

Review of Extreme Weather Events on Agriculture, Food Prices, and Household Welfare

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Abstract: *Extreme weather events such as droughts, floods, heatwaves, cyclones, storms, and irregular rainfall have become important sources of risk for agricultural production, food markets, and household welfare. Agriculture is highly dependent on climatic conditions, making farming households particularly vulnerable to sudden changes in temperature, precipitation, water availability, and the frequency and intensity of extreme events. The effects of these shocks extend beyond direct crop and livestock losses because reductions in agricultural supply can influence food prices, agricultural wages, employment, household income, food consumption, nutrition, and poverty. Evidence reviewed in this paper indicates that droughts and floods can reduce crop yields, damage livestock and agricultural infrastructure, interrupt transportation and market access, and increase production uncertainty. These supply disruptions can subsequently generate food-price increases and greater price volatility, particularly in regions where households depend heavily on local agricultural production.*

Keywords: Extreme Weather Events, Food Security, Climate Change, Drought, Floods, Agricultural Production, Rural Livelihoods

I. INTRODUCTION

Extreme weather events represent one of the major risks confronting agricultural and food systems. Agriculture depends directly on temperature, rainfall, soil moisture, water availability, and seasonal climatic conditions; consequently, abnormal weather can rapidly translate into production losses and income instability. Droughts can reduce soil moisture and crop yields, floods can destroy standing crops and livestock assets, heatwaves can reduce plant productivity and animal performance, while cyclones and storms can damage farms, irrigation systems, storage facilities, roads, and other agricultural infrastructure. The consequences can extend beyond the farm because agriculture is closely connected with food processing, transportation, employment, household income, and local markets. FAO evidence shows that climate variability and extreme events have increasingly affected agricultural areas and food security, with small-scale farmers, herders, fishers, and other natural-resource-dependent populations facing particularly high exposure.

The economic consequences of extreme weather occur through several interconnected pathways. A weather shock may initially reduce production, which decreases the quantity of food available in local markets. If supply falls substantially while demand remains relatively stable, food prices may increase. Higher food prices can reduce purchasing power, particularly among households that spend a large proportion of their income on food. At the same time, agricultural households may experience lower farm income because of crop failures, livestock mortality, reduced yields, or lower agricultural employment. Therefore, the same event can affect households through both sides of the food system: reducing their income while increasing the cost of food. FAO has documented this relationship by noting that climate extremes can generate agricultural productivity losses, food-price spikes, income losses, and deterioration in food access.

The household-welfare consequences are not uniform. Households that are net food producers may experience some protection from higher food prices when they have marketable surpluses, whereas small farmers who are net food buyers can simultaneously experience production losses and higher food costs. Landless agricultural labourers may be particularly affected when weather events reduce demand for farm labour and agricultural wages. Urban poor households can also be affected through food-price increases even when they are not directly exposed to agricultural losses. Consequently, the ultimate effect of extreme weather depends on household assets, income sources, access to markets, food expenditure patterns, social protection, insurance, and the availability of alternative livelihood opportunities.

EXTREME WEATHER EVENTS AND AGRICULTURAL PRODUCTION

The agricultural sector is directly exposed to climatic variability. Drought is one of the most damaging hazards because prolonged water shortages can reduce germination, plant growth, flowering, grain formation, and final yields. Severe drought can also reduce pasture availability and water resources for livestock. Flooding creates a different set of risks by causing waterlogging, soil erosion, crop destruction, livestock losses, and infrastructure damage. Heatwaves can reduce crop productivity through heat stress and can also affect livestock through reduced feed intake, productivity, fertility, and higher mortality risks.

Extreme weather also affects agriculture indirectly. Roads, bridges, electricity systems, irrigation infrastructure, storage facilities, and agricultural markets may be damaged during floods, storms, or cyclones. Farmers may therefore face difficulties in obtaining inputs or transporting produce to markets. Such disruptions can increase production costs and post-harvest losses. FAO's recent assessment emphasizes that disasters affect agricultural systems through immediate production losses as well as cascading effects involving infrastructure, markets, finance, and ecosystem services.

Small-scale farmers are especially vulnerable because agricultural production often represents both their principal source of income and an important source of household food. A single severe shock can therefore affect consumption and income simultaneously. Households with limited savings may be forced to sell livestock, tools, land, or other productive assets to meet immediate consumption needs. Such coping strategies can reduce their capacity to recover from subsequent shocks and may contribute to persistent poverty.

EFFECTS ON CROP AND LIVESTOCK PRODUCTION

Crop production is affected by extreme weather through changes in yield, cultivated area, cropping intensity, and production quality. Drought can reduce yields through water stress, whereas excessive rainfall can damage roots, increase fungal diseases, cause nutrient losses, and delay harvesting. Heat extremes can shorten crop-development periods and reduce grain or fruit formation. The effects can be particularly severe when extreme events occur during critical growth stages.

Livestock systems are also vulnerable. Drought reduces pasture and water availability and can increase feed costs. Heat stress can reduce livestock productivity and reproductive performance. Floods and cyclones can cause direct livestock mortality and destroy shelters and feed supplies. Because livestock often function as financial assets for rural households, losses can have consequences extending well beyond the immediate agricultural season.

Climate variability may also affect fisheries, forestry, and other natural-resource activities. Thus, the effects of extreme weather should be assessed across the wider agricultural and food system rather than only in terms of crop yields. Recent research emphasizes that climate change and extreme weather can influence food security and nutrition through interconnected food, health, water, and social-protection systems.

EXTREME WEATHER EVENTS AND FOOD PRICES

One of the most important indirect effects of agricultural weather shocks is their influence on food prices. When extreme weather reduces domestic production, markets may experience lower supply. If food stocks, imports, or alternative production regions cannot compensate for the shortage, prices may increase. Price responses depend on the

size and geographical extent of the shock, trade connectivity, inventories, transportation systems, government policies, and the availability of substitute products.

Food-price volatility is particularly important for poor households. When food represents a large share of household expenditure, even a moderate increase in staple-food prices can substantially reduce real purchasing power. Households may respond by reducing consumption, purchasing cheaper foods, reducing dietary diversity, delaying non-food expenditures, or borrowing money. FAO reports that climate extremes can contribute to food-price spikes and volatility and that these effects are especially important for urban poor households, agricultural labourers, rural poor households, and small-scale producers who are net food buyers.

International markets can sometimes reduce the impact of local production shortages by allowing food-deficit regions to import from other regions. However, when extreme weather occurs simultaneously across major producing regions, global supply effects can become more substantial. Food trade, stocks, market integration, and price policies therefore influence how an agricultural shock is transmitted to consumers. Recent World Bank analysis similarly identifies climate risks as a source of agricultural supply disruptions, food-price pressures, and threats to food and nutrition security.

HOUSEHOLD INCOME AND EMPLOYMENT EFFECTS

Extreme weather can reduce household income through several channels. Farmers may lose crops or livestock, agricultural labourers may lose employment opportunities, and small businesses connected with agriculture may experience reduced demand. In regions where agriculture dominates the local economy, a major weather event can therefore produce wider economic effects.

Agricultural wages can also decline when weather-related production losses reduce labour demand. At the same time, households may face increased expenditure on food, housing repair, healthcare, transportation, and agricultural recovery. The combination of declining income and rising expenditure can significantly reduce household welfare.

Evidence from Afghanistan, for example, indicates that droughts and floods can increase food insecurity both directly and indirectly through effects on food prices and agricultural wages. This demonstrates why household-level analysis should consider both the direct agricultural consequences of weather shocks and the wider market mechanisms through which these shocks affect welfare.

EFFECTS ON HOUSEHOLD FOOD SECURITY AND NUTRITION

Food security is commonly understood through four interconnected dimensions: availability, access, utilization, and stability. Extreme weather can influence all four. Production losses reduce availability; income losses and food-price increases reduce access; changes in food quality and dietary composition affect utilization; and repeated shocks undermine stability.

Households may cope with food shortages by reducing meal frequency, consuming smaller quantities, replacing preferred foods with cheaper alternatives, or reducing dietary diversity. These responses can have particularly important consequences for children, pregnant women, older people, and households already experiencing poverty. FAO evidence indicates that climate variability and extremes can affect food access, nutrition, food quality, and food safety in addition to production.

Recent systematic evidence also indicates that climate crises are associated with reduced household food consumption and dietary diversity, although the magnitude of effects varies according to household assets, agroecological conditions, institutional support, and other contextual factors.

POVERTY AND HOUSEHOLD WELFARE

The welfare effects of extreme weather are closely associated with household vulnerability. Wealthier households may have savings, insurance, irrigation, diversified income, private storage, or access to credit that allows them to recover

more quickly. Poor households generally have fewer such options. Consequently, an identical weather shock may produce very different welfare consequences across households.

Repeated exposure can create a poverty trap. After a crop failure, a household may sell productive assets to purchase food. The loss of these assets can reduce future agricultural productivity and income. Children may also be withdrawn from school to contribute to household labour or income. Migration may become another coping strategy. Although migration can provide income through remittances, involuntary displacement can also create social and economic costs. Household welfare therefore needs to be evaluated using multiple indicators, including income, consumption, food security, nutrition, assets, employment, education, health expenditures, indebtedness, and livelihood resilience.

COMPARATIVE REVIEW OF MAJOR EXTREME WEATHER EVENTS

Extreme weather event	Agricultural effect	Food-market effect	Household welfare effect	Common coping/adaptation measures
Drought	Crop failure, reduced pasture, livestock losses, lower yields	Reduced supply and higher prices	Income loss, food insecurity, indebtedness	Drought-resistant crops, irrigation, crop diversification, insurance
Flood	Crop destruction, waterlogging, soil erosion, livestock mortality	Supply disruption and transport constraints	Asset losses, displacement, reduced income	Flood-resistant infrastructure, drainage, early warning, savings
Heatwave	Heat stress, lower crop and livestock productivity	Reduced supply and possible price increases	Lower farm income, health and labour impacts	Heat-tolerant varieties, shade, irrigation, adjusted planting dates
Cyclone/Storm	Crop, livestock, infrastructure and storage damage	Market disruption and temporary shortages	Asset destruction, employment loss, displacement	Cyclone shelters, resilient infrastructure, insurance
Extreme rainfall	Crop damage, erosion, disease and nutrient losses	Seasonal supply volatility	Farm-income instability and food-access problems	Improved drainage, soil conservation, diversified production
Cold/Frost events	Damage to temperature-sensitive crops and horticulture	Reduced availability of affected products	Lower producer income and higher replacement costs	Protective structures, frost-resistant varieties
Compound events	Simultaneous or sequential production losses across sectors	Stronger supply disruptions and price volatility	Severe income, consumption and asset losses	Integrated risk management, social protection, contingency planning

The table demonstrates that different hazards operate through different immediate mechanisms, but their consequences can converge through agricultural losses, market disruption, income reduction, and food insecurity. FAO's evidence emphasizes that floods, droughts, and storms are among the major hazards affecting food production and that their effects can propagate through the broader food system.

DIFFERENTIAL EFFECTS ON VULNERABLE GROUPS

The effects of extreme weather are strongly differentiated across households. Smallholder farmers may experience direct production losses, whereas landless labourers may experience employment and wage losses. Urban households may face mainly food-price effects. Women can experience increased unpaid care and household responsibilities when food, water, and health conditions deteriorate. Children may face nutritional and educational consequences when household resources become constrained.

Geographical differences are also important. Rain-fed farming areas are generally more exposed to rainfall variability than irrigated regions. Areas with weak transportation and market infrastructure may experience stronger price effects because food cannot be moved easily from surplus to deficit areas. Households in fragile or conflict-affected regions may face compounded risks because institutional capacity and access to assistance are limited.

ADAPTATION AND RESILIENCE STRATEGIES

Reducing the welfare consequences of extreme weather requires interventions across farm, market, and household levels. At the farm level, adaptation can include drought- and heat-tolerant crop varieties, water-saving irrigation, crop diversification, agroforestry, improved soil management, better livestock systems, and climate-informed planting decisions. Early-warning systems can help farmers prepare for impending droughts, floods, storms, and heatwaves.

At the market level, adequate food storage, improved transport infrastructure, market information systems, diversified supply sources, and efficient trade can reduce the transmission of local production shocks into severe food shortages. Agricultural insurance and accessible credit can help households rebuild productive capacity after disasters.

Social protection is another important component of resilience. Recent FAO evidence indicates that anticipatory social-protection measures, including forecast-based cash transfers, can improve short-term food security, protect productive assets, reduce negative coping strategies, and support household wellbeing when assistance is delivered before or around climate shocks.

Although a substantial body of literature examines climate and agriculture, several research gaps remain. First, many studies focus on individual hazards rather than compound and sequential events. Second, agricultural production, food prices, and household welfare are often examined separately even though they are connected through market and income pathways. Third, more longitudinal research is required to determine whether households fully recover after extreme events or experience persistent welfare losses. Fourth, research should pay greater attention to gender, age, asset ownership, landholding size, access to credit, and livelihood diversification as factors that shape vulnerability.

There is also a need for better integration of remote-sensing climate data, agricultural production statistics, market-price data, and household surveys. Recent systematic research highlights that household-level evidence remains geographically concentrated and often relies on cross-sectional data, limiting understanding of longer-term welfare trajectories.

II. CONCLUSION

The reviewed evidence demonstrates that extreme weather events can create a chain of interconnected effects beginning with environmental shocks and extending through agricultural production, food markets, household income, consumption, nutrition, and overall welfare. Droughts, floods, heatwaves, storms, and other extreme events can reduce agricultural productivity and damage productive assets, while supply disruptions can contribute to higher food prices and greater price volatility. Households dependent on agriculture are exposed through both production and income channels, while poor consumers can be affected through higher food expenditures. The resulting reduction in purchasing power may lead households to reduce food consumption, alter dietary choices, sell assets, borrow money, or reduce other essential expenditures. These effects can become particularly severe when extreme weather occurs repeatedly or together with economic, conflict, or institutional shocks.

The evidence also demonstrates that vulnerability is not determined by exposure alone. Household assets, income diversification, access to irrigation, credit, insurance, markets, infrastructure, social protection, and early-warning information influence the ability to withstand and recover from extreme weather. Therefore, resilience strategies should combine climate-smart agricultural practices with reliable markets, disaster-risk management, social protection, agricultural insurance, and anticipatory action. Strengthening these systems can reduce the immediate welfare losses associated with extreme weather while also improving the long-term resilience of agricultural and food systems.

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