



## The Invisible Tax on the World's Harvest

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*“Post-harvest losses cost the global economy hundreds of billions of dollars each year and the burden falls heaviest on the farmers and communities least able to bear it.”*

In a village on the outskirts of Maiduguri, in northeastern Nigeria, a smallholder farmer named Fatima Musa watches a third of her tomato harvest soften and spoil before a buyer ever arrives. There is no refrigerated truck. There is no cold storage within fifty kilometres. There is only the sun, the heat, and the mathematics of loss—a calculation that plays out with quiet devastation across the developing world every single day. Post-harvest loss—the reduction in quantity or quality of food after it leaves the farm—is one of the most consequential and least discussed problems in agricultural economics. The Food and Agriculture Organization of the United Nations estimates that roughly one-third of all food produced globally for human consumption is lost or wasted each year. The share attributable to post-harvest losses in low- and middle-income countries is disproportionately large, concentrated in the period between farm-gate and first point of sale. The numbers translate into staggering economic waste: hundreds of billions of dollars annually, representing not just food but the water, labour, energy, and land that produced it.

### Counting the Cost

Any honest accounting of post-harvest losses must begin by acknowledging how poorly they have historically been measured. Data is patchy, methodologies inconsistent, and the definitional boundaries between loss and waste contested. Nevertheless, the best available estimates are sobering. The World Bank has put the economic value of food loss and waste globally at approximately \$940 billion per year. A 2019 study published in Nature Food estimated that reducing food loss and waste by just fifty percent could provide enough calories to feed an additional 1.5 billion people.

In sub-Saharan Africa, post-harvest losses for cereals alone have been estimated at between 10 and 20 percent of total production, with losses for perishables such as fruit, vegetables, and fish running considerably higher in some commodity chains, exceeding 40 to 50 percent. South and Southeast Asia present a similar picture: rice post-harvest losses across Asia are estimated at 8 to 26 percent, depending on the country and the stage of the value chain examined. In India, the National Academy of Agricultural Sciences has estimated annual post-harvest losses worth over Rs. 92,000 crore—a figure that dwarfs the annual budget of many state agricultural departments.

The economic harm is not distributed evenly. Farmers—who are typically the least capitalised actors in the food system—bear a disproportionate share of the loss. When perishable produce cannot be moved quickly or stored adequately, farmers are forced to sell at distress prices, accept lower grades, or discard produce entirely. The downstream actors—processors, traders, retailers—are better positioned to manage spoilage through cold chains, contracts, and market power. The loss, in economic terms, is systematically offloaded upstream.

*"Every kilogram of food lost after harvest represents not just a calorie that failed to reach a plate—it represents the water, the land, the labour, and the capital that went into producing it, all rendered worthless."*

—Agricultural economist, International Food Policy Research Institute (IFPRI)

## The Infrastructure Deficit

The proximate causes of post-harvest loss are well understood: inadequate storage, poor transport infrastructure, absence of cold chain facilities, insufficient processing capacity, and weak market linkages. What is less often acknowledged is that these are not natural conditions—they are the cumulative result of decades of underinvestment in rural infrastructure, compounded by structural adjustment programmes of the 1980s and 1990s that dismantled state-run grain boards and extension services without replacing them with functioning private alternatives.

Cold chain infrastructure illustrates the problem with particular clarity. India, one of the world's largest producers of fruits and vegetables, has cold storage capacity sufficient for roughly 11 percent of its perishable output, and much of that capacity is concentrated in a handful of states and commodities. Sub-Saharan Africa's cold chain coverage is even thinner: the International Institute of Refrigeration estimates that Africa has approximately 1 percent of the cold chain infrastructure per capita that Western Europe possesses.

The economic consequences are predictable. Mango farmers in Mali, tomato growers in Tanzania, fish processors in Bangladesh—all absorb losses that better infrastructure would eliminate. Road quality compounds the problem. A study by the International Livestock Research Institute found that in parts of East Africa, journey times to market that exceed six hours are associated with dramatically higher spoilage rates for perishables. The cost of poor road infrastructure thus passes through the supply chain in the form of spoiled food—an externality that rarely appears in transport ministry budget discussions but falls squarely on farmers and consumers.

## When Markets Fail to Price Loss

Standard economic theory holds that if post-harvest losses are costly, market participants will have incentives to reduce them. The theory is not wrong in principle; it is inadequate in practice. The farmers sustaining the heaviest losses are typically those with the least access to capital for investment in storage or processing, the weakest bargaining positions in commodity markets, and the poorest access to market information. The price signal exists; the capacity to respond to it does not.

This is where a cluster of interventions—some market-based, some public—have shown genuine promise. Warehouse receipt systems, through which farmers deposit grain with a certified warehouse and receive a tradeable receipt they can use as loan collateral, have been successfully implemented in countries including Tanzania, Zambia, and Ethiopia. By allowing smallholders to sell at a time of their choosing—rather than at harvest when prices are seasonally depressed—these systems reduce distress sales and post-harvest losses simultaneously. A careful evaluation by the International Food Policy Research Institute found that warehouse receipt programmes in Ethiopia improved farm incomes by between 6 and 12 percent among participating households.

Hermetic storage technologies—low-cost sealed grain bags and metal silos that prevent moisture and pest ingress—have demonstrated the capacity to reduce post-harvest losses for cereals by 50 percent or more in randomised controlled trials across sub-Saharan Africa, at a cost of between five and twenty-five dollars per unit. The economics are compelling: a single season's loss prevention typically recovers the cost of the technology. Yet adoption rates remain low, constrained by access to finance, limited distribution networks, and, in some cases, simple unfamiliarity.

## The Environmental Ledger

The economic costs of post-harvest loss are damaging enough. The environmental costs are arguably more serious still. Food that is produced but never consumed represents a complete

waste of the inputs—land, water, fertiliser, fuel—that went into its production, along with avoidable greenhouse gas emissions. The FAO estimated in its landmark 2013 report on food wastage that the carbon footprint of global food loss and waste, if treated as a country, would make it the third-largest emitter of greenhouse gases in the world, behind only China and the United States.

Water deserves particular attention. Agriculture accounts for approximately 70 percent of global freshwater withdrawals. When food is produced and then lost before consumption, the water embedded in that production—virtual water, in the parlance of resource economists—is also effectively wasted. The World Resources Institute has estimated that the virtual water content of global food waste is equivalent to three times the volume of Lake Geneva annually. In water-stressed regions already facing long-term decline in groundwater tables, this is not an abstract environmental statistic.

There is, then, a triple dividend available from reducing post-harvest losses: economic savings for farmers and food systems, improved food security for consumers, and reduced pressure on natural resources and the climate. It is a dividend that current policy frameworks are only beginning, slowly, to attempt to capture.

*"The infrastructure gap is not a natural condition. It is a policy choice, accumulated over decades, and it can be reversed by policy choices made now."*

*—Senior economist, World Bank Agriculture Global Practice*

### **Gender, Power, and Who Loses Most**

Post-harvest loss is not gender-neutral. In many agricultural societies, women are disproportionately responsible for post-harvest handling—drying, threshing, winnowing, storage, and processing—yet they typically have less access to improved storage technologies, less control over household income to invest in them, and less representation in the cooperatives and farmer organisations through which group storage solutions are often organised. Research by the International Center for Tropical Agriculture has documented that women farmers in sub-Saharan Africa and South Asia tend to experience higher post-harvest losses than male counterparts farming comparable crops, a disparity driven by asset poverty and market exclusion rather than knowledge or competence.

Addressing this dimension requires more than technology deployment. It requires deliberate design of programmes to ensure women can participate through accessible credit, community storage models with equitable governance, and extension services that reach women farmers directly rather than defaulting to male household heads. Countries that have built these elements into their post-harvest programmes—including Rwanda's cooperative-based cold storage initiatives and Bangladesh's post-harvest handling training through women's self-help groups—have reported better outcomes both in loss reduction and in income distribution.

### **Conclusion**

Post-harvest loss is not an inevitable feature of agricultural systems in developing countries. It is a consequence of underinvestment, market failure, and institutional neglect—all of which are amenable to intervention. The economic case for action is unambiguous: the returns to investment in storage infrastructure, cold chain development, and smallholder finance consistently exceed those of equivalent investments in yield-focused production technologies, and they do so while reducing environmental pressure rather than adding to it.

Three priorities stand out from the evidence. First, public investment in rural storage infrastructure—including community grain banks, hermetic storage subsidies, and cold chain nodes at aggregation points—can generate rapid returns in loss reduction without waiting for private markets to act. Second, warehouse receipt systems and structured commodity market reforms can restore price discovery and reduce distress selling, improving both farm incomes and incentives for on-farm storage investment. Third, the environmental value embedded in loss reduction must be better priced through food waste levies, sustainability procurement

standards, and revised national accounting frameworks that treat food loss as the resource depletion it actually represents.

The grain spoiling in Fatima Musa's yard is not just a personal tragedy. It is a systemic failure with a systemic remedy. The tools, the evidence, and the economic logic all point in the same direction. What remains, as so often, is the political will to follow them.

### By The Numbers

Figure	Description
~\$940B	Estimated global annual economic cost of food loss and waste (World Bank)
~33%	Share of all food produced globally that is lost or wasted each year (FAO)
10-20%	Typical post-harvest cereal loss rate in sub-Saharan Africa
40-50%	Post-harvest losses for perishables in some developing-country value chains
1%	Africa's cold chain infrastructure per capita relative to Western Europe (IIR)
50%+	Potential loss reduction from hermetic storage technologies in RCTs

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