerated** root zone.

Crop residues and roots are returned to the biological system.

The purpose is therefore not to restore one bacterium.

The purpose is to restore the habitat in which the entire biological community can function.

Bt belongs within that community.

So do countless other bacteria and fungi, entomopathogens, predatory insects, parasitoids, spiders, birds and other organisms involved directly or indirectly in regulating herbivorous insects.

This is why PQNK pest protection cannot scientifically be reduced to the statement:

"Bt bacteria control the pests."

The more accurate statement is:

Bt represents one component of a much larger ecological pest-regulation network that PQNK seeks to restore.

4. One Gene Versus an Ecosystem

This reveals the fundamental difference between the two approaches.

A Bt crop uses an extraordinarily precise piece of biological knowledge: a selected gene enables the crop to produce an insecticidal protein active against particular susceptible insects.

But that intervention remains **target-specific**.

The surrounding production system may still have compacted soil.

It may still contain hardpan.

It may still be tilled.

It may still be irrigated excessively.

It may still be exposed to extreme surface temperatures.

Its mycorrhizal networks may remain damaged.

Its predator populations may remain depleted.

Its soil organic matter may continue declining.

Its nutrient cycle may remain dependent on soluble fertiliser.

Its weed ecology may remain chemically managed.

The plant has acquired an additional defence mechanism.

The ecosystem has not necessarily been repaired.

PQNK works from the opposite direction.

Instead of asking:

How can we modify the maize plant so that it survives this production environment?

PQNK asks:

What is wrong with the production environment that requires us repeatedly to redesign the plant?

That is a fundamentally different scientific question.

5. Pest Outbreak Is an Ecological Signal

In a functioning ecosystem, insects are not absent.

Nor should pest management be scientifically described as an ecosystem in which nothing attacks a crop.

Herbivorous insects are part of the ecosystem.

So are the organisms that consume, infect, parasitise and compete with them.

The objective is therefore **regulation rather than extermination**.

When agricultural landscapes are biologically simplified, ecological checks can weaken. A large uniform population of genetically similar plants simultaneously provides an abundant food source. If predators, parasitoids and microbial antagonists are diminished while crop physiology is also altered by excessive nitrogen, water imbalance or other stresses, particular insect populations can escape normal ecological regulation.

Industrial agriculture commonly responds after this imbalance appears:

pest → pesticide → resistance → stronger/new pesticide → renewed resistance.

Genetic insect resistance can interrupt part of this sequence for target pests, sometimes very effectively.

But evolution continues.

Resistance to Bt traits is therefore not merely hypothetical. Resistance-management requirements exist precisely because sustained exposure to a particular insecticidal trait creates selection pressure.

PQNK seeks another level of defence:

ecological redundancy.

Instead of placing pest regulation predominantly upon one toxin, one gene or one chemical, biological control emerges from many interacting mechanisms.

If one relationship weakens, others remain.

That is how resilient natural ecosystems are organised.

6. The Scientific Error Would Be to Turn This Into an Anti-GMO Argument

PQNK does not need to deny biotechnology in order to question whether biotechnology is being applied to the correct problem.

Bt technology is genuine science.

Genetic engineering is genuine science.

Plant breeding is genuine science.

Soil microbiology is genuine science.

Ecology is also genuine science.

The error occurs when one level of science is evaluated while the system surrounding it is ignored.

The relevant equation is not:

GENETICS = YIELD

It is closer to:

GENETICS × SOIL × WATER × BIOLOGY × CLIMATE × MANAGEMENT = CROP PERFORMANCE

An excellent genotype cannot express its full potential in a dysfunctional environment.

Conversely, restoring the environment may reveal that some traits previously considered essential were compensating for management-induced problems.

That proposition should be tested rather than assumed.

7. The Question of Pakistan's Seed Sovereignty

The Business Recorder article introduces another issue that PQNK considers important: **dependency**.

The article's concern is that uncontrolled pollen movement from GM maize could affect non-GM maize and ultimately undermine Pakistan's developing domestic hybrid-seed sector.

This deserves formal biosafety and coexistence analysis rather than rhetoric from either side.

But PQNK broadens the definition of agricultural sovereignty.

A farmer is dependent not only when seed comes from elsewhere.

He is dependent whenever essential productive functions have been removed from his farm and converted into purchased inputs.

If fertility comes predominantly from bags, fertility has been externalised.

If pest regulation comes predominantly from bottles, pest protection has been externalised.

If soil structure requires repeated mechanical reconstruction, soil architecture has been externalised.

If increasingly specialised genetics are needed to tolerate the environment created by the production system, resilience itself becomes increasingly externalised.

PQNK seeks to bring these functions back inside the farm.

The farm itself becomes productive capital.

Living soil becomes the nutrient-processing system.

Organic cover becomes thermal protection.

Aggregated soil becomes water infrastructure.

Deep roots become nutrient and moisture exploration.

Biodiversity becomes part of pest regulation.

The farmer manages the system that produces the crop rather than purchasing an ever-growing collection of substitutes for lost ecosystem functions.

8. Pakistan Needs a Third Treatment in the GMO Trials

This is perhaps the most important recommendation of this Knowledge Paper.

Pakistan should not decide the maize question by comparing only:

Treatment A

Non-GM hybrid maize + conventional management

with

Treatment B

GM maize + conventional management

because both treatments leave one enormous variable unchanged:

the agricultural production system.

Add:

Treatment C

The same best-performing non-GM hybrid + complete PQNK management

The comparison should be replicated across Pakistan's principal maize environments and conducted for multiple seasons.

Measure:

- grain yield and yield stability;
- irrigation water applied;
- rainfall infiltration and soil water storage;
- root depth and rooting density;
- hardpan/penetration resistance;
- soil aggregation and porosity;
- soil temperature;
- soil organic carbon;
- microbial and fungal community indicators;
- naturally occurring Bt presence and dynamics;
- predator and parasitoid diversity;
- target and non-target insect populations;
- pesticide applications;
- fertiliser requirement;
- plant nutrient status;
- grain nutritional composition;

- mycotoxin incidence;
- seed cost;
- total production cost;
- gross margin and farmer profit.

And because Bt ecology is central to the hypothesis, Pakistan's universities should explicitly investigate **what happens to indigenous Bt populations and the wider pest-regulating microbiome as degraded conventionally managed soil transitions into PQNK management.**

That would convert an assertion into a measurable scientific question.

9. An Even Better Experiment

A rigorous study could go further and use a factorial design:

Genetics	Production system
Non-GM hybrid	Conventional
GM/Bt hybrid	Conventional
Non-GM hybrid	PQNK
GM/Bt hybrid	PQNK

This separates **genetic effects from management-system effects**.

Researchers could then determine whether:

GM provides an advantage irrespective of soil management;

PQNK provides an advantage irrespective of genetics;

the two interact;

or restoration of biological function substantially changes the apparent need for the engineered trait.

That is the experiment capable of informing national policy.

Not ideology.

Not industry claims.

Not anti-GMO claims.

Measurement.

10. Bt Is the Perfect Example of the Larger PQNK Argument

There is something revealing about humanity's relationship with *Bacillus thuringiensis*.

Nature evolved a bacterium capable of producing highly specific insecticidal proteins.

Humans discovered it.

We isolated it.

We identified its genes.

We learned how its proteins work.

We transferred selected genes into plants.

And we built a global agricultural technology around that discovery.

That is remarkable science.

But there is another scientific question waiting underneath it:

What else was operating alongside that bacterium in living soil that we have not yet understood?

Bt was never alone.

It existed within a biological network containing bacteria, fungi, protozoa, nematodes, arthropods, plants, insects and their predators and pathogens.

Modern biotechnology became extraordinarily skilled at studying the **component**.

PQNK asks agriculture to rediscover the **system**.

This is precisely the distinction raised repeatedly in PQNK between chemistry and biology. Chemistry does not disappear in biological soil. Neither does genetics.

Chemistry, genetics, physics and microbiology all continue operating.

The difference is **who manages the reactions**.

Industrial agriculture increasingly attempts to manage them externally.

PQNK restores the biological system that manages them internally.

11. A Necessary Scientific Qualification

One claim must be avoided because it would weaken rather than strengthen the PQNK case:

"Because Bt naturally exists in soil, restoring soil biology automatically gives a crop the same protection as a Bt transgenic plant."

Current science does **not** establish that.

Natural Bt occurrence, abundance, strain composition, Cry-protein expression, movement between ecological niches and interaction with target insects are complex. Research describes soil as an important reservoir but also notes important limits on vegetative multiplication and gaps in our understanding of Bt ecology.

PQNK makes a more substantial and scientifically testable proposition:

Restore the complete biological ecosystem first, measure the resulting pest regulation, and only then determine which technological interventions remain necessary.

That position can withstand scientific scrutiny.

12. The Decision Pakistan Should Make First

Pakistan does not presently need to answer the philosophical question:

Are GM crops good or bad?

That is too crude a question for a sophisticated agricultural system.

The immediate question is narrower and experimentally answerable:

Does Pakistan need genetically engineered maize to solve problems that may be substantially produced by the way maize is presently grown?

There is only one responsible way to find out.

Test it.

Put Pakistan's best conventional hybrid beside the proposed GM hybrid.

Then put that same conventional hybrid into soil whose biological architecture has been restored through PQNK.

Give each treatment equal scientific scrutiny.

Measure everything.

Follow it for several seasons.

Publish the complete results.

And allow the evidence to decide.

Conclusion: Before Engineering Life, Restore Life

The GMO maize debate presents Pakistan with an opportunity larger than a regulatory decision.

It gives the country an opportunity to reconsider what agricultural technology means.

For more than a century, agricultural development has progressively concentrated on what humans can **add to the field**:

better fertiliser,

better pesticide,

better machinery,

better seed,

better genes.

PQNK asks what may be the more important question:

What did we remove from the field that made all these additions necessary?

Bt provides the perfect illustration.

The bacterium came first.

The biological system came first.

The insect and its predators came first.

The soil food web came first.

The plant-microbe relationship came first.

Biotechnology discovered one mechanism within that extraordinary system and learned how to reproduce it inside a crop.

PQNK proposes that we now undertake the other half of the scientific journey:

restore the system from which the mechanism came.

Pakistan should therefore neither embrace GMO maize merely because it is advanced technology nor reject it merely because it is genetically engineered.

It should demand a more complete experiment.

Before changing the plant, restore the soil.
Before replacing biological functions, restore them.

Before deciding what technology agriculture needs, measure what a functioning agricultural ecosystem can already do.

That is not opposition to science.

That is the experiment science has not yet adequately performed.

Pedaver Knowledge Paper | PQNK — The Natural Ecosystem Science of Production Agriculture

Suggested classification: Soil · Biodiversity · Pest Ecology · Maize · Genetics · Production Systems · Agricultural Policy

Primary question answered: *If Bt originates in nature, should Pakistan first restore the soil biological system before deciding that Bt genetic engineering is necessary for maize?*

The Business Recorder article that prompted this paper is available here: GMO maize threat to Pakistan's emerging maize industry. The Government of Pakistan's description of its current evidence-based GM maize review is here: Prime Minister's Committee on Genetically Modified Corn.

Applying PQNK without understanding nature's operating system will not deliver abundance, stability, or nutrient density.

*PQNK (pronounced "picnic")—the regenerative & sustainable **Pristine Organic Farming System** —is grounded in **Natural Ecosystem Science**. This science employs perennial biodiversity, protects soil with organic mulch, and avoids practices such as water inundation, tillage disturbance, and leaving soil bare.*

*It is the **process** that matters most. PQNK is a pristine production system designed not merely for yield, but for optimal, balanced output—where quality, sustainability, and ecological harmony emerge from a self-regulated, zero-external-input methodology.*

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