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Brick Kilns and Agricultural Productivity in Bangladesh

Evidence from Satellite Data and a Natural Experiment

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Overview

Bangladesh's brick kiln industry plays a critical role in supplying construction materials for rapid urbanization. However, the sector remains largely informal and weakly regulated, with widespread extraction of fertile topsoil and substantial emissions of particulate matter and black carbon. These practices raise growing concerns about long-term environmental degradation, agricultural productivity, and food security.

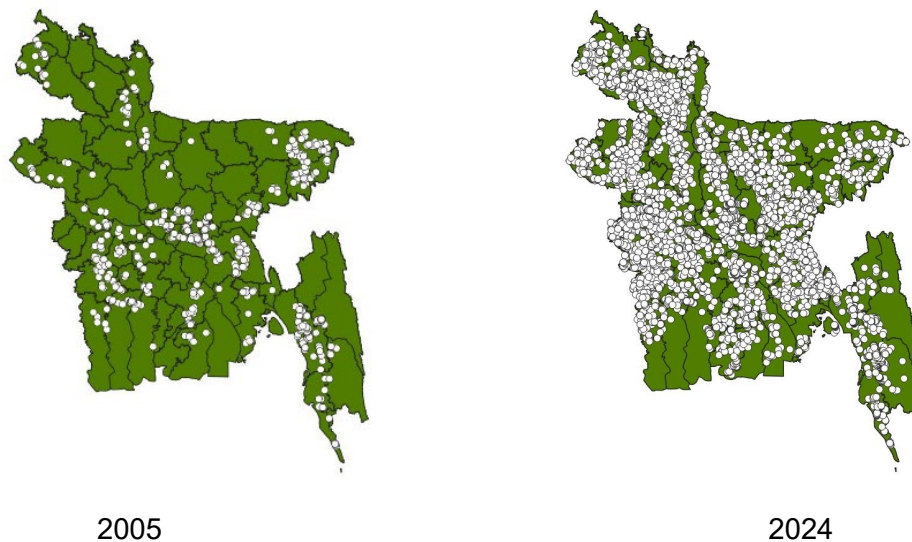
This policy brief summarizes new national-scale evidence on the impacts of brick kiln expansion on agricultural productivity in Bangladesh. Using satellite-based vegetation data covering more than two decades and a newly constructed geospatial inventory of brick kilns, the study provides causal estimates of how kiln establishment affects vegetation health and crop productivity over time.

Key findings

- ▶ **Rapid expansion of brick kilns in agricultural areas:** The brick sector expanded sharply between 2000 and 2024, with kilns highly clustered in peri-urban and fertile agricultural regions (Figure 1).
- ▶ **Persistent declines in vegetation health:** Satellite-derived NDVI declines immediately following kiln establishment, with no evidence of differential pre-trends.

- ▶ **Cumulative and long-lasting agricultural damage:** A marginal increase in kiln presence is associated with roughly a 1 percent annual decline in vegetation productivity, with effects accumulating over time (Figure 2).
- ▶ **Mechanisms consistent with soil degradation and air pollution:** Topsoil removal and particulate deposition reduce photosynthesis, soil fertility, and long-term land productivity.
- ▶ **Food security implications:** Concentration of kilns in staple crop regions poses a growing threat to national food security by eroding the productive base of agriculture

Figure 1: Brick kilns establishment in Bangladesh – 2005 versus 2024



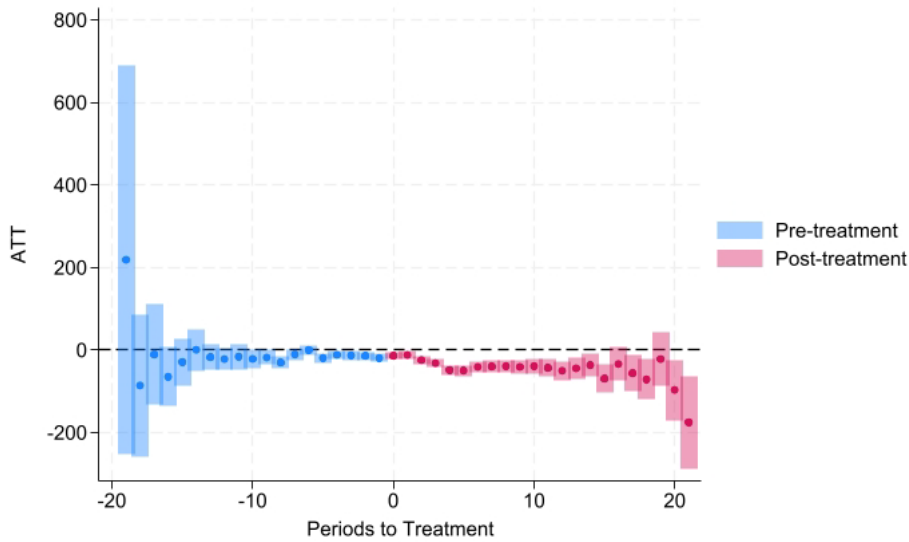
Source: Authors.

Evidence and approach

The analysis combines annual MODIS satellite NDVI data from 2002–2024 with a machine-learning-based geospatial inventory of more than 9,000 brick kilns and administrative boundaries covering over 7,000 unions and municipalities. A continuous and staggered difference-in-differences framework is used to compare vegetation outcomes before and after kiln establishment, accounting for heterogeneous timing and exposure intensity. Results are robust across specifications and show no evidence of pre-treatment differences between affected and unaffected areas.

Satellite-derived NDVI is strongly correlated with rice production and yields in Bangladesh, validating its use as a scalable proxy for agricultural productivity. Compared with traditional survey-based methods, NDVI offers a low-cost, high-frequency, and spatially detailed tool for monitoring environmental stress and emerging risks to food security.

Figure 2: Event-study plot showing persistence decline of NDVI value post brick kilns establishment



Source: Authors.

Why this matters for policy

Without corrective action, continued kiln expansion risks undermining decades of investment in irrigation, crop intensification, and rural development. These losses are likely to fall disproportionately on smallholder farmers located near industrial clusters and pose a growing threat to national food security in Bangladesh by eroding the productive base of crop production. By degrading land in high-yield rice-growing regions, kiln expansion also weakens the resilience and stability of Bangladesh’s food system in the face of climate and demographic pressures.

Recommendations

Strengthen spatial zoning and land-use planning:

Introduce and enforce clear zoning rules that restrict brick kiln operations in high-yield agricultural zones, floodplains, and ecologically sensitive areas. Priority rice-producing regions should be explicitly protected to prevent long-term productivity losses. Satellite-based monitoring can support transparent identification of violations and reduce discretion in enforcement.

Enforce limits on topsoil extraction and mandate soil replacement:

Strengthen enforcement of existing regulations that prohibit the use of fertile topsoil for brick production. Beyond enforcement, design scalable interventions that work directly with brick kiln owners to promote the replacement of topsoil after extracting soil from lower layers. Training, technical guidance, and monitoring can help internalize environmental costs while maintaining industrial output.

Accelerate transition to cleaner brick kiln technologies:

Scale up incentives, financing mechanisms, and regulatory pressure to encourage adoption of cleaner kiln technologies with lower emissions and reduced soil demand. Experimental evidence shows that

advanced zigzag kiln technologies can substantially reduce fuel use, air pollution, and reliance on fertile soil compared to traditional designs (Brooks et al. 2025). Wider adoption would reduce environmental damage while improving energy efficiency and profitability.

Integrate satellite-based NDVI monitoring into regulatory and agricultural oversight:

Traditional survey-based measures of agricultural productivity are costly, infrequent, and limited in spatial coverage. Satellite-derived NDVI offers a scalable, low-cost, and high-frequency complement that can detect localized productivity losses linked to industrial pollution and land degradation. Institutionalizing NDVI-based monitoring within environmental and agricultural agencies would support early warning systems, spatially targeted inspections, and more responsive food security policy.

Support restoration in affected agricultural areas:

Develop targeted land restoration and soil rehabilitation programs around inactive or relocated kiln sites. These may include organic soil amendments, crop diversification, reforestation, and land reclamation measures aimed at restoring ecosystem function and agricultural productivity. Satellite data can be used to track recovery over time and prioritize intervention areas.

Conclusion

Brick kiln expansion in Bangladesh has imposed significant, cumulative, and long-lasting costs on agricultural productivity. However, these impacts are not inevitable. Data-driven zoning, satellite-based monitoring, cooperative engagement with kiln operators, and cleaner technologies provide a feasible pathway to balance industrial growth with agricultural sustainability and national food security.

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