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Enhancing Food Security in a Changing Climate:

Adaptation Options for Smallholder and Microenterprise Development Initiatives

This FIELD Brief is the fifteenth in a series of papers produced by USAID's Financial Integration, Economic Leveraging and Broad-Based Dissemination Support (FIELD-Support) Leader with Associates (LWA) Award. The FIELD-Support LWA, managed by FHI 360, is a consortium of leading organizations committed to advancing the state-of-the-practice of microfinance and microenterprise development through innovation, learning, and exploration.

FIELD Briefs support this objective by sharing what we have learned and fostering dialogue on key issues. This issue was written by Earl Saxon. It benefitted from the advice of Paul Bundick, Don Henry, and Clint Curtis.

Introduction

Changes in the frequency and severity of extreme weather events already undermine food security, especially for those who rely on rain-fed agriculture. Anthropogenic greenhouse gas emissions are already contributing to climatic anomalies. More are inevitable, even under the most optimistic mitigation scenarios. Smallholder farmers[1] are the most numerous and most vulnerable farmers, while micro- and small-enterprises (MSEs)[2] provide critical links in the food value chains[3] on which the non-farm population depends.

A great deal of effort is rightly directed towards increasing the productivity of smallholders. However, MSEs are often ignored, despite the fact that poor post-harvest handling in the food value chain forces farmers to produce smaller harvests for fear of low prices after a bumper harvest or having unsold produce rotting in the field. Better services by MSEs would also enhance local food security by reducing wastage during processing, storage, and transport (Parfitt et al. 2010).

This FIELD Brief presents strategies development practitioners can use to assist smallholders and MSEs throughout the food value chain to buffer the impacts of climate change and contribute to the broader goals of strengthening livelihood and fostering broader economic development, especially for vulnerable populations.

[1] For the purpose of this Brief, smallholders are those farmers relying on rain-fed traditional agriculture and traditional stock rearing. They purchase some labor and other inputs and market some crops, but their market engagement is too limited to influence either the cost of their inputs or the price of their produce. They are distinct from both non-market subsistence farmers and commercial farmers.

[2] MSEs have less than 50 employees. In the food value chain, MSEs supply farm inputs and post-harvest processing, storage, transport and distribution, but lack the scale and market dominance characteristic of national monopolies and large, often international, enterprises.

[3] The term "food supply chain" describes the quantitative flow of agricultural inputs to the farm and of produce from "farm to fork," while "food value chain" is intended to capture both the progressive increase in utility to the consumer and the commercial benefits that flow back down the chain.

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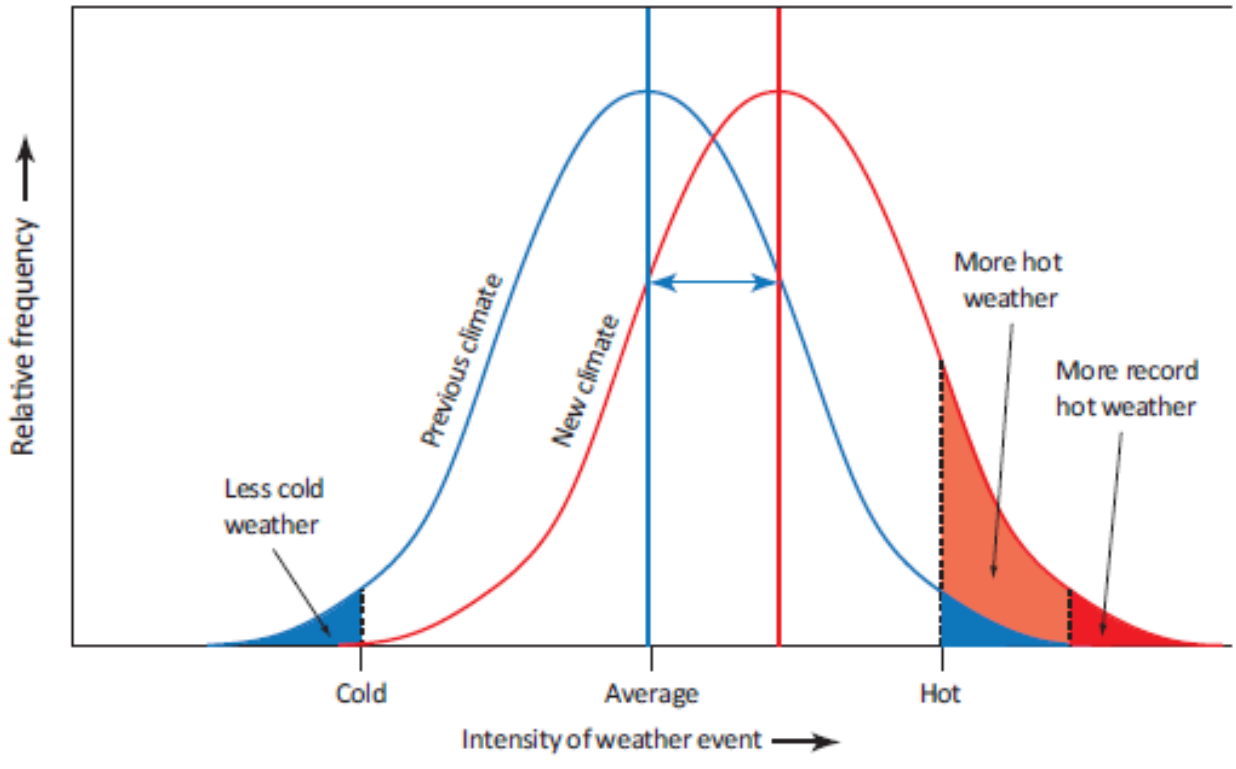
Impacts of Climate Change on Rural Food Security

Climate change is already undermining development gains made by many smallholders and investments made by MSEs, frustrating the efforts of development practitioners to enhance broader food security. In many parts of the world, development practitioners are finding their successes literally washed away or drying up due to increasingly severe weather events.

In many parts of the world, more extreme weather is increasing the ***severity*** of crop failures and undermining the ability of farmers to anticipate and cope with erratic conditions. While once-in-a-century floods or droughts allow plenty of time to recover lost assets and restore traditional livelihood practices, traditional coping strategies fail under more frequent and/or more devastating weather-driven crop failures. At the same time, progressively more severe warming will eventually pass critical thresholds for soil moisture, increasing the ***frequency*** of crop failures. Communities face a crisis when the consequences of climate-driven disasters make it impossible for post-disaster interventions to return affected communities to their previous livelihoods and levels of food security.

Climate models cannot forecast exactly when and where catastrophic weather conditions will occur, but they clearly indicate inevitable shifts (Figure 1). Since observed emissions of greenhouse gases continue to track the most severe model scenarios, planning for worst-case outcomes is prudent.

Figure 1 *A small shift in average temperatures results in significant changes to the frequency and severity of extreme conditions: more hot and record hot weather, less cold and extremely cold weather. For farming communities, this reduces soil moisture, even if rainfall increases somewhat. Significant changes must then be made to crop selection, planting practices, pest control, soil fertility management, and harvest timing (IPCC 2001).*



In places like the Sahel and the Horn of Africa, where food security is already marginal, communities will have to make wrenching transitions away from traditional agricultural production methods. Where

climate poses increasing, but still manageable, threats to food security, such as flood-prone parts of Bangladesh and Pakistan, communities can increase their resilience through better design and management of infrastructure and practices that accommodate seasonal fluctuations. In locations where traditional farming practices already cope with a range of stresses, as in the highlands of east Africa and South America, simple buffering strategies—like greater reserves for seed supplies and enhanced early-delivery mechanisms for episodic relief supplies—will help smallholders resist increasing climate stress.

Smallholder farmers are particularly vulnerable to social risks (such as governance failures), and physical risks (such as shifts in regional weather patterns). Together, these undermine smallholders' income and exhaust their traditional local relief mechanisms. Widespread crop failures result in large unrecoverable sunk costs and stranded assets, reversing years of economic progress, and leaving entire regions without subsistence crops and famine foods on which local people depend.

A changing climate's impact

Widespread crop failures result in large unrecoverable sunk costs and stranded assets for smallholder farmers in particular, reversing years of economic progress, and leaving entire regions without subsistence crops and famine foods on which local people depend.

Such risks are inadvertently amplified by development initiatives that make entire regions dependent on large dams for irrigation and those that convert entire districts to the production of a single cash crop. Ironically, the pursuit of short-term efficiency can actually undermine the stability of food security in areas prone to disasters and gradual climate change. In the language of systems engineering, the safety of agro-ecosystems in the face of natural and human disturbances depends on buffers: multiple food value chains, multiple crops, and multiple actors. Often, investments that make agro-ecosystems more productive, but also more vulnerable, only serve to undermine long-term food security and increase the magnitude of relief efforts needed when disasters strike. Rapid-onset disasters may be somewhat unpredictable as to when and where they occur, but the fact that they will occur, and the wisdom of preparing for them, is entirely predictable.

Addressing chronic food insecurity

Integrating disaster risk reduction, disaster relief, disaster recovery, economic development, and adaptation to climate change may seem an impossible goal, but must be pursued.

The recent experiences of Pakistan and Ethiopia provide illustrative examples of the consequences of separating agricultural development from disaster planning in the face of increased climate variability. Both countries are vulnerable to droughts and floods. Both have experienced increasing disparities in the welfare of rain-fed farmers versus those who can afford irrigation and drainage works. Both have recently experienced extreme weather events so severe that entire districts face stark choices between migration to cities and long term dependency. However, the same disasters that sweep away economic assets and undermine social institutions provide unique opportunities for implementing climate-adaptive strategies that can improve livelihoods and food security—provided that adequate preparation has been made well in advance.

Integrating disaster risk reduction, disaster relief, disaster recovery, economic development, and adaptation to climate change may seem an impossible goal, but must be pursued for two reasons. First, victims of disasters need the whole process of rescue, recovery, restoration, development, and adaptation to work seamlessly. Second, unless climate adaptation strategies are considered as an integral part of effective disaster preparation, relief, recovery, and development, the impacts of rapid climate change will tip many episodically food insecure communities into chronic food insecurity.

In order to prevent the spread of chronic food insecurity, development practitioners will have to pursue risk management strategies that anticipate frequent and severe disturbances, just as financial planners consider the risk of loss of assets, not just the return on assets. Agro-ecosystems have to be diversified, pressure on natural resources reduced, and water sources buffered through multiple minor improvements in order to avert wide-spread systemic failures.

Climate-Adaptive Strategies for Smallholders and MSEs

Two distinct food value chains have arisen in many developing countries. The food security of large, coastal cities is buffered by the connection of their food value chains to commercial-scale food producers in diverse locations, many of which are overseas. In contrast, the food security of rural, interior villages and towns is vulnerable because their food value chains are connected only with local producers, all subject to simultaneous peaks and short-falls in production. Rural villages and towns only have access to global supplies under the most dire circumstances and even then, not always.

Adaptive Strategies for Farmers

If episodic food insecurity is not to become chronic, most smallholders will need sustainable and flexible adaptation strategies to maintain their already precarious food security.

Cumulative stresses on many rural communities—especially the combination of social and/or political instability with more frequent crop failures—already exceed the palliative capacities of donors, national safety net programs, and conventional risk-transfer mechanisms. If episodic food insecurity is not to become chronic, most smallholders will need sustainable and flexible adaptation strategies to maintain their already precarious food security. This section discusses adaptative strategies for the farmers and suppliers on whom those rural villages and towns depend in good times and bad.

Fortunately, many adaptation strategies do not require technological breakthroughs or massive amounts of capital for their success. They require only modest improvements in knowledge and efficient use of resources. However, they do require decision makers to decide to take the impacts of climate change seriously (Parry et al. 2007) and they require donor and recipient institutions to integrate short-term and long-term adaptation strategies into disaster relief and development initiatives. While such decisions require some degree of consensus at local, national, regional, and global levels, there is no need for one level to wait for the others to engage.

Many organizations are currently testing methods to help farmers integrate adaptive strategies into their farming practices (e.g. ACDI/VOCA 2011, SwissRe 2011) and Bangladesh has a national adaptation strategy for its agricultural sector. However, local and national initiatives would benefit from a more systematic approach to aligning adaptation strategies with the pace and severity of impacts from increased climate variability and rapid climate change.

- **Resistance strategies** are the starting point for anticipating mild and gradual impacts of climate change on food security. They aim to improve productivity under current and marginally more severe weather conditions. In many cases, resistance strategies need only to identify and remove obstacles to more widespread adoption of current best practices, such as planting quick growing rice varieties to minimize crop losses due to severe weather events.

- **Resilience strategies** are needed as extreme weather events increase and average local climate conditions deteriorate. They aim to restore productivity after severe and prolonged disruptions. Often these will require investments to buffer vulnerable systems (e.g. increased storage, or financial mechanisms to insure or replace lost assets). At-risk communities may be unable, or unwilling, to divert their limited resources to support resilience strategies. This is a problem practitioners already

face in fostering disaster preparation to minimize post-disaster recovery costs. Climate change can be regarded as a disaster in slow motion.

- **Transition strategies** are essential for communities already facing chronic food insecurity and those in areas where traditional farming systems are certain to fail under even moderate climate change scenarios. Transition strategies need to anticipate that local climates and ecosystems will not return to historical norms after extreme events. Transition strategies will be needed to help households, communities, countries, and regions adapt to unfamiliar climate regimes and novel ecosystem conditions.

Although the need for adaptation strategies may not be obvious until climate change makes current strategies unsustainable, by then it will be too late to initiate critical changes and avert widespread suffering. Since early action must be taken despite uncertainty about the pace of climate change and poor knowledge of critical climate thresholds for agro-ecosystems, development practitioners must avoid large investments in resistance strategies that will be wasted if and when resilience strategies are needed, or resistance and resilience strategies that would be wasteful, if not counterproductive when transition strategies are needed (Stafford Smith 2009). Small, iterative investments in multiple strategies that keep future options open are both less expensive in the short term and less risky in the long term.

Figure 2. ***Climate-adaptive strategies for smallholders and MSEs.*** *Though the examples are taken from current initiatives in two countries, they apply to the agro-ecosystems on which most people in the developing world depend.*

Agro-ecosystem at risk from increasingly severe impacts of climate change	Resistance to increased climate variability	Resilience to rapid climate change	Transition to "new" normal climate conditions
Staple crops fail due to erratic monsoon (Bangladesh)	Plant quick-growing rice varieties	Increase reserves to provide food and replacement seeds	Plant quick and slow growing varieties at the same time
Coastal arable land is lost to erosion, falling ground water quality and rising sea levels (Bangladesh)	Re-establish mangroves and embankments	Use pumping and re-injection methods to manage irrigation and desalination	Restore degraded lands and relocate production elsewhere after transitional development of intensive fish farming
Fish are swept out of ponds by floods (Bangladesh)	Build earthen bunds around fish ponds	Raise fish in cages in ponds and rivers	Raise fingerlings, release them during floods, and capture them afterwards
Drought devastates pastoral stock (Ethiopia)	Build water tanks	Establish insurance and mutual funds for early de-stocking	Get tradesman training for urban employment
Drought devastates crops (Ethiopia)	Mulch plantings to retain soil moisture	Increase reserves to provide food and replacement seeds	Restore marginal lands for pastoral use and intensify cropping in less marginal areas

The logic is simple. As impacts of climate change increase, the stability—as well as the availability and accessiblity of appropriate food supplies—decline, and may do so with unexpected severity and pace. Initially, impacts can be buffered by more efficient post-harvest processing, more effective long-term storage, and less expensive long-distance transportation. As the food value chain becomes progressively less stable, food security will increasingly depend on reducing waste, enhancing the quality of food produced, and improve the handling, processing, and transport of agricultural products.

Ideally, smallholders and MSEs will be able to make improvements at each linkage point in the post-harvest food value chain: reduced losses during milling, drying, and bagging; reduced pest infestation, biological contamination, and spoilage in storage; and, reduced breakage and waste during trasport and distribution. Local socio-economic and climate conditions, available technology, and the specific needs of each crop are likely to determine which adaptive strategies optimise stability of the entire value chain. Some may require planning and implementation long before critical conditions force donors, recipients, and beneficiaries to adopt crash solutions that prove inefficient if not ineffective.

Methods to Improve Current Strategies and Identify New Ones

Adaptive assessment and management—testing management actions empirically and amending them based on results (Holling 1978)—is a well-established approach to natural resource management, and scenario-based strategic planning (Schwartz 1991) is standard practice in fields such as defense and energy industries where irresolvable uncertainty cannot be accepted as a barrier to action. These tools have been widely applied to managing dynamic systems where conventional military, political, economic, and social institutional approaches fail (see Figure 3 below).

However, the application of such decision support approaches to climate-adaptive development has just begun. Case studies (InterAction 2011) and comprehensive toolkits (CARE 2010) exist to help development practitioners design and implement climate-adaptive programs to help communities cope with, and adapt to, physical and social obstacles to creating more efficient food value chains.

Characteristically, development takes place in situations in which stakeholders with conflicting views and asymmetric power influence future outcomes that no single group can completely control. Donor agencies and governments must engage key stakeholders and opinion leaders who could assist one another to act effectively if only they could find some shared goals (Kahane 2004). The first step is to "get the whole system in the room" using group consultation tools such as the System-wide Collaborative Action for Livelihoods and the Environment (SCALE) Methodology (AED 2004).

Experts can support a consultative process to develop adaptation strategies by identifying critical climate vulnerabilities of agro-ecosystems as well as climate vulnerabilities in proposed development interventions. More often than not, smallholders and MSEs would be unable to cope with the recurrence – or increased frequency – of historical extreme events. Similarly, it is not the average conditions of a distant future that will undermine food security, but the "leading edge" impacts likely to occur within a decade or two.

After reaching some consensus on plausible futures to avoid and other(s) to aim for, participants in a scenario planning process consider the urgency of action and the role(s) each can play in anticipating the impacts of climate change and, thereby, attenuating them. Often, this will involve a series of conditional bargains of the form, "If this happens, I will do this and you will do that." Thus, they establish both objective criteria for action and mutually verifiable monitoring of responses.

Development funders, practitioners, host countries, and beneficiaries have divergent and sometimes contradictory commitments to the outcome of development initiatives. They will also suffer the consequences of failure quite differently. Not surprisingly, those least able to cope with short-term risk are the least able to prepare for long-term risks associated with climate change.

A Look at Feed the Future

Food security and climate change are two of USAID's top development priorities. The US government's Feed the Future initiative addresses these challenges in two ways. First, it explicitly adds the goal of

"stability" to the three criteria for food security: accessibility, availability, and utilization. Second, it has a strategic approach to rapidly expand food production by targeting key crops and regions within selected countries.

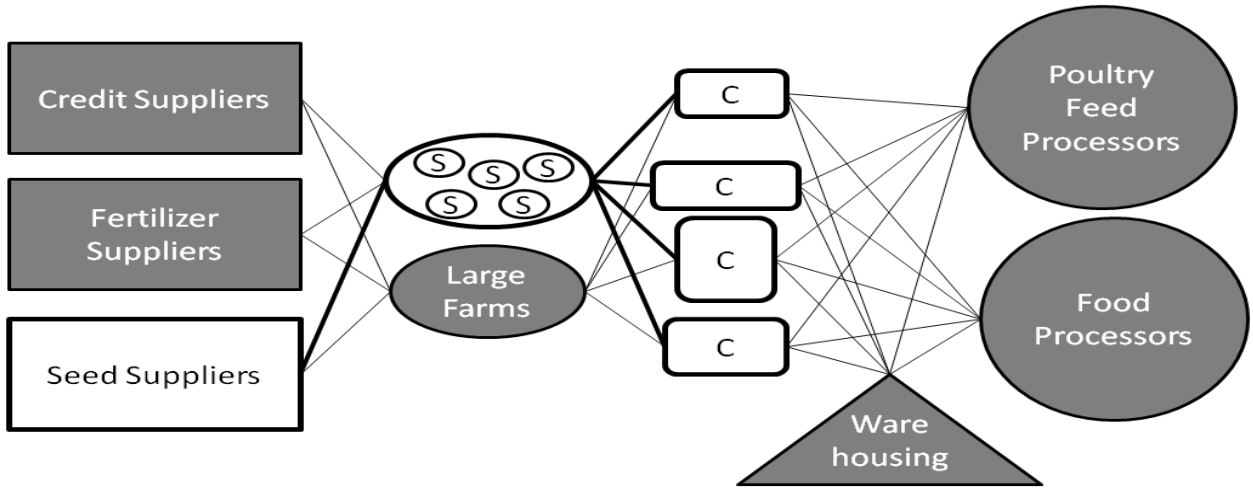
Senegal's initial Feed the Future project, for example, recognizes that variations in production must be buffered by increased capacity and reliability of transport, storage, processing, and distribution. Consequently, it makes investments in MSEs that operate within the food value chain.

USAID's Feed the Future Initiative

Feed the Future's regional program investments seek to mitigate regional food security risks from drought, flood, disease, and natural disaster, which have long contributed to food insecurity. Particularly in tropical environments, climate change poses increasing threats to food security in the form of more frequent droughts and floods, more violent weather events, rising sea level and sea surface temperatures, increased incidence and severity of pests and disease, and changes in the distribution and ecology of agricultural pests and pathogens *(USG 2010:22).*

Feed the Future has selected two intervention zones in Senegal where child malnutrition is already very high: the northern irrigated rice growing area; and, the southern rain-fed maize growing area (Keck 2011:7). In both regions, agriculture is vulnerable to increased climate variability. Senegal's Feed the Future strategy considers the possible consequences (positive and negative) of climate change on the choice of seeds and focuses on seed suppliers, small farmers and harvest consolidators as intervention points (represented in white boxes in Figure 4 below).

Figure 3. *Feed the Future's intervention points in Senegal's maize value chain (white boxes above) are seed suppliers, small farms (S) and harvest consolidators (C) (Keck 2011:16)*



A comprehensive, climate-adaptive food value chain initiative would include a range of strategies, to be implemented according to the current and future vulnerability of each link in the food value chain. **Resistance strategies** to buffer the food value chain could include larger, climate-controlled storage, improved crop cleaning and drying, better storage to avoid losses to pests, additional processing to reduce spoilage and more robust packaging to withstand difficult transport conditions. **Resilience strategies** could include enhancing water storage and the efficiency of irrigation methods and the selection of seed varieties that maintain yields under current climate variability but decrease the likelihood of crop failure during extremely wet or dry years and whenever credit or fertilizer are in short supply. Last, but not least, **transition strategies** should consider the long-term viability of both the northern and southern agricultural areas and the benefits of concentrating production in one or the other if both cannot be maintained.

Conclusion

Smallholders and MSEs operate at a scale that does not afford the luxury of ignoring any risks. While the pace and severity of climate change may be fundamentally uncertain, the direction is clear and the benefits of adaptation for food producers in climates that are already marginal are unambiguous. Reserve supplies, redundant mechanisms, training in multiple skills, and maintaining support networks may all adversely affect the bottom line in the short-term, but they are essential to agro-enterprise survival in the long-term.

Ensuring that food security initiatives are climate adaptive—and inclusive of smallholders and MSEs—will reduce episodic and chronic food insecurity. Business as usual will not.

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