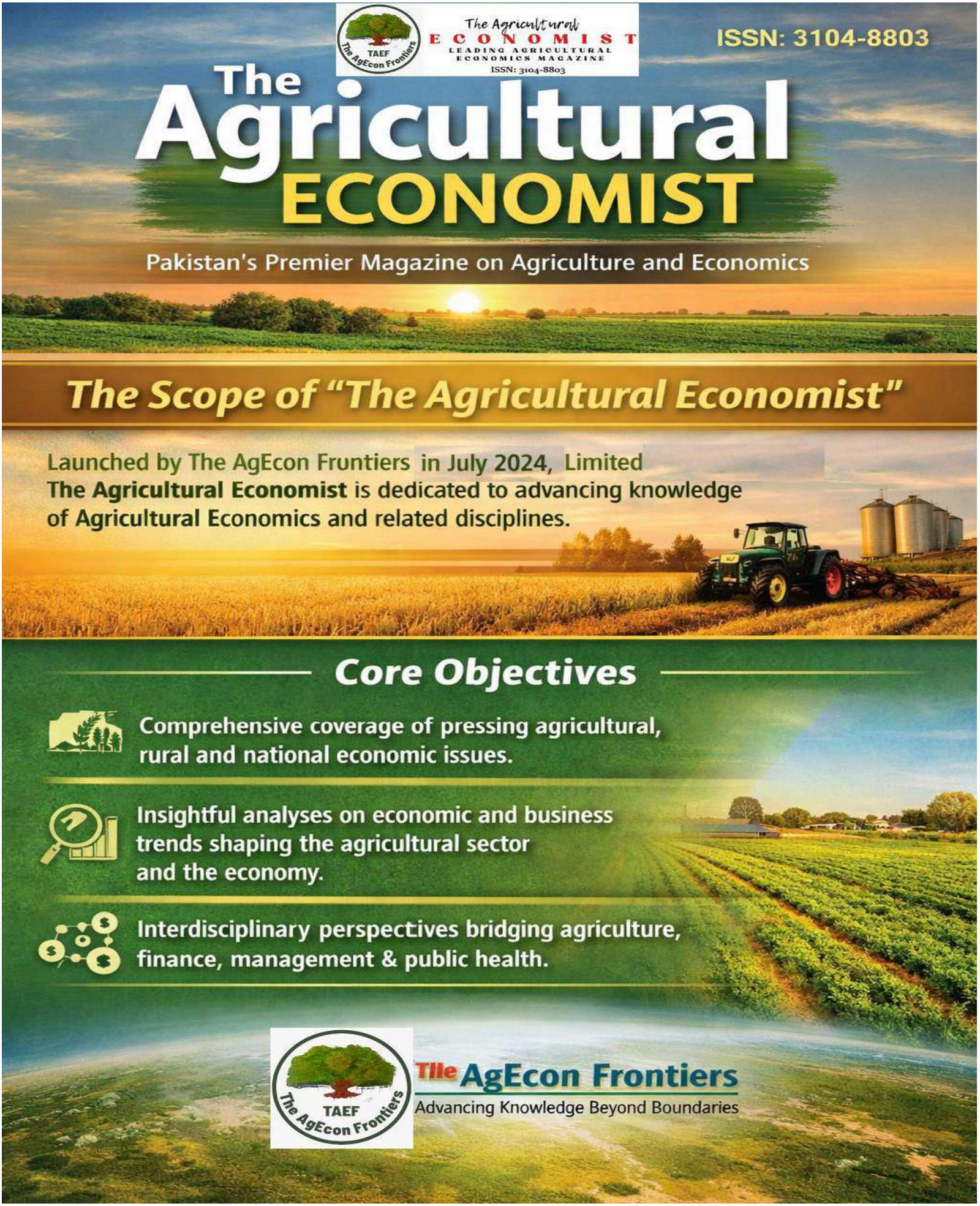
ISSN: 3104-8803



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ISSN: 3104-8803

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EDITORIAL

April Focus- Resilience in Agriculture: Navigating Modern Challenges

Explore how resilience in agriculture has evolved from seasonal variability to navigating complex challenges like climate change, global supply chains, and economic pressures. Learn about the importance of adaptation and sustainability in today's unpredictable environment.

Muhammad Khalid Bashir

4/1/2026

Resilience in agriculture has entered a new and far more complex phase. What was once understood as the ability to withstand seasonal variability has now evolved into the capacity to navigate systemic, overlapping, and often unpredictable shocks. Climate change is no longer a distant threat but a present and intensifying reality. Global supply chains remain vulnerable to geopolitical tensions, pandemics have reshaped labor and logistics systems, and economic pressures continue to squeeze both producers and consumers. In this environment, resilience is not merely about survival, it is about adaptation, transformation, and long-term sustainability.

For countries like Pakistan, where agriculture contributes significantly to GDP and employs a large share of the labor force, the stakes are particularly high. The sector is not only an economic engine but also the backbone of rural livelihoods and national food security. Yet it remains highly exposed to climate risks, resource constraints, and structural inefficiencies. Building resilience, therefore, is not an abstract goal, it is a national imperative.

This month's theme, "Cultivating Resilience: The Role of Innovation, Inclusion, and Sustainability" reflects the need to move beyond conventional approaches and adopt a more integrated and forward-looking framework. These three pillars are deeply interconnected, and progress in one area reinforces outcomes in the others.

Technology has emerged as a central driver of resilience in modern agriculture. The rapid advancement of digital tools, artificial intelligence, remote sensing, and biotechnology is transforming how agricultural systems operate. Farmers today have access to weather forecasts, soil data, and market information through mobile platforms, enabling more informed and timely decision-making. Precision agriculture techniques such as targeted irrigation, variable rate fertilization, and automated pest management are improving efficiency while reducing environmental impact.

In Pakistan, the gradual diffusion of digital agriculture is beginning to reshape traditional practices. Mobile-based advisory services, satellite-driven crop monitoring, and early warning systems for extreme weather events are helping farmers manage risks more effectively. However, the adoption of these technologies remains uneven. Smallholder farmers, who constitute the majority, often face barriers related to affordability, digital literacy, and access to infrastructure. Bridging this digital divide is essential if technology is to serve as a true equalizer rather than a source of further inequality.

At the same time, innovation must extend beyond tools to include institutional and financial mechanisms. Access to credit, crop insurance, and risk-sharing instruments can significantly enhance farmers' ability to invest in resilient practices. Blended finance models and public-private partnerships have the potential to mobilize resources on a scale, particularly for climate-smart agriculture initiatives. Without such support systems, even the most advanced technologies will struggle to achieve widespread impact.

Equity is the second pillar of resilience, and it is often the most overlooked. Agricultural systems cannot be resilient if large segments of the population are excluded from opportunities and resources. Smallholder farmers, women, and marginalized communities play a critical role in food production, yet they frequently operate under constraints that limit their productivity and adaptive capacity.

Women represent a substantial share of the agricultural workforce but continue to face barriers in land ownership, access to finance, and participation in decision-making processes. Addressing these disparities is not only a matter of social justice but also of economic efficiency. Evidence consistently shows that empowering women in agriculture leads to higher productivity, improved household nutrition, and greater resilience to shocks.

In Pakistan, strengthening rural institutions and promoting inclusive policies are key to unlocking this potential. Cooperative models, farmer organizations, and community-based initiatives can enhance bargaining power, facilitate access to markets, and promote knowledge sharing. At the same time, targeted interventions such as gender-sensitive extension services and inclusive financing schemes are necessary to ensure that benefits reach those who need them most.

Sustainability forms the third pillar and serves as the foundation upon which long-term resilience is built. The environmental challenges facing agriculture are profound. Soil degradation, water scarcity, biodiversity loss, and rising greenhouse gas emissions are threatening the very resources on which agriculture depends. Climate change is amplifying these pressures, with more frequent and severe droughts, floods, and heatwaves disrupting production systems.

Sustainable agricultural practices are therefore essential not only for environmental protection but also for economic viability. Regenerative agriculture, conservation tillage, crop diversification, and integrated water management are among the approaches that can enhance resilience while maintaining productivity. These practices improve soil health, increase water-use efficiency, and reduce vulnerability to climate shocks.

However, the transition to sustainability requires enabling conditions. Farmers must have access to knowledge, input, and markets that support sustainable practices. Policy frameworks should provide incentives such as subsidies for efficient irrigation systems or payments for ecosystem services that align economic and environmental objectives. Research institutions also play a critical role in developing locally adapted solutions that address specific agro-ecological conditions.

In Pakistan, the need for sustainable resource management is particularly urgent. Water scarcity is intensifying, with the country ranking among the most water-stressed in the world. The over-extraction of groundwater, inefficient irrigation practices, and declining water quality pose significant risks to agricultural productivity. Addressing these challenges requires a combination of technological innovation, policy reform, and behavioral change at the farm level.

Looking ahead, resilience must be embedded across all levels of the agricultural system. At the policy level, governments must prioritize investment in research and development, infrastructure, and climate adaptation strategies. Programs that support climate-resilient agriculture such as drought-resistant crop varieties, improved irrigation systems, and disaster risk management frameworks should be scaled up and integrated into national development plans.

The private sector also has a crucial role to play. Agribusinesses, technology firms, and financial institutions can drive innovation, expand market access, and provide the resources needed to scale solutions. By building inclusive value chains and investing in sustainable practices, businesses can contribute to a more resilient and equitable agricultural system.

Farmers themselves remain at the center of this transformation. Their knowledge, experience, and willingness to adapt are essential for the success of any resilience strategy. Supporting farmers through extension services, training programs, and access to information is critical for enabling informed decision-making and fostering innovation at the grassroots level.

At the same time, resilience must be understood as a dynamic process rather than a fixed outcome. Agricultural systems must be capable not only of absorbing shocks but also of adapting to changing conditions and, where necessary, transforming fundamentally. This requires a long-term perspective, continuous learning, and collaboration across sectors and stakeholders.

The challenges facing agriculture in 2026 are significant, but they are not insurmountable. With the right combination of technology, inclusive policies, and sustainable practices, it is possible to build systems that are not only resilient but also productive, equitable, and environmentally sound.

In this issue, we bring together insights from researchers, practitioners, and policymakers who are working at the forefront of agricultural resilience. Their experiences and perspectives highlight both the challenges and the opportunities that lie ahead. From digital innovations and climate-smart practices to community-driven initiatives, these examples demonstrate that resilience is not just a concept, it is a reality that can be achieved through collective effort and strategic action.

As we move forward, one message stands out clearly: resilience must be cultivated intentionally. It requires investment, coordination, and a shared commitment to building a better future for agriculture. The choices we make today will determine the capacity of our food systems to withstand tomorrow's challenges.

Warm regards,
Muhammad Khalid Bashir
Managing Editor

The Agricultural Economist, Vol. 3(4)
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SPOTLIGHT

War's Devastating Impact on the Environment

Explore how war not only causes political and humanitarian crises but also leads to significant ecological damage. Discover the lasting effects of conflict on climate systems, pollution, and ecosystems, highlighting the interconnectedness of our planet's environmental health.

Mithat Direk

4/10/2026

Earth is often described as the only known planet where life thrives, but what makes it extraordinary is not merely the presence of water or air, it is the astonishing balance of natural systems that sustain life. The planet operates like a finely tuned masterpiece, where temperature, atmosphere, oceans, and land interact in near-perfect harmony. At the Equator, where sunlight is most intense, glaciers still crown high mountains such as Mount Kilimanjaro, while in northern countries like Norway, warm ocean currents and atmospheric circulation make farming possible in regions that would otherwise remain locked in ice. This remarkable equilibrium of shape, gravity, oceans, and climate forms the geophysical foundation that scientist's study through Earth's geoid and climate systems, but for humanity it simply means one thing: a livable home.

Yet this balance is far more fragile than it appears. Over centuries, human activity has steadily disturbed the natural systems that regulate climate. Industrialization has filled the atmosphere with greenhouse gases, large-scale deforestation has weakened carbon absorption, and unplanned urbanization has altered local weather and hydrological cycles. Even infrastructure such as dams, while useful for irrigation and flood control, can reshape river ecosystems and regional climates.

One of the least discussed yet most destructive drivers of environmental instability is war. Armed conflict does not only devastate cities and human lives; it also leaves deep ecological scars. Bombings ignite fires, destroy forests, contaminate soil and water, release massive carbon emissions, and disrupt ecosystems for decades. Military machinery consumes enormous fossil fuels, while damaged infrastructure can trigger chemical leaks and long-term pollution. In this sense, every war is also an environmental disaster, silently wounding the planet long after the guns fall silent.

War, Human Ego, and the Ecological Collapse It Leaves Behind

At the root of most wars lies a deep human weakness: ego. Nations rarely admit it in such simple terms, yet beneath the language of security, sovereignty, or retaliation often sits the same ancient impulse, pride, rivalry, resentment, and the desire to dominate. From the earliest moral stories of humanity, such as Cain and Abel, conflict has often emerged not merely from scarcity but from wounded recognition and jealousy. In the modern world, this same unchecked ego no longer uses stones or fists; it commands missiles, drones, tanks, and industrial-scale destruction. The tragedy is that the battle humanity most urgently needs is the internal one against greed, arrogance, and short-term political ambition. Instead, that unresolved inner conflict is projected outward, and nature becomes one of war's silent victims.

When war erupts, the environmental consequences are immediate and long-lasting. Explosions do far more than destroy infrastructure and claim lives. They release toxic particulates, nitrogen oxides, sulfur compounds, heavy metals, and combustion residues into the air. These pollutants settle into soil, seep into groundwater, contaminate crops, and weaken biodiversity. Forests burn, agricultural land becomes barren, and rivers become carriers of chemical waste. Repeated bombardment also alters local heat dynamics, raises surface temperatures, and disrupts moisture cycles, contributing to irregular rainfall, dust storms, and localized climate instability. In regions already vulnerable to climate stress, conflict accelerates ecological tipping points. The result is visible in warmer winters, shifting seasonal calendars, declining snowfall, and erratic monsoon behavior that many communities are already experiencing.

A stark example is Gaza, where repeated bombardment over a highly compressed land area has created not only a humanitarian catastrophe but an ecological emergency. In such dense conflict zones, explosions inject enormous volumes of dust, smoke, toxic aerosols, and construction debris into the atmosphere. These emissions interact with cloud formation, reduce air quality, contaminate rainwater, and intensify urban heat conditions. Similar ecological degradation is evident across Ukraine, Yemen, Syria, and Sudan, where war has devastated cropland, forests, irrigation systems, and water reserves.

While fires, floods, and industrial disasters also damage ecosystems, war differs in one critical way: it is sustained destruction. Nature can often recover from a single shock, but repeated bombardment strips away its regenerative capacity. A burned forest may regrow, yet land scarred by explosives and toxic residues can remain ecologically impaired for generations.

Healing War-Torn Ecosystems

Preventing environmental destruction during war is one of the most difficult challenges of our time because conflict, by definition, tears apart both human systems and natural systems. Yet while it may be impossible to eliminate all ecological harm during armed conflict, it is possible to reduce long-term damage and improve recovery through wiser post-war principles. The first and most important principle is restraint after the fighting ends. Human institutions often rush toward visible reconstruction, roads, concrete walls, artificial landscaping, and rapid urban replacement, because of these signal political progress. But ecological recovery rarely follows the same timeline. Soil needs time to restore microbial life, water tables need time to cleanse themselves, and native vegetation must re-establish natural succession patterns. In many cases, the most scientifically sound intervention is controlled non-intervention: protecting damaged land from further disturbance and allowing native species, insects, birds, and soil organisms to regenerate naturally.

A second principle is cultural reconnection with the earth itself. Modern societies increasingly treat soil, mud, and wilderness as disorder rather than life-support systems. This mindset shapes how post-conflict spaces are "cleaned" and rebuilt, often replacing living landscapes

with sterile surfaces. Yet many traditional knowledge systems, from Anatolian wisdom and the teachings of Yunus Emre to Indigenous ecological ethics, understand that a single tree, wetland, or patch of fertile soil contains generations of life processes. Rebuilding must therefore include ecological literacy, native species restoration, and community education that treats land as a living partner rather than inert property.

The greatest misunderstanding, however, lies in how environmental war damage is measured. Conventional economics tries to assign a monetary cost to destroyed forests, poisoned rivers, or cratered farmland. But these figures capture only surface repair. They do not include the loss of microbial biodiversity, pollinator networks, groundwater filtration, carbon sequestration, seed banks, medicinal flora, or centuries-old soil formation processes. A bomb crater is not merely a hole in the ground; it is the destruction of an entire living ecosystem. Some losses may take decades to restore; others may be irreversible. In that sense, the environmental cost of war exceeds financial valuation because what is destroyed is not simply land, but the biological memory of place itself.

Shared Responsibility and the Irreversible Ecology of War

Environmental destruction caused by war can never be contained within political borders. Toxic smoke, chemical residues, particulate matter, and heavy metals released during conflict move through atmospheric currents, river systems, groundwater channels, and marine ecosystems without regard for national sovereignty. A bomb detonated in one territory may release pollutants that later fall as acidified rain in another country, settle in shared river basins, or enter fisheries far beyond the battlefield. This ecological interdependence means that the responsibility for post-war restoration cannot rest solely on the affected nation. Every neighboring state, and indeed the wider international community, has a direct stake in recovery because air, water, biodiversity corridors, and climate systems are inherently shared resources.

This is why regional cooperation is not simply desirable but ecologically necessary. Mountain ecosystems, monsoon systems, transboundary rivers, forests, and migratory wildlife routes connect nations far more deeply than diplomatic maps suggest. Yet the global governance architecture remains poorly designed for environmental peacebuilding. A major contradiction lies at its center: many of the same powerful states and industries that profit from arms sales are later positioned as donors for reconstruction and ecological rehabilitation. The global weapons economy generates concentrated financial gains, while the environmental costs, soil toxicity, forest loss, water contamination, and carbon emissions, are socialized across populations and future generations.

Can this damage be fully reversed? The scientifically honest answer is no. Ecological restoration can reduce harm, but some losses remain permanent or only partially recoverable over centuries. The legacy of the atomic bombings of atomic bombings of Hiroshima and Nagasaki demonstrated how radiation and thermal shock destroyed soil structure, vegetation, and microbial ecosystems for years, leaving long-lasting ecological scars.

The implications are even more alarming in places such as Gaza, historically linked to the Fertile Crescent, one of humanity's earliest agricultural zones. Repeated bombardment in such fertile landscapes destroys far more than buildings. It burns seed banks, sterilizes topsoil, disrupts pollinators, and eradicates plant life that underpins both food systems and carbon absorption. Because forests, croplands, and natural vegetation act as critical carbon sinks, their destruction releases stored carbon into the atmosphere and weakens the planet's ability to regulate temperature. In this sense, every war-driven forest fire or scorched field contributes directly to global warming, making extreme weather more likely far beyond the conflict zone itself.

Conclusion

War is not only a political or humanitarian catastrophe but also a profound ecological shock that disrupts the fragile equilibrium sustaining life on Earth. The planet's climate systems, atmospheric balance, oceans, and terrestrial ecosystems function as an interconnected web, and even small disturbances can trigger cascading effects. War represents one of the most intense and sustained forms of such disturbance, releasing toxic pollutants, accelerating deforestation, degrading soils, and destabilizing local and regional climate systems long after active conflict ends.

The deeper insight is that environmental destruction in war is not accidental, it is structural. It emerges from human systems driven by rivalry, power, and unchecked ambition, where ecological costs are rarely considered in strategic calculations. Yet the consequences are neither local nor temporary. Pollutants and carbon emissions travel across borders, ecosystems collapse beyond frontlines, and climate instability intensifies globally. In this sense, every conflict becomes a shared environmental burden carried by present and future generations.

While ecological recovery is possible, it is often incomplete and slow. Some landscapes may regenerate, but others, especially those subjected to repeated bombardment, chemical contamination, or soil sterilization, may never fully return to their original state. This makes prevention far more important than restoration.

Ultimately, the article argues for a fundamental shift in how humanity understands war: not only as a breakdown of peace, but as a breakdown of planetary stewardship. Protecting the environment must become part of post-conflict recovery, international cooperation, and even ethical constraints on warfare itself. A livable future depends on recognizing that the Earth's systems are shared, finite, and irreplaceable.

Please note that the views expressed in this article are of the author and do not necessarily reflect the views or policies of any organization.

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The Agricultural Economist, Vol. 3(4)
ISSN: 3104-8803

Fuel Crisis Impact on Agriculture in Pakistan

The fuel crisis of 2024–2026 has highlighted the critical link between agriculture and energy economics in Pakistan. Rising diesel costs threaten farmers' production and profitability, leading to ripple effect across entire food system.

Muhammad Umar

4/29/2026

Imagine waking up to find that the cost of filling your petrol tank has doubled within months. Now translate that shock into the daily reality of a farmer who depends on diesel to run tractors, tube wells, and transport produce to market. For millions of Pakistanis between 2024 and 2026, this is not hypothetical, it is an economic squeeze that has reached deep into the heart of agriculture. By early 2026, petrol prices surged to around PKR 458 per liter, while diesel, the backbone of farm operations, crossed PKR 520.

For agriculture, the consequences have been immediate and severe. Land preparation, irrigation, harvesting, and post-harvest transport all rely heavily on fuel. As diesel prices climbed, so did the cost of ploughing fields, pumping groundwater, and moving crops from rural farms to urban markets. For smallholders already operating on thin margins, this has translated into reduced profitability or even outright losses.

The ripple effects extend beyond the farm gate. Higher transport costs have increased food prices, contributing to food inflation and reducing affordability for consumers. Input costs have also risen, as fertilizers and seeds, many of which depend on energy-intensive production and logistics, have become more expensive. In some regions, farmers have responded by reducing cultivated areas, shifting to less input-intensive crops, or cutting back on irrigation, all of which threaten overall agricultural output.

While global oil price volatility and geopolitical tensions have played a role, domestic factors including currency depreciation and heavy fuel taxation have amplified the crisis. What emerges is a clear lesson: energy policy is agricultural policy. Without affordable and stable fuel, the entire food production system becomes vulnerable, placing both farmer livelihoods and national food security at risk.

When Fuel Prices Rise, Farms Pay the Price

To understand the severity of Pakistan's fuel crisis, one must examine the collision between global oil shocks and domestic economic fragility and nowhere is this collision more destructive than in agriculture. In early 2026, global crude oil prices surged toward $135 per barrel due to geopolitical tensions, particularly around the Strait of Hormuz, a critical artery for global oil supply. For Pakistan, an energy-import-dependent economy, this external shock was significant. However, the deeper damage came from internal vulnerabilities.

The Pakistani Rupee depreciated sharply, crossing PKR 310 per US dollar, amplifying the cost of imported fuel. At the same time, domestic taxation, especially the Petroleum Development Levy (PDL), which accounted for nearly 35% of petrol prices, further inflated fuel costs. This created a "double burden" for farmers: rising global prices compounded by domestic fiscal pressures.

Agriculture, which relies heavily on diesel, absorbed the shock immediately. Tube wells used for irrigation became significantly more expensive to operate, with costs rising by 35-40% within a year. For smallholder farmers, this translated into reduced irrigation frequency, directly affecting crop yields. Water-intensive crops like wheat and sugarcane suffered, while cotton production declined, threatening both food security and export revenues.

The impact extended across the agricultural value chain. Transporting inputs such as fertilizers and seeds became costlier, raising overall production expenses. Similarly, moving harvested crops to markets increased logistics costs, which were ultimately passed on to consumers in the form of higher food prices. This cost-push inflation disproportionately affected low-income households, tightening the link between energy prices and food insecurity.

In essence, what appears as a fuel crisis is an agricultural crisis in disguise. When diesel prices rise, the cost of food production rises with it, exposing the structural dependence of Pakistan's farming system on energy. Without targeted policy interventions such as fuel subsidies for agriculture or investment in energy-efficient irrigation the sector remains highly vulnerable to future shocks.

When Fuel Becomes a Burden on Farms and Families

By 2026, the debate over fuel prices in Pakistan had moved beyond economics into questions of fairness and governance. The term "unlawful" became common in public discourse, reflecting frustration with a pricing mechanism that appeared disconnected from global realities. When petrol prices jumped by 55 rupees per liter in a single week, far exceeding the proportional increase in international oil prices, many saw it not as a market adjustment but as a policy failure. At the center of this controversy was the Petroleum Development Levy (PDL), which significantly inflated retail prices and turned fuel from a necessity into a costly burden.

For the agricultural sector, this pricing structure had particularly damaging consequences. Farmers depend heavily on diesel for irrigation, land preparation, and harvesting. When fuel prices rise sharply due to taxes rather than purely global costs, production expenses increase without any corresponding improvement in productivity. This erodes farm profitability and discourages investment in agriculture. In effect, the tax system indirectly penalizes food production, raising concerns about long-term food security.

The broader economic and social impacts have been equally severe. Rising fuel costs have fueled inflation, disrupted supply chains, and triggered protests among transport workers and daily wage earners. For rural households, where incomes are already unstable, higher transport and input costs translate into reduced access to markets and essential goods. The uncertainty created by frequent price adjustments further undermines confidence, discouraging both private investment and long-term planning.

Ultimately, the issue is not just high fuel prices but how those prices are determined. A lack of transparency, combined with heavy taxation, has shifted the burden onto ordinary citizens and farmers alike. Without reforms that balance fiscal needs with economic sustainability, fuel pricing risks becoming a structural constraint on growth particularly in agriculture, where affordability of energy is directly tied to national food security.

Protecting Agriculture in a High-Fuel-Cost Economy

Pakistan cannot produce its own oil at scale, which means the solution to recurring fuel crises lies not in extraction but in structural reform especially to protect agriculture, the backbone of the rural economy. If the country is to avoid a repeat of the 2026 shock, policy responses must prioritize efficiency, transparency, and targeted support for farmers.

A critical first step is ensuring tax transparency in fuel pricing. The Petroleum Development Levy (PDL) should be capped as a fixed percentage, making prices predictable and easier to plan around. For farmers, this predictability is essential. Cropping decisions, irrigation schedules, and input purchases all depend on cost expectations. When fuel prices fluctuate unpredictably, farm planning becomes a gamble rather than a calculated decision.

Equally important is prioritizing fuel allocation. In times of scarcity, agriculture and public transport should take precedence over non-essential consumption. Targeted rationing mechanisms can help preserve foreign exchange while ensuring that tractors run, tube wells operate, and food supply chains remain intact.

Investment in domestic refining capacity is another strategic necessity. Reducing reliance on imported refined fuel can lower long-term costs, indirectly benefiting the agricultural sector by stabilizing diesel prices. However, immediate relief for farmers must come through targeted subsidies. Expanding digital platforms such as farmer support cards allows the government to deliver diesel subsidies directly to smallholders, ensuring efficient use of resources without broad fiscal leakage.

Finally, reducing agriculture's dependence on diesel is crucial. Promoting solar-powered irrigation systems and energy-efficient machinery can gradually insulate farmers from fuel price shocks. In parallel, strengthening rail and electric transport systems can lower logistics costs for moving agricultural goods.

The road ahead demands a shift from reactive crisis management to proactive resilience building. Protecting agriculture from fuel volatility is not just an economic necessity, it is fundamental to ensuring food security and rural stability in Pakistan.

Conclusion

The fuel crisis of 2024–2026 has made one reality unmistakably clear: agriculture in Pakistan is deeply intertwined with energy economics. What began as a surge in global oil prices quickly evolved into a domestic agricultural emergency, amplified by currency depreciation, heavy taxation, and structural inefficiencies. For farmers, rising diesel costs were not just an inconvenience, they were a direct threat to production, profitability, and survival.

The consequences have rippled across the entire food system. Reduced irrigation, shrinking cultivated areas, and rising input costs have constrained agricultural output, while higher transport expenses have driven food inflation, placing additional pressure on already vulnerable households. In this context, fuel pricing is no longer a standalone fiscal issue; it is a determinant of food security and rural stability.

However, the crisis also offers a pathway for reform. By improving transparency in fuel pricing, prioritizing energy access for agriculture, investing in domestic refining, and promoting renewable alternatives like solar irrigation, Pakistan can reduce its vulnerability to external shocks. Targeted subsidies and digital support mechanisms can further protect smallholders without overburdening public finances.

Ultimately, resilience lies in recognizing that sustainable agriculture requires stable and affordable energy. Without this alignment, economic shocks will continue to translate into food crises. The lesson is clear: safeguarding agriculture is not just about supporting farmers; it is about securing the nation's future.

Please note that the views expressed in this article are of the author and do not necessarily reflect the views or policies of any organization.

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The Agricultural Economist, Vol. 3(4)
ISSN: 3104-8803

POLICY BRIEFS

Gulf Conflict's Impact on Global Food Systems

The Gulf conflict highlights the intricate connection between geopolitics and modern food systems. Discover how missile exchanges and trade tensions influence food prices and supply chains, affecting everything from bread to transport costs.

Mithat Direk

4/3/2026

The world is once again holding its breath. As tensions intensify between the US-Israel alliance and Iran, the consequences are moving far beyond diplomacy and defense. For ordinary households, the most immediate risk may not be visible on the battlefield but at the grocery shelf. History repeatedly shows that wars may be fought with weapons, but their costs are often paid through higher prices for bread, rice, milk, and transport. The first and fastest transmission channel is oil. Since the escalation that began on February 28, 2026, energy markets have reacted sharply, with Brent crude surging above $110 per barrel and at points nearing $113, driven by fears surrounding the Strait of Hormuz, through which nearly one-fifth of global oil trade passes.

This matters because modern agriculture is deeply energy intensive. Diesel powers tractors, tube wells, harvesters, and transport trucks. Fertilizer production depends heavily on natural gas, while cold chains and food processing facilities require uninterrupted electricity and fuel. When oil spikes, the cost of every stage of the food value chain rises.

This is the classic cost-push inflation mechanism. Food prices increase not necessarily because there is less wheat or rice available, but because it becomes more expensive to produce, store, and move them from farm to consumer. Rising maritime insurance premiums, shipping delays, and rerouted vessels through safer corridors further amplify freight costs. The IMF has previously shown that higher global shipping costs quickly pass through into domestic consumer inflation, particularly food items.

For import-dependent countries such as Pakistan, Bangladesh, Egypt, and many Gulf food-importing states, the risks are even greater. Higher fuel prices weaken currencies, raise import bills, and place pressure on already fragile foreign exchange reserves. Wheat, edible oil, pulses, and fertilizer imports all become costlier in local currency terms.

The danger is that what begins as an oil shock can evolve into a broader food security crisis, especially for low-income households that already spend a large share of income on food. If the conflict prolongs, inflation may no longer remain a market issue, it could become a humanitarian one, where geopolitical instability in the Gulf translates directly into hunger, malnutrition, and deeper rural poverty across vulnerable nations.

The Fertilizer Bomb

Beyond oil, one of the most dangerous yet often overlooked consequences of conflict in the Gulf is the fertilizer shock that can quickly spread across global food systems. Every loaf of bread, every bowl of rice, and every basket of vegetables begins with healthy soil, and modern agriculture depends heavily on nitrogen-based fertilizers to maintain that productivity. The Gulf region plays a pivotal role in supplying these essential agricultural inputs to world markets, making it a silent backbone of global food security.

The risk becomes alarming when we consider that nearly one-third of global fertilizer exports move through the Strait of Hormuz. Any disruption, whether from military tensions, shipping delays, or a full blockade, would immediately tighten global supply and push fertilizer prices sharply upward. For import-dependent agricultural economies such as Türkiye, this creates a severe production shock. The country has already experienced an 8.8% contraction in its agricultural sector in recent years, largely driven by rising input costs and financial pressures on farmers.

Higher fertilizer prices force farmers to reduce application rates, delay planting, or shift to lower-input crops. The result is lower yields, weaker crop quality, and reduced overall food supply. These farm-level pressures eventually reach consumers through higher supermarket prices, intensifying food inflation and threatening household food affordability, particularly for low-income families.

How the World Economy Breaks

We are living in a deeply interconnected “just-in-time” global economy, where even a narrow maritime chokepoint can destabilize trade, prices, and growth across continents. The Gulf functions as the central roundabout of this system, and the Strait of Hormuz is its most fragile pressure point. Nearly 20% of the world’s oil supply moves through this single passage, making it one of the most economically sensitive waterways on earth.

If this route is blocked or even partially disrupted, the economic shock spreads instantly. Shipping costs are the first to surge as war-risk insurance premiums spike and freight companies reroute vessels over much longer distances. These detours add thousands of miles, delay deliveries, and tighten global supply chains. At the same time, Middle Eastern airspace can quickly become a no-fly zone, forcing major international carriers to suspend flights or alter routes. Airlines in Asia and Europe, including carriers such as Lufthansa and Cathay Pacific, have already faced fare hikes and route disruptions as fuel prices rise.

The final blow is inflation. Higher fuel, freight, and logistics costs feed directly into manufacturing, retail, and food distribution. UN Trade and Development warns that such energy shocks quickly raise living costs worldwide, with the burden ultimately

transferred to consumers through higher prices.

Türkiye's Tightrope Walk in a Fragile Global Food System

For Türkiye, the current Gulf crisis is not just a distant geopolitical confrontation, it is a direct economic threat to food prices, farm profitability, and household welfare. Türkiye remains an agricultural powerhouse, exporting globally competitive products such as hazelnuts, wheat flour, fruits, and processed foods. Yet beneath this strength lies a major structural weakness: deep dependence on imported energy, fuel, and petrochemical-based farm inputs. This dependence turns every external shock into domestic inflation.

Because agriculture relies heavily on diesel for irrigation, harvesting, cold storage, and transport, any disruption in Gulf oil flows immediately raises farmgate and retail prices. Even when Turkish wheat fields are productive, the cost of diesel, fertilizers, pesticides, and logistics can make food significantly more expensive for consumers. Recent empirical work on Türkiye confirms that diesel and fertilizer prices transmit strongly into wheat and other staple prices, amplifying inflationary pressures across the food chain.

This is why the warning from agricultural economists and sector leaders remains critical: self-sufficiency is not simply about producing crops, but about reducing structural dependence on imported energy and industrial inputs. If these weaknesses remain unresolved, even strong harvests cannot shield domestic markets from price shocks.

History offers an important comparison. Unlike the 1991 Gulf War, which was primarily an oil shock, the 2026 crisis is unfolding in a far more interconnected global system. Modern agrifood supply chains operate with extreme efficiency but limited redundancy, meaning even small regional disruptions can create disproportionate global effects. Recent research in *Frontiers in Sustainable Food Systems* highlights how geopolitical tensions trigger "asymmetric vulnerabilities," where localized disruptions spread rapidly through food, finance, fertilizer, and transport networks.

The global warning signs are already visible. FAO and UNCTAD note that disruptions in the Strait of Hormuz are now simultaneously affecting fuel, fertilizer, and food corridors, intensifying volatility in cereal and commodity prices. The bottom line is simple: instability in the Gulf translates into higher grocery bills in Türkiye. The most effective defense is resilience, strategic reserves, diversified suppliers, renewable energy in agriculture, and stronger support for local farmers.

Conclusion

The Gulf conflict reminds us that modern food systems are no longer shaped only by rainfall, soil, and harvest cycles; they are equally determined by geopolitics, trade corridors, and energy security. What begins as missile exchanges and naval tensions in a distant region can rapidly travel through oil markets, fertilizer supply chains, shipping routes, and insurance costs before finally appearing as higher prices for bread, milk, vegetables, and transport. The Strait of Hormuz has become more than a strategic chokepoint; it is a pressure valve for global food inflation.

For countries such as Türkiye and many developing import-dependent economies, the crisis exposes a deeper structural vulnerability: reliance on imported fuel, petrochemicals, and external logistics networks. Even productive domestic agriculture cannot fully protect consumers when the costs of irrigation, harvesting, storage, and transportation surge simultaneously. The lesson is clear: food security in the twenty-first century is inseparable from energy resilience and supply-chain diversification.

The most urgent policy response lies in building shock-resistant food systems through strategic reserves, renewable energy use in agriculture, diversified sourcing of inputs, and stronger support for local producers. In an interconnected world, peace in the Gulf is not only a diplomatic necessity, but also increasingly a prerequisite for affordable food, stable rural livelihoods, and social welfare across the globe.

Please note that the views expressed in this article are of the author and do not necessarily reflect the views or policies of any organization.

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Pakistan's Agricultural Tax Dilemma Explained

Explore the complexities of Pakistan's agricultural tax system and its impact on rural sustainability. Discover how taxation can affect small farmers facing high costs and climate challenges, and the need for a balanced approach.

Tarim Nayyab

4/7/2026

Imagine a farmer in rural Punjab beginning his day before sunrise, walking across dry fields that depend on costly inputs and uncertain weather. To prepare the land, he must purchase fertilizer, diesel, seeds, pesticides, and often rent or maintain a tractor. Each of these essential inputs already carries direct or indirect taxation through sales taxes, fuel levies, import duties on machinery parts, or embedded costs passed down through supply chains. By the time the crop is harvested, transported, and sold, the farmer has already paid multiple hidden taxes long before any formal income assessment begins.

Now shift the view to Islamabad. From the perspective of fiscal policymakers, agriculture contributes nearly 22% of GDP and absorbs around 40% of Pakistan's labor force, yet its

contribution to total tax revenues remains disproportionately low. This imbalance has become increasingly controversial as Pakistan faces recurring fiscal deficits, rising debt obligations, and pressure from international lenders to broaden the tax base. For institutions concerned with revenue reform, the argument is straightforward: a sector of such economic weight cannot remain largely outside meaningful taxation forever.

This creates Pakistan's central agricultural tax dilemma. Farmers, especially smallholders, argue that rising input costs, water shortages, climate shocks, and weak support prices already leave them with razor-thin margins. Additional taxation may push many into debt or discourage production altogether. The government, however, sees untapped fiscal space in a sector long shielded by political sensitivity.

The real issue is not whether agriculture should be taxed, but how taxation can distinguish between subsistence farmers and large commercial landowners. Poorly designed tax policy risks weakening food security, rural incomes, and investment in farm productivity. Smart agricultural taxation, by contrast, can improve equity, raise revenue, and protect the farmers who feed the country.

Agricultural Taxation in Pakistan: Why Design Matters More Than Rates

Agricultural taxation matters because taxes do far more than raise revenue, they shape incentives, investment decisions, and ultimately national food security. The basic economic principle is straightforward: taxes influence behavior. When farm-related taxes are predictable, moderate, and intelligently structured, farmers are more likely to invest in better seeds, efficient irrigation, mechanization, and soil improvement. This strengthens yields, raises rural incomes, and supports poverty reduction. But when taxes become excessive, unevenly enforced, or poorly targeted, they discourage investment, reduce productivity, and can even accelerate rural distress migration.

In Pakistan, taxation affects agriculture through multiple channels. There are direct taxes, such as Agricultural Income Tax (AIT) and land revenue, and indirect taxes embedded in fertilizers, pesticides, diesel, machinery, and spare parts. In addition, farmers face "hidden taxation" through weak procurement systems, delayed support prices, and policy distortions that suppress farm-gate returns. The cumulative burden often matters more than the headline tax rate.

The current system remains deeply fragmented. Agricultural Income Tax is a provincial subject, yet its collection remains strikingly low relative to the sector's economic size. Despite agriculture contributing around one-fifth of GDP, tax collection from this source remains only a small fraction of potential revenue due to exemptions, underreporting, and weak enforcement part, particularly among large commercial landowners. This creates a serious equity problem where wealthy agricultural elites often contribute less than formal salaried professionals. Land revenue is even more outdated. Based on colonial-era assessment structures, it raises minimal resources and bears little relationship to modern land values, productivity, or profitability. Its economic relevance today is largely symbolic.

The IMF's push to align agricultural income taxation with broader income tax structures has intensified this debate. While the principle of horizontal equity is valid, applying high tax rates without distinguishing smallholders from large absentee landlords risks harming vulnerable rural households. The real solution lies in a progressive framework: protect subsistence and small farmers, tax large commercial profits transparently, digitize land and income records, and rationalize indirect taxes on farm inputs. Poor tax design can weaken agriculture, but smart taxation can improve both fairness and fiscal sustainability.

The Economic Consequences of Raising Taxes on Agriculture

The real-world impact of higher agricultural taxation is best understood through how farmers respond to cost pressures. Economic evidence consistently shows that when taxation raises the cost of production, output and investment tend to suffer. Studies on Pakistan's agricultural economy have long suggested that even modest increases in agricultural income taxation can reduce the sector's contribution to GDP over time. While the percentage effects may appear numerically small, in a sector of this scale the cumulative losses translate into billions of rupees in reduced farm output, lower rural incomes, and weaker food security.

The transmission mechanism is straightforward. When taxes raise the price of fertilizers, pesticides, diesel, machinery, or seeds, farmers reduce input use to protect already thin profit margins. Less fertilizer weakens soil productivity, delayed machinery replacement lowers efficiency, and reduced pesticide use increases crop losses. The result is lower yields and weaker marketable surplus. This effect is particularly damaging for export-oriented crops such as rice and cotton, where higher tax-related production costs reduce Pakistan's competitiveness against producers like India, Vietnam, and Brazil.

The burden is most severe for smallholders. Farmers operating five to ten acres often lack liquidity, formal credit, and crop insurance. Even a modest tax increase on diesel, certified seeds, or tractor parts can push them toward informal borrowing, distress sales of livestock, or eventual land transfer to larger operators. In this way, poorly designed taxation can accelerate rural inequality and land concentration.

Consumers are not insulated either. Higher farm costs eventually pass through the value chain into wheat flour, sugar, edible oil, and vegetable prices, disproportionately hurting poor urban households that spend a large share of income on food.

A deeper problem lies in elite capture and tax evasion. Large landowners frequently exploit exemptions, weak documentation, and political influence to minimize tax liabilities, while smaller farmers face indirect burdens and local levies. In addition, below-market procurement prices for crops such as wheat and sugarcane act as a form of implicit taxation, transferring value from rural producers to urban consumers. In many cases, this hidden burden may exceed the visible tax system itself.

Agricultural Taxation: Between Burden, Opportunity, and Structural Reform

Agricultural taxation is often framed as a burden on farmers, but in reality, it is a policy instrument that can either accelerate rural development or deepen stagnation depending on how it is designed and implemented. In well-functioning systems, taxation is not merely a tool for revenue extraction; it becomes a mechanism for redistribution, infrastructure development, and productivity enhancement in the rural economy.

One of the strongest arguments in favor of effective agricultural taxation is its potential to finance rural infrastructure. If even a fraction of the estimated Rs. 69.5 billion lost annually through exemptions and evasion were collected, it could be redirected toward farm-to-market roads, cold storage facilities, and irrigation upgrades. These investments directly reduce post-harvest losses and improve farmer incomes by strengthening supply chains and market access.

Equally important is the role of smart, targeted tax incentives. International evidence suggests that well-structured tax relief on solar irrigation systems, climate-resilient seeds, and farm mechanization can significantly boost productivity. Countries using such tools strategically have experienced faster agricultural growth by lowering input costs and encouraging modernization. However, the effectiveness of these measures depends on accessibility and transparency.

A critical issue in Pakistan's context is equity. A fair taxation system would ensure that wealthy landowners contribute proportionately, like salaried workers and small business owners, while smallholders are protected. Without this balance, taxation risks reinforcing inequality rather than correcting it.

However, policy design alone is not enough. Implementation remains the weakest link. Weak institutional capacity, lack of transparency, poor coordination between tax authorities and agricultural departments, and political resistance from powerful landowning groups continue to undermine reform efforts. As a result, even well-intentioned tax policies often fail to reach their developmental potential.

Ultimately, agricultural taxation must be viewed not as a standalone fiscal tool, but as part of a broader rural transformation strategy that links revenue generation with productivity, equity, and long-term food security.

A Practical Path Toward Agricultural Tax Reform in Pakistan

Pakistan's agricultural tax system requires urgent restructuring to balance fairness, revenue generation, and rural development. A first step is introducing a progressive agricultural income tax. Smallholders with limited landholdings (e.g., under 5 acres) should remain exempt, while medium-scale farmers contribute modestly and large commercial landowners are taxed at rates comparable to non-agricultural sectors. This tiered approach ensures equity while expanding the tax base.

Second, taxation of large landholdings must be strengthened. Existing land revenue rates are outdated and eroded by inflation. Revising these rates upward and enforcing them strictly would ensure that extensive landowners contribute proportionately to the economy.

Third, tax administration must be modernized. Digitizing land records, integrating tax systems with subsidy and crop insurance databases, and using satellite imagery to verify cultivated land can significantly reduce evasion and improve transparency. Simplification of payment systems is equally important to improve compliance.

Fourth, better coordination between federal and provincial authorities is essential. While agriculture is constitutionally a provincial subject, fiscal stability requires a harmonized framework, possibly involving federal oversight for collection and equitable redistribution of revenues.

Finally, and most critically, tax revenues must be visibly reinvested in agriculture. Farmers will only accept taxation if they see tangible returns in the form of rural roads, irrigation systems, storage facilities, and agricultural services. Without this feedback loop, resistance will remain high and compliance weak. A trust-based fiscal contract between the state and farmers is essential for long-term reform success.

Conclusion

Pakistan's agricultural tax dilemma ultimately reflects a deeper structural contradiction between fiscal survival and rural sustainability. On one hand, the state urgently needs to broaden its tax base to address persistent fiscal deficits, rising debt obligations, and external financing pressures. On the other hand, agriculture remains a fragile livelihood system for millions of small farmers already exposed to high input costs, climate shocks, water stress, and volatile output prices. In this context, poorly designed taxation risks becoming not a tool of development, but a driver of rural distress.

The key lesson from the analysis is that the problem is not taxation itself, but its design, enforcement, and distributional fairness. When large landowners remain undertaxed while smallholders face rising indirect burdens through inputs and market distortions, the system becomes inequitable and economically inefficient. Similarly, hidden forms of taxation, such as suppressed procurement prices and weak market returns, often impose greater pressure on farmers than formal tax policies.

A workable solution lies in progressive and data-driven reform. Small farmers must be protected, medium farmers treated fairly, and large commercial landholders taxed transparently and proportionately. At the same time, modernization of land records, digitization of tax systems, and reinvestment of revenues into rural infrastructure are essential to build trust and improve compliance. Most importantly, agricultural taxation must be integrated into a broader rural development strategy rather than treated as a standalone fiscal instrument. Ultimately, a balanced agricultural tax system can serve both equity and efficiency: strengthening state revenues while supporting food security, rural investment, and long-term agricultural productivity in Pakistan.

Please note that the views expressed in this article are of the author and do not necessarily reflect the views or policies of any organization.

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Climate Change: Economic Challenge for Pakistan

Climate change has evolved into a major economic challenge for Pakistan, impacting agriculture, inflation, and poverty. The 2022 floods and ongoing climate volatility highlight the need for urgent action to address these macroeconomic risks.

Muhammad Amjed Iqbal, Muhammad Khalid Bashir & Meerab Ahmad

4/15/2026

For millions of Pakistanis, climate change is no longer an abstract scientific warning, it is a lived economic shock. Imagine waking to find an entire village submerged, homes erased, crops buried in silt, and livestock swept away. This devastating reality was experienced by nearly

33 million people during the catastrophic floods of 2022, and renewed extreme flooding in 2025 reinforced a painful truth: climate volatility is becoming a recurring feature of Pakistan's development landscape.

What makes this crisis especially dangerous is that its costs extend far beyond damaged roads and collapsed houses. Every flood destroys standing crops, disrupts rural labor markets, wipes out livestock assets, and interrupts transport systems that connect farms to cities. A single extreme weather event can erase years of household savings and push already vulnerable families deeper into poverty. For farmers, it means lost harvests; for traders, broken supply chains; for the government, emergency spending, reconstruction costs, and growing fiscal pressure.

Climate change is therefore not simply an environmental issue; it is a macroeconomic threat. Floods, droughts, heatwaves, and erratic rainfall patterns reduce agricultural productivity, increase food inflation, widen trade deficits through emergency imports, and place new pressure on foreign exchange reserves. Insurance losses, damaged infrastructure, and reduced industrial output further slow GDP growth.

Pakistan now faces a critical policy challenge: whether to continue treating climate disasters as isolated emergencies or recognize them as structural economic risks requiring permanent adaptation strategies. Investments in flood-resilient infrastructure, climate-smart agriculture, watershed restoration, and disaster financing are no longer optional development goals; they are essential economic safeguards.

Until climate resilience is embedded into fiscal planning, rural development, and national growth strategy, every extreme weather event will continue to translate into deeper economic instability. In Pakistan's case, the sky is no longer just bringing rain, it is increasingly shaping the country's economic future.

Pakistan at the Epicenter of Climate Risk

Pakistan stands on the frontline of the global climate crisis despite contributing less than one percent to total greenhouse gas emissions. This stark imbalance between responsibility and vulnerability makes the country one of the clearest examples of climate injustice in the world. Recent climate risk assessments continue to rank Pakistan among the most exposed nations, largely because of its fragile geography, dense population along river systems, and high dependence on climate-sensitive agriculture.

The reason lies in the country's physical landscape. In the north, the Himalayan, Karakoram, and Hindu Kush ranges hold one of the world's largest concentrations of glacial ice outside the polar regions. In the south, the Arabian Sea influences monsoon systems and coastal flooding risks. Connecting both extremes is the Indus River, the backbone of Pakistan's irrigation, agriculture, and food economy. This geography has always required careful water management, but climate change is turning natural variability into systemic disaster.

Rapid glacial retreat is now disturbing the seasonal flow of the Indus Basin. Rising temperatures accelerate snow and glaciers melt, increasing spring and summer flood risks while also threatening lower downstream water availability in later seasons. At the same time, monsoon systems are becoming far more intense. During the 2022 mega-flood, some southern regions experienced rainfall many times above normal, overwhelming already saturated floodplains and drainage systems.

Human pressures worsen the crisis. Deforestation, encroachment on floodplains, poorly maintained embankments, and weak urban drainage have stripped away natural protection buffers. When extreme rainfall collides with glacial melt and degraded landscapes, the result is a perfect storm of floods, crop losses, infrastructure destruction, and mass displacement.

Pakistan's climate vulnerability, therefore, is not driven by one factor alone. It is the dangerous convergence of geography, economic dependence on the Indus system, and weak land-use management that places the country at the epicenter of climate risk.

The 2022 Floods: When Climate Disaster Became an Economic Shock

The 2022 floods were not simply an episode of extreme weather; they became one of the most expensive economic disasters in Pakistan's history. The official Post-Disaster Needs Assessment estimated total damage and economic losses at roughly $30 billion, with reconstruction needs exceeding $16 billion. In macroeconomic terms, this represented a shock equal to nearly 5 percent of national GDP, an enormous loss for an economy already facing fiscal and external pressures.

The agriculture sector absorbed one of the heaviest blows. More than 4 million acres of cropland were damaged, while cotton, rice, sugarcane, vegetables, and early wheat areas remained underwater for weeks. Cotton losses alone severely disrupted Pakistan's textile value chain, reducing export potential and weakening industrial activity. Livestock losses were equally devastating, with over 1.1 million animals lost, wiping out the productive assets and savings of rural households. The damage to agriculture and livestock was estimated at approximately $3.7 billion, directly translating into lower rural incomes, higher food inflation, and additional pressure on imports.

Infrastructure destruction multiplied the crisis across the wider economy. More than 13,000 kilometers of roads and 439 bridges were damaged, severing farm-to-market connectivity and disrupting trade, health access, and relief delivery. Housing losses were catastrophic, with nearly 900,000 homes destroyed and around 1.4 million damaged, while over 22,000 schools were affected. Every rupee diverted toward reconstruction reduced fiscal space for future development spending.

Most devastating, however, was the human cost. Around 33 million people were affected, and nearly 8 million were displaced, many losing crops, livestock, shelter, and livelihoods simultaneously. These losses pushed millions closer to poverty, making the floods not only a climate disaster but a long-term development setback for Pakistan's economy.

The Economic Chain Reaction of Climate Shocks

Climate disasters do not end when the rain stops or the floodwater recedes. Their most dangerous impact lies in the chain reaction they unleash across the economy, one that can continue for years through inflation, poverty, weak investment, and fiscal stress. In Pakistan, this cascading effect has become one of the clearest examples of climate-induced economic uncertainty.

The first shock is usually agricultural. When floods, heatwaves, or droughts destroy crops, the immediate result is lower food supply. Wheat, vegetables, fodder, cotton, and rice shortages quickly translate into higher food prices. Poor households, which already spend a large share of income on food, are forced to reduce consumption, borrow informally, or sell household assets. This weakens nutrition, increases debt dependency, and reduces the ability of families to invest in education, healthcare, or small enterprises. What begins as a weather shock soon becomes a human capital crisis.

The macroeconomic spillover is equally severe. Lower farm output reduces agro-processing activity, slows transport and wholesale trade, and weakens export performance, especially in climate-sensitive sectors such as cotton and rice. The World Bank estimated that the 2022 floods alone reduced Pakistan's GDP by approximately 2.2 percent in a single fiscal year, with agriculture accounting for the largest contraction. This scale of output loss is particularly damaging for an economy already burdened by inflation, debt servicing, and low fiscal space.

At the same time, government revenues are declining. Lower business activity reduces tax collection just as public spending requirements surge for relief, reconstruction, and social support. This creates a vicious cycle: reduced fiscal capacity delays investment in resilient roads, flood defenses, drainage, and irrigation systems, leaving the economy even more exposed to the next disaster.

Breaking this cycle requires a resilience-centered economic roadmap. Climate-smart infrastructure must become standard, including elevated roads, reinforced bridges, urban drainage, and flood-resistant housing. Evidence consistently shows that each rupee invested in resilience prevents multiple rupees in future disaster losses. Climate-smart agriculture is equally essential through drought-resistant seeds, crop diversification, drip irrigation, and affordable crop insurance.

Pakistan also needs permanent disaster risk financing tools such as contingency funds, sovereign insurance, and catastrophe-linked bonds so that future disasters do not automatically trigger emergency borrowing. Better early warning systems, real-time river monitoring, and mobile alert networks can reduce both human and asset losses.

Beyond adaptation, long-term resilience depends on economic diversification. Overdependence on climate-sensitive agriculture magnifies national vulnerability. Expanding manufacturing, digital services, renewable energy, and water-efficient industries can create buffers against repeated climate shocks.

Ultimately, climate disasters are no longer isolated environmental events. They are systemic economic shocks that move from crops to prices, from prices to poverty, and from poverty to slower national growth. Pakistan's future stability will depend on how quickly climate resilience is integrated into fiscal planning, agriculture, infrastructure, and social protection.

Conclusion

Climate change has firmly shifted from an environmental concern to a defining economic challenge for Pakistan's future. The repeated floods, glacial disruptions, extreme monsoon events, and rising climate volatility now directly influence agricultural productivity, inflation, fiscal stability, infrastructure investment, and poverty outcomes. What the 2022 floods exposed, and the 2025 shocks reinforced is that climate disasters are no longer rare emergencies; they are recurring macroeconomic risks capable of reversing years of development gains within weeks.

The true danger lies in the multiplier effect. A flood is no longer just a rural tragedy, it becomes food inflation in urban markets, lower textile exports, rising public debt, weakened household savings, disrupted schooling, and delayed infrastructure development. This interconnected chain reaction makes climate resilience central to economic governance rather than a side issue of environmental policy.

Pakistan's path forward must therefore combine resilient infrastructure, climate-smart agriculture, stronger water governance, disaster financing mechanisms, and social protection systems that respond rapidly aftershocks. Equally important is long-term economic diversification so that national growth is not overwhelmingly tied to climate-sensitive sectors.

For policymakers, the message is clear: climate adaptation is no longer optional spending, but a strategic investment in macroeconomic stability, food security, and human welfare. The countries that prepare early will absorb shocks better; those that delay will repeatedly pay reconstruction costs. In Pakistan's case, the economy of the future will increasingly be determined by how effectively the country converts climate vulnerability into climate resilience.

Please note that the views expressed in this article are of the author and do not necessarily reflect the views or policies of any organization.

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Climate Change: A Defining Economic Challenge

Climate change has evolved into a pressing economic and social challenge, with rising temperatures and declining agricultural productivity leading to forced migration and significant economic losses. The interconnected consequences are already unfolding, highlighting the urgent need for action.

Syed Ali Ummar

4/20/2026

You've heard the warnings, but the real story of climate change isn't about distant glaciers or endangered wildlife, it's about your income, your security, and the future stability of your home. For many people, climate change still feels abstract, something reserved for scientists, policy debates, or international conferences. But that perception is dangerously outdated. The reality is far more immediate: climate change is already shaping economies, livelihoods, and human settlements across the world.

The planet has warmed by approximately 1.1°C since the industrial revolution. On paper, that number appears insignificant, barely noticeable in daily life. But on a planetary scale, it represents a profound shift in Earth's energy balance. This "fever" is not gentle. It disrupts weather systems, intensifies extreme events, and destabilizes natural cycles that human societies depend on. Heatwaves become longer and more intense, rainfall becomes erratic, and droughts and floods occur with increasing frequency and severity.

The consequences are no longer theoretical. Agricultural yields are becoming less predictable, driving food price volatility.

Infrastructure is being damaged by extreme weather, increasing repair costs and insurance burdens. Coastal areas are facing rising sea levels, threatening property and displacing communities. In many regions, these pressures are already forcing people to migrate in search of safer and more stable living conditions.

Three realities are becoming increasingly clear. First, some climate impacts are effectively irreversible on human timescales. Second, the economic costs are escalating rapidly, affecting both governments and households. Third, climate change is no longer just an environmental issue, it is a driver of social and economic displacement. The challenge ahead is not whether change will occur, but how societies adapt to a future that has already begun.

The Irreversible Clock of Climate Change

Here is the uncomfortable truth at the heart of climate science: carbon dioxide does not simply disappear. It accumulates. When we burn coal, oil, or natural gas, we release CO_2 into the atmosphere, where it behaves like a persistent thermal blanket, trapping heat and altering the planet's energy balance. Even if global emissions stopped overnight, an unrealistic scenario, the existing concentration would linger for centuries, with a portion remaining for millennia. In practical terms, this means that today's emissions lock in future climate conditions. The consequences are not abstract; they are intergenerational, shaping the environmental realities your descendants will inherit.

According to the Intergovernmental Panel on Climate Change, limiting global warming to 1.5°C requires achieving net-zero emissions by mid-century. Yet the structural dependency on fossil fuels remains overwhelming, supplying roughly 80% of global energy demand. This creates a systemic inertia: economies are attempting rapid decarbonization while still anchored to carbon-intensive infrastructure.

More critically, the planet is approaching biophysical tipping points, thresholds beyond which changes become self-reinforcing and effectively irreversible. The destabilization of polar ice sheets could commit the world to multi-meter sea level rise over time, fundamentally reshaping coastlines and displacing hundreds of millions. Thawing permafrost introduces another feedback loop, releasing methane, a greenhouse gas significantly more potent than CO_2, thereby accelerating warming in a self-amplifying cycle. Meanwhile, coral reef systems, already severely degraded, signal the fragility of marine ecosystems under thermal stress.

Despite this stark outlook, mitigation still matters. Each increment of avoided warming reduces economic losses, ecological damage, and human suffering. The window for meaningful intervention has narrowed, but it has not yet closed. The critical constraint now is not scientific uncertainty; it is the pace of collective action.

The Economic Shockwave of Climate Change

Let's frame climate change in the language policy makers and markets respond to economic loss. Beyond environmental degradation, global warming is increasingly understood as a systemic macroeconomic risk. A widely cited study published in *Nature Sustainability* estimates that each 1°C increase in global temperature could reduce global GDP by approximately 12%. This is not a marginal slowdown; it represents a structural contraction in economic output.

If current emission trajectories persist, the world is on course for roughly 3°C of warming by the end of the century. Translating that into economic terms implies a potential halving of global GDP by 2100. This would not resemble a typical cyclical recession; it would constitute a prolonged, structural economic decline, more severe than the combined shocks of the Great Depression, the 2008 financial crisis, and the COVID-19 downturn.

The transmission mechanisms are diffuse but relentless. Agricultural productivity is already under pressure, with heat stress reducing yields of staple crops such as wheat and maize by 5–20% in vulnerable regions. In agrarian economies across South Asia and Sub-Saharan Africa, these losses directly threaten food security and rural livelihoods. Livestock productivity declines under thermal stress, while ocean acidification disrupts fisheries that sustain billions.

Labor markets are equally exposed. The International Labor Organization projects that by 2030, heat stress could eliminate the equivalent of 80 million full-time jobs globally. Outdoor sectors (construction, agriculture, logistics) face declining work hours and rising health risks, translating into income loss and reduced aggregate productivity.

Financial systems are beginning to reflect these risks. In high-exposure regions, insurance markets are retreating as climate-related disasters (floods, wildfires, storms) become more frequent and severe. As private insurers withdraw, the burden of risk shifts to households and governments, increasing fiscal pressure and personal financial vulnerability.

Perhaps most concerning is the distributional dimension. Regions with the lowest historical emissions, South Asia, the Sahel, and small island states, are disproportionately affected. Climate change, therefore, operates not only as an environmental crisis but as a regressive economic force, amplifying global inequality by transferring risk and hardship toward those least responsible.

Climate Displacement and the Emerging Migration Crisis

Human mobility has always been part of economic and social adjustment, but climate change is transforming it into forced displacement on an unprecedented scale. The current international legal architecture is not equipped for this shift. Under the 1951 Refugee Convention, individuals fleeing environmental collapse such as sea-level rise or prolonged drought are not formally recognized as refugees. Instead, they are categorized as migrants, leaving them without specific legal protections or resettlement rights. This gap creates a growing population in regulatory limbo.

The scale of displacement is already significant. Each year, an estimated 20 to 30 million people are forced from their homes due to sudden climate-related disasters, including floods, cyclones, and wildfires. These are not hypothetical projections; they are ongoing disruptions affecting livelihoods, infrastructure, and human security. Looking ahead, the World Bank projects that by 2050, more than 216 million people could be internally displaced due to slow-onset climate impacts such as water scarcity, declining agricultural productivity, and rising sea levels.

Low-lying and densely populated regions are particularly vulnerable. Coastal zones in countries like Bangladesh, Vietnam, and Egypt face existential risks as sea levels continue to rise, a trend extensively documented by the Intergovernmental Panel on Climate Change. For these populations, gradual inundation does not represent a temporary shock but a permanent loss of habitable land. Simultaneously, arid and semi-arid regions such as the Sahel—are experiencing intensified drought cycles. The near collapse of Lake Chad

illustrates how environmental degradation can exacerbate competition over scarce resources, often triggering conflict and instability.

Most climate-induced movement is expected to occur within national borders, placing immense pressure on urban centers. Cities such as Dhaka and Lagos are already struggling to absorb large inflows of displaced populations, resulting in the expansion of informal settlements, strained public services, and heightened public health risks.

Although frameworks like the Global Compact for Migration acknowledge these challenges, they lack binding enforcement mechanisms. Without a robust legal and institutional response, climate-driven displacement risks becoming one of the most significant humanitarian and governance failures of the 21st century.

From Awareness to Urgency

Strip away the rhetoric, and the conclusion is stark. Climate change is no longer a future risk; it is a locked-in trajectory with escalating consequences. The scientific consensus, led by assessments from the Intergovernmental Panel on Climate Change, is clear: a significant portion of climate damage is now irreversible in human timescales. Atmospheric carbon concentrations, accumulated over decades, will continue to shape temperatures, sea levels, and weather patterns for generations. The objective, therefore, is no longer restoration, but containment limiting further deterioration.

From an economic standpoint, inaction is not a neutral choice; it is a high-cost decision. Macroeconomic projections increasingly show that unchecked warming could erode a substantial share of global wealth. This is not comparable to routine financial downturns or cyclical recessions. It represents a structural breakdown in productivity, asset stability, and market functioning. Infrastructure damage, supply chain disruptions, declining agricultural output, and rising adaptation costs collectively point toward systemic economic stress rather than temporary volatility.

On the ground, the human implications are already visible. Displacement, food insecurity, and climate-induced disasters are no longer isolated events, they are becoming recurrent features of daily life in many regions. Each extreme weather event, each failed harvest, and each overwhelmed city is not an anomaly but a signal of a shifting baseline. These are cumulative costs, building overtime and disproportionately affecting the most vulnerable populations.

What follows from this is not a need for abstract optimism, but for structural transformation. Climate policy cannot remain peripheral or reactive. It must be integrated into core economic planning, energy systems, urban development, and international cooperation frameworks. Incremental adjustments will not match the scale of the challenge.

The situation is analogous to a system under critical stress: delayed response increases the cost and reduces the available options. The remaining question is not whether action is required, but whether it will be timely and coordinated enough to prevent the most severe outcomes.

Conclusion

Climate change is no longer a distant environmental concern; it is a defining economic and social challenge of our time. The evidence presented throughout this article points to a single, unavoidable reality: the world has already crossed critical thresholds, and the consequences are unfolding in real time. Rising temperatures, declining agricultural productivity, forced migration, and mounting economic losses are not isolated phenomena; they are interconnected outcomes of a system under stress.

The persistence of carbon in the atmosphere means that many of these changes cannot be reversed within human lifetimes. What remains within our control is the scale of future damage. Every policy decision, investment choice, and development pathway taken today will determine whether the coming decades are defined by managed transition or systemic disruption. The cost of inaction, measured in lost livelihoods, weakened economies, and human suffering, far exceeds the cost of timely intervention.

Equally important is the issue of equity. Those who contributed least to the problem are bearing the heaviest burdens, particularly in agrarian and low-income regions. This imbalance underscores the need for coordinated global action that prioritizes resilience, adaptation, and inclusive development.

Ultimately, the question is not whether climate change will reshape our world, it already is. The real question is whether institutions, markets, and societies can respond with the urgency and scale required. The window for incremental change has closed. What is needed now is deliberate, structural transformation to safeguard both current and future generations.

Please note that the views expressed in this article are of the author and do not necessarily reflect the views or policies of any organization.

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Pakistan's Agricultural & Environmental Governance

Explore how Pakistan's environmental and agricultural challenges reflect a governance system struggling to implement effective actions. Discover the potential of district-level agricultural resource conservation departments to bridge the gap between policy and practice.

Muhammad Rafi Qamar

4/21/2026

You do not need technical data to recognize that Pakistan’s environmental stress is intensifying, you can see it, breathe it, and feel it in declining soil quality. Each winter, cities like Lahore are engulfed in smog, driven in part by widespread crop residue burning across Punjab. At the same time, agricultural land is steadily losing its vitality, becoming less productive and more dependent on chemical inputs. These are not

isolated issues; they are symptoms of a deeper institutional disconnect.

Pakistan is not short of institutions. The Ministry of Climate Change, Pakistan Agricultural Research Council, National Agricultural Research Centre, Environmental Protection Departments, and the Pakistan Climate Change Authority all operate with mandates that intersect climate, agriculture, and environmental protection. However, these entities largely function in silos, limiting their effectiveness at the farm level. The issue is not capacity, it is coordination.

A practical solution lies not in creating entirely new structures, but in reorganizing existing resources into integrated, district-level units: Agricultural Resource Conservation Departments (ARCDs). These units would serve as operational hubs, translating policy into practice and connecting scientific knowledge directly with farmers.

The urgency of such reform becomes clear when examining the key challenges. First, seasonal smog linked to crop burning has evolved into a recurring public health crisis, yet current regulatory bodies lack localized engagement with farmers. Second, soil degradation, driven by excessive chemical use and poor land management, has reduced fertility, increasing production costs and environmental damage. Third, climate change impacts such as floods and heatwaves are intensifying, while opportunities like carbon sequestration remain underutilized due to weak extension services.

Equally critical is the communication gap. Farmers, particularly smallholders, are disconnected from formal knowledge systems. Information flows through informal networks rather than institutional channels, reducing the adoption of sustainable practices. Finally, economic constraints dominate decision-making. Farmers often rely on harmful practices like residue burning because they are cost-effective in the short term, even if they generate long-term losses.

An integrated district-level approach would align environmental goals with economic incentives, ensuring that sustainability is not an abstract concept but a practical, profitable choice. Without such coordination, Pakistan risks continuing a cycle where policies exist on paper, but impacts remain invisible on the ground.

Bringing Solutions to the Farmer's Doorstep

The strength of this proposal lies in its administrative realism. It does not call for new infrastructure or an expanded bureaucracy; instead, it restructures existing institutional capacity into a coherent, district-level delivery mechanism. By integrating operational wings of the Pakistan Agricultural Research Council, National Agricultural Research Centre, and the Pakistan Climate Change Authority, Agricultural Resource Conservation Departments (ARCDs) would function as localized, multi-service platforms. For farmers, this translates into a "one stop shop" where advisory services, technical support, and regulatory guidance are accessible within their own district.

This institutional redesign directly addresses persistent inefficiencies in service delivery. Currently, farmers must navigate fragmented systems, travel long distances to access soil diagnostics, extension advice, or compliance information. ARCDs would consolidate these services, reduce transaction costs and improve uptake of sustainable practices.

In addressing crop residue burning, ARCDs would combine enforcement with viable alternatives. In coordination with Environmental Protection Departments, regulatory compliance would be strengthened but paired with practical solutions such as converting stubble into compost, mulch, or biochar. Access to machinery for in-situ residue management, facilitated through rental schemes or cooperatives, would further reduce reliance on burning. This dual approach aligns environmental objectives with farmer incentives, producing cleaner air and improved soil structure.

Soil health management would be significantly enhanced by decentralizing laboratory services currently concentrated within NARC. District-level soil testing would enable precise input use, reducing excessive fertilizer application and associated costs. In parallel, ARCDs would promote conservation agriculture techniques, including zero tillage, crop rotation, and cover cropping, thereby restoring soil fertility and resilience.

A critical innovation lies in integrating climate mitigation with farm economics. Through collaboration with the Pakistan Climate Change Authority, ARCDs could operationalize carbon sequestration initiatives. Farmers adopting practices such as agroforestry or reduced tillage would not only improve land productivity but could also access financial incentives through carbon markets or public subsidy schemes.

Equally important is the communication strategy. ARCDs would prioritize localized engagement, conducting training in regional languages, establishing demonstration plots, and upgrading the capacity of existing extension personnel. This ensures that knowledge transfer is practical, visible, and context specific.

Finally, ARCDs would serve as institutional bridges, linking federal policy frameworks with ground realities. By incorporating farmer representation into district advisory structures, they would enable feedback loops that refine policy design and implementation. In effect, ARCDs transform fragmented governance into an integrated, responsive system anchored at the farm level.

A Cost-Effective Reform with High Returns

One of the most compelling aspects of the Agricultural Resource Conservation Department (ARCD) model is its fiscal practicality. Rather than demanding new funding from an already constrained public budget, the proposal focuses on reallocating and pooling existing resources from institutions such as the Pakistan Agricultural Research Council, National Agricultural Research Centre, and provincial Environmental Protection Departments. This approach minimizes financial strain while maximizing institutional efficiency.

At the district level, the estimated annual budget remains modest. Personnel costs, based on re-assigned staff rather than new hiring, are projected at approximately PKR 9.3 million. Operational expenses including laboratory services, mobility (vehicles), farmer training programs, and demonstration plots account for around PKR 20.3 million. An additional PKR 2 million is allocated for farmer incentives, encouraging the adoption of environmentally sustainable practices, while a contingency reserve of about PKR 1.86 million ensures responsiveness to unforeseen challenges.

In total, the annual cost per district is estimated at roughly PKR 24 million (around USD 86,000). When scaled nationally across approximately 150 districts, this investment remains relatively small compared to the economic damage caused by recurring smog episodes, declining agricultural productivity, and climate-related disruptions. In cost-benefit terms, ARCDs represent a high-impact, low-cost institutional reform with substantial long-term returns.

The Urgent Implementation Agenda

Turning the ARCD concept into reality does not require sweeping institutional upheaval; it requires targeted administrative action and political will. The first step is legislative clarity. A concise legal instrument should formally re-designate relevant operational wings of the Pakistan Agricultural Research Council, National Agricultural Research Centre, and the Pakistan Climate Change Authority into district-level Agricultural Resource Conservation Departments. This legal backing would eliminate ambiguity and provide a mandate for integrated service delivery.

Second, human capital must be updated, not replaced. Existing officers already possess strong technical foundations, but they require short, intensive training in modern sustainable agriculture practices such as conservation tillage, residue management, and climate-smart farming. A structured two-week refresher program can rapidly align field staff with current scientific knowledge and policy priorities.

Third, institutional coordination must be formalized. Clear operational protocols should define the roles and interactions between the Ministry of Climate Change, provincial Environmental Protection Departments, and ARCDs. Without this, overlapping mandates could recreate the very fragmentation the reform seeks to resolve. A standardized framework for data sharing, enforcement support, and joint programming is essential.

Equally critical is participatory design. Policy effectiveness depends on local relevance, which can only be achieved by engaging farmers directly. Village councils and farmer groups should be consulted to ensure that services reflect actual constraints, whether financial, technical, or logistical.

If implemented effectively, the medium-term outcomes are transformative. Air quality improvements could significantly reduce seasonal smog, while soil restoration practices would enhance productivity and reduce input costs. Farmers would shift from being perceived as contributors to environmental degradation to active agents of climate mitigation through practices like carbon storage. The rural economy would benefit from higher yields, lower costs, and emerging income streams. The pathway forward is clear: integrate existing capacity, decentralize delivery, and act with urgency.

Conclusion

Pakistan's environmental and agricultural challenges are no longer isolated technical issues; they are symptoms of a governance system that struggles to translate knowledge into action. The country does not lack institutions, expertise, or even financial resources. What it lacks is integration. By reorganizing existing capacities into district-level Agricultural Resource Conservation Departments, Pakistan has an opportunity to bridge the persistent gap between policy design and field-level implementation.

The strength of the ARCD model lies in its practicality. It aligns environmental sustainability with economic incentives, ensuring that farmers are not burdened by reform but benefit from it. Cleaner air, healthier soils, reduced input costs, and new income opportunities through climate-smart practices are not distant goals, they are achievable outcomes within a relatively short timeframe. More importantly, this approach restores the central role of farmers as partners in national development rather than passive recipients of policy.

The cost of inaction is already visible in worsening smog, declining soil productivity, and increasing rural vulnerability. Continuing along the current fragmented path will only deepen these challenges. In contrast, a coordinated, district-focused system offers a scalable and cost-effective alternative. The choice is clear: maintain institutional silos or build functional bridges. The future of Pakistan's agriculture, and its environmental health, depends on making the right decision now.

Please note that the views expressed in this article are of the author and do not necessarily reflect the views or policies of any organization.

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Pakistan's Agriculture: A 2026 Transition

In 2026, Pakistan's agricultural landscape is undergoing a critical transition amid rising input costs and climate stress. With policy changes testing the resilience of smallholders, the sustainability of production is at stake.

Azizullah Noondani

4/30/2026

For generations, farming in Pakistan has been more than just an occupation, it has been a social identity, a source of stability, and the backbone of the rural economy. Yet, by 2026, that foundation is under visible strain. Conversations with farmers across Punjab and Sindh no longer revolve around seasonal rhythms or harvest celebrations. Instead, they center on volatile input prices, erratic weather patterns, and a growing sense of uncertainty about the future of agriculture itself.

This moment represents what many agricultural economists describe as a "great paradox." On the surface, the sector remains robust. Agriculture continues to feed a population of nearly 245 million, employs close to 40% of the labor force, and contributes around one-fifth of the country's GDP. These indicators suggest resilience. However, beneath this macro-level strength lies a system under pressure from multiple, overlapping shocks.

Input costs have surged dramatically, diesel, fertilizers, and seeds are no longer affordable for smallholders operating on thin margins. Climate variability has intensified, with delayed monsoons, unexpected heatwaves, and water scarcity disrupting traditional cropping cycles. At the same time, policy shifts driven by fiscal constraints and international commitments have reduced the scope of government support. Subsidies are being rationalized, and market

forces are playing a larger role in determining prices and access to inputs.

For large, capital-intensive farms, adaptation may be possible through technology and scale. But for the smallholder farmer, the one managing five acres with limited access to credit, irrigation, or market information, this transition is far more precarious. The risks are not just economic; they are existential. The central question, therefore, is not whether agriculture will survive in Pakistan, but whether its most vulnerable producers can remain part of that future.

The Wheat Shock: Policy Retreat and Market Uncertainty

The wheat sector in Pakistan has long operated under a relatively predictable framework, anchored by the Minimum Support Price (MSP). This mechanism ensured that farmers had a guaranteed buyer, the government, at a pre-announced price, reducing market risk and stabilizing rural incomes. While imperfect, it provided a critical layer of certainty in an otherwise volatile agricultural environment.

In 2026, that certainty has largely disappeared. Under fiscal pressure and policy commitments linked to international financial institutions, the government has significantly reduced its role as a procurement agent. The withdrawal has effectively shifted wheat pricing to open market dynamics, exposing farmers to price volatility they are ill-equipped to manage. The result has been sharp and unpredictable fluctuations, with wheat prices in Punjab ranging between PKR 3,700 and PKR 4,650 per 40 kg. For smallholders, this variability is not just inconvenient, it is destabilizing.

At the same time, production costs have surged. The removal of energy subsidies has increased the cost of irrigation, land preparation, and harvesting. Fertilizer and transport expenses have also risen, compressing already thin profit margins. In many cases, the market price during harvest barely covers, or even falls below, the cost of production. This inversion of the cost–price relationship has undermined the economic viability of wheat cultivation.

Farmers have responded rationally by reallocating land toward alternative crops such as oilseeds and pulses, which offer relatively better price prospects and lower risk exposure. Consequently, wheat acreage has declined, contributing to a projected national output of approximately 27.5 to 28.9 million metric tons, well below the estimated domestic requirement of around 32 million tons.

This emerging supply gap necessitates imports, placing additional pressure on foreign exchange reserves. What appears as a market adjustment is, in effect, a structural policy shock with direct implications for food security and macroeconomic stability.

The High-Input Trap: When Productivity Becomes Unaffordable

The economics of farming in Pakistan has shifted from a question of yield to a question of affordability. Nowhere is this more visible than in the fertilizer market. Inputs that were once considered essential and accessible have rapidly turned into financial burdens. A bag of DAP fertilizer that cost around PKR 5,000 just a few years ago now ranges between PKR 11,500 and PKR 14,000, while urea prices have climbed close to PKR 4,800 per bag. This escalation represents an increase of over 120–150%, far outpacing the modest rise in farm-gate prices of crops.

This imbalance has created what can be termed a "high-input cost trap." Modern agriculture depends heavily on chemical fertilizers to maintain soil fertility and ensure yields. Without them, productivity drops sharply. Yet purchasing these inputs increasingly requires farmers especially smallholders to rely on informal credit from middlemen (arthi). These credit arrangements are rarely neutral; they bind farmers into tied sales, forcing them to sell their produce at predetermined, often unfavorable prices. What begins as a seasonal loan quickly evolves into a cycle of dependency and reduced bargaining power.

In response, alternatives like solar-powered tubewells are being promoted as long-term cost-saving solutions. While technically viable, their adoption remains limited due to high upfront investment costs, often ranging between PKR 150,000 and PKR 250,000 per acre. For small farmers with limited landholdings and no access to affordable credit, such technologies remain out of reach. Without targeted financial mechanisms such as subsidized credit or input support this transition risks deepening inequality, where only large farmers can sustain productivity while smallholders are gradually excluded from viable agriculture.

Climate and Resource Collapse

By 2026, climate variability in Pakistan is no longer an environmental concern, it has become a binding economic constraint on agriculture. The production system is facing a structural mismatch between historical practices and current climatic realities. Rain-fed regions experienced a rainfall deficit of nearly 25%, while average temperatures remained about 1.2°C above long-term norms. For biological systems like crops, even marginal deviations in temperature and moisture translate into disproportionate yield losses.

The impact across major crops has been severe and uneven. Cotton output declined by nearly 31%, disrupting the supply chain of the textile sector, which accounts for roughly 60% of Pakistan's export earnings. This shortfall forces reliance on imports, eroding foreign exchange reserves and weakening trade balances. Wheat production dropped by an estimated 9–13%, intensifying food security concerns. Maize, a critical input for poultry feed, fell by around 15%, signaling downstream inflation in protein sources such as chicken. Even relatively resilient crops like sugarcane and rice showed stagnation or marginal decline, indicating systemic stress rather than crop-specific shocks.

These outcomes underscore a fundamental breakdown: traditional cropping calendars, input strategies, and irrigation practices are no longer aligned with climatic conditions. The production function itself has shifted, but adaptive responses remain limited. Compounding this is a deepening water crisis. Pakistan has crossed the threshold of absolute water scarcity, with per capita availability falling below 500 cubic meters as defined by the Falkenmark Index. In response, farmers are increasingly extracting groundwater, often at unsustainable rates. Aquifer depletion, estimated at around half a meter annually, is particularly acute in intensively cultivated regions.

In Sindh's Lower Indus Basin, the problem is further aggravated by poor groundwater quality. Excessive pumping of saline water contributes to soil salinization, gradually rendering land infertile. This is not a temporary productivity shock but a long-term degradation of the asset base itself. What emerges is a dual crisis: declining yields above ground and deteriorating resources below it, placing the future of agriculture under serious threat.

Conclusion

Pakistan's agricultural story in 2026 is no longer one of quiet resilience, it is one of decisive transition. The convergence of policy withdrawal, rising input costs, and accelerating climate stress has exposed the structural fragility of a system that once appeared stable. What was long sustained by subsidies, predictable weather, and informal credit

networks is now being tested by market volatility, water scarcity, and fiscal constraints. For millions of smallholders, farming is no longer just uncertain, it is increasingly unsustainable under existing practices.

Yet, within this disruption lies a critical opportunity. The pressures facing agriculture are forcing a long-overdue shift from short-term productivity toward long-term resilience. The emergence of digital tools, precision farming, improved storage systems, and alternative financing mechanisms signals the beginning of a new agricultural paradigm—one that is leaner, data-driven, and resource-efficient. However, this transition will not be automatic or inclusive without deliberate policy support.

The future of Pakistan's agriculture will depend on how effectively it balances market liberalization with farmer protection, technological advancement with accessibility, and environmental sustainability with economic viability. Smallholders must not be left behind in this transformation, as they remain the backbone of food security and rural livelihoods.

Ultimately, the path forward is clear: adapt, innovate, and invest in resilience. If managed wisely, this period of crisis can become a turning point, reshaping agriculture into a system capable of feeding the nation while withstanding the uncertainties of a changing world.

Please note that the views expressed in this article are of the author and do not necessarily reflect the views or policies of any organization.

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The Agricultural Economist, Vol. 3(4)
ISSN: 3104-8803

Mealworm-Based Poultry Feed: A Solution for Pakistan

Discover how mealworm-based poultry feed offers Pakistan a sustainable alternative to soybean meal, reducing import dependence and enhancing profitability for smallholder farmers.

Areeba Fatima

4/13/2026

The farmlands surrounding Mianwali, Pakistan, offer an important window into the realities of rural poultry production. Across these communities, smallholder farmers begin their day before sunrise, tending to poultry that serves as both a dependable source of household income and an affordable supply of animal protein. Yet a persistent concern echoes across these farms: the rising cost of feed is steadily eroding profitability and threatening the sustainability of small-scale poultry enterprises.

At the center of this challenge is the country's strong dependence on imported soybean meals, the principal protein component of commercial poultry feed. Because soybean prices are closely tied to global commodity markets, currency fluctuations, and international trade disruptions, local poultry farmers are highly vulnerable to external price shocks. Whenever global prices rise, the effects are felt immediately in rural Pakistan through higher production costs, reduced margins, smaller flock sizes, and, in many cases, forced liquidation of birds. Given that poultry remains the most affordable meat source for millions of households, this challenge is not only an issue of farm economics but also a growing concern for national food and nutrition security.

This situation raises an important question for sustainable agricultural development: can Pakistan reduce its reliance on imported soy by adopting locally producible, high-protein alternatives? One promising solution lies in the yellow mealworm (*Tenebrio molitor*), an insect species increasingly recognized worldwide for its efficiency, nutritional value, and low environmental footprint in animal feed systems.

The evidence suggests that mealworm-based poultry feed has strong potential as a practical and economically viable substitute in Pakistan's rural poultry sector. However, the most significant barrier is not nutritional adequacy or biological feasibility. The real constraint lies in farmer awareness, attitudes, and trust. Adoption of innovative feed alternatives depends heavily on extension services, demonstration effects, and confidence in market outcomes. As a result, the transition toward sustainable poultry nutrition in Pakistan may depend as much on behavioral acceptance and institutional support as on the scientific merits of the feed itself.

The Hidden Cost of Soy Dependency and the Promise of Mealworm-Based Poultry Feed

Pakistan's poultry sector has emerged as one of the country's most dynamic agricultural success stories, supplying affordable animal protein, generating rural employment, and supporting thousands of small and medium-scale enterprises. However, beneath this impressive growth lies a structural vulnerability: heavy dependence on imported soybean meals as the dominant protein source in poultry feed. This reliance has created both economic and environmental challenges that increasingly threaten the long-term sustainability of the industry.

From an economic perspective, imported soybean meal exposes poultry farmers to global commodity price volatility, exchange-rate fluctuations, and international supply disruptions. A price shock in global soybean markets is transmitted almost immediately into local feed costs, directly squeezing the profit margins of farmers in districts such as Mianwali and other poultry-producing regions. For smallholders operating on limited working capital, these fluctuations can quickly translate into reduced flock sizes, lower output, and in severe cases, exit from poultry farming altogether.

The environmental implications are equally significant. Large-scale soybean cultivation in exporting countries is often associated with deforestation, high water consumption, intensive land use, and carbon emissions linked to international transport. In effect, Pakistan's poultry production system imports not only protein but also the environmental footprint embedded in global soy supply chains.

This challenge is particularly striking because chickens are naturally adapted to insect-based diets. As omnivorous foragers, poultry instinctively consumes insects, larvae, and worms in natural environments, making insect protein a biologically compatible feed source. This creates a strong case for alternatives such as yellow mealworms (*Tenebrio molitor*), which offer exceptional nutritional value through high-quality protein, essential amino acids, and beneficial fats.

The real advantage of mealworms lies in their production efficiency. They can be raised in compact vertical systems, require minimal land and water, and can convert low-value organic waste such as vegetable scraps, stale bread, and grain residues into high-value feed protein. This aligns closely with circular economy principles by transforming waste into productive agricultural inputs.

Scientific evidence increasingly shows that insect protein can significantly reduce the carbon footprint, land demand, and water intensity of poultry feed systems. The remaining challenge, therefore, is no longer scientific feasibility, but the development of farmer awareness, market trust, and scalable production models that can integrate mealworm farming into Pakistan's rural poultry economy.

From Scientific Potential to Farmer Adoption

The transition toward mealworm-based poultry feed in Pakistan is not simply a question of nutritional science; it is fundamentally a question of farmer behavior, perception, and trust. While scientific evidence has already established the nutritional suitability and environmental efficiency of yellow mealworms (*Tenebrio molitor*) as a protein-rich poultry feed ingredient, the real challenge lies in understanding whether small-scale farmers are willing to adopt this innovation in practice.

Field-based evidence from poultry-producing areas such as Mianwali highlights an important distinction between knowledge and behavior.

Many smallholder and free-range poultry farmers are already somewhat aware of insect-based feed alternatives. They may have heard about the concept through informal networks, agricultural discussions, or emerging digital content. However, simple awareness does not automatically translate into adoption decisions. Knowledge of a new technology, by itself, is often insufficient to overcome habitual practices and established feeding systems.

What proves far more decisive is farmer attitude. Where poultry producers perceive mealworms as safe, cost-effective, natural, and beneficial for flock health, the likelihood of adoption rises significantly. Positive attitudes act as the behavioral bridge between information and practical use. Once the feed is seen as a smart way to reduce dependence on expensive soybean meals and improve farm profitability, willingness to experiment increases considerably.

At the same time, a strong psychological and cultural barrier remains. In many rural communities, insects are traditionally associated with dirt, pests, or crop damage rather than productive agricultural inputs. This "yuck factor" creates hesitation, even where economic benefits are clear. Some farmers express concern about whether insect-based feed might alter the taste of eggs or meat, while others feel that shifting away from grain-based feeding challenges inherited farming wisdom passed down through generations.

These responses should not be interpreted as resistance to innovation, but rather as evidence that technology adoption in rural agriculture is deeply shaped by culture, trust, and social norms. For mealworm-based feed systems to scale successfully, policy and extension efforts must move beyond awareness campaigns and focus on demonstration farms, peer learning, trust-building, and evidence-based farmer engagement. The future of sustainable poultry nutrition in Pakistan will depend as much on behavioral acceptance as on scientific feasibility.

Building Trust and Driving Adoption of Mealworm-Based Poultry Feed in Rural Pakistan

The pathway toward widespread adoption of mealworm-based poultry feed in Pakistan depends less on technical awareness and more on building farmer confidence through practical engagement. Since attitudes play a far greater role than simple information, the strategy for change must shift from awareness campaigns toward trust-based demonstration and community learning.

The most effective starting point is field demonstration. Rather than relying on brochures or lectures, pilot mealworm production units should be established at local agricultural training centers, livestock extension offices, or village-level demonstration farms. When farmers can physically observe the production process and watch poultry naturally consume mealworms with enthusiasm, skepticism begins to decline. Practical exposure transforms the concept from an unfamiliar idea into a visible, credible solution.

Equally important is hands-on farmer training. Rural poultry producers need simple, low-cost methods for establishing mealworm bins using locally available materials. Training should focus on practical management, waste-based feeding systems, hygiene, harvesting, and incorporation into poultry diets. Once farmers understand that household organic waste and grain residues can be converted into high-value protein feed, the economic attractiveness of the system becomes far more convincing.

Peer learning is another critical driver of behavioral change. Adoption spreads most effectively through trusted community figures rather than external messaging alone. Supporting progressive and respected farmers in each village with starter mealworm kits can create local success stories that encourage wider experimentation. When neighboring farmers observe healthier birds, lower feed costs, and stable production outcomes, confidence spreads organically through social networks.

Language and framing also matter. Positioning mealworms as a "natural protein supplement" rather than simply "insect feed" helps align the practice with poultry's natural feeding behavior and reduces psychological resistance. This reframing connects innovation with tradition rather than presenting it as a disruptive departure from established norms.

Beyond feed economics, mealworm production also strengthens climate resilience and food security. Unlike soy or grain-based protein sources, mealworms can be raised indoors with minimal land, water, and weather exposure. For smallholders facing increasing climate uncertainty, this offers a localized and adaptable protein source that functions as a form of farm-level risk diversification. At the national level, replacing imported soybean meal with locally produced insect protein can reduce foreign exchange pressure, strengthen rural enterprise development, and improve the sustainability of Pakistan's poultry value chain.

Conclusion

Mealworm-based poultry feed offers Pakistan a practical pathway to reduce import dependence, improve smallholder profitability, and strengthen long-term food security. The country's heavy reliance on imported soybean meals has made poultry farmers highly vulnerable to exchange-rate volatility, global commodity shocks, and rising feed costs, all of which directly threaten the affordability of the nation's most accessible animal protein source. In this context, yellow mealworms present a scientifically sound and economically promising alternative.

Their high protein content, efficient feed conversion, low land and water requirements, and compatibility with circular economy principles make them especially suitable for rural poultry systems. By converting household organic waste and crop residues into valuable feed protein, mealworm production can create localized, climate-resilient supply chains that benefit both farmers and the environment. For smallholders, this innovation can lower production costs, stabilize flock management, and reduce exposure to global soy market disruptions.

However, the future of this transition depends less on biology and more on behavior. The decisive factors are farmer trust, positive attitudes, demonstration-based learning, and peer influence within rural communities. Awareness alone is insufficient unless supported by visible success stories, practical training, and extension systems that reduce perceived risk.

Ultimately, mealworm-based feed should be viewed not merely as a poultry nutrition innovation, but as a broader rural development opportunity. It supports climate-smart agriculture, import substitution, waste recycling, and decentralized enterprise creation. If supported through pilot projects, farmer training, and policy incentives, it could become a transformative component of Pakistan's sustainable poultry economy and a model for resilient livestock feeding systems in other developing regions.

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The Agricultural Economist, Vol. 3(4)
ISSN: 3104-8803
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Sustainable Pest Management with Biological Control

Discover how predator-based biological control can transform agriculture by reducing reliance on chemical pesticides. Learn about the role of predatory insects like lady beetles and lacewings in sustainable pest management, promoting ecological balance and protecting pollinators.

Aftab Ali

4/16/2026

For decades, modern agriculture has often resembled a battlefield. Farmers across Pakistan and the wider world have fought a constant war against aphids, caterpillars, whiteflies, mites, and other destructive pests that threaten crop yields and farm incomes. The most common weapon in this struggle has been chemical pesticides. At first, these sprays appeared to offer an efficient and immediate solution: apply the chemical, eliminate the pest, and protect the harvest. Yet over time, the hidden economic, environmental, and health costs of this approach have become impossible to ignore.

Chemical pesticides rarely stop at the target pest. They seep into the soil, reducing microbial health and weakening long-term soil fertility. Runoff carries residues into canals, rivers, and groundwater, threatening water quality and aquatic ecosystems. Even more concerning, traces of these chemicals often remain on vegetables, fruits, and grains that reach household kitchens, raising food safety and public health concerns. Beyond this, excessive pesticide use destroys beneficial insects such as bees, parasitoids, and natural predators that are essential for pollination and ecological balance.

A more sustainable answer, however, has been present in nature all along. Across crop fields, orchards, and vegetable farms, tiny predatory insects quietly regulate pest populations every day. Lady beetles feed voraciously on aphids, lacewing larvae consume whiteflies and soft-bodied insects, and predatory bugs attack mites and caterpillars before outbreaks become severe. These biological control agents function as nature's own pest management workforce.

Their importance goes far beyond pest suppression. By reducing dependence on chemical sprays, natural predators help restore biodiversity, protect pollinators, improve soil and water quality, and lower input costs for farmers. This makes them central to integrated pest management and climate-smart agriculture. The future of sustainable farming may therefore depend less on stronger chemicals and more on working with ecological systems already present in the field. In these tiny predators lies a powerful pathway toward safer food, healthier ecosystems, and more resilient agricultural production systems.

Escaping the Pesticide Trap: Why Sustainable Pest Control Matters

Pest attacks remain one of the most serious threats to agricultural productivity and farm profitability. When aphids invade soybean fields, whiteflies spread across cotton, or caterpillars consume mustard and vegetable crops, the losses go far beyond damaged leaves. Farmers face reduced yields, lower product quality, higher production costs, and in severe cases, the loss of an entire season's income. For smallholders already operating on thin margins, even a minor infestation can destabilize household livelihoods.

In response, chemical pesticides have long been the default solution because they offer speed, familiarity, and immediate visible results. However, this short-term success has created a long-term trap. Repeated use of the same active ingredients allows pest populations to develop resistance, making conventional sprays less effective over time. Farmers are then forced to apply higher doses or switch to stronger and often more hazardous chemicals, increasing both production costs and ecological damage.

The consequences extend well beyond the farm boundary. Excessive pesticide use contaminates soil, pollutes irrigation water, harms beneficial insects, and leaves residues on fruits and vegetables entering local markets. Food safety concerns are rising as pesticide residues increasingly become linked with chronic health risks, including hormonal imbalance, neurological disorders, and certain cancers.

The real challenge today is not simply eliminating pests but doing so without undermining human health and ecosystem stability. This is why sustainable agriculture is shifting toward nature-based solutions. Encouraging beneficial predators, conserving pollinators, and integrating ecological pest management offer a safer and more resilient pathway forward—one where crop protection no longer comes at the expense of public health.

Nature's Precision Defenders: Predatory Insects as the First Line of Crop Protection

Among the most effective yet underappreciated allies in sustainable agriculture are predatory insects, the field's own biological control agents. These tiny hunters patrol crops, orchards, kitchen gardens, and field margins every day, feeding on the pests that threaten yields and farm incomes. Unlike broad-spectrum chemical pesticides that eliminate both harmful and beneficial organisms, predatory insects are remarkably selective. They target crop-damaging pests while preserving pollinators and ecological balance, making them one of nature's most efficient pest-management systems.

One of the most recognizable examples is the lady beetle (family Coccinellidae). While the adult is well known for its bright spotted shell, the larval stage is even more valuable in crop protection. Lady beetle larvae are aggressive predators of aphids, mealybugs, and other soft-bodied insects. A single individual can consume thousands of aphids during its life cycle, providing continuous and cost-free suppression in crops such as vegetables, oilseeds, pulses, and fruit orchards.

Equally important is the green lacewing (family Chrysopidae). Although the adults feed mainly on nectar and pollen, the larvae often called "aphid lions" are voracious predators. They attack aphids, thrips, mites, whiteflies, and insect eggs by piercing the prey and extracting body fluids. Their efficiency makes them

particularly valuable in integrated pest management systems.

Hoverfly larvae provide another powerful line of defense. While adult hoverflies contribute to pollination, their larvae actively prey on aphids and similar pests in vegetable fields, rose gardens, and orchards. This dual ecological role strengthens both pest suppression and crop pollination services.

A broader group of generalist predatory bugs, including minute pirate bugs and big-eyed bugs, further expands biological control by attacking whiteflies, spider mites, thrips, and young caterpillars. Their ability to feed on multiple pest species helps prevent outbreaks before they escalate.

Together, these predatory insects act as a self-sustaining biological security force. By continuously hunting multiple prey items each day, they maintain ecological equilibrium, reduce pesticide dependence, and support healthier, more resilient farming systems.

Predator Insects Delivering Practical Pest Control

The role of predator insects in crop protection is no longer confined to laboratories or textbook ecology; it is now a proven field-level strategy for sustainable agriculture. Across diverse farming systems from soybean landscapes in Brazil to wheat, alfalfa, and mustard fields in South Asia evidence consistently shows that stronger predator populations significantly suppress pest outbreaks and reduce dependence on chemical pesticides.

Field observations from agricultural research institutions, including studies conducted in Pakistan, highlight the remarkable efficiency of ladybird beetles in controlling aphid infestations. In crops such as mustard and fodder legumes, these beneficial insects have repeatedly emerged as one of the most reliable natural enemies. Where their populations are conserved, aphid numbers decline rapidly, often eliminating the need for repeated chemical sprays. This not only lowers production costs but also protects pollinators, soil organisms, and beneficial arthropods that are usually harmed by broad-spectrum pesticides.

Success is even more striking in protected cultivation systems. In greenhouses producing tomatoes, cucumbers, capsicum, and other high-value vegetables, growers are increasingly using deliberate releases of predator insects as part of biological control programs. Green lacewings are introduced to suppress aphids, while predatory mites are used against spider mites and thrips. The outcome is healthier crops, better-quality produce, and minimal pesticide residues, an important advantage for both domestic consumers and export markets.

This model forms the ecological backbone of organic and residue-free farming. By planting flowering borders, reducing indiscriminate pesticide use, and creating habitats that support hoverflies, lacewings, and predatory bugs, farms can establish self-sustaining pest regulation systems. Such biologically active fields remain productive while reducing environmental contamination, strengthening biodiversity, and improving long-term agroecosystem resilience.

Ecological and Economic Gains of Predator-Based Pest Management

The transition from chemical pesticides to predator-based biological control offers benefits that extend far beyond immediate pest suppression. At its core, this approach helps restore ecological balance within farming systems while simultaneously improving economic returns and public health outcomes. Reduced pesticide dependence means fewer toxic residues entering rivers, groundwater, and surrounding landscapes. This directly protects aquatic life, beneficial soil fungi, earthworms, and microorganisms that are essential for nutrient cycling and long-term soil fertility. A cleaner agroecosystem also improves the sustainability of nearby rural environments and reduces contamination risks for surrounding communities.

One of the most significant gains is the protection of pollinators. Bees and other pollinating insects are highly vulnerable to broad-spectrum pesticide exposure, and their decline poses serious risks to fruit, vegetable, and oilseed production. Predator insects, by contrast, target crop pests without harming pollinators, allowing both natural pest regulation and pollination services to function together. This creates a more resilient and productive farming landscape.

Biodiversity also improves substantially. Farms that conserve lady beetles, lacewings, hoverflies, and predatory bugs often become habitats for birds, spiders, soil fauna, and other beneficial organisms. Such biologically rich fields are less prone to pest outbreaks and more stable over time. From an economic perspective, farmers benefit through reduced expenditure on synthetic pesticides, fewer spray operations, and improved market value for residue-free or organic produce, which increasingly attracts premium prices. The public health implications are equally important. Lower pesticide residues on fruits and vegetables reduce consumer exposure to harmful chemicals, contributing to safer diets and better long-term health outcomes.

However, biological control is not an instant solution. Predator insects work best as preventive or early-stage management tools because they require time to establish and suppress pest populations. Their success also depends on careful ecosystem stewardship, including reduced chemical spraying, habitat provision through flowering strips or hedgerows, and patience from farmers. While occasional ecological trade-offs may occur, the broader environmental, economic, and human health benefits make predator-based pest management one of the most promising pathways toward sustainable agriculture.

Conclusion

Predator-based biological control represents one of the most practical and transformative pathways for reducing agriculture's long-standing dependence on chemical pesticides. The evidence is now clear: sustainable pest management is no longer about applying stronger chemicals, but about restoring ecological processes that naturally regulate pest populations. Lady beetles, lacewings, hoverflies, and other predatory insects provide continuous, selective, and cost-effective crop protection while preserving pollinators, soil biodiversity, and water quality.

For farmers, this transition offers both economic and ecological rewards. Reduced pesticide purchases, fewer spray applications, and access to premium markets for residue-free produce directly improve profitability. At the same time, healthier soils, stronger pollination services, and greater on-farm biodiversity create more resilient production systems capable of withstanding pest outbreaks and climate stress. For consumers, the shift means safer fruits and vegetables with lower chemical residues, strengthening food safety and long-term public health.

The broader significance lies in system transformation. Predator conservation aligns strongly with integrated pest management, climate-smart agriculture, and organic farming principles, making it relevant for both smallholders and commercial producers. While successful adoption requires patience, habitat management, and reduced indiscriminate

The Agricultural Economist, Vol. 3(4)
ISSN: 3104-8803

spraying, the long-term benefits far outweigh the limitations.

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Embracing Sustainable Agriculture Practices

Discover how aligning farming practices with plant biology leads to improved soil fertility, efficient water use, and reduced pest pressures. Embrace sustainable agriculture for a resilient farming system that can withstand climate and economic challenges.

Shamsa Bano

4/27/2026

Imagine a farm where soil stays firmly in place even during heavy rains, where crops survive dry spells with minimal water, and where pests are controlled naturally by beneficial insects instead of costly chemicals. This is not an idealistic vision, it is the practical outcome of sustainable agriculture, driven largely by the biological intelligence of plants. Plants are far more than passive elements in farming systems. They are active engineers of the ecosystem. Through their roots, plants interact with complex microbial communities that enhance nutrient availability and improve soil structure.

These microorganisms help bind soil particles together, reducing erosion and increasing the soil's ability to retain water. In drought conditions, certain plant species can regulate water use efficiently, maintaining productivity even under stress. Above the ground, plants contribute to natural pest management. By attracting beneficial insects such as pollinators and predators, they create a balanced ecological system where harmful pests are controlled biologically. This reduces reliance on synthetic pesticides, lowering costs for farmers and minimizing environmental damage.

Plants also play a critical role in regulating climate at the farm level. Through transpiration, they release water vapor into the atmosphere, influencing local humidity and temperature. At the same time, they capture carbon dioxide, helping to mitigate climate change while improving soil organic matter. In essence, sustainable agriculture is not about fighting nature, it is about working with it. By understanding and leveraging plant-based systems, farmers can build resilient, productive, and environmentally sound agricultural landscapes.

The Living Infrastructure of Resilient Farming

The foundation of any food system is soil, yet it is one of the most degraded resources in modern agriculture. Across many regions, topsoil is being lost through wind erosion, water runoff, and continuous intensive cultivation. When soil structure breaks down, it loses its ability to hold nutrients and water, directly undermining farm productivity. Sustainable agriculture begins by reversing this decline, and plants are central to that process.

Beneath the surface, plant roots perform critical engineering functions. They bind soil particles together, improving aggregation and reducing erosion during heavy rainfall. At the same time, roots create channels that enhance water infiltration and aeration, supporting a diverse community of microorganisms. This underground biological network is essential for nutrient cycling and long-term soil fertility.

Certain plants go even further by actively enriching the soil. Leguminous crops such as beans and lentils form symbiotic relationships with nitrogen-fixing bacteria, enabling them to convert atmospheric nitrogen into forms usable by plants. This natural process reduces dependence on synthetic fertilizers, lowering production costs and minimizing environmental pollution. Practices like crop rotation build on this principle, alternating nutrient-depleting crops with soil-restoring ones to maintain balance. Similarly, cover crops protect the soil during fallow periods, acting as a living barrier against erosion while sustaining microbial activity.

Water management is equally critical in an era of increasing climate variability. Plants play a key role in regulating moisture through transpiration, a process that influences local humidity and temperature. In drought-prone conditions, selecting crop varieties with adaptive traits such as deep root systems or reduced leaf surface can significantly improve resilience. These plants access water from deeper soil layers and minimize losses through evaporation.

Integrated systems such as agroforestry further enhance water efficiency. By combining trees with crops, farmers create microclimates that reduce heat stress and improve soil moisture retention. Organic practices like mulching add another layer of protection, conserving water by limiting evaporation and improving soil structure.

Harnessing Biodiversity and Plant Chemistry for Climate-Resilient Farming

Modern agriculture has long relied on chemical control to manage pests, often treating farms as simplified production units rather than living ecosystems. While pesticides can provide short-term relief, their overuse has led to resistant pest populations, declining pollinator numbers, and degraded soil health. This approach, especially under monoculture systems where a single crop dominates vast areas, creates ideal conditions for pests to multiply rapidly. In such systems, a field becomes a uniform food source, making it easier for pests to spread unchecked.

An alternative strategy lies in biodiversity-driven farming. By increasing plant diversity through practices such as intercropping and mixed cropping, farmers can disrupt pest cycles naturally. When multiple crops grow together, pests that specialize in one plant species are less likely to locate and infest their host. This ecological complexity mimics natural systems, where diversity enhances resilience. Companion planting offers practical examples: certain plants release biochemical compounds that deter harmful organisms or attract beneficial insects. For instance, flowering plants can draw predators like lady beetles, lacewings, and parasitic wasps, which feed on crop-

damaging pests. In this way, biodiversity acts as a biological defense system, reducing reliance on synthetic inputs.

Beyond pest control, plants possess sophisticated internal mechanisms to cope with environmental stress. Climate change exposes crops to heat stress, drought, salinity, and nutrient imbalances, all of which can reduce yields. However, plants respond dynamically. They regulate water loss through stomatal closure, adjust growth patterns, and produce protective compounds such as antioxidants to limit cellular damage.

One of the most intriguing discoveries in plant science is the role of melatonin, a compound also found in humans. In plants, melatonin functions as a stress regulator. It enhances root development, improves nutrient uptake, and reduces oxidative stress caused by harsh environmental conditions. Experimental studies show that plants treated with melatonin exhibit greater tolerance to drought and nutrient deficiency, maintaining productivity under adverse conditions.

These insights highlight a broader shift in agricultural thinking. Instead of relying solely on external chemical inputs, sustainable farming increasingly leverages natural biological processes, both at the ecosystem level through biodiversity and at the cellular level through plant physiology. By integrating these approaches, farmers can build systems that are not only productive but also resilient, environmentally sound, and better adapted to the uncertainties of a changing climate.

Putting It All Together: The Farmer as Student

So, what does all this mean for the person putting the seeds in the ground? It means a radical shift in mindset. For generations, industrial agriculture has treated nature as a problem to be dominated, controlled, and beaten into submission with chemicals and heavy machinery. But sustainable farming flips this script entirely. It asks the farmer to become a student of the land, seeing nature not as an enemy to conquer, but as a partner to understand.

Integrating botanical knowledge doesn't require a university degree, but it does require patience, curiosity, and sharp observation. A farmer who understands plant physiology knows exactly how deep it is to irrigate, avoiding the waste of precious water. A farmer who respects plant interactions knows never to plant the same family of crops like tomatoes or peppers in the same spot year after year, thus preventing the build-up of diseases. A farmer who values biodiversity knows to leave the hedgerow standing, recognizing that the "weeds" and wildflowers are a bustling hotel, housing the bees that will pollinate the orchard and the ladybugs that will devour the aphids.

For too long, we have looked at plants as simply "biomass," "yield per acre," or a commodity to be harvested. But the deeper science of botany reveals them to be dynamic, intelligent organism-living systems capable of building their own soil, sourcing their own fertilizer, managing their own water budget, and defending themselves against pests. Our job as stewards of the earth is not to micromanage every leaf and root, but to get out of their way, learn their language, and lend a helping hand when needed.

Conclusion

Sustainable agriculture ultimately rests on a simple but powerful realization: plants are not just inputs in the production process; they are the system itself. When farmers align their practices with plant biology, the results extend far beyond higher yields. Soil becomes more stable and fertile, water is used more efficiently, and pest pressures decline without heavy reliance on chemicals. These gains are not isolated; they reinforce one another, creating a resilient farming system capable of withstanding climate and economic shocks.

The future of agriculture is not about increasing external input but about improving internal processes. Healthy soils built through root systems and microbial activity reduce input costs. Biodiversity-driven pest management lowers chemical dependency. Plant-based stress responses, including natural compounds like melatonin, open new pathways for climate adaptation. Together, these approaches shift farming from a high-cost, high-risk model to a more balanced and sustainable one.

For policymakers and practitioners alike, the message is clear: investment in plant science, farmer education, and ecosystem-based practices is essential. Sustainable agriculture is not a compromise on productivity; it is a smarter way to achieve it. By working with plant systems rather than against them, agriculture can secure food production, protect natural resources, and build long-term resilience for future generations.

Please note that the views expressed in this article are of the author and do not necessarily reflect the views or policies of any organization.

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The Agricultural Economist, Vol. 3(4)
ISSN: 3104-8803

RURAL COMMUNITY

Sustainability of Pakistan's Poultry Sector

Explore the challenges facing Pakistan's poultry sector, focusing on the critical role of small-scale farmers. Learn about rising feed costs, middlemen exploitation, and the impact on rural livelihoods and nutritional security.

Aliza Ahsan Ali, Aisha Khatoon & Sadaf Fiaz

4/3/2026

When consumers pick up a pack of chicken from the market, they rarely think about the small farmer behind it. Yet across Pakistan, especially in rural Punjab and Khyber Pakhtunkhwa, that farmer is under severe financial pressure. On paper, Pakistan's poultry sector appears to be a remarkable success story. It has emerged as the world's 11th largest poultry producer, expanding at an annual growth rate of nearly 7.3%. The industry provides livelihoods to around 1.5 million people and contributes more than 40% of the country's total meat supply, making it a cornerstone of both rural employment and national food security.

However, behind these promising statistics lies a growing crisis for small-scale producers who operate with limited capital and thin profit margins. Their biggest challenge is feed cost, which now consumes an overwhelming 70-80% of total production expenses. Farmers repeatedly say that *dana* (feed) has become the main reason their businesses are becoming unsustainable. The prices of maize and soybean meals, the two most critical ingredients in poultry feed, have risen sharply over the past year. Maize alone absorbs nearly 65% of Pakistan's total corn output because of its dominant role in poultry rations.

The pressure intensified after the lifting of restrictions on GMO soybean imports in late 2024, which revived poultry expansion but also stimulated stronger demand for maize as feed production increased. Domestic maize demand is expected to reach 9.1 million tonnes in 2025–26, surpassing available supply and naturally driving prices upward.

Adding to this burden, the 2026 Federal Excise Duty of Rs10 per day-old chick has created fresh uncertainty. Industry leaders warn that this tax discourages hatchery operations, reduces chick availability, and raises production costs further. For small farmers, this is not merely a tax, it is a direct threat to survival, pushing many toward closure and ultimately increasing chicken prices for Pakistani households.

Markets, Disease, and Financial Exclusion

For Pakistan's small poultry farmers, rising feed prices are only one part of a much larger crisis. Another major challenge is the long-standing *arhti* or middleman system, which keeps farmers locked in weak bargaining positions. Most small-scale producers lack direct access to urban wholesale markets, cold-chain transport, or retail networks. As a result, they are forced to sell live birds and eggs to brokers at prices determined entirely by intermediaries. The farmer bears the production risk, but the middleman captures the market power.

This trap becomes even more damaging during periods of oversupply. In early 2026, egg prices in Pakistan dropped sharply when exports to Gulf countries slowed due to regional conflict and disrupted trade routes. Stocks originally destined for Middle Eastern markets were redirected into domestic channels, creating a sudden glut in local markets. When supply flooded wholesale mandis, farmgate prices crashed, leaving many small farmers selling below cost. Since brokers control transport, timing, and final sale negotiations, farmers had virtually no leverage to protect their margins.

Disease adds another layer of vulnerability. For many poultry farmers, the constant fear is not only price collapse but the sudden appearance of Newcastle Disease, Gumboro, Avian Influenza, or Fowl Typhoid. A major 2025 field study covering 140 poultry farms across Pakistan highlighted how frequent these outbreaks remain in small and medium operations. The study linked disease prevalence to poor hygiene, overcrowded sheds, reuse of rice husk litter, and weak feed management practices. Importantly, it was found that better-educated farmers experienced fewer outbreaks and used antimicrobials more responsibly, reducing both mortality and resistance risks.

Yet in many rural districts, trained veterinarians are scarce. Farmers often turn to unqualified local practitioners who prescribe antibiotics without diagnosis, leading to treatment failure and sometimes mass mortality. The economic consequences can be devastating, especially for households whose poultry shed is their main income source.

Weak biosecurity further magnifies the problem. Many small farms operate in open sheds or backyard systems where birds remain exposed to wild birds, rodents, contaminated visitors, and unsafe water sources. Basic practices such as footbaths, equipment disinfection, litter replacement, and controlled shed access are often missing, either because farmers cannot afford them or lack training. Climate shocks make these weaknesses worse. During the 2025 floods in Khyber Pakhtunkhwa, thousands of poultry birds died, and dozens of livestock shelters were destroyed, exposing how fragile rural poultry infrastructure remains in the face of disasters.

The final barrier is finance. Poultry farming requires continuous cash flow for chicks, feed, medicines, vaccines, electricity, and labor. However, most rural farmers remain excluded from formal credit because they lack land titles, collateral, or the documentation banks require. Many therefore rely on informal moneylenders charging exploitative rates, which traps them in cycles of debt. Although government schemes such as the Punjab Agriculture Loan Scheme offer subsidized and interest-free loans for poultry units, awareness remains low and application procedures are often too technical for small farmers. Without easy credit, insurance, and financial literacy support, one disease outbreak or market crash can erase years of hard work overnight.

Climate Change and the Fight for Survival in Pakistan's Poultry Sector

Climate change has emerged as one of the most serious long-term threats facing Pakistan's small-scale poultry farmers. The country is already on the front lines of global climate

vulnerability, and poultry production systems, especially in rural and peri-urban areas, are highly exposed to rising temperatures, erratic rainfall, and extreme weather events. For poultry farmers, climate stress is not an abstract environmental issue; it directly affects bird survival, feed efficiency, disease incidence, and farm income.

Sudden heatwaves reduce feed intake, slow bird growth, and sharply increase mortality, particularly in broiler units operating in poorly ventilated sheds. At the same time, unseasonal rainfall and flooding damage poultry housing, spoil feed stocks, contaminate drinking water, and create ideal conditions for bacterial and viral outbreaks. The devastating 2025 floods in Khyber Pakhtunkhwa clearly demonstrated how climate disasters can wipe out thousands of birds within days while also destroying shelters and rural veterinary infrastructure. Most small farmers simply do not have climate-resilient sheds, cooling systems, drainage, or emergency savings to recover from such losses.

Despite these risks, there are encouraging examples of targeted support. In October 2025, the King Salman Humanitarian Aid and Relief Centre (KSrelief) launched a livelihood restoration initiative in Khyber Pakhtunkhwa. The project provides poultry birds, feed kits, and hands-on training to vulnerable households, while parallel livestock support is being extended through goat distribution and silage management programs. Such interventions demonstrate that even modest investments in training, inputs, and asset replacement can significantly strengthen rural resilience.

The broader lesson is clear: Pakistan's small poultry farmers remain essential to national food security, yet they cannot continue carrying this burden alone. A forward-looking poultry policy must integrate climate-smart housing, early warning systems, veterinary outreach, subsidized vaccines, affordable credit, and farmer training. If smallholders are strengthened, Pakistan protects not only rural livelihoods but also the affordability of protein for millions of households.

Conclusion

Pakistan's poultry sector may be expanding rapidly, but its long-term sustainability depends on the survival of the small-scale farmers who form its foundation. These producers are far more than suppliers of chicken and eggs; they are critical actors in rural livelihoods, employment generation, and the country's nutritional security. Yet the article clearly shows that they are trapped in a cycle of rising feed costs, middlemen exploitation, recurring disease outbreaks, weak biosecurity, financial exclusion, and increasing climate vulnerability.

The challenges are interconnected. Expensive maize and soybean feed raises production costs, while disease and poor veterinary outreach increase mortality risks. Market distortions created by brokers reduce farmers' bargaining power, and the absence of affordable credit prevents investment in better housing, cooling, and biosecurity systems. Climate shocks such as floods and heatwaves then magnify every existing weakness. Together, these pressures threaten not only farm incomes but also the affordability of poultry protein for ordinary Pakistani households.

The way forward requires a smallholder-centered poultry policy that combines farmer training, disease surveillance, accessible veterinary services, climate-resilient infrastructure, subsidized vaccines, and simple credit and insurance products. Strengthening direct market linkages and farmer cooperatives can also reduce dependence on middlemen. Protecting small poultry farmers ultimately means protecting rural resilience, public nutrition, and Pakistan's broader food security future.

Please note that the views expressed in this article are of the author and do not necessarily reflect the views or policies of any organization.

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Global History of Health Decentralization Insights

Explore the global history of health decentralization and its impact on responsive healthcare. Learn how strong institutions, fair financing, and national stewardship are essential for successful governance in health.

RURAL COMMUNITY

Amina Tariq

4/9/2026

Over the last four decades, the governance of health systems has undergone a quiet but transformative shift. Across countries with very different political traditions, economic capacities, and institutional histories, authorities have steadily moved away from central ministries toward provinces, districts, municipalities, and in some cases even autonomous hospitals. This process, widely known as decentralization, has been championed as a solution to rigid bureaucracy, slow decision-making, and the inability of centralized systems to respond to local realities.

At first glance, the appeal is powerful. Local governments and district managers are often far better positioned to understand the immediate health needs of their populations than officials sitting in national capitals. A rural district struggling with maternal mortality, vaccine hesitancy, malnutrition, or water-borne disease requires context-specific solutions that national one-size-fits-all policies may fail to provide. By moving decision-making authorities, fiscal resources, and administrative responsibility closer to the community, decentralization promises faster responses, stronger accountability, and more citizen-centered care.

However, the real-world experience has shown that decentralization is far from a universal cure. Its outcomes depend heavily on institutional capacity, fiscal design, political coordination, and local governance quality. In some countries, it has strengthened primary healthcare, improved maternal and child services, and encouraged innovation in local health delivery. In others, it has fragmented financing, widened regional disparities, weakened national disease control programs, and left poorer districts unable to meet even basic service standards.

The true lesson is that decentralization is not inherently good or bad; it is a governance instrument whose success depends on how responsibilities, funding, and accountability mechanisms are structured. This makes it one of the most important issues in contemporary public health economics and policy reform. By examining lessons from countries such as Brazil, Italy, Norway, and Pakistan, the broader story becomes clear: decentralization can either democratize health systems or deepen inequality, depending on the political and fiscal architecture that supports it.

Why Countries Chose to Decentralize Health Care

The global movement toward decentralizing healthcare emerged from a broader wave of political and economic reform that began in the late 1970s and accelerated through the 1980s and 1990s. Many governments started to question whether highly centralized states could deliver timely, efficient, and locally relevant public services. Large ministries were increasingly viewed as bureaucratic, costly, and disconnected from the daily realities of citizens, especially in rural and underserved areas. In response, decentralization was promoted as a governance reform that could bring decision-making closer to the people who use health services.

From an economic standpoint, centralized health systems were criticized for relying on uniform national policies for highly diverse populations. A single national plan may fail to reflect major regional differences in geography, poverty, culture, epidemiology, and infrastructure. For example, a district facing high maternal mortality, malnutrition, and unsafe drinking water requires a very different intervention package than an urban industrial zone dealing primarily with diabetes, cardiovascular disease, and air pollution. Decentralization promised flexibility by allowing provinces, districts, and local governments to design services around their own disease burdens and social realities.

Politically, the reform was closely tied to democratization and local accountability. When local authorities are given real control over budgets, staffing, and service delivery, citizens can exert pressure more directly through elections, community forums, and local representation. Health policy becomes a visible local responsibility rather than a distant national promise.

However, decentralization is not a single reform model. It can involve political devolution, administrative delegation, or fiscal decentralization, each carrying different risks and opportunities. These distinctions are especially critical in Pakistan, where nearly two-thirds of the population still lives in rural areas, yet health outcomes remain deeply unequal across provinces and districts.

Pakistan: Devolution Without Preparation

Pakistan's decentralization experience offers one of the clearest lessons in how governance reform can fail when institutional readiness is ignored. The 18th Constitutional Amendment transferred health from the federal government to the provinces, a move intended to strengthen provincial autonomy and improve responsiveness to local needs. In theory, this was a major democratic step. In practice, however, the transition exposed deep weaknesses in fiscal coordination, administrative planning, and service continuity problems that were felt most sharply in rural communities.

The most immediate impact was the sudden disruption of nationally coordinated public health programs. Flagship initiatives such as the Lady Health Workers (LHW) program, Expanded Program on Immunization (EPI), maternal health outreach, and disease surveillance systems were left in a state of uncertainty. Provinces inherited major responsibilities without a clearly sequenced transfer of budgets, supply chains, technical systems, or performance monitoring structures. In many districts, this led to delayed salaries, medicine shortages, inconsistent vaccine supply, and confusion over reporting lines.

The rural consequences were severe. The Lady Health Workers program, once celebrated globally for deploying over 100,000 women into villages to provide maternal, child, and preventive care, lost much of its national uniformity after devolution. Provinces began implementing different standards for training, supervision, incentives, and logistics. While relatively stronger provinces such as Punjab and parts of Sindh managed partial continuity, rural Balochistan and remote southern districts faced serious operational decline.

This divergence revealed the deeper risk of decentralization without preparation: local autonomy can widen inequality when subnational capacity is uneven. In fragile rural regions, the breakdown of outreach services translated into missed immunization, weaker antenatal care, stalled disease surveillance, and preventable maternal and child deaths.

The central lesson is stark. Decentralization is not merely the transfer of authority; it is the transfer of systems. Without phased implementation, fiscal clarity, and institutional strengthening, reform can unintentionally punish the very rural populations it is meant to empower.

The Rural Reality: When Decentralization Deepens Health Inequality

The most fragile casualty of health decentralization is often equity, particularly in countries where regional disparities are already severe. Under centralized systems, health financing usually operates through national risk pooling, where revenues collected from wealthier regions help subsidize services in poorer districts. This implicit solidarity allows rural and low-income populations to access at least a minimum standard of care, even when their local tax base is weak. Once financing is decentralized, however, this redistributive mechanism can begin to fracture.

The result is a widening gap between places that can finance health and places that cannot. Wealthier provinces and urban districts can build better hospitals, attract specialists, maintain medicine stocks, and invest in diagnostics and digital systems. Poor rural districts, by contrast, remain trapped with weak infrastructure, understaffed facilities, and chronic shortages. Without strong fiscal equalization transfers from the center,

decentralization can transform geography into destiny.

In Pakistan, this pattern is clearly visible. After devolution, stronger provinces, especially Punjab, were able to expand tertiary hospitals and high-profile urban services in Lahore, Rawalpindi, and other major cities. Meanwhile, rural districts such as Tharparkar, Rajanpur, Dera Bugti, and remote parts of Balochistan continued to struggle for basic medicines, skilled birth attendants, and functioning emergency transport. The consequences are stark: maternal and infant mortality remains dramatically higher in these areas than in major urban centers.

The key lesson is that decentralization alone does not guarantee fairness. Unless accompanied by robust equalization formulas, targeted rural transfers, and national minimum service standards, it risks reinforcing the very inequalities that health systems are meant to reduce.

What the World Teaches Us About Decentralization and Health Equity

International experience offers a rich set of lessons on when decentralization strengthens health systems and when it deepens inequality. One of the most successful examples comes from Brazil, where decentralization was carefully embedded within a constitutional commitment to health as a universal right. Municipalities were given responsibility for delivering primary healthcare, family medicine, immunization, and community outreach. However, the federal government did not abandon its role. It retained strong control over financing flows, service standards, and redistribution mechanisms. Through guaranteed per-capita transfers and targeted incentives for poorer municipalities, even disadvantaged rural areas received stable funding. This balance between local flexibility and national stewardship helped Brazil achieve major gains in child survival, vaccination coverage, and maternal health, particularly in historically neglected regions.

European cases reinforce the same lesson. In Italy and Spain, regional autonomy often improved efficiency and innovation in wealthier northern regions, but it also widened territorial inequalities. Richer regions could invest in modern hospitals, specialists, and advanced diagnostics, while poorer southern areas struggled with deficits and service cuts, forcing patients to migrate internally for treatment. By contrast, Scandinavian systems, especially Norway, demonstrate how decentralization can remain equitable when paired with strong fiscal equalization. Norway's funding formulas explicitly adjust for age structure, remoteness, climate, transport barriers, and social vulnerability, recognizing that serving a remote Arctic settlement costs far more than serving an urban district.

For Pakistan, the global lesson is unmistakable: decentralization only works when the federal government shifts from direct control to strategic stewardship. This means retaining responsibility for fiscal redistribution, minimum national service standards, disease surveillance, emergency coordination, and pooled drug procurement.

This creates the central paradox of decentralization: successful local autonomy depends on a strong center. Local governments need the freedom to adapt services to their populations, but they also need a national framework that protects equity and coordinates functions that cannot be fragmented. When this balance is achieved, decentralization can produce systems that are both locally responsive and nationally fair.

A Cautious Path Forward for Rural Pakistan

Pakistan's future approach to decentralization in health must be far more strategic than past reforms. The priority is to clearly distinguish which functions require national coordination and which can be localized. Certain public health programs, especially immunization, polio eradication, disease surveillance, drug regulation, and the Lady Health Workers framework, depend on uniform standards, pooled procurement, and nationwide monitoring. These should remain federally coordinated in design, financing, and technical oversight, even when day-to-day delivery is carried out by provinces and districts. Fragmenting such high-impact programs has already shown how quickly rural populations can suffer.

The second requirement is true fiscal decentralization alongside administrative devolution. Rural districts cannot be assigned responsibilities for maternal health, primary care, nutrition, and emergency referral systems without predictable resources. Pakistan urgently needs a transparent, formula-based transfer mechanism that allocates more funds to poorer and harder-to-reach districts, considering poverty levels, remoteness, disease burden, and gender vulnerability. Without such equalization, devolution risks becoming a transfer of blame rather than a transfer of capacity.

Third, institutional capacity must precede authority. Giving more decision-making power to rural district health officers without management skills, real-time data, procurement support, or logistics systems is not empowerment, it is systemic neglect. Investment in management training, digital health information systems, telemedicine support, and modern supply chain tracking are essential before further powers are devolved.

Finally, decentralization must be anchored in village-level accountability. District health committees, union council oversight, community scorecards, and women's representation in local health planning can ensure that services respond to real needs. When rural citizens, especially women, can shape how resources are spent, decentralization becomes not just a governance reform but a pathway to equitable public health delivery.

Conclusion

The global history of health decentralization offers a powerful but cautionary lesson: moving authority closer to the people can improve responsiveness, but only when it is matched with strong institutions, fair financing, and national stewardship. Decentralization is not a magic formula for better healthcare; it is a governance choice whose success depends on how well power, money, standards, and accountability are aligned.

Pakistan's experience after the 18th Constitutional Amendment demonstrates both the promise and the danger of reform. While provincial autonomy created space for local adaptation, the absence of phased planning, fiscal equalization, and institutional preparation exposed rural communities to serious service disruptions. The result was not simply administrative confusion, but real human costs in the form of missed immunization, weakened maternal care, and widening rural–urban health inequalities.

The central policy lesson is clear: a strong center and empowered local systems are complements, not substitutes. National coordination must continue for immunization, disease surveillance, procurement, and redistribution, while districts should gain flexibility in delivery and local problem-solving. For rural Pakistan, this balance is essential to ensure that decentralization reduces, not deepens, existing inequalities.

Ultimately, the goal is not merely to devolve authority, but to build a health system where geography no longer determines survival. If designed carefully, decentralization can become a tool for rural inclusion, stronger primary care, and more accountable governance. If designed poorly, it risks turning local autonomy into localized inequity.

Please note that the views expressed in this article are of the author and do not necessarily reflect the views or policies of any organization.

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Combat Farm Parasites for Healthier Livestock

Parasites are hidden thieves on every farm, stealing silently. Learn how strategic deworming, pasture rotation, and good hygiene can help farmers manage parasites effectively, leading to thriving animals, increased milk production, and stronger rural communities.

Rimsha Jamil & Muhammad Imran

4/14/2026

For millions of small-scale farmers across rural Pakistan, livestock is far more than a productive asset, it is a family's savings account, daily nutrition source, and financial safety net. Every morning begins with feeding animals, cleaning sheds, checking water, and closely watching goats, sheep, buffaloes, or cows for signs of health and growth. Farmers invest time, labor, and emotion into every animal because healthy livestock means milk on the table, stronger offspring, manure for crops, and better prices in local markets. Yet within this system, an invisible threat quietly undermines these efforts every single day.

This hidden thief is parasitic disease. Internal parasites such as gastrointestinal worms, liver flukes, and protozoa, along with external parasites like ticks, lice, mites, and biting flies, continuously weaken animal health without always causing sudden death. Their damage is gradual but economically devastating. Animals eat less, lose weight, produce less milk, grow slowly, suffer poor fertility, and become more vulnerable to secondary infections. In many cases, farmers only recognize the problem when animals appear weak, fail to conceive, or fetch lower prices in the mandi.

The real danger lies in how silently parasites reduce productivity. A cow may survive but produce less milk for months. A goat may remain alive yet fail to gain enough weight for Eid sales. A buffalo calf may grow slowly because nutrients are being stolen internally by worms. Across thousands of farms, these small daily losses accumulate into major economic damage for rural households and the national livestock economy.

Understanding this invisible burden is essential for sustainable agriculture. Effective parasite control through regular deworming, improved shed hygiene, pasture management, clean drinking water, and early veterinary support can dramatically improve animal productivity and farm income. Managing parasites is therefore not only an animal health intervention, it is a livelihood strategy that protects rural prosperity, strengthens food security, and builds resilience in Pakistan's agricultural future.

The Silent Economic Drain of Parasitic Diseases in Livestock

Parasitic diseases represent one of the most dangerous yet least recognized threats to livestock productivity in Pakistan's rural farming systems. These parasites exist in many forms, including internal helminths that inhabit the stomach, intestines, lungs, or liver, protozoan infections such as coccidiosis that damage the intestinal lining, and external parasites like ticks, lice, mites, and biting flies that feed on blood and irritate the skin. Their widespread presence makes them constantly risk across smallholders and commercial livestock farms alike.

What makes parasites especially dangerous is their silent and chronic nature. Unlike sudden outbreaks of viral or bacterial disease that produce visible illness or rapid mortality, parasitic infections often remain subclinical for long periods. Animals may continue eating, walking, and appearing outwardly normal, which leads many farmers to underestimate the problem. However, inside the body, nutrients are being diverted, blood is being lost, and immune defenses are being weakened. The result is a gradual but persistent decline in productivity.

The economic consequences are severe. A goat carrying a heavy worm burden may yield significantly less milk over an entire lactation cycle. Calves suffering from chronic coccidiosis often experience slow growth, requiring additional months to reach marketable weight. Sheep infested with ticks may produce poor-quality wool and become more susceptible to bacterial and viral diseases due to weakened immunity. These outcomes directly reduce farm income through lower milk sales, delayed meat production, reduced fertility, and in severe cases, animal mortality.

The financial burden extends beyond visible production losses. Farmers also face indirect costs through repeated deworming treatments, veterinary consultations, extra feed requirements, and reduced sale prices in livestock markets where unhealthy animals attract lower bids. Secondary infections further

multiply expenses because parasite-weakened animals become easy targets for other diseases.

For smallholder households already operating on narrow margins, these losses can undermine household nutrition, reduce school spending, and increase dependence on debt. Effective parasite control is therefore not only an animal health necessity but a critical economic strategy for protecting rural livelihoods and sustaining Pakistan's livestock-based agriculture.

The Economic Rewards for Effective Parasite Management

The encouraging reality for livestock farmers is that parasitic diseases are highly manageable, and effective control can significantly improve farm profitability. Parasites may be a hidden drain on animal productivity, but with timely prevention and strategic treatment, their impact can be greatly reduced. This turns parasite management from a veterinary task into a direct income-enhancing investment for rural households.

The first and most immediate benefit is higher productivity. Healthy animals use nutrients efficiently for milk production, body growth, and reproduction rather than losing them to worms, protozoa, or blood-sucking external parasites. Research consistently shows that well-planned deworming and tick control programs can raise milk yield by 15–30% and improve weight gain by 20–40%. For smallholder farmers, such gains can substantially increase daily cash flow and improve returns on the livestock markets.

Another major advantage is improved feed conversion efficiency. Feed is one of the largest costs in livestock production, and parasites effectively divert this costly nutrition away from the animal. Once parasites are controlled, every kilogram of fodder, concentrate, or crop residue contributes directly to growth, milk, and body condition. This lowers the cost of production per liter of milk or kilogram of meat.

Reproductive performance also improves. Animals free from chronic parasite burdens conceive more easily, maintain pregnancies better, and produce healthier offspring with stronger survival rates. Even one additional healthy calf, lamb, or kid can significantly raise annual household income.

Most importantly, preventive parasite management reduces emergency veterinary costs, lowers mortality risk, and minimizes secondary infections. These savings strengthen farm resilience, improve household livelihoods, and make livestock production more sustainable across Pakistan's rural economy.

Integrated Parasite Management

The long-term solution to livestock parasites is not excessive reliance on chemicals, but a smarter and more sustainable system known as Integrated Parasite Management (IPM). For many years, farmers have depended heavily on anthelmintic drugs and acaricides as the first line of defense against worms, ticks, and other parasites. While these medicines remain important, their indiscriminate and repeated use has created a growing global problem: drug-resistant parasites. In many livestock systems, worms are increasingly surviving standard treatments, reducing the effectiveness of medicines that farmers once trusted.

Beyond resistance, chemical overuse also creates environmental and food safety concerns. Residues may remain in milk and meat, soil quality may deteriorate, water sources can become contaminated, and beneficial organisms such as dung beetles and soil insects may be harmed. This makes a multi-pronged management strategy far more effective than a single chemical approach.

Integrated Parasite Management combines several preventive and control measures. The first principle is strategic deworming rather than routine blanket treatment. Animals should be treated based on risk, age, body condition, and seasonal parasite pressure, preferably under veterinary guidance. Young, weak, and highly infected animals often require priority treatment, while unnecessary dosing of healthy stock should be avoided.

Pasture rotation is another highly effective tool. Since many parasites complete part of their life cycle on pasture, moving animals between grazing sections interrupts reinfection and reduces larval buildup. Likewise, shed hygiene and manure management are essential. Regular manure removal, proper composting, raised feeding troughs, and clean drinking water significantly reduce parasite exposure.

Nutrition also plays a defensive role. Animals receiving adequate protein, energy, and essential minerals develop stronger immune responses, making them naturally more resistant to parasite establishment and damage. Over time, selective breeding can further strengthen herd resilience by favoring animals that consistently show lower parasite burdens.

This integrated approach lowers treatment costs, preserves drug effectiveness, protects environmental health, and improves livestock productivity. For Pakistan's smallholders, IPM offers a practical pathway toward healthier animals, stronger incomes, and more sustainable rural livestock systems.

Building Sustainable Rural Futures Through Parasite Management

Effective parasite management extends far beyond improving the productivity of individual livestock farms; it represents a foundational pillar for strengthening rural economies, enhancing food security, and building climate-resilient agricultural systems. When livestock are healthier and more productive, the benefits cascade through entire rural communities, shaping livelihoods, nutritional outcomes, and long-term development trajectories.

At the household level, reduced parasite burden translates into more stable and predictable incomes. Farmers are less frequently forced into distress sales of animals or emergency borrowing to cover veterinary costs. This financial stability enables families to plan with greater confidence, invest in better housing, diversify income sources, and prioritize children's education, particularly for girls in rural areas where economic pressure often determines schooling decisions. In this way, livestock health becomes directly linked to human development outcomes.

At the broader societal level, parasite control strengthens national food security. Pakistan's growing demand for affordable animal protein (milk, meat, and eggs) depends heavily on efficient and productive livestock systems. When animals are free from parasitic stress, they convert feed into higher-quality output, increasing the availability of nutritious food in local markets and help stabilize prices for low-income consumers. Improved animal health also reduces disease transmission risks, contributing to safer food systems.

Environmental gains are equally significant. Reduced reliance on chemical dewormers helps protect soil biodiversity, water quality, and beneficial insect populations. Practices such as rotational grazing and improved manure management enhance soil fertility and carbon sequestration, contributing to climate-smart agriculture. These ecological benefits are increasingly important as Pakistan faces rising climate variability.

Despite these advantages, adoption remains limited due to persistent barriers. Many farmers lack awareness of the true economic cost of

parasites, while veterinary services remain inaccessible in remote areas. Poverty constrains preventive action, drug resistance is spreading, and climate change is altering parasite dynamics, making management more complex.

Addressing these challenges requires coordinated action. Farmers must adopt basic monitoring and hygiene practices, extension systems must prioritize education and outreach, researchers must develop better diagnostics and resistance mapping tools, and young professionals must bridge science with rural applications.

Conclusion

Parasites are hidden thieves on every farm. They steal silently, invisibly, day after day. But thieves can be caught. With the right knowledge, strategic deworming, pasture rotation, good hygiene, strong nutrition, and selective breeding, farmers can fight back. When parasites are managed effectively, animals thrive. Milk pails fill faster. Kids grow stronger. Market prices have improved. Families escape the cycle of debt. Rural communities become more stable, more resilient, and more sustainable.

This is not complicated science. It is practical, proven, and within reach of every farmer, from the smallest home stead to the largest commercial herd. The only missing piece is awareness and action. So, share this article. Talk to a farmer about parasites. Visit your local veterinary clinic. Ask questions. Because every animal saved from parasites is a family fed, a child educated, and a step toward a more prosperous, sustainable Pakistan. The thief is real. But so is the solution. Let's get to work.

Please note that the views expressed in this article are of the author and do not necessarily reflect the views or policies of any organization.

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Managing Seasonal Parasite Outbreaks in Livestock

Seasonal parasite outbreaks, especially in April, are predictable and manageable. Learn how to protect livestock health and improve farm profitability by addressing internal and external parasites effectively.

Rimsha Jamil & Muhammad Imran

4/22/2026

As winter recedes and April introduces warmer temperatures and damp soil conditions, farms enter a biologically active period that extends beyond crop growth. This seasonal transition also triggers a rapid increase in parasitic activity, posing a serious threat to livestock health and farm profitability. What may appear as a routine seasonal shift is a critical risk window for farmers who rely on animal productivity for income. April creates near-ideal ecological conditions for parasite proliferation. Rising temperatures accelerate biological processes, while residual soil moisture from late winter or early spring rainfall supports the survival and mobility of parasite larvae.

For internal parasites, particularly gastrointestinal worms, this environment speeds up life cycles deposited in pastures hatch more quickly, and larvae reach infectious stages within days rather than weeks. Similarly, liver flukes benefit from increased populations of freshwater snails, their intermediate hosts, which thrive in wet conditions. External parasites also become significantly more aggressive during this period. Ticks, lice, and mites experience population surges as warmer weather enhances their reproduction rates and host-seeking behavior. Infestations can spread rapidly across herds, especially where animals are closely grazed or housed.

The economic implications are substantial. Parasite burdens reduce feed efficiency, slow weight gain, decrease milk production, and increase veterinary costs. In severe cases, they can lead to mortality, directly impacting farm income. Left unmanaged, these effects compound over time, eroding profitability during a season that should otherwise support growth.

Understanding April as a high-risk period allows farmers to shift from reactive to preventive management. Timely intervention, through monitoring, strategic treatment, and pasture management, can significantly reduce losses. In essence, controlling parasites in April is not just a health measure; it is a financial strategy critical to sustaining livestock productivity.

Internal and External Parasites in Livestock

Parasites affecting livestock can broadly be divided into internal and external categories, both of which impose significant but often underestimated economic costs on farmers. Internal parasites are particularly dangerous because they operate silently within the animal, causing damage long before visible symptoms emerge. One of the most notorious is Haemonchus contortus, commonly known as the barber pole worm. It feeds on blood in sheep and goats, leading to anemia, weakness, reduced productivity, and in severe cases, death. Farmers may notice pale gums, lethargy, and weight loss despite normal feeding, indicating a serious underlying infection.

Another major internal parasite is Fasciola hepatica, which targets the liver of cattle, sheep, and goats. By damaging liver tissue, it disrupts metabolism, reduces feed conversion efficiency, and lowers milk production. The economic loss is often gradual but substantial, as the disease progresses unnoticed until productivity declines become significant. In pigs, infections caused by Ascaris suum can impair growth and cause respiratory complications, particularly in younger animals.

In contrast, external parasites are more visible but equally harmful. Ticks, for instance, not only extract blood but also act as vectors for serious diseases, weakening animals and reducing overall farm output. Mites and lice create persistent irritation, leading to excessive scratching, skin damage, and secondary infections. This stress directly affects feeding behavior and growth performance. Flies, especially biting species, further compound the problem by disturbing animals during grazing, reducing feed intake and productivity over time.

Together, these internal and external parasites form a dual threat. While one drains health from within, the other disrupts from outside, both steadily eroding livestock performance, farm efficiency, and ultimately, farmer income if left unmanaged.

The Economic Impact of Parasites and the Role of Farm Management

Parasites are not just a biological problem, they are a direct financial drain on livestock operations. Their impact is most visible in reduced productivity, which translates immediately into lower farm income. One of the earliest effects is on growth rates. Young animals infected with parasites utilize feed less efficiently, meaning they require more time and resources to reach market weight. This increases feeding costs while reducing the final market value, especially if animals remain underdeveloped.

Milk production is another critical area affected. Parasitic infections interfere with nutrient absorption and increase physiological stress, leading to noticeable declines in milk yield. Even a modest reduction sustained over a full lactation period can result in substantial revenue loss for dairy farmers. Similarly, reproductive performance deteriorates under parasite pressure. Infected animals often exhibit delayed maturity, lower conception rates, and higher incidences of reproductive failure. This not only affects current output but also weakens future herd potential.

Operational costs also rise significantly. Frequent use of dewormers, acaricides, and veterinary services adds to farm expenses. The situation becomes more complex when parasites develop resistance to commonly used treatments, forcing farmers to invest in more expensive alternatives. In severe infestations, mortality becomes a real risk, leading to complete loss of investment in affected animals.

However, the severity of these impacts varies widely across farms, largely due to management practices. Poor sanitation, overcrowding, and continuous grazing on the same land create ideal conditions for parasite buildup. Inadequate housing, particularly damp and poorly ventilated spaces, further accelerates the spread of external parasites. Conversely, farms that implement pasture rotation, maintain hygiene, and monitor animal health regularly are better positioned to control parasite loads effectively. In essence, while parasites are inevitable, their economic impact is largely determined by management decisions within the farmer's control.

Integrated Parasite Control: A Practical Strategy for Farmers

Effective parasite control does not require complex science, requires consistency, planning, and informed decision-making. A structured approach to parasite management can significantly reduce production losses while improving overall herd health. One of the most critical steps is strategic deworming. Rather than reacting to visible illness, farmers should adopt preventive treatment schedules based on seasonal risk patterns. In many regions, April represents a peak risk period, making it an essential time for intervention under veterinary guidance.

Pasture management plays an equally important role. Rotational grazing prevents the accumulation of parasite larvae in a single field, reducing infection pressure on animals. Allowing pastures to rest for several weeks disrupts parasite life cycles naturally. Alongside this, proper manure management, regular cleaning, composting, and safe disposal limits the spread of eggs and larvae, making it one of the most cost-effective control measures.

Environmental adjustments further strengthen control efforts. Maintaining pasture hygiene by draining wet areas, trimming overgrown vegetation, and minimizing habitats for intermediate hosts such as snails can reduce parasite survival. External parasites should be managed through the careful use of acaricides and insecticides, with product rotation to avoid resistance. Routine animal inspections are essential for early detection.

Nutrition is often overlooked but remains fundamental. Well-fed animals develop stronger immunity, enabling them to resist infections and recover more effectively. Equally important is record-keeping, tracking affected animals, high-risk pastures, and treatment outcomes help refine future strategies.

Farmer education amplifies all these efforts. Accessing guidance from veterinarians, extension services, and agricultural institutions improves decision-making and encourages community-level control. Ultimately, integrated parasite management is about shifting from reactive treatment to proactive prevention, ensuring healthier livestock, higher productivity, and more stable farm income.

Conclusion

Seasonal parasite outbreaks, particularly in April, are not unavoidable shocks but predictable biological events that can be effectively managed with the right approach. This article has highlighted that parasites both internal and external pose a dual threat to livestock health and farm profitability, quietly reducing productivity through lower growth rates, declining milk yields, and weakened reproductive performance. However, the extent of these losses is not determined by nature alone; it is largely shaped by farm management decisions.

The key insight is simple: prevention is more effective and less costly than cure. Farmers who adopt integrated parasite management combining strategic deworming, rotational grazing, improved sanitation, and proper nutrition can significantly reduce infection pressure and safeguard their herds. Early monitoring, timely intervention, and informed decision-making transform parasite control from a reactive expense into a proactive investment.

Equally important is the role of knowledge. Farmers who understand parasite life cycles and transmission pathways are better equipped to interrupt them. Community awareness and support from veterinarians and extension services further strengthen these efforts, creating a collective defense against infestation.

Ultimately, managing parasites is not just about animal health, it is about economic resilience. By planning ahead and acting early, farmers can protect their livestock, stabilize their income, and ensure sustainable productivity throughout the year.

Please note that the views expressed in this article are of the author and do not necessarily reflect the views or policies of any organization.

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The Agricultural Economist, Vol. 3(4)
ISSN: 3104-8803

Agriculture in Türkiye: A Partnership with Nature

Explore the interconnected systems of agriculture in Türkiye, highlighting the importance of partnership with nature. Discover the signs of ecological stress, including declining groundwater and yield stagnation, and understand these systemic responses.

Mithat Direk

4/30/2026

Have you ever tried to grow a high-quality tomato in the extreme heat of Southeastern Anatolia in July? Or forced greenhouse cucumbers in the freezing interior of Central Anatolia without controlled systems? Of course not. Every farmer, from the olive growers of Aegean Türkiye to the wheat producers of Konya Plain, knows a fundamental truth: agriculture is governed by seasons and ecology, not human ambition. You do not command nature; you adapt to it.

Yet modern agriculture has promoted a risky illusion in Türkiye as well: that with enough chemical fertilizer, expanded irrigation from dams like Atatürk and GAP projects, and intensive pesticide use, crops can be produced anywhere, anytime. For a period, this illusion worked. Yields increased, export markets expanded, and rural incomes improved. But beneath the surface, hidden costs accumulated, soil organic matter declined, groundwater levels dropped in central basins, and agro-ecosystems weakened. What looks like productivity is often ecological debt.

Agriculture in Türkiye is not separate from ecology; it is ecology itself. Soil, water, climate variability across Anatolia, and biodiversity in Mediterranean and Black Sea regions are not inputs to be exploited but living systems to be sustained. When balance is disrupted, the outcome is predictable: rising input dependency, yield stagnation, and climate vulnerability.

Across Türkiye, this reality is becoming visible. Despite increased fertilizer use, yield gains in wheat and barley are flattening in many rain-fed areas. Irrigation expansion in semi-arid regions is accelerating aquifer stress. Pest pressure in greenhouse production zones is increasing chemical dependency. The land is responding. The soil remembers. And by 2026, the cumulative ecological cost of intensified agriculture is shaping the future of Turkish farming.

The Living Soil: Foundation of Sustainable Agriculture

Beneath every productive farm in Türkiye lies a living ecosystem often mistaken for inert earth. Soil is a biological infrastructure hosting billions of microorganisms that regulate fertility, water retention, and plant health. From the volcanic soils of Cappadocia to the alluvial plains of Çukurova, soil health determines agricultural success.

Yet this system is under pressure. Industrial runoff near expanding industrial belts, excessive pesticide use in greenhouse clusters such as Antalya, and untreated wastewater irrigation in peri-urban zones have introduced contamination risks. Many farmers still do not conduct soil testing before planting, a critical gap in decision-making. Without diagnostics, fertilizers are applied blindly, increasing costs and environmental leakage.

This “fertilizer dependency” has become widespread in Türkiye as well. Nitrogen and phosphorus applications are often based on tradition rather than soil needs, causing nutrient imbalance and nitrate leaching into groundwater systems, particularly in intensive farming regions.

Organic matter loss is another silent crisis. Monocropping in cereal belts and intensive tillage in Central Anatolia reduces carbon content, weakening water retention capacity. Rebuilding soil health requires crop rotation with legumes such as chickpea and lentil, green manure integration, and conservation tillage practices increasingly promoted by Turkish agricultural research institutes. Soil erosion remains a long-term threat, especially in sloped Mediterranean and Black Sea terrains. Maintaining ground cover through cover crops and residue retention is essential for preventing irreversible topsoil loss.

Water Wisdom and the Ecology of Survival

Water is one of Türkiye’s most strategically managed yet unevenly distributed agricultural resources. Despite large dam investments and irrigation schemes like GAP, inefficiencies persist in field-level water use. Flood irrigation remains dominant in many regions, resulting in significant losses. The first requirement for reform is measurement. Water accounting at farm and basin levels is essential for efficiency planning. Without accurate data, irrigation decisions remain based on tradition rather than crop demand.

Water quality is equally critical. In regions such as Konya Basin, over-extraction of groundwater has increased salinity risks, gradually degrading soil productivity. Regular water testing should be integrated into agricultural extension services. Pressurized irrigation systems, drip and sprinkler technologies widely used in modern Turkish greenhouse agriculture, offer major efficiency gains, reducing water consumption significantly compared to flood irrigation. Although initial costs are high, long-term savings and yield stability justify adoption.

A growing concern is wastewater irrigation near urban-industrial corridors. This introduces heavy metals and pathogens into agricultural systems, posing both environmental and public health risks. Ecological balance is equally important. Monoculture farming in wheat and industrial crop zones increases vulnerability to pests. Integrating biodiversity through field margins, pollinator habitats, and agroforestry systems improves resilience. A resilient farm collaborates with nature rather than attempting to dominate it.

Rethinking Energy, Waste, and Climate in Agriculture

Agriculture in Türkiye is transitioning from an energy-dependent system to one that can increasingly generate its own energy. Solar irrigation systems are expanding rapidly in sun-rich regions such as Southeastern Anatolia and the Mediterranean coast. These systems reduce dependence on diesel and stabilize farm-level energy costs. Organic waste management also offers major opportunities. Livestock manure, particularly in dairy-intensive regions like Central Anatolia, can be converted into biogas, producing both renewable energy and nutrient-rich fertilizer slurry. This supports circular agricultural systems.

However, crop residue burning remains a concern in parts of Anatolia, contributing to air

pollution and soil carbon loss. Composting and biochar production offer sustainable alternatives that improve soil fertility. Chemical input management remains critical. Farmers must adopt record-keeping systems to optimize fertilizer and pesticide use. The principle of "minimum effective dose" is increasingly promoted by Turkish extension services to reduce costs and environmental damage.

Climate change intensifies these challenges. Rising temperatures, irregular rainfall in continental regions, and increasing drought frequency require adaptive strategies such as reduced tillage, drought-resistant seed varieties, and methane reduction practices in livestock systems.

Conclusion

The central lesson for Türkiye is clear: agriculture is not a system of control over nature but a partnership with it. Soil, water, climate, energy, and biodiversity are interconnected systems that respond collectively to human management. Across Türkiye, signs of ecological stress are visible, declining groundwater in Central Anatolia, rising input costs in greenhouse agriculture, and yield stagnation in rain-fed cereals. These are not isolated problems but systemic responses.

Yet the trajectory is not irreversible. Soil health can be restored through organic matter regeneration. Water efficiency can improve through modern irrigation technologies. Energy resilience can be strengthened through renewables and biogas systems. Waste can be transformed into resource value. The future of Turkish agriculture depends on whether it continues along the path of intensification or shifts toward ecological alignment. The soil does not forget, but it does recover when given the chance.

Please note that the views expressed in this article are of the author and do not necessarily reflect the views or policies of any organization.

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The Agricultural Economist, Vol. 3(4)
ISSN: 3104-8803

RURAL FINANCE

Rural Health Financing Crisis in Pakistan

Explore the crisis of rural health financing in Pakistan, highlighting issues of equity, access, and policy priorities. Learn how transport costs, medicine shortages, and delayed financing turn treatable conditions into tragedies for rural families, pushing them deeper into poverty.

Sheeza Khalid

4/2/2026

Imagine being a mother in rural Charsadda, watching your child burn with fever while the nearest Basic Health Unit is 10 kilometers away. There is no private transport, public buses are costly, and even reaching the facility offers no guarantee that medicines will be available. In too many cases across rural Pakistan, this delay turns a manageable fever into pneumonia, dehydration, or a life-threatening emergency. This is not simply a story of unfortunate timing; it is the predictable outcome of a deeply underfunded and inequitable health financing system.

Across Pakistan, households still bear a heavy share of healthcare costs directly from their own pockets, and this burden falls most harshly on rural families with unstable incomes. When illness strikes, the poor do not cut entertainment spending; they skip meals, sell livestock, borrow at high interest, or withdraw children from school. Healthcare has become a poverty trap that reproduces deprivation across generations.

The macro picture is equally alarming. Pakistan's public health expenditure remains only 0.9% of GDP, far below international benchmarks for developing economies. This chronic underinvestment is reflected in weak rural infrastructure, medicine shortages, understaffed BHUs, and limited financial protection for the poor. The consequences are visible in key human development indicators: infant mortality remains 50 deaths per 1,000 live births, while life expectancy is just 67.6 years, significantly below the South Asian average.

These lost years are concentrated in villages, peri-urban settlements, and underserved districts where distance, transport costs, and service gaps delay treatment until minor illness becomes catastrophic. In such settings, health financing is not merely a budgetary issue, it is the difference between early treatment and preventable death. Until Pakistan treats rural health investment as a core pillar of human capital and poverty reduction, these tragedies will continue to repeat themselves.

The 75% Problem: Why Health Cards Still Miss Rural Pakistan

On paper, Pakistan's health card system appears to be a breakthrough in social protection. The Sehat Sahulat Program was created to shield low-income households from catastrophic hospital expenses by allowing eligible families to receive cashless inpatient treatment while the government pays the insurance premium. In principle, this should prevent illness from pushing families into debt. Yet rural reality tells a very different story.

Recent Gallup Pakistan data shows that only 19% of households report currently using the health card, meaning roughly four out of five Pakistani households remain outside its effective reach. This gap is particularly severe in rural districts, where awareness is weak, registration support is limited, and access to empaneled hospitals remains geographically difficult. For many families in South Punjab, interior Sindh, rural Balochistan, and remote KP valleys, the program often feels more symbolic than practical.

Even households that are technically eligible frequently do not know how to verify coverage, which hospitals are included, or what procedures are covered. Registration and facilitation systems are often centralized at district headquarters rather than union councils or BHUs, creating hidden transport and opportunity costs that discourage rural uptake. In effect, the scheme's design often assumes an urban user with digital access, transport, and administrative literacy.

Yet there is an important model of success. Khyber Pakhtunkhwa's Sehat Card Plus has evolved into one of Pakistan's strongest provincial health protection systems, with all KP residents eligible for cashless inpatient treatment up to Rs1 million per family annually. Its simplified eligibility verification through SMS 8500, NADRA-linked identification, and broad hospital network have improved usability for rural families.

The broader lesson is clear: health insurance only works when people can reach and understand it. Expanding rural awareness campaigns, decentralizing facilitation to local councils, strengthening transport-linked referral systems, and widening outpatient coverage are essential if Pakistan wants its health cards to become real instruments of rural financial protection rather than urban policy headlines.

The Budget Betrayal: Cutting Rural Health While Ignoring Smart Revenue

At a time when rural Pakistan urgently needs stronger primary healthcare, the 2025–26 federal budget has moved in the opposite direction. Health sector allocations under the Ministry of National Health Services, Regulations and Coordination have been cut by nearly 16%, falling from Rs 54.87 billion to Rs 46.10 billion. This reduction is far more than an accounting adjustment, it directly affects the development side of health spending, the very component that finances new rural health centers, upgrades Basic Health Units, procures diagnostic equipment, and expands the Lady Health Worker network that serves as the backbone of preventive care in villages.

For rural households, such cuts mean longer travel distances, fewer medicines, delayed maternal care, and weaker disease surveillance. In areas already struggling with transport barriers and doctor shortages, reducing development expenditure deepens the divide between urban hospitals and village-level care. The burden ultimately shifts back onto households through higher out-of-pocket expenses, worsening the cycle of rural poverty and poor health outcomes.

What makes this even more frustrating is that Pakistan is simultaneously overlooking obvious public-health revenue opportunities. Health

economists and tax simulations in 2025 show that a Rs 39 increase in Federal Excise Duty per cigarette pack could generate an additional Rs 67.4 billion annually, while also reducing cigarette consumption by nearly 6.9%. That single measure could more than offset the federal health cut and finance rural clinics, vaccine cold chains, maternal health services, and nutrition programs for years.

Instead, by freezing tobacco taxation while cutting health development, policy choices appear to prioritize industry stability over public welfare. The result is a double loss: fewer resources for rural healthcare and continued health damage from products that disproportionately harm low-income households. In terms of public health economics, this is not merely a budget decision, it is a missed opportunity to convert harmful consumption into lifesaving rural investment.

A Practical Roadmap for Rural Health Financing in Pakistan

The evidence from rural Pakistan increasingly shows that effective health financing is not about spending more alone, it is about spending smarter, targeting better, and ensuring that money reaches the patient. The strongest lessons from the ground point toward three highly practical strategies.

The first lesson is precision targeting through poverty data. The Khyber Pakhtunkhwa social health protection model succeeded because it relied on existing Benazir Income Support Program (BISP) Proxy Means Test scores to identify the households most in need. This data-driven approach reduced leakages and improved inclusion of vulnerable families, particularly women and rural households. In a resource-constrained country, universal promises without targeting often dilute impact. Smart targeting ensures that scarce fiscal space translates into real protection for those most likely to delay treatment because of cost.

The second lesson is to repair the financial plumbing of rural health systems. A recurring problem in Pakistan is not only low allocation but delayed fund release and cumbersome approvals. Budgets often reach district systems late in the fiscal year, forcing rushed expenditures while Basic Health Units spend months without medicines, vaccines, fuel, or maintenance support. For frontline effectiveness, BHU and Rural Health Centre managers need predictable quarterly releases, delegated spending authority, and digital financial tracking systems. Health financing fails when funds remain trapped in administrative layers while village clinics operate with empty shelves.

The third and perhaps most transformative shift is the move from hospital-only protection toward outpatient and primary care coverage. Rural households are more frequently burdened by routine yet essential expenses: antibiotics for pneumonia, glucose tests for diabetes, prenatal supplements, hypertension screening, and transport for follow-up visits. Covering these low-cost outpatient services prevents minor illnesses from becoming costly hospital emergencies. This is where the expansion of outpatient coverage under provincial health card reforms becomes especially promising.

The path forward is therefore clear. Pakistan's new National Health and Population Policy 2025–34 sets the right direction by emphasizing stronger BHUs, empowered Lady Health Workers, and increased spending targets. But policy statements only matter when translated into district-level execution.

The real choice facing Pakistan is not technical, it is political and moral. The country can continue with underfunded rural clinics, delayed financing, and catastrophic household spending, or it can scale evidence-based models, strengthen tax-funded health protection, and guarantee that rural families receive timely primary care. At its core, this is about equity: whether a child born in a village is granted the same chance of survival, health, and dignity as one born in an urban center.

Conclusion

The crisis of rural health financing in Pakistan is ultimately a crisis of equity, access, and policy priorities. The article demonstrates that illness becomes deadly in villages not simply because diseases are severe, but because distance, transport costs, medicine shortages, weak insurance uptake, and delayed public financing turn treatable conditions into catastrophes. For rural households, the burden of out-of-pocket spending does more than strain budgets, it pushes families deeper into poverty through debt, livestock sales, school dropouts, and lost livelihoods.

What emerges clearly is that Pakistan does not lack workable solutions. The evidence already exists in successful provincial experiences such as Khyber Pakhtunkhwa's Sehat Card Plus, data-driven targeting through BISP poverty scores, and the growing shift toward outpatient and primary care coverage. Likewise, smarter fiscal choices such as earmarked tobacco taxation and timely frontline budget releases could significantly strengthen Basic Health Units, rural health centers, and Lady Health Worker services.

The real challenge is implementation and political commitment. If policy remains trapped in urban-centric systems and delayed administrative processes, rural communities will continue paying for healthcare with both money and lives. But if Pakistan chooses to invest in decentralized, well-targeted, and prevention-focused rural health financing, the gains will extend far beyond hospitals to human capital, labor productivity, and poverty reduction. In the end, the measure of progress is simple: whether a child in Charsadda, Tharparkar, or Dera Bugti has the same chance of surviving a fever as a child in Lahore or Islamabad.

Please note that the views expressed in this article are of the author and do not necessarily reflect the views or policies of any organization.

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The Agricultural Economist, Vol. 3(4)
ISSN: 3104-8803

Pakistan's Food Import Paradox

Explore the complexities of Pakistan's food import paradox, a challenge impacting macroeconomic stability and agricultural potential. Understand the implications of an $8.14 billion import bill despite vast agricultural resources.

Zulfiqar Ali Saqlain

4/6/2026

A typical dinner table in Lahore, Karachi, or Peshawar tells the story of Pakistan's culinary richness, steaming rice, warm roti, lentils, vegetables, and dishes generously cooked in oil. It is a meal deeply rooted in culture, comfort, and daily nourishment. Yet beneath this familiar plate lies an uncomfortable economic reality: much of what sustains that meal increasingly depends on imported inputs, quietly draining scarce foreign exchange reserves.

Pakistan presents a striking agricultural paradox. The country remains one of the world's most important producers of wheat and rice, with basmati exports recognized across markets from the Middle East to Africa. Vast agricultural plains in Punjab and Sindh continue to generate staple crops that support both domestic consumption and export earnings. However, despite this strong agrarian base, Pakistan's food import bill in 2025 climbed to an alarming $8.14 billion, exposing deep structural weaknesses in food system planning, crop diversification, and agro-industrial policy.

The contradiction is most visible in edible oils, pulses, tea, and other essential commodities that households consume daily but which domestic agriculture has failed to supply adequately. Massive dependence on imported palm oil, soybean products, lentils, and even certain feed ingredients means that every household meal now carries an invisible foreign exchange burden. What appears to be an ordinary plate of food is, in macroeconomic terms, also a demand for the country's dollar reserves.

This issue goes beyond trade statistics. As Pakistan celebrates occasional current account improvements, the rising food import bill signals vulnerability in national food security and economic resilience. A depreciating rupee, global commodity shocks, or supply chain disruptions at Karachi Port and Port Qasim can rapidly turn basic food affordability into a national economic crisis. In this sense, food imports are no longer merely a consumption issue, they are becoming one of the most critical pressure points in Pakistan's external sector stability.

The Fragile Surplus: How Food Imports Are Undermining External Stability

At first glance, Pakistan's external account performance in fiscal year 2025 appeared to signal a remarkable turnaround. Between July and April, the country recorded a current account surplus of $1.9 billion, a rare achievement for an economy that only recently faced severe balance-of-payments stress and required emergency support from the International Monetary Fund. For policymakers at the State Bank of Pakistan, this surplus provided temporary relief, helping stabilize the rupee, restore confidence, and ease immediate pressure on foreign reserves.

A major driver of this improvement was the extraordinary strength of workers' remittances. Overseas Pakistanis, particularly those in the Gulf, Europe, and North America, continued to act as the country's financial lifeline. In March 2025 alone, remittances touched a record $4.1 billion, injecting vital dollar liquidity into the economy. These inflows strengthened household purchasing power across cities such as Sialkot, Lahore, and Faisalabad, where remittance-dependent families saw their consumption capacity improve.

However, these apparent surplus masks a deeper structural vulnerability. Remittances do not remain idle; they immediately translate into household demand, much of which is increasingly directed toward imported food items and processed essentials. The result is a dangerous circular pressure on the same foreign exchange that remittances initially support.

The latest data from the Pakistan Bureau of Statistics reveals the scale of the risk. In the first quarter of FY26, food imports surged by 35.5%, while July 2025 alone recorded a food import bill of $743 million, representing a sharp 44.9% month-on-month increase. This trend suggests that rising household purchasing power is being absorbed by commodities Pakistan has failed to produce competitively at home, particularly edible oils, pulses, tea, and feed-related inputs.

The implication is stark: Pakistan may be financing consumption-led food dependence through remittance inflows. If this pattern persists, the hard-won current account surplus could quickly erode, turning a short-term macroeconomic success into a renewed external vulnerability.

The Big Three Behind Pakistan's Food Import Drain

Pakistan's food import burden is increasingly concentrated in three major commodities that quietly absorb billions of dollars from the country's foreign exchange reserves: edible oil, pulses, and wheat. These are not luxury items, they are daily essentials found in almost every household meal, which is why their import dependence has become such a serious macroeconomic concern.

The first and largest pressure point is edible oil. Pakistan has become one of the world's biggest buyers of palm oil, sourcing primarily from Indonesia and Malaysia. Imports are projected to reach nearly 3.5 million metric tons in 2025, reflecting deep structural weaknesses in domestic oilseed development. Local cultivation of sunflower, canola, and soybeans remain insufficient, meeting only around one-third of national demand. As a result, everything from roadside samosas to packaged snacks and household curries carries an embedded dollar cost through imported oil.

The second challenge is the pulse paradox. Pakistanis are among the world's largest consumers of lentils such as chana, masoor, and moong, which remain vital low-cost protein sources, especially for low-income households. Yet domestic pulse production has stagnated because farmers increasingly shift toward more commercially attractive crops like sugarcane and rice. This has created dependence on imports from Canada, Australia, and Myanmar, making dal prices highly sensitive to exchange-rate volatility and global commodity markets.

The third and perhaps most frustrating component is wheat. Despite being a major wheat producer, Pakistan continues to face periodic shortages driven by climate shocks, weak storage systems, pest losses, and speculative hoarding. Post-harvest losses remain significant, with a large share of output wasted before reaching consumers. This forces

costly emergency imports, turning a staple crop into a recurring external sector liability. Together, these three commodities illustrate how domestic production gaps are steadily converting food security weaknesses into foreign exchange stress.

Climate Stress, Remittance-Led Consumption, and Pakistan's Rising Food Import Trap

Pakistan's growing food import dependence cannot be understood without placing climate change at the center of the discussion. Agriculture remains the backbone of rural livelihoods and national food security, yet it is increasingly exposed to extreme heat, erratic rainfall, and water stress. The devastating floods of 2022 drew global attention, but the less visible heatwaves of 2024 and 2025 have been equally damaging for crop productivity. High temperatures during grain formation reduce wheat yields, delayed monsoons weaken cotton and oilseed performance, and prolonged dry spells reduce pulse output in rain-fed areas. The economic result is severe: domestic supply falls just when demand remains stable or even rises.

Recent agricultural performance has already reflected this vulnerability, with major crop production showing a sharp decline. Once local shortages emerge, the government is often forced into emergency imports of wheat, edible oil, pulses, and feed ingredients. This creates a dangerous macroeconomic chain reaction: climate shock reduces harvests, domestic prices rise, political pressure intensifies, and the treasury turns to global commodity markets where purchases must be made in US dollars. In effect, Pakistan is not merely importing food; it is importing the financial consequences of climate fragility and weak climate resilience in agriculture.

A second and more subtle force deepening the crisis is the remittance-consumption linkage. Rising remittances from overseas Pakistanis have strengthened household purchasing power and temporarily supported the current account, but they have also shifted consumption toward higher-value imported food items. Families increasingly purchase branded edible oils, imported lentils, packaged foods, tea blends, and premium rice varieties. This pattern creates an economic leakage effect in which foreign exchange earned through remittances quickly flows back out through food imports.

The implication for policymakers is critical: without climate-resilient agriculture, domestic oilseed revival, improved pulse productivity, and smarter food consumption incentives, even strong remittance inflows may fail to protect Pakistan's external balance. What appears as a current account cushion today could easily become tomorrow's food-driven balance-of-payments pressure.

The Numbers Behind Pakistan's Food Import Anxiety

The statistics behind Pakistan's food economy are the kind that keep economists awake long after midnight because they reveal a structural imbalance that can no longer be ignored. Start with agriculture: in FY25, the sector grew by only 0.56%, effectively stagnating in a country of more than 257 million people where population growth continues to outpace food production. This means domestic agriculture is barely adding enough output to maintain current consumption, let alone build strategic food security.

The external sector tells an equally worrying story. By November 2025, Pakistan's trade deficit had widened by nearly 33% year-on-year, reaching $2.86 billion, with rising imports and weakening exports putting renewed pressure on the balance of payments. Food imports have emerged as one of the major drivers of this widening gap, second only to machinery in many monthly trade assessments.

The most alarming figure, however, is the $8.14 billion food import bill in FY25, a number that exposes how deeply Pakistan now depends on foreign farms to feed its people. This amount is several times larger than many flagship social protection allocations and represents a major drain on scarce foreign exchange reserves. Rather than investing adequately in domestic oilseeds, pulses, storage systems, and climate-resilient agriculture, the country is effectively exporting dollars to compensate for weak farm productivity at home.

The macroeconomic implication is stark: unless agricultural growth accelerates meaningfully, food imports will continue to erode current account gains, weaken the rupee, and increase inflationary risks for already vulnerable households.

Breaking Pakistan's Current Account Food Trap

Pakistan's current account pressure can best be understood as a vicious financial cycle in which food imports steadily weaken the country's external stability. The current account balance functions much like a household ledger: foreign exchange enters through exports, remittances, and services, while it exits through imports, debt servicing, and profit repatriation. The problem begins when food imports surge sharply. A 35% rise in imported edible oil, pulses, and wheat means billions of dollars flow outward, forcing the State Bank to draw down already limited foreign exchange reserves to stabilize payments and defend the rupee.

Once reserves begin to thin, the rupee depreciates. A weaker rupee then makes every imported commodity, from palm oil to lentils, even more expensive in domestic markets. This raises food inflation, intensifies public pressure, and often compels the government to arrange even more imports or short-term external borrowing to stabilize supplies. The result is a self-reinforcing spiral: higher imports weaken the currency, a weaker currency raises food costs, and higher costs create political and fiscal pressure for further imports. What appeared as a $1.9 billion current account surplus was largely the temporary result of lower global energy prices and exceptional remittance inflows rather than deep structural reform.

Breaking this cycle requires bold agricultural restructuring. The priority is an oilseed revolution built around domestic canola, sunflower, and soybean expansion so that Pakistan reduces its dependence on imported palm oil. This requires seed support, price incentives, farmer extension, and local crushing capacity. The second priority is fixing post-harvest losses through modern silos, cold storage, and grain logistics. Pakistan loses enormous quantities of wheat and pulses after harvest, and reducing these losses may be cheaper than emergency imports. Third, the country needs climate-smart agriculture, including heat-resistant seeds, improved irrigation efficiency, and a shift away from water-intensive sugarcane toward pulses and oilseeds. Without these structural changes, food imports will remain a recurring threat to the rupee, inflation stability, and Pakistan's macroeconomic sovereignty.

Conclusion

Pakistan's food import paradox is no longer just a trade issue; it has become a defining challenge for macroeconomic stability, rural transformation, and long-term national sovereignty. An $8.14 billion food import bill in a country with vast agricultural potential reflects not scarcity of land, but scarcity of strategic planning. The growing dependence on imported edible oil, pulses, and even emergency wheat exposes deep structural failures in crop

diversification, storage, climate resilience, and value-chain management.

The broader danger lies in the way this dependence interacts with the external account. Remittances and temporary declines in global oil prices may create short-lived current account relief, but these gains remain fragile when household demand increasingly translates into imported food consumption. Climate shocks, stagnant agricultural growth, and post-harvest losses further intensify this vulnerability, converting domestic farm weakness into foreign exchange pressure and food inflation.

The way forward requires more than incremental reform. Pakistan must treat domestic oilseed development, pulse productivity, grain storage modernization, and climate-smart agriculture as pillars of economic security. Investment in farmer incentives, heat-resilient seed systems, efficient irrigation, and agro-processing infrastructure can gradually reduce the dollar cost embedded in everyday meals.

At its core, this is about transforming food from an external liability into a domestic strength. If Pakistan succeeds, every plate served at home will nourish not only families but also economic resilience, rural livelihoods, and the stability of the rupee itself.

Please note that the views expressed in this article are of the author and do not necessarily reflect the views or policies of any organization.

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AI Reshapes Pakistan's Financial Sector

Explore how artificial intelligence is transforming Pakistan's financial sector, enhancing efficiency and inclusion. Discover the impact of AI-driven credit scoring, instant payments, and advanced fraud detection on user experiences.

Muhammad Abuzar

4/23/2026

Imagine waking up, unlocking your phone, and completing a financial transaction in seconds (paying bills, sending money to a relative in a remote village, or even applying for a loan) without stepping into a bank. No queues, no paperwork, no delays. What feels like a simple tap on a screen is powered by a complex digital system working in the background. At the center of that system is artificial intelligence.

This is not a future scenario; it is already shaping everyday financial life in Pakistan. AI, which refers to machines capable of learning from data and making decisions, has become a foundational technology in the country's growing fintech ecosystem. Platforms like Easypaisa and JazzCash are no longer just payment tools; they are intelligent systems that analyze user behavior, detect suspicious transactions, and personalize financial services.

In practical terms, AI acts as an invisible assistant. It helps detect fraud by identifying unusual patterns in transactions, reducing the risk of financial loss. It speeds up loan approvals by assessing creditworthiness using alternative data, making financial services accessible even to those without formal banking histories. It also enhances customer experience by predicting user needs, whether it is suggesting savings options or offering tailored financial products.

For ordinary Pakistanis, this transformation is significant. Farmers can receive payments instantly, small business owners can manage cash flow more efficiently, and families can access financial services that were once out of reach. AI is not just improving convenience; it is expanding financial inclusion.

Pakistan's Digital Finance Boom and Its Rural Transformation

Pakistan's shift toward digital finance is not gradual, it is exponential. In the fiscal year 2024-25, the country recorded approximately 9.1 billion retail digital transactions, with a total value exceeding PKR 612 trillion. Even more striking is that nearly 88% of all financial transactions now occur through digital channels. This means that for most Pakistanis, financial activity whether paying utility bills, purchasing goods, or transferring money has moved from physical spaces to mobile screens.

A key driver of this transformation is the rapid expansion of branchless banking. According to the State Bank of Pakistan, more than 731,000 agents are now operating nationwide. These agents, often small shopkeepers, function as local financial access points, especially in underserved and remote regions. From rural Punjab to distant areas of Balochistan and Khyber Pakhtunkhwa, they are bridging the gap between formal financial systems and unbanked populations.

This transformation has profound implications for rural finance. Historically, rural households faced barriers such as long distances to banks, lack of documentation, and limited access to credit. Digital platforms, supported by AI, are changing this landscape. Farmers can now receive crop payments instantly, access microloans based on transaction histories, and manage savings without leaving their villages. Small rural businesses benefit from improved cash flow management and secure transactions.

Artificial intelligence plays a critical enabling role by analyzing transaction data, assessing credit risk, and detecting fraud in real time. It ensures that this large-scale digital ecosystem remains efficient, secure, and inclusive. In essence, Pakistan's digital finance boom is not just about technology, it is about integrating rural economies into the national financial system.

AI and Financial Inclusion: Transforming Rural Finance in Pakistan

Artificial intelligence is not just improving financial services, it is fundamentally reshaping access, especially for rural populations that have long been excluded from formal banking systems. One of the most critical areas where AI is making an impact is fraud prevention. Pakistan faces significant financial losses due to scams and cybercrime, but AI-driven systems are now acting as real-time safeguards. By analyzing transaction patterns continuously, these systems can instantly flag suspicious activities such as unusual transfers or transactions from unfamiliar locations. For rural users, many of whom are new to digital finance,

this layer of protection builds trust and encourages adoption of mobile banking platforms.

Equally transformative is AI's role in expanding access to credit. Traditionally, rural farmers, small shopkeepers, and informal workers were considered "unbankable" due to the absence of formal credit histories. AI changes this by using alternative data (mobile usage, digital wallet transactions, and payment behavior) to assess creditworthiness. Institutions guided by policies from the State Bank of Pakistan are increasingly leveraging such tools to meet financial inclusion targets. This has enabled small farmers to access seasonal loans, invest in inputs, and stabilize their incomes, while rural entrepreneurs can expand their businesses without relying on informal lenders.

Customer service has also evolved through AI-powered chatbots integrated into platforms like JazzCash and Easypaisa. These tools provide instant assistance in local languages, eliminating the need for physical bank visits, an especially important benefit in remote areas.

Finally, AI enables personalized financial services. By learning user behavior, it can recommend savings plans, remind users of payments, and optimize transaction methods. For rural households, this means better financial planning and improved resource management.

AI-Driven Finance and Its Broader Economic Impact in Pakistan

The integration of artificial intelligence into Pakistan's financial system is producing measurable economic shifts, particularly by accelerating financial inclusion and strengthening rural economies. According to the Pakistan Financial Inclusion Index, 58.1% of adults now have access to formal financial services, a notable rise from 54.8% in 2023. This seemingly incremental increase translates into millions of individuals, many from rural and previously underserved communities, gaining access to secure savings, payments, and credit facilities.

For rural households, the implications are profound. Farmers can now receive crop payments directly into digital wallets, eliminating delays and reducing dependence on middlemen. Women in remote villages, often excluded from formal banking due to mobility and social constraints, can save and manage money privately through mobile platforms. Small rural entrepreneurs can access microloans based on digital transaction histories, enabling them to invest in inventory, expand operations, and smooth cash flow. These changes are gradually formalizing rural economies and improving financial resilience.

Cost efficiency is another major outcome. AI-driven automation is estimated to reduce operational costs in the financial sector by 20-30%. Lower administrative and processing costs allow banks and fintech platforms such as Easypaisa and JazzCash to offer services at reduced fees, making digital finance more accessible to low-income users. This affordability is critical for widespread adoption in rural areas.

At a macro level, the shift toward digital transactions is fueling the growth of Pakistan's digital economy. Reduced reliance on cash improves transparency, enhances tax documentation, and attracts investment into the fintech sector, generating employment and innovation.

However, challenges remain. Data privacy concerns are significant, as AI systems rely on large volumes of personal information, while regulatory frameworks are still evolving. Cybersecurity threats continue to grow in sophistication, requiring constant vigilance. Additionally, over-reliance on automated systems introduces operational risks, making human oversight essential. Finally, a shortage of skilled professionals in AI and data science could constrain future progress.

Policy Momentum and the Future of Inclusive Digital Finance

Pakistan's policy direction on artificial intelligence and digital finance signals a strong commitment to transforming the financial landscape, particularly for underserved and rural populations. The government's pledge to invest $1 billion in AI by 2030, alongside proactive regulatory support from the State Bank of Pakistan, reflects a strategic recognition that technology can accelerate financial inclusion and economic modernization. By encouraging banks and fintech providers to adopt AI for fraud detection, credit scoring, and risk management, policymakers are laying the groundwork for a more efficient and accessible financial system.

For rural Pakistan, these developments carry significant implications. Digital financial services powered by AI are reducing long-standing barriers such as distance, documentation requirements, and high transaction costs. Farmers can receive payments instantly, access seasonal credit without traditional collateral, and manage savings through mobile platforms. Women in rural areas, who often face mobility and social constraints, can now participate more actively in financial decision-making. Small businesses benefit from faster transactions and improved cash flow, strengthening local economies.

At the individual level, the impact is already visible. Whether in urban centers or remote villages, people can transfer money, pay bills, and access financial services with unprecedented ease. However, increased access also requires greater awareness. Users must adopt basic digital security practices such as safeguarding personal information and using authentication tools to fully benefit from these systems.

Looking ahead, the sustainability of this transformation depends on continued investment in human capital, particularly in AI and digital skills, as well as robust data protection frameworks. While AI is not a complete solution to all financial challenges, it is a powerful enabler. If supported by sound policy and responsible use, it can drive inclusive growth, strengthen rural finance, and integrate millions more Pakistanis into the formal economy.

Conclusion

Artificial intelligence is no longer a background innovation in Pakistan's financial sector, it is now a central force reshaping how money moves, how services are delivered, and who gets access to them. As this article has shown, AI is not just improving efficiency; it is redefining inclusion. From instant payments through platforms like Easypaisa and JazzCash to AI-driven credit scoring and fraud detection, the financial system is becoming faster, safer, and more responsive to user needs.

The most transformative impact is visible in rural Pakistan, where long-standing barriers to financial access are being dismantled. Farmers, small business owners, and women in remote areas are gaining tools to save, borrow, and invest often for the first time. This shift is not only improving individual livelihoods but also strengthening the broader rural economy and integrating it into the national financial system.

However, the path forward requires careful management. Issues of data privacy, cybersecurity, and skill development must be addressed to sustain trust and innovation. AI is a powerful enabler, but its benefits depend on responsible use and supportive policies.

Ultimately, Pakistan stands at a critical juncture. If current momentum is maintained, AI-driven fintech can become a cornerstone of inclusive economic growth, bringing millions into the formal economy and reshaping the country's financial future.

Please note that the views expressed in this article are of the author and do not necessarily reflect the views or policies of any organization.

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The Agricultural Economist, Vol. 3(4)
ISSN: 3104-8803

FOOD AND NUTRITION

Challenges in Food Security and Global Supply Chains

Explore the complexities of the modern food system and the pressing challenges of food security. Discover how global supply chains face disruptions and the impact on countries reliant on imports.

Mithat Direk

4/17/2026

The journey of a single meal today reflects the complexity of a deeply interconnected global food system. Wheat may be grown on one continent, processed in another, and consumed thousands of kilometers away. Edible oils, pulses, and even vegetables often cross borders before reaching household kitchens. For decades, this global integration created efficiency, lowered costs, and ensured year-round availability of diverse foods. As long as global production remained strong, food security was largely equated with output, higher yields meant greater stability.

However, recent disruptions have exposed the fragility of this assumption. Events such as pandemics, geopolitical tensions, extreme weather shocks, and trade restrictions have demonstrated that production alone does not guarantee access. Supply chains, comprising transportation networks, storage systems, ports, and markets, are now recognized as equally critical components of food security. When these systems are disrupted, even abundant harvests fail to translate into stable food availability.

The consequences are immediate and widespread. Price volatility increases, disproportionately affecting low-income households that spend a large share of income on food. Temporary shortages emerge, not due to lack of production, but due to breakdowns in logistics and distribution. For import-dependent countries, including many in the developing world, these disruptions can quickly escalate into food crises.

This evolving reality signals a fundamental shift in how food security must be understood. It is no longer sufficient to focus solely on agricultural productivity. Resilience, diversification of supply sources, local storage capacity, and efficient distribution systems have become central pillars of modern food policy. The key question is no longer just how much food is produced globally, but how effectively systems can withstand shocks and continue delivering food reliably to every table.

The Fragility of Import-Dependent Food Systems

The transformation of food security strategies in regions such as the Middle East and North Africa highlights a critical shift from production-based resilience to import-dependent vulnerability. Faced with extreme water scarcity, limited arable land, and rapidly growing populations, many countries in these regions adopted a seemingly efficient strategy: rather than exhausting scarce natural resources on domestic agriculture, they chose to import staple foods from global markets. This approach, grounded in economic logic, allowed governments to conserve water, prioritize urban and industrial development, and benefit from comparatively cheaper international grain supplies.

For several decades, this model appeared highly effective. Global trade networks ensured a steady flow of wheat, maize, and other staples from major exporting regions such as Eastern Europe and the Americas. Ports in cities like Cairo, Algiers, and Beirut became critical entry points for food security, and reliance on imports was seen as a rational adaptation to environmental constraints. However, this strategy gradually introduced a structural dependency that limited national control over food systems.

The vulnerabilities of this model became evident during recent global disruptions. The COVID-19 pandemic exposed weaknesses in logistics, such as port closures, labor shortages, and shipping delays disrupted supply chains. Shortly thereafter, the conflict in Ukraine, one of the world's leading grain exporters, further destabilized markets by restricting Black Sea trade routes. These shocks demonstrated that food security is not solely determined by purchasing power, but by the reliability of supply chains and geopolitical stability.

Moreover, the modern food system is deeply interconnected with energy, fertilizer, and financial markets. Rising fuel costs increase transportation expenses, fertilizer price shocks reduce future agricultural output, and higher insurance premiums elevate shipping costs. As a result, countries heavily dependent on imports often face rapid price inflation and supply uncertainty during global crises.

This experience underscores a fundamental lesson: while import-based strategies may offer short-term efficiency, long-term food security requires diversification, strategic reserves, and partial domestic production to reduce exposure to external shocks.

Water Scarcity and the Architecture of Food System Resilience

Beneath the visible disruptions in global food trade lies a deeper and more persistent constraint: the accelerating depletion of water resources. Nowhere is this challenge more acute than in the Middle East and North Africa, where demographic pressure collides with extreme hydrological scarcity. Despite hosting roughly 6 percent of the global population, the region controls only about 1 percent of renewable freshwater resources. This imbalance has intensified over time as aquifers, many formed over millennia, are being extracted at unsustainable rates, while major river systems such as the Nile and the Tigris face declining flows due to upstream usage, climate variability, and prolonged drought cycles.

Water scarcity directly translates into reduced agricultural capacity. Crop production, livestock systems, and fodder availability all depend fundamentally on reliable water access. As rainfall patterns become increasingly erratic and temperatures rise, traditional farming systems are losing viability. In many countries, domestic agricultural production can no longer meet national food demand, making imports not a strategic choice but a structural necessity. This creates a paradox: the regions most exposed to global food supply shocks are also those least capable of achieving self-sufficiency through domestic production.

Addressing this vulnerability does not imply abandoning global trade, but rather redesigning food systems to enhance resilience, the capacity to absorb shocks while maintaining stability. One critical pillar is strategic food storage. Modern grain reserves function as national buffers, allowing governments to stabilize supply and prices during temporary disruptions. Countries with adequate storage capacity can avoid panic-driven imports and mitigate volatility in domestic markets.

Equally important is investment in cold chain infrastructure. In high-temperature environments, post-harvest losses are substantial due to inadequate storage and transportation systems. Refrigerated logistics, temperature-controlled warehouses, and efficient distribution networks extend shelf life, reduce waste, and improve food availability without requiring additional production.

Technological innovation is also reshaping agricultural possibilities. Controlled environment agriculture including greenhouses, vertical farms, and hydroponic systems enables food production with minimal water use and reduced dependence on climatic conditions. These systems can operate in arid zones, recycling water efficiently and producing high-value crops year-round. While they cannot fully replace staple crop production, they significantly enhance local food availability.

Finally, precision irrigation technologies offer substantial efficiency gains. Drip irrigation, soil moisture sensors, and data-driven water management systems allow targeted application of water directly to plant roots, minimizing losses and maximizing productivity. In water-constrained regions, such approaches can dramatically improve output per unit of water.

Designing Resilient Food Systems in an Era of Global Uncertainty

Resilience in modern food systems does not imply isolation from global markets, nor does it support complete dependence on them. The emerging consensus points toward a hybrid model, one that strategically combines international trade with strengthened domestic and regional capacities. Such an approach recognizes the structural realities of resource constraints while minimizing exposure to external shocks.

For staple commodities such as wheat, rice, and maize, which require extensive land and water resources, continued participation in global trade remains essential. However, this reliance must be managed through long-term procurement agreements, diversified import sources, and well-maintained strategic reserves. These measures provide a buffer against sudden supply disruptions and price volatility in international markets.

In contrast, perishable food items (vegetables, fruits, and herbs) are better suited to localized production systems, particularly through controlled-environment agriculture. Producing these goods closer to urban consumption centers reduces post-harvest losses, transportation costs, and supply chain vulnerabilities. Similarly, protein systems such as poultry, eggs, and aquaculture benefit from regionalized production models that ensure freshness, reduce logistical dependence, and enhance food safety.

This hybrid configuration offers flexibility. It allows countries to remain integrated within global markets while maintaining fallback options during crises. In an era increasingly defined by climate variability, geopolitical tensions, and market instability, such adaptability is a defining feature of resilient economies.

The broader transformation lies in how food security itself is conceptualized. It is no longer confined to agricultural output alone but intersects with logistics, energy systems, financial stability, and international relations. Countries that succeed in this environment will not necessarily be those with the largest agricultural sectors, but those that optimize resource use, invest in technology, and design systems capable of absorbing shocks without systemic failure.

Ultimately, food security has become a strategic priority linked directly to national stability. The tools require strategic storage, cold chain infrastructure, precision agriculture, and data-driven management are already available. The challenge now lies in implementation. As global uncertainty intensifies, the transition toward resilient, hybrid food systems is no longer optional; it is a prerequisite for sustainable development and long-term economic security.

Conclusion

The modern food system has delivered remarkable efficiency, but recent disruptions have revealed a fundamental weakness: access to food is no longer guaranteed by production alone. As global supply chains become more complex and interconnected, they also become more vulnerable to shocks, whether from pandemics, geopolitical conflicts, energy crises, or climate change. For many countries, especially those heavily dependent on imports, food security has shifted from a question of affordability to one of reliability.

The key lesson is clear: resilience must now sit at the center of food policy. This does not mean abandoning global trade but rather strengthening it with safeguards. Strategic grain reserves, diversified import partnerships, efficient cold chains, and investments in local production systems can reduce exposure to sudden disruptions. Equally important is the adoption of water-efficient technologies and controlled-environment agriculture, particularly in resource-constrained regions.

A balanced, hybrid approach offers the most practical path forward combining the strengths of global markets with the stability of domestic capacity. In this evolving landscape, food is no longer just an agricultural commodity; it is a strategic asset tied to economic stability, public welfare, and national security.

Countries that recognize this shift and act decisively will be better prepared for future uncertainties. Those that fail to adapt risk turning temporary supply disruptions into long-term food crises.

Please note that the views expressed in this article are of the author and do not necessarily reflect the views or policies of any organization.

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The Agricultural Economist, Vol. 3(4)
ISSN: 3104-8803

Milk Production: Balancing Science & Economics

Explore the intricate balance of biology, economics, and environmental management in milk production. Discover how effective feed quality, animal health, and production cycles drive profitability in the dairy sector, especially for high-yielding cows.

Mithat Direk

4/24/2026

Every morning, millions of people pour a glass of milk without a second thought. Yet this everyday staple is one of the most nutritionally complete foods available, containing proteins, fats, carbohydrates, vitamins, and essential minerals in a single package. What makes it even more remarkable is its origin: a cow, converting simple plant-based feed into a highly valuable human food. Behind this transformation lies a complex biological and economic system that farmers manage daily.

At the core of dairy production is feed efficiency. Farmers do not measure feed in its raw, wet form because much of it consists of water. Instead, they focus on "dry matter", the actual nutrient content after removing moisture. On average, a dairy cow requires approximately 1.25 to 1.44 kilograms of dry matter to produce one liter of milk. This figure highlights both the efficiency and the cost structure of milk production, as feed represents the largest expense in dairy farming.

However, not all feed is equal. The quality of dry matter plays a decisive role in productivity. Low-quality roughage, such as fibrous or over-mature hay, limits digestion and reduces milk yield. In contrast, high-quality feed, comprising nutrient-rich fodder like alfalfa, balanced silage, and protein supplements, optimizes rumen function and significantly boosts output. A well-fed cow can produce several times more milk than one on a poor diet, using roughly the same biological system.

This relationship between feed and output underscores a fundamental principle of dairy economics: productivity depends less on the animal itself and more on how it is nourished. Efficient feeding strategies not only increase milk yield but also reduce costs per liter, making dairy farming more profitable and sustainable in the long run.

The Lactation Cycle of a Dairy Cow

A high-producing dairy cow can be understood as a biological athlete, with her most demanding phase occurring immediately after calving. This period, known as early lactation, represents the peak of metabolic intensity. During the first three months, a well-managed cow can produce around 40 liters of milk per day, an extraordinary output that requires equally substantial nutritional support. To sustain this level of production, she consumes approximately 50 kilograms of total feed daily, typically provided as a total mixed ration (TMR). This carefully balanced diet ensures that every bite contains the necessary energy, protein, fiber, vitamins, and minerals.

What makes early lactation particularly remarkable is its efficiency. For every kilogram of dry matter intake, the cow can produce about 1.6 liters of milk. This conversion rate reflects an optimized interaction between feed quality, digestion, and metabolic function. Farmers closely monitor this ratio, as it serves as a key indicator of productivity and profitability. Cows that fall below this benchmark are often considered less efficient, prompting adjustments in feeding or management.

As lactation progresses, however, production naturally declines. In the later stages, daily milk yield typically drops to around 25 liters, while feed intake decreases to roughly 36 kilograms. The cow's body begins transitioning toward recovery and preparation for the next calving cycle. Efficiency also declines slightly, with approximately 1.44 kilograms of dry matter required to produce one liter of milk.

This shift is not a failure of the system but a normal biological pattern. Dairy farming, therefore, operates as a continuous cycle, balancing peak production periods with recovery phases, to maintain both animal health and long-term productivity.

Building the Perfect Dairy Ration

The productivity of a dairy cow is not accidental, it is engineered through a precisely balanced feeding system known as the total mixed ration (TMR). This "recipe" is the foundation of milk production, combining different feed components in exact proportions to maximize both animal health and output. If one kilogram of this feed were analyzed on a dry matter basis, it would reveal a carefully structured nutritional profile designed to meet the cow's complex metabolic needs.

Approximately 70% of the ration consists of carbohydrates, which serve as the primary energy source. These are derived from fibrous materials like hay and silage, as well as starch-rich grains such as maize and barley. Protein makes up about 18% of the mix and plays a critical role in milk synthesis, particularly in forming milk proteins. Common sources include soybean meal, canola meal, and cottonseed cake. Around 6% of the ration is fat, providing concentrated energy and contributing to higher butterfat levels in milk. The remaining 6% consists of essential vitamins and minerals, including calcium, phosphorus, and trace elements that support bone strength, metabolism, and overall health.

Equally important is the structural balance of the diet. Roughage, long-fiber feed like hay and silage, typically accounts for 50–60% of the total ration, maintaining rumen function and preventing digestive disorders. The remaining 40–50% comprises concentrates, which enhance energy density and productivity. Any imbalance in this ratio can reduce efficiency or even harm the animal, making feed formulation both a science and an economic decision for farmers.

When Feed Policy Fails: A Lesson from Water-Stressed Dairy Expansion

The expansion of dairy farming has often been framed as a reliable pathway to rural income growth, but the experience of Central Anatolia reveals the risks of ignoring ecological constraints. In this semi-arid region, policymakers and extension services strongly encouraged farmers to invest in dairy production, presenting it as a stable and profitable enterprise. For a time, the strategy appeared successful. Farmers adopted high-yielding feed systems centered on maize, a crop known for its energy density and productivity, and milk output increased rapidly.

However, this growth model rested on a fragile foundation. Maize is highly water-intensive, particularly under dry climatic conditions.

Sustaining large-scale cultivation requires continuous groundwater extraction. Initially, this was not perceived as a constraint, as aquifers had historically provided reliable water supplies. Over time, however, the imbalance between water withdrawal and natural recharge became evident. Groundwater levels declined sharply, wells began to fail, and irrigation costs increased significantly.

The apparent success of the dairy sector has masked a deeper environmental depletion. What looked like agricultural modernization was, in effect, an unsustainable conversion of water resources into short-term output gains. Eventually, the ecological limits imposed themselves. Water scarcity intensified to the point where authorities were compelled to restrict further dairy expansion.

The core lesson is structural: dairy development is inseparable from resource management. Feed production, particularly in water-scarce regions, must align with local ecological capacity. Without sustainable fodder systems, dairy farming transitions from an economic opportunity into a long-term environmental liability, undermining both agricultural resilience and rural livelihoods.

Rethinking the Narrative: Cows, Climate, and the Future of Dairy

In recent years, a growing global narrative has cast livestock, particularly dairy cattle, as major contributors to climate change. This perspective, often amplified in policy debates and media discussions, tends to simplify a complex biological and agricultural system into a single issue: methane emissions. It is true that cows produce methane through enteric fermentation, and methane is a potent greenhouse gas. However, framing the cow solely as an environmental liability overlooks its broader ecological and economic role.

A dairy cow performs a unique biological function that few systems can replicate. It converts inedible biomass such as grass, crop residues, and agricultural by-products into nutrient-dense food for humans. This process, enabled by the rumen, represents a form of natural resource efficiency often described as "biological upcycling." In many regions, especially where crop cultivation is limited, livestock are essential for transforming otherwise unusable land into productive food systems.

The current discourse also intersects with the rapid development of alternative food technologies, including plant-based and lab-grown dairy substitutes. While these innovations may contribute to future food security, they are not without their own environmental and economic costs, including high energy use and industrial processing requirements. The debate, therefore, should not be framed as a binary choice between traditional and synthetic systems, but rather as a question of optimization, how to make existing livestock systems more sustainable.

The real challenge lies in management. Sustainable dairy production depends on balanced feeding systems, efficient water use, and responsible land management. As seen in cases like Central Anatolia, ignoring these factors leads to ecological strain, regardless of the production system.

Ultimately, the future of dairy is not about eliminating cows but improving how they are integrated into agro-ecosystems. The focus should shift from blame to balance, recognizing the cow not as a problem, but as a component of a broader, interdependent system rooted in soil, water, and sustainable resource use.

Conclusion

Milk production is far more than a simple farm activity, it is a finely balanced system where biology, economics, and environmental management intersect. From the efficiency of converting 1.25–1.44 kilograms of dry matter into a liter of milk, to the carefully structured feeding strategies that sustain high-yielding cows, the dairy sector reflects both scientific precision and economic discipline. At its core, profitability depends not on the cow alone, but on how effectively farmers manage feed quality, animal health, and production cycles.

At the same time, the experience of Central Anatolia highlights a critical warning: dairy expansion cannot be separated from resource sustainability. Ignoring water constraints and feed systems can quickly transform opportunity into long-term environmental stress. This reinforces the need for context-specific policies that align agricultural growth with ecological limits.

Equally important is the evolving global debate around livestock and climate change. While environmental concerns are valid, reducing the role of cows to a single emission metric overlooks their unique contribution to food systems, particularly their ability to convert low-value biomass into nutrient-rich food.

The path forward lies in optimization, not elimination. Sustainable dairy farming requires integrated approaches that improve feed efficiency, conserve natural resources, and support farmer livelihoods. If managed wisely, the journey from grass to glass can remain one of the most efficient and resilient food production systems in the world.

Please note that the views expressed in this article are of the author and do not necessarily reflect the views or policies of any organization.

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Food Waste in Pakistan: A Rural Challenge

Rural food waste in Pakistan is a critical issue impacting food security, nutrition, and health. In Punjab's agricultural heartlands, communities face significant losses of milk, vegetables, grains, and meals, affecting household welfare and national nutrition outcomes.

Naveed Farah & Maryam Majeed

4/29/2026

In the fertile wheat fields of Punjab, where agriculture defines both livelihood and identity, a troubling paradox continues to unfold. The same households that produce food for the nation are often unable to utilize it efficiently, leading to quiet but persistent food waste. This is not the visible excess of urban consumption; it is a dispersed, everyday loss occurring at the household levels small quantities of wasted

grains, spoiled milk, overcooked meals, and perishable vegetables that decay before they can be consumed. While each instance may appear insignificant, collectively they impose a substantial economic and nutritional cost on rural families.

At the core of this issue lies a set of structural constraints rather than behavioral negligence. Rural households frequently lack access to basic storage infrastructure. Without refrigeration or proper grain storage facilities, food items are highly vulnerable to spoilage, pests, and environmental conditions. Milk turns sour within hours in summer temperatures, grains are damaged by insects, and fresh produce deteriorates rapidly. These limitations reduce the effective availability of food, even when production levels are adequate.

Seasonality further intensifies the problem. During peak harvest periods, supply temporarily exceeds household consumption capacity. In the absence of preservation technologies such as drying, processing, or cold storage, surplus food cannot be stored or marketed efficiently. As a result, valuable produce is lost, translating into forgone income and reduced dietary diversity.

This "silent burden" of food waste has direct implications for rural welfare. It undermines food security, contributes to malnutrition, and weakens already fragile household economies. Addressing requires not only awareness but investment in rural infrastructure, storage solutions, and simple preservation techniques that can transform surplus into sustenance rather than loss.

The Hidden Face of Hunger in Rural Households

The most painful contradiction within rural food systems is that waste and hunger often coexist within the same household. Families who lose small amounts of food daily are frequently the same ones facing periodic food shortages. This is not a paradox of abundance but one of constraints, inefficiencies, and deeply rooted social practices. A mother discarding spoiled food in the morning may still ration meals later in the day, prioritizing her children while compromising her own nutrition. In such settings, food waste is not a sign of excess, it is a symptom of limited capacity to manage, store, and distribute food effectively.

Cultural norms further complicate this issue. In many rural communities, hospitality is closely tied to generosity, particularly during weddings, religious events, and communal gatherings. Preparing large quantities of food is a social expectation, signaling respect and honor. However, without refrigeration or preservation facilities, leftovers deteriorate rapidly. What begins as a gesture of goodwill often ends in avoidable waste. Similarly, serving practices contribute to inefficiencies. Plates are often filled generously, especially for guests and children, leading to uneaten portions. In some cases, leaving a small amount uneaten is culturally interpreted as satisfaction, unintentionally reinforcing wasteful behavior.

Beyond economic loss, the most critical consequence is nutritional. Rural diets are already dominated by staple grains, with limited intake of protein-rich and micronutrient-dense foods such as milk, vegetables, eggs, and meat. These items are also the most perishable. When they spoil, the loss is not just food, it is lost nutrition. Children miss essential vitamins for cognitive development, women lose vital nutrients needed for maternal health, and the elderly face weakened immunity.

Thus, food waste in rural Pakistan is not merely a logistical issue; it is a direct contributor to malnutrition. Addressing requires both behavioral awareness and practical interventions to ensure that available food translates into actual nourishment.

The Hidden Health Crisis Behind Food Waste

The consequences of food waste in rural households extend far beyond lost meals, they directly affect both physical health and psychological well-being. When food spoils or is consumed past its safe condition, it becomes a significant source of foodborne illness. In many villages, families cannot afford to discard food easily, so they often take risks, reusing cooking oil multiple times or eating leftovers that have been exposed to heat and bacteria for long hours. This can lead to diarrhea, stomach infections, and dehydration. For young children, whose immune systems are still developing, such illnesses can quickly become severe or even fatal.

Access to healthcare further complicates the situation. In many rural areas, basic health units are distant, under-resourced, or costly to reach. As a result, what begins as a minor stomach issue can escalate into a serious health crisis. These cases are rarely documented formally, yet they form a persistent, underlying burden on rural health systems, quietly affecting productivity, school attendance, and overall quality of life.

Beyond physical illness, the emotional toll is equally significant. Women, who are primarily responsible for managing food preparation and storage, carry the stress of ensuring that nothing is wasted while also meeting cultural expectations of hospitality. When food spoils, it often leads to feelings of guilt and frustration. When there is too little to serve guests, it can bring embarrassment. Over time, this constant pressure contributes to anxiety and mental fatigue.

Understanding the Roots and Pathways to Change

Food waste in rural Pakistan is often misunderstood as carelessness, but it is deeply rooted in structural limitations and social practices that shape everyday life. At the most basic level, the absence of storage infrastructure plays a decisive role. Many rural households lack refrigerators, airtight containers, or even well-ventilated storage spaces. In a climate marked by intense heat and humidity, perishable foods such as milk, vegetables, and cooked meals spoil quickly. Grains, if not properly stored, fall victim to insects and rodents. Even the most careful household cannot fully prevent losses under such conditions.

Equally important is the gradual erosion of traditional knowledge. Older generations possessed practical skills, sun-drying vegetables, fermenting foods, and preserving surplus through pickling, that extended shelf life without modern technology. As lifestyles change and younger generations move away from these practices, this low-cost knowledge is fading. At the same time, modern preservation methods remain largely inaccessible due to cost and limited electricity supply, creating a gap between old wisdom and new solutions.

Market access further compounds the problem. Farmers producing seasonal surpluses such as mangoes, tomatoes, or guavas often lack timely access to markets. Poor rural roads, high transport costs, and absence of cold chains mean that produce cannot be sold before it deteriorates. What could have been income becomes waste. Social norms also play a subtle but powerful role. Hospitality traditions encourage abundance, especially during gatherings, leading to over-preparation and inevitable leftovers that cannot be stored safely.

Gender dynamics add another layer. Women manage food preparation but often lack control over financial decisions. Bulk purchasing, driven by distance or cost considerations, increases the risk of spoilage. Without decision-

making authority, efficient planning becomes difficult.

Addressing this issue requires practical, culturally grounded solutions rather than expensive interventions. Reviving traditional preservation techniques through community knowledge-sharing can immediately reduce waste. Simple storage improvements such as sealed grain containers, ventilated racks, or solar-powered community cooling systems can significantly extend food life. Educating households on portion planning can gradually shift norms toward valuing efficiency alongside hospitality.

Improving market linkages is equally critical. Village-level aggregation, better transport coordination, and digital platforms can help farmers sell surplus produce before it spoils. Integrating food waste awareness into existing health and nutrition programs can reinforce its importance as part of household well-being. Finally, empowering women with greater control over budgeting and purchasing decisions can lead to more efficient food management.

Making the Invisible Visible: A Rural Food Imperative

Food waste in rural Pakistan persists not because it is ignored, but because it is normalized woven into daily routines in ways that rarely attract attention. It exists in small, scattered moments: a vegetable left too long in the heat, leftover bread diverted to livestock, or milk that turns sour before it can be consumed. These are not dramatic losses, yet their cumulative impact is profound. They quietly erode household food availability, nutritional quality, and financial stability.

Recognizing this hidden burden is the first step toward meaningful change. When waste is seen clearly, it shifts from being an unavoidable inconvenience to a solvable problem. This shift in perception is critical because the implications go far beyond the kitchen. Reducing food waste directly strengthens food security, improves dietary diversity, and enhances public health outcomes in rural communities. It also preserves the economic value of food that has already required labor, water, and inputs to produce.

The pathway forward does not depend on complex or costly interventions. Modest, context-specific improvements such as better household storage, renewed use of traditional preservation techniques, and awareness around portion management can yield substantial benefits. Equally important is reshaping social norms in ways that maintain cultural values while minimizing unnecessary excess.

Ultimately, addressing rural food waste is about restoring efficiency and dignity to the food system. When households can conserve what they produce and purchase, they move closer to nutritional security and economic resilience. The transformation begins with attention, seeing what has long been overlooked and acting with practical intent to ensure that food fulfills its fundamental purpose: nourishment.

Conclusion

Rural food waste in Pakistan is not a marginal issue of household inefficiency; it is a structural challenge with deep implications for food security, nutrition, health, and rural livelihoods. Across Punjab's agricultural heartlands, the paradox remains stark communities that produce the nation's food are simultaneously unable to preserve and fully utilize it. What appears as small daily losses of milk, vegetables, grains, and cooked meals accumulates into a significant drain on household welfare and national nutritional outcomes.

The analysis shows that this waste is not driven by negligence but by systemic constraints: inadequate storage infrastructure, limited access to preservation technologies, weakening traditional knowledge, market inefficiencies, and rigid social norms around hospitality. These factors interact to create conditions where food spoilage becomes routine rather than exceptional. As a result, rural households often experience both waste and hunger within the same economic space, intensifying the burden on women, children, and low-income families.

The consequences extend beyond economics. Food waste directly contributes to malnutrition by reducing access to nutrient-rich foods, increases exposure to foodborne illnesses, and imposes psychological stress on caregivers managing scarce resources under cultural pressure. It also weakens rural economies by eroding the value of already-limited agricultural output.

Addressing this challenge requires a shift from awareness to action. Practical interventions, improved storage systems, revival of indigenous preservation techniques, better market linkages, and targeted nutrition messaging, can significantly reduce losses. Equally important is empowering women and reshaping social norms to balance hospitality with efficiency.

Ultimately, reducing rural food waste is not merely about saving food; it is about strengthening resilience, improving nutrition, and ensuring that agricultural production translates into real human well-being. Making the invisible visible is the first step toward transforming rural food systems into more efficient and equitable structures.

Please note that the views expressed in this article are of the author and do not necessarily reflect the views or policies of any organization.

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The Agricultural Economist, Vol. 3(4)
ISSN: 3104-8803

PUBLIC HEALTH ECONOMICS

Understanding Health Inequality and Its Causes

Explore how health inequality is a reflection of social and economic imbalances, affecting life expectancy and human potential. Discover the impact of environment, income security, and access to care on health outcomes.

Imam Un Nas

4/2/2026

Imagine entering a world where the address on your birth certificate predicts your lifespan more accurately than your genetic profile. For millions of people, this is not a metaphor, it is the lived reality of health inequality. The latest World Health Organization global evidence shows that social determinants such as income, education, housing, employment, and neighborhood conditions shape most health outcomes, often outweighing medical care or inherited biology. In practical terms, the place where a person is born, grows up, studies, and works can determine whether they live a long healthy life or face preventable illness and early death.

The numbers are startling. The global life expectancy gap between the highest- and lowest-performing countries reaches 33 years, while children born in low-income countries are 13 times more likely to die before age five than those in wealthier nations. Even more importantly, WHO estimates that closing wealth-related health inequalities within low- and middle-income countries could save 1.8 million children every year.

This crisis is not limited to poorer nations. Within wealthy countries, health follows a steep social gradient. Poorer neighborhoods often face polluted air, weaker schools, insecure jobs, poor housing, and limited access to preventive care. When illness strikes, the consequences go beyond physical suffering; it can destroy earnings, deepen poverty, and reduce lifetime opportunities. In this sense, inequality becomes biologically embedded.

The central message is clear: poor health is rarely just a medical issue. It is the outcome of unequal social and economic structures. If governments want healthier populations, they must invest not only in hospitals but also in education, decent housing, labor protections, and equitable local development.

The Vicious Cycle of Stress, Environment, and Financial Shock

Poverty damages health far more than limited food choices or the inability to afford exercise. Its deeper effect lies in how it continuously exposes people to unsafe environments, chronic stress, and financial vulnerability that gradually wear down both body and mind. This creates a vicious cycle in which poor health reduces earning capacity, and lower income further worsens health outcomes.

The first pathway is environmental exposure. The World Health Organization reports that 99% of the global population breathes air that exceeds recommended safety limits, but the burden falls disproportionately on low-income communities. Poorer households are often concentrated near highways, industrial zones, brick kilns, waste-burning sites, or poorly regulated landfills, where pollution exposure is constant. Because housing choices are constrained by affordability, families cannot simply relocate to cleaner neighborhoods, making respiratory disease, cardiovascular illness, and childhood asthma more common.

The second pathway is what health economists call financial toxicity. Even when illness is treatable, the cost of treatment itself can become a driver of poverty. Recent WHO-World Bank estimates show that 2.1 billion people worldwide face financial hardship because of out-of-pocket health spending, while 1.6 billion are pushed deeper into poverty by these expenses. Medicines, diagnostics, transport, and hospital fees can consume a large share of already limited household income, forcing families to sacrifice nutrition, education, or shelter.

The third mechanism is psychological stress. Poverty means constant anxiety about rent, food, school fees, job security, and debt. This relentless mental pressure contributes to depression, anxiety disorders, hypertension, sleep disruption, and weakened immunity. Over time, stress becomes biologically embedded, increasing the risk of both physical and mental illness. In this way, poverty is not only an economic condition, it becomes a long-term health hazard that reproduces inequality across generations.

What Actually Works to Close the Health Gap?

The good news is that health inequality is no longer being treated as an unavoidable social reality. By 2025, governments and global institutions are increasingly recognizing that better health is not merely a welfare objective, it is a growth strategy, a labor market policy, and a long-term economic investment. The emerging policy playbook focuses on reducing the structural barriers that keep poorer communities trapped in cycles of illness and low productivity.

The first and most powerful solution is universal health coverage with financial protection. The latest WHO-World Bank Global Monitoring Report shows that the global health service coverage index improved from 54 in 2000 to 71 in 2023, while the share of people facing financial hardship from out-of-pocket spending fell from 34% to 26%. The critical next step is ensuring that essential services are free at the point of use for poor and vulnerable households. When costs are removed, people seek treatment earlier, preventing minor conditions such as hypertension or diabetes from escalating into catastrophic hospital events.

A second breakthrough is the growing view that housing, nutrition, and water security are health interventions. A child living in damp housing, breathing polluted air, or drinking contaminated water cannot be “treated” through prescriptions alone. This is why governments are increasingly adopting multisectoral approaches that link health ministries with

housing, sanitation, and local development departments.

Third, countries are expanding community health worker and navigator systems. These frontline workers are trusted local figures who help vulnerable families access clinics, understand insurance, collect medicines, and adhere to treatment. Their strength lies in bridging the gap between formal health institutions and fragile households that often distrust or cannot navigate bureaucratic systems.

Most importantly, policymakers are now reframing public health spending as economic policy. Healthier workers are more productive, children miss fewer school days, and fewer households fall into poverty due to medical bills. Investments in clean air, mental health, prevention, and primary care therefore generate returns far beyond hospitals, they strengthen labor productivity, social mobility, and national competitiveness.

The bottom line is simple: health inequality is the result of policy design, which means it can also be solved through better policy design. The evidence is now clear that universal coverage, local action, and cross-sector public investment are among the most effective tools for building both healthier societies and stronger economies.

Conclusion

The evidence is now overwhelming that health inequality is not simply a medical problem but a reflection of deeper social and economic imbalances. Where people live, the air they breathe, the quality of their housing, the security of their income, and their ability to afford treatment all combine to shape life expectancy, productivity, and human potential. Poverty does not merely coexist with illness, it actively produces it through environmental exposure, chronic stress, financial hardship, and limited access to preventive care.

What makes this issue urgent is that its consequences extend far beyond hospitals. Poor health weakens labor productivity, reduces educational attainment, increases dependency, and slows economic growth. In this sense, health inequality becomes both a social injustice and a macroeconomic burden. The encouraging reality, however, is that the solutions are now well established. Universal health coverage, stronger community-based care, better housing, clean environments, nutrition security, and local institutional action can significantly narrow the health gap.

The central lesson is clear: healthier societies are built through smarter policy choices, not luck. When governments treat health as part of economic planning, social protection, and local development, they create returns that extend across generations. Closing the health gap is therefore not only a moral imperative but also one of the most powerful investments a nation can make in sustainable and inclusive growth.

Please note that the views expressed in this article are of the author and do not necessarily reflect the views or policies of any organization.

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The True Value of Vaccines: Health & Economic Impact

Vaccines are essential for health security and economic resilience. They prevent disease, support healthcare systems, and protect vulnerable populations from financial ruin during outbreaks. Discover the multifaceted value of vaccines in safeguarding health and stabilizing economies.

Muneeb ur Rehman

4/3/2026

For more than a century, vaccines have held a unique place in public health. They do something few medical interventions can: they stop disease before it begins. Their success is quiet and often invisible, measured not in treatments delivered but in illnesses avoided. Outbreaks that never occur, hospital beds that remain empty, lives that unfold without interruption. Entire generations grow up healthier, often without realizing how much has been prevented on their behalf. For decades, vaccines were also seen as one of the most cost-effective tools in medicine. Simple to produce, relatively easy to distribute, and capable of protecting millions, they became the benchmark for efficient health spending. Immunization programs were widely described as the closest thing to a guaranteed return on investment in public health.

But that landscape is shifting. The image of low-cost vaccines delivered through established systems is being replaced by a new wave of scientific innovation. Messenger RNA vaccines, rapidly developed and highly adaptable, have transformed the speed of response to emerging diseases. Advanced recombinant technologies offer stronger and longer-lasting immunity. At the same time, novel delivery systems are being designed to reduce dependence on cold storage and expand reach into underserved areas.

These advances have expanded what vaccines can do, but they have also complicated how we value them. Costs are rising. Delivery is becoming more technically demanding. The old assumption that vaccines are always the cheapest option no longer holds in every case.

What emerges is a more complex reality. Vaccines remain one of the most powerful tools in public health, but understanding their true value now requires looking beyond price alone and toward long-term impact, resilience, and the broader economics of prevention.

From Simple Interventions to Strategic Investments

For decades, the economic case for vaccines was almost self-evident. Most childhood immunizations were inexpensive, easy to store, and delivered through established public health systems. Cost-effectiveness analyses consistently showed overwhelming returns: a small upfront investment translated into large savings in future treatment costs, avoided productivity losses, and reduced mortality. Vaccines were not just life-saving, they were

budget-saving. They became the gold standard of efficiency in public health spending.

That clarity is fading. Scientific progress has expanded what vaccines can do, but it has also made them more complex as economic decisions. Platforms such as mRNA have redefined the speed and precision with which vaccines can be developed, especially in response to emerging threats. At the same time, these technologies come with higher production costs, sophisticated manufacturing requirements, and more demanding distribution systems.

This shift forces policymakers into more nuanced decisions. A vaccine that is highly effective but significantly more expensive raises difficult trade-offs. Its value may vary across populations, offering substantial benefits to high-risk groups while appearing less efficient for younger, healthier individuals. Questions of timing also emerge. Should limited budgets prioritize immediate needs, or invest in prevention strategies whose full benefits may only appear years later? And how should systems weigh broader goals like resilience and equity alongside strict cost considerations?

To navigate this complexity, health economists rely on cost-utility analysis, using measures such as quality-adjusted life years and disability-adjusted life years. These tools allow vaccines to be compared directly with other health interventions, from cancer therapies to chronic disease management. Yet even these frameworks are being stretched. Modern vaccines generate benefits that extend beyond individual protection, including reduced transmission, economic stability, and system-wide resilience.

The result is a more layered understanding of value. Vaccines are no longer simply low-cost interventions with universal returns. They are strategic investments, where impact depends on context, targeting, and timing. The challenge is no longer proving that vaccines are worth it, but determining how, where, and for whom they deliver the greatest value.

Rethinking Value in the Fight Against Infectious Diseases

Malaria forces a different kind of economic thinking. Unlike many other infectious diseases, it already has a set of highly cost-effective tools, bed nets, indoor spraying, and preventive treatment. Vaccines do not replace these measures; they add another layer to an already complex strategy. That distinction matters. In 2024 alone, malaria caused an estimated 282 million cases and 610,000 deaths worldwide, with the overwhelming burden falling on sub-Saharan Africa. Hundreds of thousands of children still die each year from a disease that is both preventable and treatable.

The arrival of vaccines like RTS,S and R21/Matrix-M has begun to change this landscape. Clinical trials show that both can reduce malaria cases by more than half during the most vulnerable early years of life, with even stronger protection when doses are timed to seasonal transmission. Real-world rollout has confirmed these gains, with measurable declines in child mortality and severe illness. The cost, particularly for newer formulations like R21, has been kept relatively low through global partnerships, making large-scale deployment feasible. Yet the key insight is not just effectiveness or affordability. It is complementarity. Vaccines work best when layered onto existing interventions, strengthening rather than replacing them.

Dengue presents a more delicate challenge. Here, the science introduces risk alongside benefit. Because of the way immunity develops, vaccinating individuals who have never been infected can increase the chance of severe disease later. This turns a straightforward vaccination campaign into a targeted strategy that may require prior screening. That added step reshapes the economics, raising costs and logistical demands. Still, evidence shows that when applied carefully, vaccines like TAK-003 can significantly reduce cases and hospitalizations, generating substantial long-term savings. The margin for error, however, is narrower, and success depends heavily on precision.

Beyond these disease-specific cases lies a broader, often overlooked benefit. Vaccines reduce the need for antibiotics by preventing infections in the first place. This slows the spread of antimicrobial resistance, one of the most pressing global health threats. Yet traditional economic models rarely capture this effect. They also tend to underestimate indirect benefits such as herd immunity, where protection extends beyond those vaccinated.

Taken together, these examples reveal a shift in how vaccines must be understood. Their value no longer sits in simple cost comparisons, but in how they interact with systems, behaviors, and long-term risks. The economics of vaccination is becoming less about isolated interventions and more about how each piece strengthens the whole.

Rethinking How We Measure Value

As vaccines grow more sophisticated, the way we evaluate them needs to catch up. Traditional economic models were built for simpler interventions and often miss key dimensions of value that modern vaccines generate.

One major limitation is the reliance on static models, which assess direct effects but ignore how vaccines interrupt transmission. When dynamic transmission models are used instead, they capture herd immunity, showing how vaccinating one group protects many others. This alone can significantly increase the estimated value of immunization programs.

Equity is another missing piece. Standard analyses tend to treat all populations the same, but vaccines often deliver the greatest benefits to the most vulnerable. Protecting low-income households from illness also shields them from catastrophic health expenditures, an outcome that carries both economic and social value.

A broader societal perspective further changes the picture. When productivity losses from illness and premature death are included, vaccines appear far more cost-effective. One study showed that excluding these losses increased the cost per quality-adjusted life year by nearly half, underscoring how much traditional models leave out.

Recent evidence reinforces this shift. A 2025 study of a next-generation mRNA vaccine estimated a cost of just $16,241 per QALY gained, well below typical willingness-to-pay thresholds, with returns reaching up to nearly ten dollars for every dollar invested.

Vaccines as Long-Term Social Investments

What becomes clear in this evolving landscape is that vaccines cannot be judged by price alone. Their true value lies in what they prevent, protect, and preserve over time. Beyond individual health, vaccines act as stabilizers for entire systems. During outbreaks, they ease pressure on hospitals, protect frontline workers, and reduce the economic shock that widespread illness can bring.

They also play a quiet but powerful role in social protection. For vulnerable populations, avoiding disease often means avoiding financial ruin. A single hospitalization can push families into poverty, especially in low- and middle-income settings. Vaccines interrupt that cycle before it begins, offering not just health security but economic resilience.

There is also a time dimension that is easy to overlook. Vaccines create space for societies to respond, adapt, and innovate. They slow the spread of disease, buying critical time for research, policy, and preparedness. And as technologies mature, costs tend to fall, meaning today's expensive breakthroughs may become tomorrow's standard, affordable tools.

At its core, the debate is about priorities. Investing in vaccines means valuing prevention over reaction, long-term gains over short-term savings. It requires systems that reward innovation while ensuring access remains fair.

Conclusion

Modern vaccines have quietly crossed a threshold. They are no longer defined by low cost and simplicity, but by complexity, precision, and long-term impact. The old narrative of vaccines as automatic "best buys" still holds in spirit, but not always in structure. Today's immunization decisions require deeper judgment, about who benefits most, when interventions matter most, and how value unfolds over time.

What this new landscape reveals is not a weakening of the case for vaccines, but a strengthening of it. When broader effects are accounted for, reduced transmission, protection against financial shocks, and resilience during crises, the value of vaccines often exceeds what traditional models capture. The challenge is that these benefits are harder to measure, slower to appear, and unevenly distributed.

For policymakers, the task is no longer to justify vaccination in general, but to design smarter strategies. This means targeting high-impact groups, integrating vaccines with other health interventions, and adopting evaluation frameworks that reflect real-world complexity. It also means accepting that some of the most valuable investments in health are those whose returns are not immediately visible.

In the end, vaccines remain one of the strongest tools we have, not because they are cheap, but because they are transformative. The real shift is in how we understand their worth: not as isolated interventions, but as foundations of healthier, more resilient societies.

Please note that the views expressed in this article are of the author and do not necessarily reflect the views or policies of any organization.

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Chronic Disease & Aging Population in Rural Pakistan

Explore how the rise of chronic disease and an aging population are reshaping the economic and social landscape of rural Pakistan. This silent crisis threatens households, drains resources, and deepens generational poverty.

Rimsha Jamil

4/8/2026

Across the quiet villages, scattered hamlets, and agricultural heartlands of rural Pakistan, a slow-moving but deeply destructive crisis is unfolding. Unlike floods, droughts, or earthquakes that arrive dramatically and leave visible damage, this crisis grows silently inside homes and bodies. It is the twin challenge of rising non-communicable diseases (NCDs) and a steadily aging rural population, and together they are placing enormous pressure on household finances, labor productivity, and long-term rural resilience.

For decades, Pakistan's public health priorities were rightly centered on infectious diseases such as malaria, tuberculosis, diarrheal illness, and maternal infections. These were the dominant threats in rural life, particularly where sanitation, clean water, and immunization systems were weak. However, the disease profile has shifted. Today, diabetes, hypertension, cardiovascular disease, stroke, chronic respiratory illness, kidney disease, and cancer are increasingly the main causes of death and disability. According to global public health evidence, these chronic conditions now account for most deaths in Pakistan, fundamentally changing the economics of rural health.

The danger becomes even greater when combined with demographic change. Rural families are now caring for a growing number of elderly parents and grandparents who require long-term medication, regular diagnostic tests, specialist consultations, and support with daily living. In areas where qualified doctors are scarce, transport is costly, and health insurance coverage remains weak, these expenses can quickly overwhelm fragile household budgets.

The economic effects are severe. Families face repeated out-of-pocket spending on medicines, transport, diagnostics, and hospital referrals, while lost workdays reduce farm productivity and wage income. A diabetic farmer missing harvest time or an elderly parent requiring constant care can push entire households into debt.

This emerging health transition is therefore not only a medical issue, but also a rural development and public health economics crisis, one that threatens livelihoods, food security, and intergenerational wellbeing unless addressed through stronger primary care, chronic disease screening, and age-sensitive rural health financing.

The Changing Face of Illness in Rural Pakistan

The profile of sickness in Pakistan's rural communities has changed dramatically over the last two decades. A visit to a village health clinic today reveals far fewer cases dominated solely by fever, diarrhea, or seasonal infections

and far more patients living with long-term chronic illness. Middle-aged farmers arrive with uncontrolled diabetes, elderly women struggle with chronic obstructive pulmonary disease, and many breadwinners now live with the after-effects of heart attacks or strokes. This shift marks a major epidemiological transition with profound economic implications for rural households.

One of the most concerning trends is the rise of hypertension and diabetes, both of which are spreading rapidly across rural populations. High blood pressure now affects a significant share of adults, while diabetes is increasingly common among older and middle-aged residents. Several structural factors are driving this rise: changing diets, reduced dietary diversity, growing consumption of low-cost processed foods, persistent tobacco use, and limited preventive screening. Many villagers remain unaware of their condition until a serious complication occurs, such as kidney failure, vision loss, stroke, or cardiovascular collapse. By then, treatment becomes far more expensive and financially devastating.

Unlike acute illness, chronic disease is not temporary. It requires lifelong spending on medicines, diagnostics, transport, and follow-up consultations, creating a continuous burden on fragile rural budgets. At the same time, Pakistan's countryside is aging. As the share of older adults steadily rises, rural families are increasingly caring for parents and grandparents with multiple overlapping illnesses such as diabetes, arthritis, hypertension, and respiratory disease. In villages where trained doctors, geriatric services, and formal elderly care are nearly absent, the responsibility falls entirely on families, often forcing younger household members, especially women, to reduce work and caregiving productivity.

The Financial Squeeze to Rural Households

The most devastating impact of chronic disease and population aging in rural Pakistan is often felt not in hospitals, but in the household budget. For millions of rural families, illness is not only a medical emergency, but also a direct economic shock that can destabilize livelihoods for years.

The first pressure point is out-of-pocket spending, which remains the dominant way rural families finance healthcare. Most households have little or no awareness of formal insurance, and even where public health protection schemes exist, access is often limited. This means families pay directly for medicines, laboratory tests, transport to district hospitals, consultation fees, and repeated follow-up visits. For a low-income farming household, the recurring cost of insulin, blood pressure medicines, inhalers, or kidney tests can consume a large share of monthly income. The result is painful trade-offs: less nutritious food, delayed school payments, postponed farm inputs, or neglected home maintenance.

The second burden is what economists describe as catastrophic health expenditure, when healthcare costs become so large that they push a family into poverty. In rural Pakistan, a single hospitalization for stroke, heart disease, or diabetes-related complications can erase years of savings. Families often respond by selling goats, cattle, or land, borrowing from informal lenders at high interest, or withdrawing children from school to contribute labor or wages. In this way, a health shock quickly becomes an intergenerational poverty shock.

The third and often overlooked cost is lost productivity. Chronic illness reduces the ability of working adults to farm, manage livestock, or perform wage labor. At the same time, elderly patients often require caregiving, forcing another family member, usually a woman, to withdraw from income-generating work.

This creates a destructive cycle: illness reduces earnings, lower earnings worsen nutrition and treatment access, and poor treatment deepens illness. In rural development terms, chronic disease becomes both a health crisis and a poverty multiplier.

The Wider Economic Damage of Chronic Disease in Rural Pakistan

The rise of chronic disease and population aging in rural Pakistan is not only a household crisis, but also a growing macroeconomic challenge with implications for national productivity, fiscal stability, and long-term development. When millions of rural families are simultaneously dealing with diabetes, hypertension, cardiovascular illness, and elderly care, the consequences extend far beyond individual suffering.

At the national level, the first impact is higher public healthcare expenditure. As chronic conditions require long-term medicines, repeated diagnostics, hospital referrals, dialysis, and emergency cardiac care, governments are forced to allocate increasing resources toward treatment. In a country where fiscal space is already constrained, this means fewer resources remain for education, irrigation, rural roads, sanitation, and clean water infrastructure, which are equally important for human development.

The second effect is a decline in labor productivity. Chronic disease increasingly affects adults in their most economically active years, particularly those aged 30 to 50 who drive agriculture, transport, rural enterprises, and informal labor markets. A farmer disabled by stroke, kidney disease, or heart complications reduces household production and national agricultural output. At scale, this weakens the very labor force that supports Pakistan's growth trajectory.

A third pressure point is the growing burden on social protection and family-based elderly support systems. As the number of older adults rises, demand for pensions, disability support, and health subsidies will increase, even though Pakistan's welfare architecture remains limited.

Rural communities suffer the worst because structural barriers amplify the crisis. Long travel distances, poor roads, weak health literacy, dependence on unqualified practitioners, limited screening services, and gender-related mobility constraints all delay diagnosis and increase treatment costs. Many villagers only discover hypertension or diabetes after catastrophic complications such as stroke, blindness, or kidney failure.

The broader implication is clear: chronic disease in rural Pakistan is no longer only a medical issue. It is a national economic growth issue, a rural productivity issue, and a human capital issue that requires urgent preventive investment.

A Practical Policy Response for Rural Pakistan

Although the rise of chronic disease and population aging presents a serious challenge, the crisis is far from irreversible. With realistic, rural-focused policy reforms, Pakistan can significantly reduce both the health and economic burden on households.

The first and most important step is to strengthen primary healthcare rather than concentrate on resources in urban tertiary hospitals. Rural Basic Health Units (BHUs) and Rural Health Centers should be equipped to routinely screen for diabetes, hypertension, heart disease, and chronic respiratory illness. Frontline nurses, Lady Health Workers, and community-based health staff can be trained to monitor blood pressure, manage glucose checks, refill essential medicines, and provide long-term counseling. Chronic disease care must become part of routine village-level services rather than a hospital-only function.

Second, Pakistan needs to expand health insurance and outpatient financial protection. Existing schemes such as Sehat Sahulat provide an important foundation, but chronic illness requires regular spending on medicines and diagnostics, not just hospitalization. Coverage for monthly medicines, glucose strips, blood tests, and follow-up visits would dramatically reduce catastrophic household spending in rural areas.

Third, prevention through community education offers the highest economic return. Low-cost awareness campaigns delivered through mosques, schools, local radio, village gatherings, and agricultural extension networks can improve knowledge about tobacco harms, diet quality, physical activity, and the importance of early screening. Even simple interventions such as village blood pressure camps or diabetes testing days can prevent costly complications later.

Fourth, telemedicine and mobile outreach can overcome geographic isolation. Remote consultations with specialists, supported by mobile clinics that visit villages for screening and medicine refills, would reduce travel costs and delays.

Finally, Pakistan must begin building elder-friendly rural health services, including trained geriatric nurses, chronic care counseling, and community day-support spaces for older adults. Such measures would ease the burden on family caregivers while improving quality of life.

Conclusion

The rise of chronic disease alongside a rapidly aging population is quietly reshaping the economic and social fabric of rural Pakistan. What makes this crisis particularly dangerous is its invisibility. It does not arrive with sudden destruction, but gradually drains household resources, weakens labor productivity, and deepens poverty over time. For millions of rural families, illness is no longer a temporary disruption but a permanent financial obligation that compounds across generations.

The evidence is clear: without timely intervention, the combined burden of non-communicable diseases and elderly care will continue to erode rural livelihoods, reduce agricultural output, and place unsustainable pressure on already fragile health systems. More importantly, it risks widening inequalities between rural and urban populations, where access to healthcare, financial protection, and awareness remains uneven.

Yet this trajectory is not inevitable. Pakistan has both the knowledge and policy tools to respond effectively. Strengthening primary healthcare, expanding outpatient financial protection, investing in prevention, and leveraging telemedicine can significantly reduce long-term costs while improving health outcomes. Equally important is recognizing elderly care as a growing policy priority rather than a private family burden.

Ultimately, addressing this silent storm is not just a health sector responsibility, it is a rural development imperative. The future of Pakistan's economy depends on whether its rural population can remain healthy, productive, and financially resilient in the face of this emerging challenge.

Please note that the views expressed in this article are of the author and do not necessarily reflect the views or policies of any organization.

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The Agricultural Economist, Vol. 3(4)
ISSN: 3104-8803

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