AGRICULTURE GLOBAL PRACTICE
DISCUSSION PAPER 10

AGRICULTURAL SECTOR RISK ASSESSMENT: METHODOLOGICAL GUIDANCE FOR PRACTITIONERS

THE WORLD BANK
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WORLD BANK GROUP REPORT NUMBER 100320-GLB

JANUARY 2016

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1818 H Street NW
Washington, DC 20433
Telephone: 202-473-1000
Internet: www.worldbank.org
Email: feedback@worldbank.org

January 2016

Cover photos:

Upper left: Kz rain desert—Mariusz Kluzniak.
Upper right: Harvesting irrigated fields—Curt Carnemark/World Bank.
Lower left: Woman plant—Yosef Hadar/World Bank.
Lower right: Drought in Kenya—Neil Palmer/CIAT.

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ACRONYMS AND ABBREVIATIONS

ARM	Agricultural risk management
ARMT	Agriculture Risk Management Team
ASRA	Agricultural sector risk assessment
CSA	Climate-smart agriculture
FAO	Food and Agriculture Organization (of the UN)
FAOSTAT	Food and Agriculture Organization Corporate Statistical Database
FMD	Foot-and-mouth disease
GDP	Gross domestic product
IFAD	International Fund for Agriculture Development
MT	Metric ton
NGO	Nongovernmental organization
NRM	Natural resource management
OLS	Ordinary least squares
SD	Standard deviation
TA	Technical assistance
TTL	Task team leader
USAID	U.S. Agency for International Development

ACKNOWLEDGMENTS

This report was developed by a team led by Vikas Choudhary, Senior Economist, and Carlos Arce, Consultant from the Agricultural Risk Management Team (ARMT) at the World Bank. The content was developed with contributions from Stephen P. D'Alessandro, Åsa Giertz, Kilara Suit, Traci J. Johnson, Tobías Baedeker, and Jorge Caballero.

This work would not have been possible without the numerous contributions from all the agricultural specialists who have participated in conducting Agricultural Risk Assessments during the last four years, of whom there are too many to list. The team would also like to extend its special appreciation to the stakeholders of agricultural supply chains in Africa, Latin America, and Eastern Europe who actively engaged in the development of sector risk assessments in those regions, bringing a great sense of realism to this experience. Their active participation obliged the team to be realistic and practical.

The team would like to thank peer reviewers for their honest and useful comments when revising earlier versions of this work. They are Willem G. Janssen, Holger A. Kray, and Diego Arias, from the World Bank. The team also thanks Lena Heron, Gloria Kessler, and Krista Jacobs from the U.S. Agency for International Development (USAID) for their support and suggestions for refining the document.

The leadership of Marc Sadler, Mark Cackler, and Preeti Ahuja was instrumental in delivering the various risk assessments and developing these methodological guidelines.

Generous funding for this activity was provided by the United States Agency for International Development and a Multi-Donor Trust Fund on Agricultural Risk Management financed by the Ministry of Foreign Affairs of the Government of the Netherlands and the State Secretariat for Economic Affairs (SECO) of the Government of Switzerland. Their encouragement and financial support allowed the gathering of significant experience that serves as the basis for this work.

EXECUTIVE SUMMARY

In the agricultural sector, risks are inherent and ubiquitous, posing potentially serious consequences for stakeholders and consumers. Risks disrupt supply chains, causing extensive financial and economic losses. Agricultural risks are also the principal cause of transient food insecurity, creating a poverty trap for millions of households across the developing world that enforces a vicious cycle of shock and recovery. Climate change is exacerbating this cycle by shifting the frequency and intensity of weather-related risks and increasing uncertainty.

Effective agricultural risk management (ARM) is crucial to increasing economic growth, improving food security, and reducing poverty. Although levels of risk vary within and between countries, lower-income and highly agriculture-dependent countries are more vulnerable to agriculture-related risks. In these countries, there is an urgent need to better assess risks, understand the interconnections between different types of risk, and improve agricultural risk management strategies.

AGRICULTURAL SECTOR RISK ASSESSMENT: AN INTEGRATED APPROACH

The World Bank's conceptual framework for ARM looks at risk from an integrated perspective. The framework views agricultural sector risk assessment (ASRA) as a tool to help decision makers understand risk exposure and to provide the basis for developing appropriate risk management solutions. ASRA is a consultative, time-bound process that provides an orderly way to analyze, identify, and prioritize risks. The process facilitates risk management policy and program design by providing a framework and tools for decision making. The ASRA's target audience includes country-level stakeholders involved in selected agricultural commodity systems, development agency decision makers, and developing country policy makers.

This report provides methodological guidance for conducting an ASRA. The guidance is based on the World Bank's Agriculture Risk Management Team's experience assisting governments in conducting sector and key commodity supply chain risk assessments in more than 20 countries.

PRACTICAL AND CUSTOMIZABLE TOOLS FOR PRACTITIONERS

The document contains practical guidance on the complexities of developing a holistic ASRA and provides a stepwise approach to conducting ASRAs, incorporating the lessons learned from assisting countries in mainstreaming risk management practices into mid-term development strategies and investments. Over time, the methodologies and tools have been refined, but the focus remains on approaching risks and risk management through an integrated perspective.

The guidelines in this report are primarily designed for use by development practitioners working in the agricultural sector in developing countries. The framework can be adapted to the particular circumstances of developing economies. In ARMT's experience, each specific assessment needs to be adapted to account for a country's unique combination of risks, institutional arrangements, and fiscal constraints.

REAPING THE BENEFITS OF ASRA

The ASRA process is a rigorous, inclusive approach to identifying potential solutions to mitigate, transfer, and cope with agricultural risks. It is also an entry point for mainstreaming ARM solutions in national development strategies, policies, and programs. By bringing together a broad group of stakeholders from the public, private, and nongovernmental sectors, an ASRA can facilitate knowledge exchange between siloed academic disciplines and ministries. The process also facilitates priority setting and alignment of policies and programs to support country development objectives.

The benefits of a more holistic and targeted risk management strategy are many. Adopting a risk management strategy can help mitigate risks before they occur. It can also lessen the impact on the government's fiscal balance, particularly at catastrophic levels, by tempering the need for costly and often poorly targeted post shock humanitarian relief to affected communities. Additionally, a well-planned ex ante risk management strategy facilitates expedient resource mobilization when risk events occur. For example, ex ante planning can assist farmers in getting back into production more quickly by using previously identified delivery channels. Finally, by better managing risk, poor rural households can avoid depleting their assets or increasing their vulnerability in the future, particularly women in disadvantaged positions in many countries.

ASRA can add value in a variety of contexts, including (i) broader agricultural sector analyses and development strategy processes; (ii) constraint and opportunity analyses undertaken in the identification and formulation of development projects that focus on value chain integration, agricultural commercialization, rural finance, export promotion, landscape planning, and so on; (iii) planning, implementation, and monitoring of sector reform programs, including those involving shifts in the commercial, regulatory, and other roles of governments in agriculture; (iv) investment appraisals by private and development finance institutions or as part of strategic assessments of agricultural lending portfolios' quality and risk exposure; and (v) as an entry point for the introduction of climate-smart agriculture (CSA) aiming at strengthening resilience in agricultural systems.

ASRA is devised to support broader sector strategy formulation efforts and the identification and formulation of proposals for investment, capacity building, and policy and regulatory reform in strategically important agricultural supply chains or within the sector as a whole.

The outcome of an ASRA is only a first step in the risk management process. Real changes that incorporate comprehensive risk management into planning and budgeting will likely be a gradual process. Ultimately, integration of risk management practices into development strategies will strengthen resilience in the longer term, thus reducing vulnerabilities among agricultural sector stakeholders and increasing the success of agricultural investment strategies.

One size does not fit all. Owing to the diversity of risks, approaches for managing them, and country

contexts, a singular blueprint for a risk management roadmap is not feasible. This document presents many examples of risk management strategies that can be pursued by various groups of stakeholders.

ASRA IMPLEMENTATION

This report presents detailed operational guidance on how to apply the conceptual framework for conducting an ASRA. Rather than presenting a methodological blueprint, this document outlines a practical approach that can be adapted to the particular circumstances of developing economies. The ASRA may be tailored to take into account the sector's structure and institutional dynamics, including factors such as supply chains, institutions, fiscal constraints, and stakeholders' capacity to deal with the effects of realized risks. Likewise, risk management solutions identified in a particular country will not necessarily fit the context of another country, however similar they may appear.

The ASRA process is a dynamic one that requires careful planning given the participation of a variety of stakeholders and the degree of analytical skills and experience desired for the assessment team. Figure ES.1 summarizes the step-by-step ASRA process.

FIGURE ES.1. THE SEQUENTIAL ASRA FLOW PROCESS

This sequential flow process has proved to be very practical in conducting ASRAs to date, but it should be adapted to the particular circumstances of the country where it is applied and should respond to the assessment's specific objectives. The step-by-step activities shown in this diagram are sequential; the findings of each step inform and serve as the basis for the next. The immediate outcome of the process is a short list of prioritized risks.

Based on the risk prioritization, a short list of potential risk management solutions can be identified. This outcome is the basis for designing a risk management strategy that in turn has various steps, ending in an **action plan** for implementation. The shortlisted solutions can be evaluated using decision filters, such as feasibility and affordability, either in a consultative stakeholder setting or individually. This report contains a list of risk mitigation, transfer, and coping solutions identified in previous ARMT country engagements as well as a list of potential decision filters. These lists are not exhaustive, but provide a starting point for discussion.

This report presents a framework for the risk identification process, providing comprehensive instructions for methodical data collection and targeted analysis. The authors discuss methods for quantifying risks under different data quality scenarios, approaches for overcoming common data limitations, and alternative methodologies for quantifying risk and estimating losses when data are incomplete. Examples of data visualization tools are included, which are useful for understanding the potential impact of different risks and for communicating findings with country governments and other stakeholders.

TOWARD A RISK MANAGEMENT STRATEGY

Effective risk management typically requires a combination of measures, some designed to remove underlying constraints and others designed to address risk directly. The report discusses different approaches for how the risk solutions identified in the ASRA can be developed into action plans incorporated into stakeholders' strategies to reduce agricultural risks. Resource availability will often determine what is possible. Whatever the case,

integrated risk management programs are more effective than stand-alone programs.

When governments assume a holistic approach and improve their ability to assess risks and their interlinkages, they can more effectively help farmers manage their risks by providing targeted information and training where they are most needed. Translating the integrated risk management strategy into concrete action requires the use of several kinds of implementation instruments. This report contains tested examples of risk management measures and highlights integrated approaches that target risks at both the micro- and macrolevels.

ASRA CHALLENGES AND LIMITATIONS

Significant practical and methodological challenges limit the assessment process and its application. The report discusses approaches for overcoming these challenges; however, one good practice is to be aware of these issues and to be consistent and explicit about the associated assumptions. The key challenges include the following:

- *Historical bias.* Assessments conducted to date have been structured to analyze risk from a historical perspective. This type of assessment provides limited opportunity for analyzing new risks that might occur in the future.
- *Data limitations.* Accessibility and reliability of good-quality, disaggregated, time series data on key variables are often very limited, which negatively affects the ability to conduct a thorough risk assessment.
- *Subjective bias.* Despite all efforts to bring objectivity and give clear analytic indicators, a broad ASRA is essentially a subjective tool and this is one of the more challenging aspects, especially during risk prioritization.
- *Risk appetite.* Poorer producers have fewer buffers and therefore tend to have a low risk appetite. Many of these households manage risks by avoiding productivity-enhancing inputs, preferring yield stability over higher-yield inputs that may increase volatility. According to the International Fund for Agriculture Development (IFAD 2011), "Risk avoidance strategies thus have high opportunity costs: some studies estimate that average farm incomes could be 10 to 20 percent higher in the absence of risk."
- *Attribution.* It is rare that one event leads to losses such that all losses can be attributed to it. In many cases, multiple risk events occur in a given year, which makes it difficult to attribute proportions to different risks.
- *Client expectations.* An ASRA is an intermediate process for managing risk, not a final product. Government political will and commitment are necessary to translate the suggested solutions into concrete government strategies and budgeting.

CHAPTER ONE
INTRODUCTION

OVERVIEW

This document provides methodological guidance for conducting an ASRA. It is primarily designed for use by development practitioners working in the agricultural sector in developing countries. Besides presenting the conceptual underpinnings of agricultural risk management, the document offers practical guidance on the complexities of developing a holistic ASRA upon which an integrated risk management strategy can be designed. Rather than presenting a methodological blueprint, this document outlines a practical approach that can be adapted to the particular circumstances of developing economies.

The conceptual framework and step-by-step illustrations presented in this methodological guidance are based on nearly a decade of experience of the World Bank's Agriculture Risk Management Team in assisting developing economies in conducting sector and key commodity supply chain risk assessments. Whereas other institutions and academic reports offer insights into the development of tools to assess agricultural risks, the guidance herein provides a practical, stepwise approach to conducting ASRAs, incorporating the lessons learned from assisting countries in incorporating risk management practices into mid-term development strategies. This approach was developed and refined over time based on experience, but each specific assessment needs to be adapted to account for a country's unique combination of risks, institutional arrangements, and fiscal constraints.

The World Bank's conceptual framework for ARM looks at risk from an integrated perspective. The framework views risk assessment as a decision support tool for designing strategies to manage risks in agriculture. The ASRA's primary objective is to assist developing countries and stakeholders to better comprehend the complexity of ARM and to develop appropriate solutions to mitigate, transfer, and cope with agricultural risks.

Despite notable progress in this field, much remains to be done to mainstream ARM into development planning and investment decisions. The mainstreaming of ARM and

subsequent development of resilient and sustainable agricultural systems has been hindered by four main constraints:

1. Lack of an integrated operational approach to ARM that is embedded in country development and investment planning;
2. Lack of expertise and capacity in developing countries in this field;
3. Lack of interaction and knowledge exchange by stakeholders and practitioners, resulting from a previously siloed approach to products, strategies, and risks; and
4. A tendency to see a constraints-based approach as the only strategy to inform investment planning.

The expanding range of experiences across several countries and agricultural commodities has extended and refined the understanding of agricultural risks, their impacts, their transmission along supply chains, and the efficacy of different strategies to manage them. These guidelines try to capture the lessons learned as a contribution to the process of mainstreaming risk management practices into policy and investment decisions. Although the literature addressing issues related to risk uses definitions of terms that conform to the particular conceptual and regulatory requirements of their users and intended purposes, risk can be looked at from various angles and disciplines, and the terminology can be confusing. Appendix A contains a glossary of terms used in this document as they apply to ASRAs.

WHAT IS AN ASRA?

An ASRA is simply an orderly process to analyze, identify, and prioritize risk, which serves as the basis for the design of risk management strategies.[1] The follow-up of incorporation of the ASRA findings into government policies and plans is not addressed in this document because every country has its own decision-making process influenced by the political economy, institutional strength and procedures, and fiscal constraints.

[1] These methodological guidelines refer to the risk assessment only. The second key step is to develop a full-fledged risk management strategy, which is not addressed in detail in this document. The way in which countries have incorporated the findings into detailed strategies and budgets has depended on the unique circumstances of each country, given their political economy, institutional capacity, and fiscal constraints.

The ASRA is devised as a consultative and time-bound process to be carried out over an estimated 12-month period. The assessment draws upon available data and qualitative and quantitative information collected through stakeholder interviews and dialogue. This information covers input supply from farm production, assembly, processing, and logistics through to the final consumer. A set of guidelines is included to facilitate the identification and characterization of different risks (appendix C) and to structure stakeholder exercises (appendix D).

The rest of this introductory chapter addresses the context and pressing needs for assessing risk in agriculture. Chapter 2 offers a holistic conceptual framework for the design of risk management strategies that can be applied and adapted according to the specific circumstances of each country. Chapter 3 describes the operational approach for conducting risk assessments for the agricultural sector. Chapters 4 through 8 detail a practical step-by-step process to assess risk. Chapter 9 introduces the issue of vulnerability, whereas chapter 10 discusses the design of risk management strategies and the mainstreaming of risk management into development-oriented investments. Chapter 11 offers as final considerations the need to pay special attention to operational challenges.

WHY BOTHER ABOUT AGRICULTURAL RISK?

Agricultural risk is the principal cause of transient food insecurity and disruption to agricultural supply chains. It creates a poverty trap and causes volatile economic growth in many developing economies. Crop failure is often the biggest shock faced by rural households and perhaps also the biggest poverty trap. Agricultural risks have a profound impact on poverty because they undermine rural entrepreneurs' (particularly farmers') possibilities to accumulate assets, invest in and develop businesses, and gain access to health and education services. The increasing prevalence of "shock-recovery-shock" cycles vastly reduces many countries' ability to plan sustainable development paths. This is especially the case in agriculture-dependent countries such as those in Sub-Saharan Africa.

Risks are inherent, ubiquitous, and varied in the agricultural sector, posing potentially serious consequences for all

stakeholders. This stems from a range of factors including the vagaries of weather, the unpredictable nature of biological processes, the pronounced seasonality of production and market cycles, the geographic separation of production from end users, and the unique and uncertain political economy of the food and agricultural sectors, both domestically and internationally (Jaffee, Siegel, and Andrews 2008).

Agricultural risk is the principal source of agricultural supply chain disruptions and commodity chain failures. Such disruptions have negative impacts that can last several years. As a result, many governments introduce policy measures to protect their population, such as export bans. These policies can trigger a ripple effect that adversely affects neighboring countries (possibly reducing grain supplies and triggering conflict). Ultimately, these protectionist policies may have adverse consequences for the country implementing them.

Although levels of risk vary from one country to the next, lower-income and highly agriculture-dependent countries are more vulnerable to agriculture-related risks. A pressing need exists for them to better assess risks, understand where they are most vulnerable, and reinforce their risk management strategies. Highlighting the types and orders of magnitude of potential risks can improve planning and investments in prioritized strategies critical for mitigating identified risks, promoting risk transfer mechanisms, and making ex ante provisions for coping with realized risks.

The benefits of a more holistic and targeted risk management strategy are many. Adopting a risk management strategy can help mitigate risks before they occur. It can also lessen the impact on the government's fiscal balance, particularly at catastrophic levels, by tempering the need for costly and often poorly targeted post shock humanitarian relief to affected communities. Additionally, a well-planned ex ante risk management strategy facilitates expedient resource mobilization when risk events occur. For example, ex ante planning can assist farmers in returning to production more quickly by using previously identified delivery channels. Finally, better risk management helps poor rural households, women, and other vulnerable groups avoid depleting their assets or increasing indebtedness in response to shocks.

WHY AN ASRA?

An ASRA identifies key vulnerabilities and areas requiring priority attention in investment, capacity building, and policy reform. The primary objective is to help decision makers understand the risk exposure of agricultural sector stakeholders and to identify risk management strategies for prioritized risks. It provides a systemwide approach to identify risks, risk exposure, the severity of potential losses, and options for risk management by the private and public sectors. Ultimately, the ARM framework is designed to inform and facilitate integration of a stronger risk management focus into sector policy planning and development.

The ASRA's target audience includes country-level stakeholders involved in selected agricultural commodity systems, development agency decision makers, and developing country policy makers. The ASRA is devised to support broader sector strategy formulation efforts and the identification and formulation of proposals for investment, capacity building, and policy and regulatory reform in strategically important agricultural supply chains or within the sector as a whole.

An *ASRA can add value* in a variety of contexts, including (i) broader agricultural sector analyses and development strategy processes; (ii) constraint and opportunity analyses undertaken in the identification and formulation of development projects that focus on value chain integration, agricultural commercialization, rural finance, export promotion, landscape planning, and so on; (iii) planning, implementation, and monitoring of sector reform programs, including those involving shifts in the commercial, regulatory, and other roles of governments in agriculture; (iv) investment appraisals by private and development finance institutions or as part of strategic assessments of agricultural lending portfolios' quality and risk exposure; and (v) as an entry point for the introduction of CSA aimed at strengthening resiliency in agricultural systems.

The outcome of an ASRA is only a first step. Real changes that incorporate comprehensive risk management into planning and budgeting will likely be a gradual process. Ultimately, integration of risk management practices into development strategies will strengthen resilience in the longer term, thus reducing vulnerabilities among

agricultural sector stakeholders and increasing the success of agricultural investment strategies.

ASRAs can complement other types of risk assessments, including (i) household or area-based risk assessments, typically focused on the vulnerability of different types of households (that is, women in disadvantaged positions), the application of (typically) informal risk sharing and coping mechanisms, and the need and scope for supplementary social protection measures; (ii) hazard vulnerability assessments intended to justify the role and design of agricultural insurance instruments for specific segments and levels of stakeholders exposed to production risks; and (iii) financial risk assessments focused on the possible budgetary and other macroeconomic impacts of major shocks.

VOLATILITY AS THE "NEW NORMAL"

During the past 20 years, new macroeconomic forces have changed the shape of many agricultural risks, not only for food crops but also for agricultural supply chains more broadly. In light of long-term trends such as globalization and climate change, managing agricultural risk is ever more crucial to shortening the shock-recovery-shock cycle. Climate change is increasing vulnerability and contributing to protracted crises, whereas globalization is connecting the world as never before through trade, financial markets, and politics. The global economy has become a more complicated space whereby, for example, shifts in U.S. grain production can affect Niger, and economic growth in China can increase global demand for high-protein agricultural products. Some analysts observe that the changing fundamentals of demand for and supply of agricultural commodities have led to the creation of thin commodity markets that are intrinsically more vulnerable to adverse events. The foregoing trends are likely to aggravate the current levels of volatility and lead to further uncertainty.

The 2007–08 global food price crisis was an inflection point for attention to global food security. Following the crisis, interest has renewed in agriculture as a key driver of development and poverty reduction for many developing economies. Furthermore, shocks including recent droughts in Australia, Russia, and the Horn of Africa; floods in Pakistan; and several food safety failures have attracted the attention of policy makers and the donor community by elevating the need to invest in agricultural systems and implement risk management systems to reduce volatility and protect investments. The development community now recognizes the need to bridge the development-relief divide and to shift the focus from simply increasing productivity and food aid effectiveness toward a holistic and integrated risk management or resilience-building approach. Food security concerns, often driven by underlying risks, are currently at the top of many countries' political agendas and discussions on agricultural risks are central to the Group of Twenty (G-20) and other multilateral and sovereign policy deliberations.

The majority of the world's projected 9 billion people by 2050 will be located in developing countries and will be disproportionately affected by climate change. To feed this growing population, policy needs to shift from designing stand-alone risk products to adopting holistic and integrated risk management approaches with an emphasis on increasing sustainability and resiliency. The ARM framework must move beyond the individual farmer and seek to build capacity in the design of integrated risk management strategies for farmers, supply chain stakeholders, and the agricultural sector as a whole. These strategies need to be incorporated into government plans to reinforce the process of managing the "new normal" of a world with higher volatility in the agricultural sector.

In the face of multiple risks, a critical consideration is the resilience of primary producers, agribusiness entities, institutions, and other supply chain stakeholders for collective action, coordination, and public-private cooperation. *One cannot understand the competitiveness and future potential of a sector without understanding players' ability to anticipate and respond to shocks. An agricultural sector development strategy that focuses solely on productivity and removal of constraints is incomplete if it ignores risk and risk management considerations*.

CLIMATE CHANGE AND AGRICULTURAL RISK

The long-term changing climate is a significant source of risk to agricultural and food systems, beyond the short-term weather risks addressed in this methodological

guidance. Scientists predict that climate change will alter climate conditions, with increased weather and climate variability expected for most locations. Climate projections suggest that impacts will include shifts in average growing conditions, increased rain and temperature variability, and greater uncertainty in predicting future climate and weather conditions. More concretely, these impacts will translate into an overall warming trend, an increasingly erratic distribution of precipitation, more frequent and more extreme weather events, and spatial shifts in pests and disease outbreaks. Climate change thus requires adjusting both to new average climatic conditions and preparing for more volatile weather with more frequent and intense extreme events in most locations. The remaining uncertainty over future long-term climate change will lead to more short-term weather volatility overall. Combined, these effects form the "new normal" to which all stakeholders need to adapt.

The possibility of the appearance of new types of extreme events will pose further challenges to the agricultural sector. For example, it is predicted that cropping systems will no longer be viable in many locations. In Africa, for instance, under a range of scenarios projected to 2050, 35 million farmers across 3 percent of the continent's land area are anticipated to switch from mixed crop-livestock systems to livestock only (Jones and Thornton 2008).

Although climate change is expected to produce both winners and losers overall, losses will far outweigh the gains, and the poor will be disproportionately affected because of their dependence on agriculture and a lower capacity to adapt (World Bank 2008). Yet stakeholders must develop the capacity to identify thresholds triggering potential new hazards and anticipate which novel extreme events may arise in order to help prepare farmers as well as national and regional systems in dealing with the risks associated with the new normal.

RESILIENCE OF AGRICULTURAL SYSTEMS AND CLIMATE-SMART AGRICULTURE

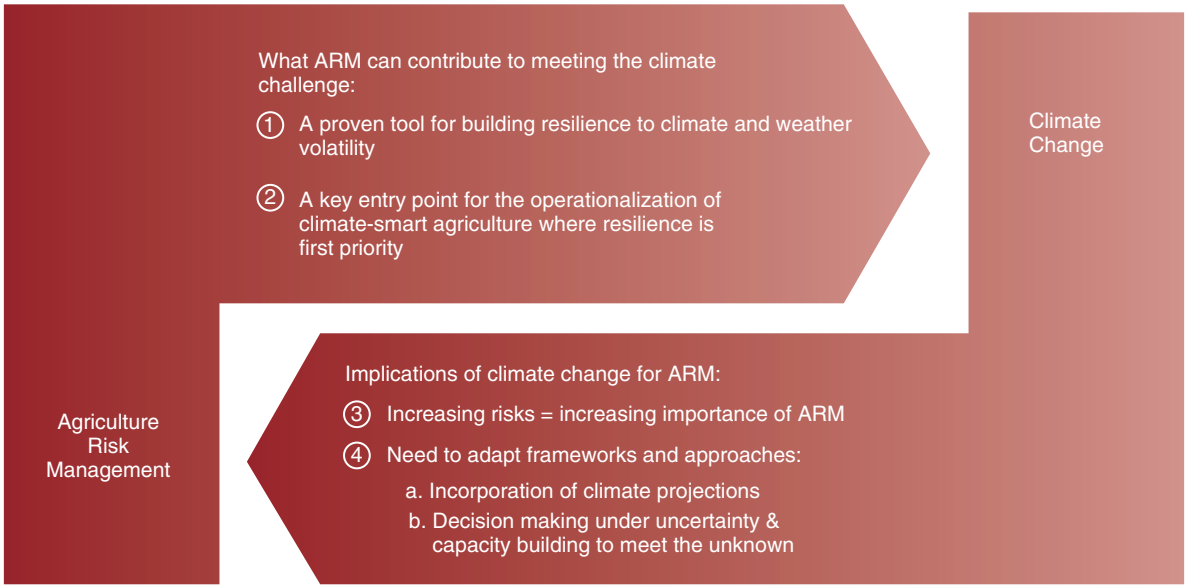
The vast majority of producers in developing countries are smallholders who are particularly vulnerable to external shocks that disrupt their livelihoods and encircle them into recurrent poverty traps. Mitigation of agricultural risk is increasingly focused on reducing the exposure and increasing the resilience of production systems and livelihoods to adverse impacts.[2] The ASRA therefore largely seeks to understand which characteristics make a country, agricultural sector, or segment of producers resilient and to identify the specific measures and processes that strengthen resilience. Resilience can be strengthened in many different ways and at different levels through political, economic, sociological, and technological interventions. For example, drought can be countered by building irrigation systems, improving water-harvesting techniques, and using agro-ecological technologies such as conservation farming, and by breeding new drought-resistant and drought-tolerant crops and livestock. Open trade policies to facilitate trans-border access to food can also strengthen resilience.

One key strategy for mainstreaming resilience into farming systems is the concept and practice of CSA. CSA is an approach for transforming and reorienting agricultural systems to support food security under the new realities of climate change. It aims to achieve three simultaneous outcomes: (i) increased productivity; (ii) enhanced resilience; and (iii) reduced emissions. A wide range of practices and approaches can increase the "climate-smartness" of production, from agro-forestry to rangeland management to climate and weather information services.

ASRA promises to serve as a methodological guidance to identify and justify strategies that strengthen the resilience of agricultural systems aimed at adapting agriculture to climate change conditions (figure 1.1). The process can be met by reconciling the short-term objectives of risk management with the medium- to longer-term objectives of climate change adaptation. Early incorporation of CSA into farming system practices also contributes to the objectives of increasing productivity, managing volatility, and boosting overall farming system resilience. *An ASRA can serve as a key entry point for operationalizing CSA strategies by providing the analytical and operational tools to strengthen resilience in agricultural systems.*

[2] *Resilience* can be defined as "the ability to withstand, recover from, and reorganize in response to crisis so that all members of society may develop or maintain the ability to thrive" (World Bank 2012).

FIGURE 1.1. CONTRIBUTION OF ASRA TO CLIMATE CHANGE ADAPTATION



CHAPTER TWO
AGRICULTURAL RISK MANAGEMENT CONCEPTUAL FRAMEWORK

This conceptual framework for ARM looks at risk from a holistic perspective and views the ASRA process as a decision support tool for designing integrated ARM strategies. The primary objective is to help decision makers understand the risk exposure of agricultural sector stakeholders and to provide the basis for developing appropriate solutions to mitigate, transfer, and cope with agricultural risks.

An expanding range of experience across several countries and agricultural commodities has extended and refined the ARMT's understanding of agricultural risks, their impacts, and their transmission across the sector as well as the efficacy of different strategies to manage risks. Distilling the experience and lessons learned in more than 20 countries, the World Bank developed the conceptual framework presented herein for assessing agricultural risks with an emphasis on practical application.

This methodology for assessing agricultural risks is based on a decade of lessons learned by the World Bank's ARMT, which has conducted numerous sector risk assessments in Niger, Honduras, Belize, Grenada, Paraguay, Ghana, Rwanda, Malawi, Kenya, Senegal, Tanzania, and Mozambique. Likewise, valuable lessons were learned from risk assessments for specific agricultural supply chains in Ghana (cocoa), Kenya (horticulture), Mozambique (cotton), Vietnam (coffee), Guyana (rice), Haiti (coffee), and Uganda (dairy and coffee), among others. (See appendix B for a complete list of risk assessments completed by the World Bank.)

THE CONCEPTUAL FRAMEWORK FOR ARM

A holistic perspective needs to (i) engage all stakeholders who are affected by agricultural risks and who take actions to manage them; (ii) consider the full range of risks; (iii) analyze different strategies to manage risk; and (iv) understand the different steps in the risk management process (as summarized in figure 2.1). An ASRA typically involves prioritizing the major risks affecting various stakeholders. The risk prioritization subsequently informs identification of specific risk management interventions and strategies to be implemented in the short to medium term.

FIGURE 2.1. KEY COMPONENTS OF AGRICULTURAL RISK MANAGEMENT

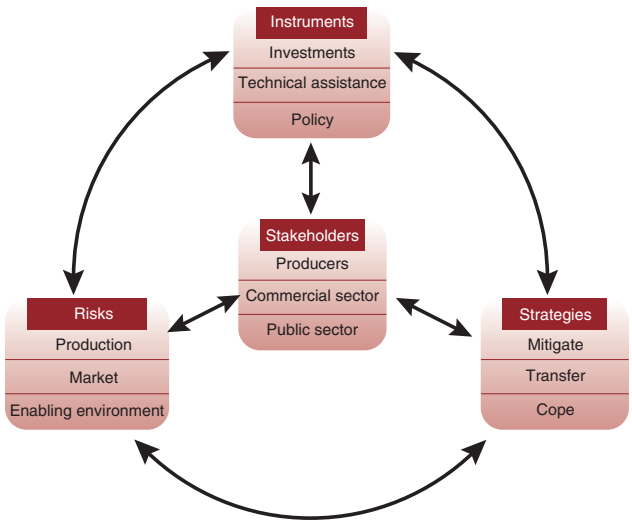
TASKS	RISKS	STAKEHOLDERS	STRATEGIES	INTERVENTIONS
• Identify • Assess • Manage	• Production • Market • Enabling environment	• Producers • Comercial sector • Public sector	• Mitigation • Transfer • Coping	• Policy reform • Investments • Technical assistance

As these components are not linear, they are better illustrated in a more dynamic fashion, as presented in figure 2.2, wherein the cycle of tasks (Identification, Assessment, and Management) interacts with the other components and flows around the needs of various stakeholders at the center of the process.

Risk management is a process that needs to be reevaluated periodically, as underlying conditions (for example, risk dynamics, levels of vulnerability) change over time. Conducting periodic risk assessments can provide valuable snapshots that assist in the design of new instruments and refinement of existing interventions.

The following sections briefly describe the key components of the ARM framework, which make up the basis for addressing the operational rationale behind an ASRA, as explained in chapters 3 through 8.

FIGURE 2.2. THE CONCEPTUAL FRAMEWORK FOR ARM



RISKS VERSUS CONSTRAINTS AND TRENDS

Conventional analyses of agricultural value chains typically emphasize efficiency and productivity, often through identification and removal of "critical constraints" or bottlenecks. This static focus ignores volatility in both production and markets and its effect on supply chain performance; it also does not address the incidence, allocation, or implications of risk or how incentives to add value among different actors (that is, smallholders and small and medium enterprises [SMEs]) might explicitly alter risk patterns. Whereas the definition of *risk* implies the presence of uncertainty and the probability of losses (for example, from a pest outbreak), the definition of *constraint* implies a certain factor known to cause suboptimal performance in agriculture (for example, poor soil) (see box 2.1).

TYPES OF RISK

Risks faced by agricultural stakeholders can be classified primarily into three categories: **production, market,** and **enabling environment risks.** Depending on the market integration of any particular supply chain and its context, each type of risk can be present, dominant, or absent. Each can also affect unique segments of the supply chain or the entire chain.

1. **Production risks:** A large number of risks affect the volume of production of agricultural commodities. These include nonextreme weather events (too little rainfall, too much rainfall, hail, frost, low temperature) and less frequent but catastrophic weather events (severe floods, droughts, hurricanes, cyclones). Outbreaks of pests and diseases can adversely affect yields, as can damage by animals, fire, and wind. Human-induced

BOX 2.1. DISTINGUISHING BETWEEN RISKS, CONSTRAINTS, AND TRENDS

It is important to differentiate **risks** from **constraints** and **trends.**

Risks are uncertain events that have the probability to cause losses. The element of uncertainty is present. As a symptom, yield volatility might be caused by a drought or pests or a disease outbreak.

Constraints are conditions that lead to suboptimal performance. For example, low yield (symptom) might be caused by lack of access to inputs or poor technology. The element of certainty is present.

Trends are longer-term or "chronic" patterns (reversible or irreversible) that provide context. For example, declining yield (symptom) might be caused by structural changes in agriculture or changes in climatic patterns (for example, desertification).

problems such as theft, fraud, and arson are also notable. These risks are usually manifested at the farm level but often affect the entire supply chain via risk transmission. Production risks are mostly associated with yield reductions but can also affect product quality (especially hail and wind damage and high humidity and excess rain leading to pests and diseases) and disrupt the flow of goods and services.

2. **Market risks:** Market risks are related to issues that affect price, quality, availability, and access to necessary products and services. Prices for inputs and outputs can be highly volatile, particularly in commodity markets where both local and global supply and demand conditions are constantly changing. Other market risks include exchange rate and interest rate volatility and counterparty and default risks. These risks usually materialize at the market level but have backward linkages to the farm, thereby affecting many different stakeholders. Directly related to price risks are risks associated with quality. Quality is affected by availability of affordable inputs, delivered and applied in a timely fashion, and by decisions about production, postharvest, and processing practices. Market-related risks vary constantly and are rarely associated with only one specific geographic location.[3] Aspects of market risk may directly affect individual actors in a supply chain and may affect producers in a single community and producer group in different ways.
3. **Enabling environment risks:** Sudden changes in the given scenarios in which business takes place such as unexpected changes in government or business regulations, the macroeconomic environment, political risks, conflict, trade restrictions, logistics, and corruption are all major enabling environment risks that can lead to financial losses for agricultural stakeholders. These risks have systemic impacts on decision making, productivity, and market options. Because incentives can change (including the distribution of rewards and risks in the supply chain), these risks can result in changes in yield quantity and quality and can even lead to disruptions in the flow of goods, services, information, and finance.

CATEGORIES OF STAKEHOLDERS

Stakeholders affected by agricultural risks can be classified into the following three major categories. A fourth category, consumers, is also affected by agricultural risks, but addressing demand-side issues directly is outside the scope of this assessment.

1. **Producers:** Operators of marginal, small, and medium-size farms make up the vast majority of agricultural producers in developing countries. They are most often severely exposed to risks and their impacts. Their capacity to manage risk is limited and they are often decapitalized by catastrophic events. Because of this, they are the leading recipients of direct and temporary government support. Larger-scale operators in agriculture run more technically intensive and integrated farming systems and have higher capacity to manage production risks but are highly exposed to market risks.

[3] Smallholder farmers typically face a systemic market risk in that their most accessible (localized) markets may be characterized by lack of access to information, poor transport and storage facilities, and low numbers of regularly active buyers.

2. **Commercial sector stakeholders:** Commercial stakeholders, including agribusinesses, traders, wholesalers and retailers, financial institutions, and input providers, have a vested interest in better ARM. This segment of participants is exposed to the various risks sourced at any point in the supply chain, but their roles and positions afford them a much higher capacity to protect their interests, manage risks, and smooth income over time.
3. **Public sector:** Public sector institutions, parastatals, government, and donors are important stakeholders that are fiscally exposed to agricultural risks and are often the main actors supporting risk management activities, and who also take into account impacts on consumers. At times, policy decisions made by these stakeholders may also be a source of risk.

INTEGRATED RISK MANAGEMENT LAYERS

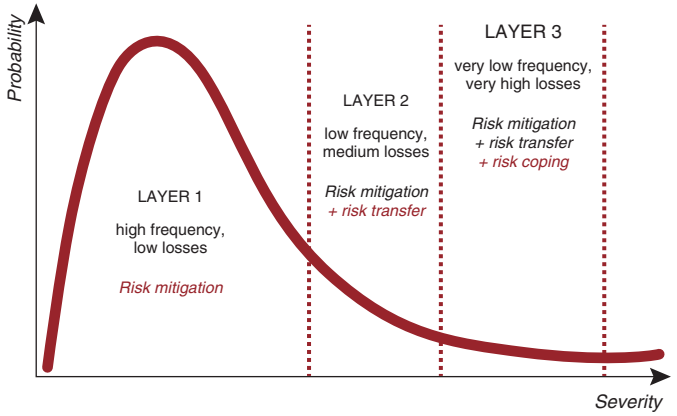
The vulnerability of individual stakeholders and the agricultural sector as a whole depends on the nature of the risks (that is, their correlation, frequency, timing, and severity) and the effectiveness of the risk management instruments in use. It is unrealistic to suppose that all risks can be managed, as one solution or product cannot serve as a "silver bullet" for all risks in all circumstances. Indeed, the existing literature discusses a complex variety of strategies. Rather than reviewing all possible risk management strategies, the strategic framework used in these guidelines presents a simplified approach for risk management strategy development for illustrative and practical purposes. The conceptual framework can be adapted to be as complex or as simple as needed, given a country's circumstances.

Following the assessment of risks and analysis of stakeholder vulnerability, risk management strategies can be proposed. A practical way to identify solutions is by classifying possible risk management strategies into three categories: mitigation, risk transfer, and coping. The appropriate set of strategies depends in part on participants' capacity to effectively use them.

1. **Risk mitigation (ex ante):** Risk mitigation strategies are actions taken prior to a risk event to reduce the likelihood of risk or the severity of losses. They are particularly useful for risks that occur with relatively high frequency but with lower impact intensity. Risk mitigation options are numerous and varied. Examples include adoption of improved agronomic practices such as soil drainage and mulching, conservation farming, and the use of short-duration and disease- and stress-resistant cultivars; irrigation and flood control infrastructure; soil and water conservation measures; changes in cropping patterns; crop and livestock diversification; income diversification; improved early warning systems; and modern information and decision support systems.
2. **Risk transfer (ex ante):** As not all effects of realized risks can be mitigated, risk transfer tools and mechanisms transfer the potential financial consequences of particular risks from one party to a willing third party, usually for a fee or premium. These mechanisms usually trigger compensation in the case of a risk-generated loss (for example, purchasing insurance, reinsurance, financial hedging tools). Although insurance and hedging are well-known forms of risk transfer, in developing countries the use of informal risk transfer within families and communities is also extremely important.
3. **Risk coping (ex post):** Some risks cannot be mitigated or transferred, so risk coping strategies are needed to help stakeholders better absorb and recover from their impacts. These instruments improve the affected population's resilience to withstand and cope with events through ex ante preparation to sustain production and livelihoods following an event. Examples include some form of compensation (cash or in-kind), social safety net programs, buffer funds, savings, strategic reserves, and livelihood recovery programs (for example, government assistance to farmers, debt restructuring, contingent financing). Such interventions are often financially beneficial and the ability to quickly respond to events often reduces losses.

Figure 2.3 illustrates these risk management strategies in the context of increasing layers of risk depending on the probability of occurrence (frequency) and the intensity or potential to cause losses (severity).

FIGURE 2.3. RISK MANAGEMENT LAYERS



The combination of different activities selected to manage risk ultimately depends largely on the findings of the ASRA, the characteristics of the identified risks, various actors' existing capacity to manage risk, and the fiscal constraints to implementing an integrated strategy. This framework can be applied to prioritize risks and interventions in a country with many risk management practices already in place, whereby stakeholders identify priorities and gaps in their current risk management strategies to enable them to adapt to a changing risk landscape.

RISK MANAGEMENT STRATEGY

The findings of an ASRA ultimately need to be incorporated into an actual plan of action with a sequencing of activities and a budget financed over the medium term. In this sense, the process of risk assessment has to be developed with clearly designated leaders who not only participate in the process but also find it useful to incorporate risk management strategies into medium-term planning. Typical stakeholders interested in the outcomes of the ASRA process are the Ministry of Finance, the Ministry of Agriculture, and other organizations related to the agricultural sector. The public sector is the most appropriate leader given the key role that public expenditures (investments and current expenses) play in ARM. The justification for public sector interventions is further supported by the public good nature of risk management, particularly in countries where the vast majority of producers are small to medium-size farmers in vulnerable positions.

OUTPUT AND PRIORITY MEASURES

The end product (output) of the ASRA process is a set of actions that require special attention to reduce vulnerability to shocks associated with the key priority risks. Moreover, resources are scarce and stakeholders need to see an explicit risk prioritization and strategy identification process whereby the proposed interventions provide clear returns in terms of agricultural growth, poverty reduction, food security, or other agricultural policy objectives. The measures can then be incorporated into government plans and budgets.

Risk management strategies are operationalized by instruments that can be planned, budgeted, and implemented for. These instruments fall into three main categories:

1. **Policy reform:** Improved risk management often entails policy reforms (for example, legal or regulatory reforms to improve access to agricultural inputs; changes in information policy to make agricultural information easily accessible to all; changes in government policy related to price formation, government procurement, or strategic grain reserves).
2. **Agricultural investment:** Although policy reforms mainly require political will, other risk mitigation measures can be costly. Examples are financial investments in irrigation infrastructure, research into drought- and disease-resistant and pest-tolerant cultivars, soil and water conservation, weather infrastructure, or updated agricultural services (for example, agricultural extension systems or disease surveillance systems). Some of these measures may already be part of a government program, with the ASRA simply calling for additional investments to strengthen capacity in those areas more vulnerable to external shocks.
3. **Technical assistance (TA):** TA is geared toward building local stakeholders' capacity (for example, training in price risk management; feasibility studies for various instruments; flood risk modeling work; development of early warning systems). Recent developments in information systems addressing agricultural risks can be easily transferred to public and private institutions that

can adapt the instruments to a country's specific conditions.

SHARED RESPONSIBILITIES

The ASRA methodology described in subsequent chapters calls for early and active participation of public and private sector representatives. Risk management is not the sole responsibility of the government or a group of participants in the sector. Moreover, it is not the sole responsibility of the Ministry of Agriculture because risks can originate at any point along a commodity supply chain and can be transmitted to other participants in agribusiness, the financial sector, or industry. In turn, risks can affect stakeholders in different ways. For example, food processors and consumers could perceive sudden price hikes negatively, but producers could view them as good news. All participants thus have a stake in ensuring that their risk perception, capacity to manage, and vested interests are taken into account and balanced. This is of utmost importance in agriculture, where the political economy of food production usually plays a key role in policy making. A well-informed ASRA with broad participation by key agricultural sector players can go a long way in the final design of acceptable and practical risk management measures, with results that can be monitored over time.

COLLABORATION AND JOINT OWNERSHIP

In facilitating the dialogue and the identification of risks and priority measures, the ASRA takes into account the divergent goals and motivations of different stakeholders. In so doing, it advances individual stakeholders' acceptance of the analysis, recommendations, and other outcomes regardless of their motivations.

Stakeholders' underlying objectives and their specific motivations for participating in the focal dialogue vary, cutting across commercial, personal, political, economic development, and even humanitarian concerns and considerations. Some goals, perspectives, and expectations may be shared; others may not. It should not be assumed that a common set of goals exists at the start of the assessment process. Indeed, a key objective of the process is to build a greater degree of common understanding as well as a commitment toward shared goals. The result should be a set of practical risk management measures that stakeholders agree will result in a more resilient sector. Early consultations and involvement of government representatives (especially from the Ministry of Finance) and interested donor agencies will enhance ownership of the process and facilitate incorporation of the recommendations into government plans. Stakeholders are also more willing to adopt new instruments and strategies if they are involved in the process. Once stakeholders understand and accept the value added of the ASRA process, the proposed strategies to manage risk will be more easily incorporated into their working plans.

Agricultural stakeholders will have incorporated risk management activities within their own area of influence to protect their financial interest against shocks. It is therefore of crucial importance for the ASRA to (i) understand very well the institutional and socioeconomic context of every group of stakeholders; (ii) identify and assess current risk management practices and their strengths and limitations; (iii) assess public and private sector capacity to manage risk; and (iv) maximize consensus among stakeholders that the ASRA's recommendations will strengthen current risk management practices.

CHAPTER THREE

OPERATIONAL APPROACH: HOW TO CONDUCT AN ASRA

Whereas the previous chapters explained the context, justification, and conceptual framework for conducting an ASRA, the remainder of the document focuses on the operational steps to apply the framework in practice. As mentioned earlier, rather than presenting a methodological blueprint, this document outlines a practical approach that can be adapted to the particular circumstances of developing economies. The ASRA may be tailored to take into account the sector's structure and institutional dynamics, including factors such as supply chains, institutions, fiscal constraints, and individuals' capacity to deal with the effects of realized risks. Likewise, risk management solutions identified in a particular country will not necessarily fit the context of another country, however similar they may appear.

WHAT IS THE OPERATIONAL APPROACH?

A great deal of literature exists on the subject of risk management. No less extensive are variations in the understanding and use of terminology. For the purpose of these guidelines, the ASRA is considered the process of identifying and prioritizing the major risks that explain agricultural gross domestic product (GDP) volatility. Once those risks are identified and assessed, the following issue is determining how stakeholders manage those risks. This process involves identifying optimal risk management solutions to be incorporated into sector risk management strategies led by the public sector.

Risk analysis using a holistic framework can be very complex and can involve several stakeholder groups. Stakeholder participation is encouraged through a process of facilitation. Given the complexities of agricultural production, processing, and commercialization, there is no shortage of risks and potential solutions to manage them. Moreover, effective risk management generally requires close cooperation

between various sector actors, each with their own particular vested interests, in complex political economy scenarios. The facilitation process requires risk assessment teams to assume a neutral position and play the role of "honest broker" among parties, with the explicit mandate to answer the following questions:

1. What are the major agricultural risks?
2. What are the optimal solutions to manage the key risks?
3. What are the gaps in current risk management strategies and plans?
4. What is the action plan to strengthen resilience to shocks in agriculture?

The risk assessment team establishes the methodology and facilitates discussion among various stakeholders to answer those questions. The use of quantitative data is critical to inform and bring a level of objectivity to the process.

The ASRA approach relies primarily on analysis of time series data, supported by other qualitative techniques for assessing risk. Techniques used in various ASRAs include the following:

1. *Time series data analysis*. This technique is preferred for assessing production risks. It involves statistical analysis of annual performance indicators for major agricultural commodities, namely, changes in area, yield, and production. Most ministries of agriculture keep historical records of these indicators. Ideally, it is optimal to obtain data disaggregated by region to isolate and analyze regions with major volatility and production losses. In the absence of time series data, production analysis can rely on yearly reports written by government agencies, commodity boards, producers' associations, and the private sector.
2. *Secondary data analysis*. An early literature review of peer-reviewed publications by academic institutions, social scientists, and agriculture specialists and an Internet search of media reports can help build the storyline related to the occurrence of risks, risk exposure, and vulnerability of various communities. Recent analytical reports that analyze the performance of agricultural supply chains usually contain valuable information regarding efficiency and productivity constraints, which is also helpful in identifying the underlying risks.
3. *Stakeholder interviews*. This important technique assesses various stakeholders' capacity to manage risks, their responses to shocks, and their degree of vulnerability in the presence of risk. Interviews can identify the causality of risk and risk transmission along supply chains, as different actors perceive and react differently to risk. Additionally, interviews with key informants who have extensive experience in analyzing the agricultural sector and have gained a reputation among stakeholders are a valuable way to build a realistic risk storyline.
4. *Qualitative analysis*. As not all risks can be assessed using quantitative techniques, the use of qualitative analysis needs to be introduced. This is particularly true when comparing the importance and ranking of nonmeasurable risks such as enabling environment risks. Team members participating in the ASRA use their best judgment during the prioritization process.
5. *Workshops and focus group discussions*. Group discussions with stakeholders at different levels and stages of the ASRA process are particularly helpful for securing feedback and validating findings. Additionally, group discussions help to neutralize those with potential vested interests who might try to direct attention to particular risks or solutions that suit their convenience.

Experience shows that all of these techniques are needed to some degree at different moments during the ASRA process. The process involves a blend of science and art, whereby quantitative analysis is combined with other analytical methods and fact-finding techniques to facilitate the prioritization process. Any degree of subjectivity can be put into context through discussions with stakeholders as well as group discussions within the ASRA. It is important that underlying assumptions related to subjective value judgments are clearly articulated so that their merits can be openly debated.

THE SEQUENTIAL FLOW PROCESS

The ASRA process proposed herein is a dynamic one that requires careful planning given the participation of a variety of stakeholders and the degree of analytical skills and experience desired for the assessment team. Figure 3.1 summarizes the step-by-step ASRA process.

This sequential flow process has proved to be very practical in conducting ASRAs to date, but it should be adapted to the particular circumstances of the country where it is applied and should respond to the assessment's specific objectives. The step-by-step activities shown in this diagram are sequential; the findings of each step inform and serve as the basis for the next.

The ASRA's outcome is a **short list of prioritized risks and corresponding solutions.** This outcome is the basis for designing a risk management strategy that in turn has various steps, ending in an **action plan** for implementation. The action plan details the interventions that stakeholders need to implement to complement current interventions and make the agricultural sector more resilient to shocks.

FIGURE 3.1. THE SEQUENTIAL ASRA FLOW PROCESS

WORK PLAN FOR THE ASRA

As part of the planning process, it has proved to be practical to elaborate a calendar of activities shared with counterparts to make them aware of when and for what purpose their participation will be needed. The more engaged the local counterparts, the greater the degree of buy-in for the methodology and ultimately of the results. Figure 3.2 illustrates a calendar of activities used in an ASRA in Tanzania. This calendar is not a blueprint but can be used as a reference.

In this illustration, the risk team listed four detailed steps that were jointly monitored between the assessment team and the government of Tanzania. Note that the calendar has a third step called "Solution Assessment" that involves developing the details on how to address the major risks prioritized earlier in the ASRA. It is the responsibility of government authorities and their partners to incorporate the action plan in government strategies and development projects, as well as to monitor and evaluate implementation.

Chapters 4 and 5 provide step-by-step guidance for assessment teams to conduct a risk assessment and a solutions assessment. Chapter 10 provides less standardized guidance for incorporating action plans into government strategies and programs given the unique nature of institutional decision making in each country.

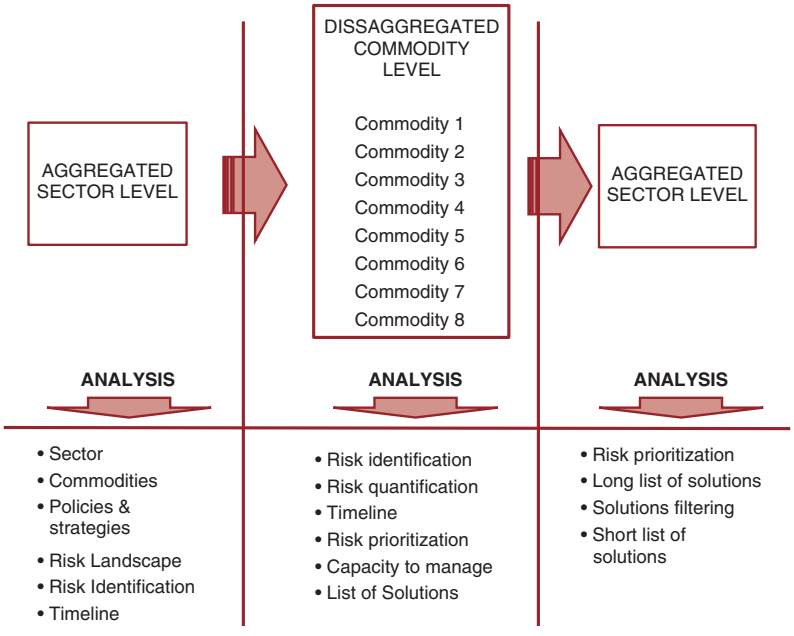
WHAT ANALYSIS AND WHEN?

Figure 3.3 shows the various pieces of analysis included in the ASRA. The process starts with sectorwide analysis during the background research phase (step 1). The analysis is then disaggregated at the supply chain commodity level to allow enough granularity for the risk prioritization process (step 4). Finally, the various commodity analyses are aggregated to conclude a risk prioritization and solution assessment that is representative of the entire agricultural sector (step 5).

FIGURE 3.2. CALENDAR OF ACTIVITIES FOR AN ASRA IN TANZANIA

Tanzania: Risk Management Review Workplan	2012			2013											
	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Step I: Inception Mission (1 week in-country mission)															
Activity 1.1: Meeting the government counterpart and explaining the objective															
Activity 1.2: Meeting other relevant stakeholders and soliciting their buy-in															
Activity 1.3: Identifying local partner institution and consultants															
Activity 1.4: Preliminary data collection															
Step II: Risk Assessment (7 week preparation, 3 weeks in-country mission, 6 weeks write-up)															
Activity 2.1: Background data collection															
Activity 2.2: Analysis of background data															
Activity 2.3: Team selection and contracting															
Activity 2.4: Risk assessment mission planning															
Activity 2.5: Risk assessment mission															
Activity 2.6: Risk assessment wrap-up workshop and sharing preliminary findings															
Activity 2.7: Report writing															
Activity 2.8: Sharing preliminary report with clients and relevant stakeholders															
Step III: Solution Assessment (2 week in-country mission, 4 week preparation and 8 week write-up)															
Activity 3.1: Background data collection															
Activity 3.2: Collection and classification of risk management intervention inventory in the country															
Activity 3.3: Analysis of efficacy and relevance of different RM interventions in the country															
Activity 3.4: Team selection and contracting (solutions experts)															
Activity 3.5: Solution assessment mission planning															
Activity 3.6: Solution assessment mission															
Activity 3.7: Risk Management Road Map workshop (2 days)															
Activity 3.8: Development of risk management implementation plan															
Activity 3.9: Report writing															
Activity 3.10: Sharing solution assessment and RM implementation plan with the clients															
Step IV: Dissemination															
Activity 4.1: Printing of Agriculture Sector Risk Assessment document															
Activity 4.2: Printing of Solution Assessment document															
Activity 4.3: Disseminating the document with the government & partner institutions															
Activity 4.4: Disseminating the document online (FARMD, USAID website, ARMT website, etc.)															
Activity 4.5: Disseminating the findings in relevant forums/meetings															

FIGURE 3.3. ANALYTICAL COMPONENTS AT COMMODITY AND AGGREGATE LEVELS



CHAPTER FOUR

STEP 1: BACKGROUND RESEARCH AND RISK IDENTIFICATION

The first step of the ASRA process is to gather background information on the agricultural sector, collect relevant data for risk analysis, and conduct a desk-level analysis before doing fieldwork. The objectives of this step are the following:

- Understand the context by analyzing current and past agricultural policies and strategies.
- Understand the dynamics of the political economy, when possible.
- Identify the structure of the agricultural sector and the role it plays within the broader economy (for example, size of sector, share in trade, labor in agriculture, rural poverty).
- Analyze trends in time series data for the various commodities related to area, yield, and production.
- Quantify and analyze variations in yield by commodity and region, noting years that show large drops in yields.
- Analyze time series rainfall data to determine trends and years of extreme volatility.
- Match historical drops in yield with realized risks, when possible.
- Identify major risks by crop, region, and stakeholder group.
- Analyze levels of vulnerability among various stakeholder groups.
- Analyze trends and variations in time series data of prices for various agricultural commodities and inputs.
- Analyze trends and levels of volatility in the foreign exchange rate and interest rates.
- Identify and predict likely impacts from climate change related to projected changes in weather and temperature.

By conducting this background analysis before the fieldwork, the team can identify in advance the sector's risk landscape and its disaggregation by commodity and by region. This exercise allows the team to become familiar with the country context, the broader economy, and more particularly, the agricultural sector. The findings of the background

research help guide the team as it proceeds with risk quantification, explained in detail in chapter 5. The qualitative analysis is conducted as part of the fieldwork, explained in detail in chapter 6.

SOURCES OF INFORMATION

Sources of information are numerous and vary from one country to the next. Government agencies (Ministry of Finance, Ministry of Agriculture, and other agriculture-related agencies, including agricultural commodity boards) can provide a great deal of the relevant data and documents needed for the background research. Additional sources of information include the following: (i) websites of various international agencies involved in analyzing the agricultural sector, with a focus on macro- or sectorwide policies and constraints, value chain analysis, regional or territorial development issues, or specific selected topics (for example, agricultural insurance, grain reserves, food security, commodity exchanges); (ii) universities and similar analytical institutions that publish the findings of research conducted on the agricultural sector, in particular the Consultative Group for International Agricultural Research (CGIAR); (iii) reports or analytical documents from commodity associations; (iv) the World Bank, which has provided useful information since 2009 when it changed its communication policy toward full disclosure, making available to the public analyses at country, sector, and commodity-specific levels, as well as on agriculture policy–related issues. Similarly, regional development banks such as the Inter-American Development Bank (IADB), Asian Development Bank, and African Development Bank, are excellent sources of analytical information; (v) the Food and Agriculture Organization Corporate Statistical Database (FAOSTAT), which has been closing the gap between its time series datasets and those published by ministries of agriculture. Additionally, the Food and Agriculture Organization (FAO) of the UN actively analyzes a wide range of agricultural issues at all levels; and (vi) the U.S. Department of Agriculture's Economic Research Service (USDA/ERS) does interesting analytical agricultural sector work in developing economies. Lastly, Internet search engines are an invaluable way to access a wealth of information. Appendix C provides a list of background data that facilitate or significantly contribute to the assessment of risks.

UNDERSTANDING THE AGRICULTURAL SECTOR

To situate risks in their context, the first stage is to form a better understanding of the agricultural sector, including its role in the economy, the importance of key agricultural commodities, the organizational structure of associated supply chains, key stakeholders and their functions, performance over time, future outlook, and the enabling environment in which they are embedded. It has proved to be practical to select as a proxy a mixed bag of agricultural commodities that together represent at least 80 percent of agricultural GDP. This provides the assessment team with a handful of commodities that are easier to handle and that are also representative of the sector in terms of value. Finally, it is important to understand the agricultural sector's relative importance in the economy (that is, as a share of GDP, share of trade, contribution to employment, levels of poverty and food insecurity in rural areas).

Preliminary analysis of agricultural supply chains often entails a comprehensive review of existing material (reports of agricultural sector reviews, studies, research theses, major news items, trade reports, and so on). Issues to be thoroughly researched include the following:

- *Demand conditions*. Identification of major markets of the commodity in question (export, regional, and domestic), end use of the commodity, characteristics of the commodity, quality attributes, demand and supply dynamics, and current and emerging market trends.
- *Supply chain structures*. The current structure of supply chains, which includes the flow of goods, information, and finance, and the degree of concentration of different operators (in terms of volume or value).
- *Stakeholders and their functions*. A brief description of the various actors in the agricultural system (those directly affecting the flow of goods, as well as those providing support services) and their functions.
- *Future outlook*. Near-term projections (demand projections, supply forecasts, and commentary on the country's commodity outlook).
- *Governance and coordination mechanisms*. The dominant governance structures and coordination

mechanisms and how they promote or inhibit the flow of information, risk sharing, and risk management across the sector.

» *Enabling environment*. The broader global enabling environment, as well as national and regional enabling environments (for example, national and regional trade policy, level of trade cooperation and integration). These play a key role in shaping the sector, so it is useful to identify their implications for risks in the sector.

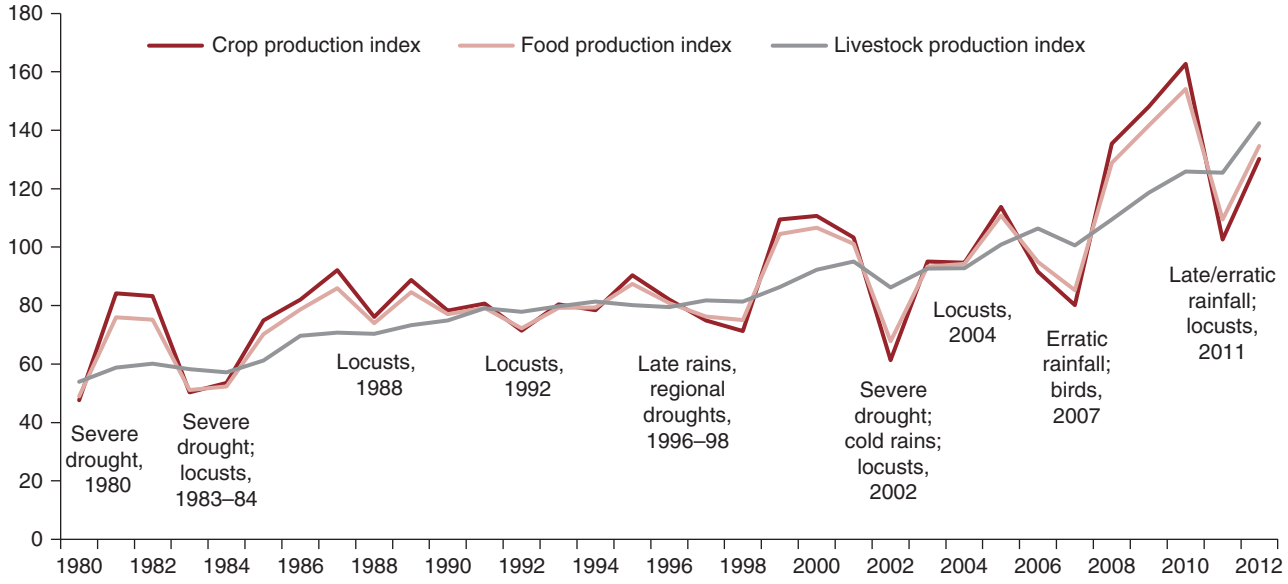
CONSTRUCTING AN EVENT TIME LINE

Developing an event time line of major past risk events helps establish correlation and, it is hoped, causation, between events and volatility. It assists in providing early indications of the major risks and their relative significance for sector growth. Time lines can also be useful in developing some initial hypotheses around principal risks facing the agricultural sector. These hypotheses can then be field-tested for rejection, further refinement, or acceptance. Creation of such a time line greatly facilitates an ASRA, but extensive time series data and information on all major events and their impacts on commodities' performance are often required and can be difficult to obtain.

A simple graph of agricultural GDP growth over time can help identify years in which agriculture was shocked by the realization of some type of event or risk. Those events can also be identified by the literature review conducted as part of the initial background research. The supporting information may appear dispersed and come from various sources. Figure 4.1 illustrates a completed event time line associated with changes in agriculture growth rates in Senegal.

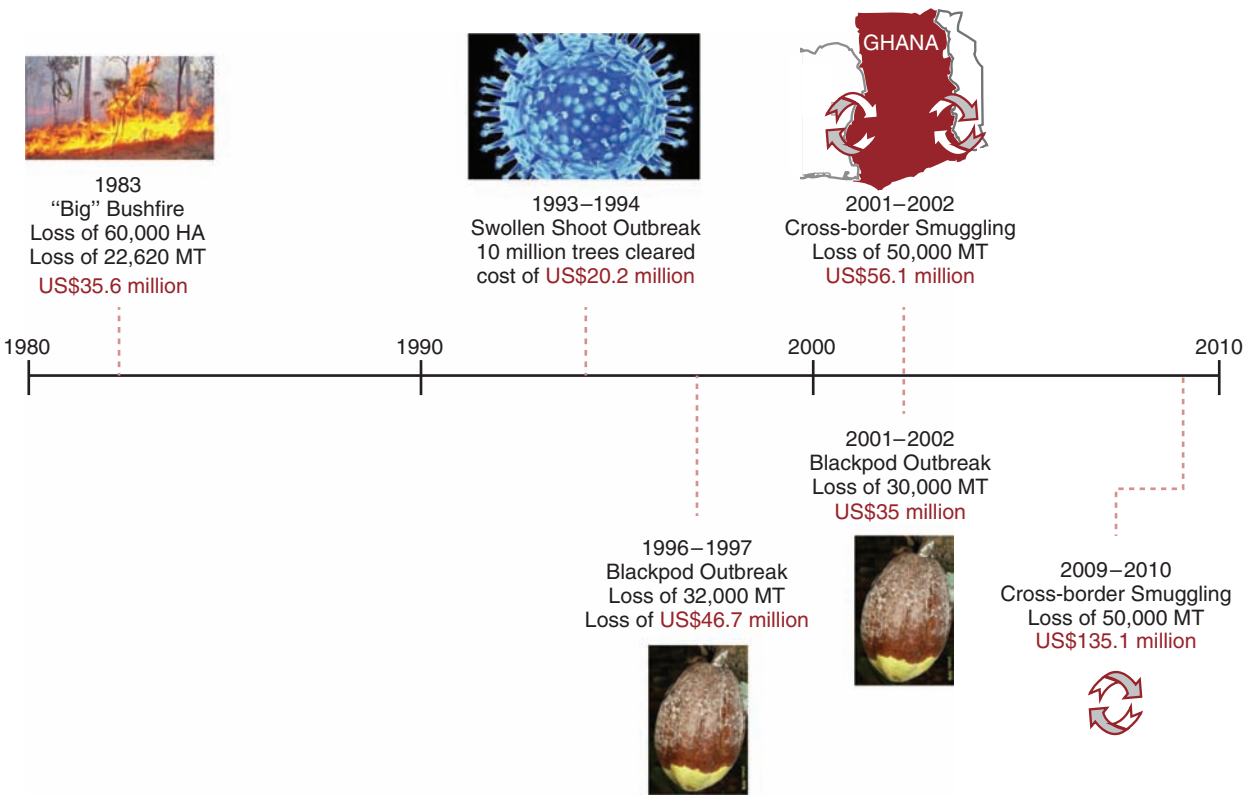
Once the available information has been compiled and organized into a time line that captures production shocks over a period of 25 to 30 years, it will need to be verified during the field visits. The description of the nature, frequency, and impact of realized risks at the aggregate sector level paints a broad picture that needs disaggregation because sector aggregation masks volatility at the commodity and regional levels. The subsequent tasks are to disaggregate the information to reveal that volatility and identify the major risks posed to particular commodities in specific regions, and to determine who is primarily affected. Drawing such a time line for each specific commodity helps identify the risks associated with specific commodities as well as their frequency over time. For example, from figure 4.2 it can be hypothesized that various risks have produced severe losses to cocoa production in Ghana. The team can go to the field to test whether

FIGURE 4.1. TIME LINE OF MAJOR SHOCKS TO AGRICULTURAL PRODUCTION IN SENEGAL, 1980–2012



Source: World Bank 2014d.

FIGURE 4.2. EVENTS TIME LINE OF RISKS TO COCOA PRODUCTION IN GHANA



these early hypotheses are correct and obtain a firsthand assessment of stakeholders' current capacity to manage similar risks.

SELECTION OF COMMODITIES

A developing economy's agricultural sector is often based on production of a wide range of agricultural products, making it difficult to select the commodities of focus for analysis. In such cases, filtering criteria can be useful. Teams can rank commodities in terms of their relative importance to export earnings or by their use for food security and domestic consumption (see table 4.1 for an illustration from Tanzania). A simple rule of thumb used in prior assessments is to choose a group of commodities whose output represents approximately 80 percent of agricultural GDP to arrive at a representative group of commodities. Some governments choose to include emerging crops for which current production may be limited but for which surging market demand demonstrates a growing trend. Other commodity selection factors include area and number of farms or producers involved in the production of each commodity or

TABLE 4.1. RELATIVE IMPORTANCE OF COMMODITIES BY VALUE IN TANZANIA

Tanzania Commodity	Relative Importance	% of AG. GDP
Livestock		**18**
Cash crops	**Export value**	
Tobaco	1	2.1
Cotton	2	1.8
Cashew nuts	3	1.5
Coffee	4	1.2
Tea	5	0.5
Food crops	**Food security**	
Maiz	1	31.1
Paddy rice	2	12.5
Bananas	3	8
Millet/sorghum	4	5.4
Cassava	5	5.2
Vegetables	6	4
Sweet potatoes	7	3.1
Other		5.6
Total		100

Source: World Bank 2013b.

contribution to rural employment. This information can assist in selecting the commodities to be analyzed. Regardless of the group of commodities chosen, the country counterparts, as end users of the findings, need to endorse the selection.

IDENTIFICATION OF KEY RISKS

Provided enough depth has been devoted to the literature review, the team should have the information to construct a long list of risks that have been mentioned as sources of volatility. This serves as the basis for the process of risk identification. In some cases, enabling environment risks are prevalent because of the nature of the political economy in the sector. In other cases, weather risks might be significant, especially for agricultural supply chains producing food crops and livestock in drought-prone countries. Market risks tend to be more predominant in export-oriented agricultural supply chains focused on production of commodities with highly volatile international markets (that is, cocoa, cotton, coffee).

The initial list of risks that arises from the preliminary literature review and data analysis will be subject to further analysis based on their historic frequency of occurrence and their capacity to cause major losses (see chapters 5 and 7). Table 4.2 illustrates the long list of risks identified in an ASRA conducted in Mozambique.

As the agricultural sector is highly vulnerable to rainfall variability, a detailed quantitative analysis of the impact of rainfall at a disaggregated level is useful. Appendix E provides an illustrative example of a quantitative analysis of rainfall and its impact on crop production in Ghana.

ASSESSMENT OF THE RISK MANAGEMENT LANDSCAPE

Another component of the background research is identification of current risk management programs and related interventions by the public and private sectors. Sometimes those programs were not necessarily designed with the objective of risk management, but addressing risk is oftentimes implicit in their activities. Understanding the existing risk management landscape lays the groundwork for the team to begin identifying gaps. Once the literature review is concluded, a gap analysis can be completed during field visits.

For example, the ASRA team in Mozambique found three intervention categories aligned with the National Investment Plan for the Agrarian Sector (PNISA) and its Strategic Plan (PEDSA); many of them were being implemented with positive impacts, albeit at a smaller, regionally localized level. The team placed greater emphasis on

TABLE 4.2. KEY IDENTIFIED RISKS IN MOZAMBIQUE'S AGRICULTURAL SECTOR

Production Risks	Market Risks	Enabling Environment Risks
Drought (late onset of rain, early cessation of rain, irregular rainfall, cumulative rainfall)	Domestic price volatility	Political unrest and violent conflict
Flood	International price volatility	Infrastructure disruption
Cyclone	Exchange rate risk	Implementation risk
Locusts	Input price volatility (for example, fertilizer, diesel)	
Wild animals	Counterparty risk	
Irregular rainfall		
Grain-eating birds		
Alluvial and soil erosion		
Heat and excessive temperature		
Wildfire		

Source: World Bank 2013a.

recommending the scale-up of those measures to the national level to meaningfully affect the whole agricultural sector. The same situation arose for the ASRA team in Paraguay, whereby foot-and-mouth disease (FMD) was identified as a priority risk for small-scale livestock herders. The government was already implementing programs to control FMD outbreaks through the National Service of Animal Quality and Health (SENACSA), but the ASRA revealed serious gaps. Strengthening the program became one of the government's risk solutions as a follow-up to the ASRA.

The initial risk assessment requires understanding the landscape of these interventions, assessing their relative efficacy, understanding principal challenges to success and scale, and identifying leverage points and necessary interventions to increase access to a wide majority of agricultural sector stakeholders. Assessing solutions to help prioritize specific interventions, scaling-up priority programs, and putting in place a risk management implementation plan are the next steps in the process of building resilience to external shocks in agriculture.

CHAPTER FIVE

STEP 2: RISK QUANTIFICATION

The task of quantifying losses caused by different risk events is a key step in the ASRA process, but it is not easy. Financial losses attributed to agricultural risks are caused by a variety of shocks related to production, market, or enabling environment factors. The impacts of some risks can be complicated to quantify in monetary terms, whereas others cannot be quantified at all. Assigning proxy values can provide an estimate of the magnitude of financial losses to allow comparison of risks, paving the way for the prioritization of major risks.

Various approaches exist to quantifying risk. The World Bank's ARMT relies primarily on time series analysis to assess production risks; variations from the historical mean to assess market risks; and qualitative analysis to assess enabling environment risks. Chapter 5 focuses on how to quantify financial losses using time series analysis when a complete set of time series data is available. The chapter also discusses methods for quantifying losses under poor data scenarios.

RATIONALE

Quantifying losses associated with a risk event enables comparison or risk ranking as an intermediate step in the risk prioritization process. Loss quantification provides an order of magnitude of the indicative losses in terms of agricultural GDP, which helps to justify investment in risk management solutions that reduce the impact of external shocks and strengthen resilience. In fact, losses are a key piece of information for any cost-benefit analysis for investing in agricultural resilience.

Ideally, if data availability permits, the quantification of losses for each commodity under study should be done as part of the deskwork phase before the field visits. The findings are very useful for determining the magnitude of loss, its causes, the stakeholders affected, and stakeholders' capacity to manage. Calculating loss estimates before the field visit makes the fieldwork much more efficient and helps facilitate discussions with stakeholders.

HOW TO QUANTIFY LOSSES ASSOCIATED WITH RISK

Several methods can be used to quantify risk, ranging from calculating the simple variation from a mean value to using sophisticated statistical software applications as is commonly done in the insurance industry. The focus herein is on conducting a simple time series analysis of risk events to arrive at the monetary value of losses caused by production risks. Other chapters address in detail how to reconcile the quantitative assessment of production losses with the qualitative assessment used to rank the significance of losses associated with market and enabling environment risks.

For production risks, calculations are made individually for each commodity under study. They are then aggregated to quantify losses for the whole agricultural sector. The step-by-step methodology to quantify production losses using yield data and production data is shown in tables 5.1 and 5.2, respectively.

Alternatively, if time series data of yields cannot be obtained or are not reliable, the calculations can be made using production data either from the country or from FAOSTAT. Using production data instead of yield data means that the loss calculation also includes changes in area, not just yield (production = yield times area). It is important to use the same methodology for all commodities so that the quantification of losses uses the same yardstick to enable risk prioritization.

Figure 5.1 provides an illustration of a loss calculation using rice yields in Tanzania. It is worth noting the following:

1. The blue line represents the actual historical records of rice yields in tons per hectare from the 1981–82 agricultural cycle until 2009–10, representing 29 years of data.

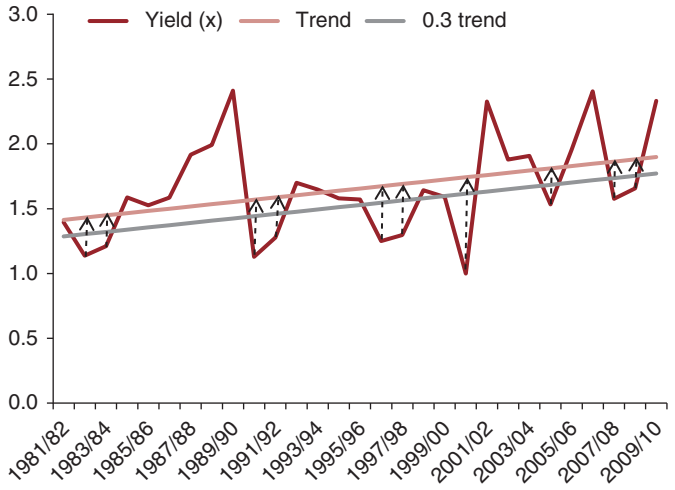
TABLE 5.1. STEP-BY-STEP METHODOLOGY FOR QUANTIFICATION OF LOSSES USING YIELD DATA

	Calculate Indicative Value of Yield Losses for Individual Crops
1	Obtain time series data for yields of a commodity from in-country data or FAOSTAT.
2	Derive linear trend for yields using ordinary least squares (OLS) and associated predictive values.
3	Calculate standard deviation (SD) for linear trend.
4	Derive threshold: Trend value minus (0.33 multiplied by SD).
5	Calculate loss below threshold = Trend value minus yield value for each year where yields are lower than threshold.
6	Calculate total output loss: Yield loss multiplied by total area harvested.
7	Get yearly prices of commodity and convert them from nominal to constant value.
8	Calculate value loss of output: Total output loss multiplied by price (at constant value).
9	Convert to US$ using annual exchange rates.
10	Calculate annual average losses: Sum of value loss for years below threshold divided by total number of years in series.

TABLE 5.2. STEP-BY-STEP METHODOLOGY FOR RISK QUANTIFICATION OF LOSSES USING PRODUCTION DATA

	Calculate Indicative Value of Production Losses for Individual Crops
1	Obtain time series for total crop production from in-country data or FAOSTAT.
2	Obtain corresponding nominal price data.
3	Calculate value of crop production in constant prices, for either a given year or an average for a given period of years; this can be done using the most recent in-country prices or the prices for the corresponding period from FAOSTAT data.
4	Derive linear trend for value of crop production using OLS and associated predicted values
5	Calculate SD for linear trend.
6	Derive threshold: Trend value minus (0.33 multiplied by SD).
7	Calculate loss below threshold: total crop prod value minus threshold value.
8	Convert to US$ using annual exchange rates.
9	Calculate annual average losses: Sum of value loss for years below threshold divided by total number of years in series.

FIGURE 5.1. PADDY RICE YIELD LOSSES IN TANZANIA (TONS PER HA), 1981–2010



Note: Ha = Hectare.

2. The red line represents the linear trend of yield over time. This linear trend can be thought of as the yield that farmers would "expect" in the absence of volatility. In other words, investment decisions for growing rice are expected to be made based on a normal year, represented by the trend line.
3. The green line represents the threshold. The threshold represents deviations from the trend (the "expected" yield) that would normally occur in the course of doing business. In other words, yield drops down to the threshold line are considered losses that are part of "doing business." This is not desirable, but is not considered extraordinary. In this case, it is calculated as one-third of a standard deviation, an arbitrary rule arrived at by trial and error. Other ways to establish the threshold (either proportions or other measures) do not provide results as consistent as those obtained from using the current threshold. The important issue is that the threshold captures major drops in yield or production that are worth taking into account for the purpose of risk identification and quantification.
4. Any deviations in yield that drop lower than the threshold are considered losses incurred because of a "risk" event. In this case, in 10 years out of 29 yield dropped below the threshold.
5. Consequently, losses in monetary value need to be calculated for those years only.

TABLE 5.3. PADDY RICE IN TANZANIA: LOSSES FOR YEARS IN WHICH YIELD DROPPED BELOW THE THRESHOLD

Years	Loss (MT)	Loss (US$)
1982/83	65,762	44,465,202
1983/84	64,303	43,478,588
1990/91	161,252	109,031,104
1991/92	94,242	63,722,253
1996/97	184,113	124,488,936
1997/98	255,477	172,741,869
2000/01	239,066	161,645,055
2004/05	191,871	129,734,130
2007/08	250,504	169,379,182
2008/09	176,671	119,456,593
Annual average	**58,044**	**39,246,307**
As percentage of Agricultural GDP:		**0.7**

Note: MT = Metric ton.

Table 5.3 shows the estimated losses associated with paddy rice production in Tanzania using time series data.

These calculations are done for each commodity under study, taking care to use the same methodology for each calculation. Once the calculations for all commodities are done, they are aggregated to estimate losses for the sector as a whole. Table 5.4 illustrates the aggregation of losses across commodities for an ASRA conducted in Paraguay.

Similarly, when data availability allows, the calculations can be disaggregated by province or region to provide more granularity in the findings. Table 5.5 illustrates regionally disaggregated results for losses found in Paraguay's ASRA.

Production shocks can affect prices in the short term, especially for goods with limited trade, so using average annual prices to demonstrate the value of the losses may be misleading. It is therefore important to determine what type of prices to use in the calculation:

- **Constant prices:** show the value associated with production losses *only*, enabling a comparison of the volume lost from year to year.

TABLE 5.4. DISAGGREGATED LOSSES BY COMMODITY IN PARAGUAY

Commodity	Local Currency (₲)	US$
Garlic	(1,540,068,785)	(355,428)
Cotton	(38,294,643,861)	(8,837,905)
Irrigated rice	(20,372,821,741)	(4,701,782)
Rice	(4,497,983,960)	(1,038,076)
Sweet potato	(6,588,120)	(1,520)
Sugarcane	(28,833,977,166)	(6,654,507)
Onion	(1,856,184,503)	(428,383)
Frutilla	(1,590,928,493)	(367,166)
Locote	(3,124,627,686)	(721,123)
Maize	(229,559,269,995)	(52,979,291)
Cassava	(124,232,296,459)	(28,671,197)
Groundnuts	(20,861,192,474)	(4,814,492)
Potatoes	(343,895,779)	(79,367)
Beans	(9,264,417,036)	(2,138,107)
Sesame	(17,441,343,466)	(4,025,235)
Soybean	(616,409,635,438)	(142,259,320)
Tomato	(16,556,806,939)	(3,821,096)
Wheat	(23,589,511,795)	(5,444,152)
Carrot	(248,496,520)	(57,350)
Banana	(14,596,653,216)	(3,368,718)
Pineapple	(3,057,428,271)	(705,615)
Pomelo	(4,685,329,530)	(1,081,313)
Total	**(1,180,964,101,235)**	**(272,551,143)**

Note: ₲ = Paraguayan guaranties.

TABLE 5.5. DISAGGREGATED LOSSES BY REGION IN PARAGUAY

Province	Local Currency (₲)	US$
Concepcion	(24,136,471,088)	(5,570,383)
San Pedro	(112,826,815,210)	(26,038,960)
Cordillera	(17,821,730,343)	(4,113,023)
Guaira	(27,770,086,845)	(6,408,975)
Caaguazu	(146,778,337,805)	(33,874,530)
Caazapa	(64,400,703,955)	(14,862,844)
Itapua	(211,046,236,386)	(48,706,724)
Misiones	(21,647,858,182)	(4,996,044)
Paraguari	(25,204,096,945)	(5,816,778)
Alto Parana	(312,719,057,093)	(72,171,488)
Central	(9,122,516,360)	(2,105,358)
Ñeembucu	(5,171,201,082)	(1,193,446)
Amambay	(39,059,203,341)	(9,014,356)
Canindeyu	(143,261,178,695)	(33,062,815)
Pte. Hayes	(3,060,072,506)	(706,225)
Alto Paraguay	(2,246,771,475)	(518,526)
Boqueron	(14,691,763,924)	(3,390,668)
Total	**(1,180,964,101,235)**	**(272,551,143)**

» **Real prices:** show joint production-price shocks, as relative price changes are captured. For some countries, ASRAs have shown that joint production-price shocks have a larger impact on the sector than production shocks alone. However, this method may also show that prices compensate for some of the impacts of risks on production.

Both methods are useful for understanding the relative importance of different risks.

SCENARIO WITH POOR-QUALITY DATA

Oftentimes the risk assessment team will find that the time series data needed for production risk identification and quantification are of poor quality or have too many missing observations. The alternative is to reconstruct the time series production data using a variety of sources. No one single way exists to reconstruct missing data, as it will always be based upon assumptions that need to be thoroughly tested with key informants with long experience in the agricultural sector. The methodology used for reconstructing time series production data for Mozambique is shown in box 5.1 for illustrative purposes. In Mozambique, disruptions in data occurred because of the long civil war. Other countries experience problems in capturing time series data on agriculture because of budget problems or complexities in capturing and processing information. In such cases, the risk assessment team needs to creatively reconstruct data using available sources and thoughtful assumptions.

SCENARIO WITH NO DATA

If the risk assessment team finds itself in a situation where the quality and quantity of data are still limited even with various sources, it will need to rely more heavily on findings from interviews with stakeholders and key informants. Thus, the fieldwork plays an even more crucial role, because the actual identification of risk events, the

BOX 5.1. ALTERNATIVE APPROACH TO CALCULATION OF PRODUCTION RISK LOSSES IN MOZAMBIQUE'S ASRA

In Mozambique, available data on actual losses caused by adverse events are neither particularly accurate nor consistent within individual data sources. To facilitate comparison and ranking of the losses attributable to various events, different data sources were combined to generate a more or less consistent time series. The calculations were as follows:

1. Gross production values were derived from FAOSTAT data.
2. The share of production from crops and agriculture that were studied represented approximately 60 percent of gross production value, crops included those that were fairly representative of the sector structure.
3. The amount of land planted in hectares for arable and permanent crops per year was derived from FAOSTAT data.
4. The estimated value per hectare of land planted with arable and permanent crops was calculated by dividing the figure for the share of production from crops and agriculture using constant 2004–06 U.S. dollars by the estimated amount of land planted for arable and permanent crops.
5. The number of hectares lost per risk event was taken from analysis of annual reports from SETSAN (food security situation reports), the PES (the Annual Balance of Economic and Social Plan and Annual Economic and Social Plans), Famine Early Warning Systems Network (FEWS NET) reports, Global Information and Early Warning System (GIEWS)/FAO reports, and data downloaded from the Early Warning System.
6. The estimated loss was calculated by multiplying the estimated value per hectare by the hectares lost in a given year caused by risk events.

Source: World Bank 2013a.

frequency of their occurrence, and their intensity will be derived primarily from interviews.

This approach has many limitations, the main one being that people generally have short memories and more easily remember recent events. Consequently, the extent and depth of field interviews need to be greater than in scenarios with more data availability. In this case, the team needs to pay particular attention to get a sense of the magnitude of losses incurred and their frequency, apart from the usual questions regarding stakeholders' capacity to manage and their vulnerability. Testing the findings in workshops with stakeholders and focus group discussions in every commodity supply chain under study is imperative.

FREQUENCY AND INTENSITY

The frequency of risk events and their capacity to produce losses (intensity) are variables that need to be estimated once the team has identified the major risks to the agricultural sector. These variables and the vulnerability to the impact of risk (expressed in this approach as the capacity to manage risk) will serve as the basis for the risk prioritization, explained in detail later in the guidelines. However, at this stage it is worth noting that these parameters need to be estimated for each commodity under consideration. Table 5.6 illustrates how observed risks to cotton in Mozambique were assessed by frequency (Probability of Event—categorized as highly probable, probable, and occasional) and intensity (Potential Severity of Impact—with impacts ranging from negligible to catastrophic).

The risks located in the upper right-hand, darker-shaded corner represent the greatest risk for this particular commodity. To obtain the broader picture for the sector as a whole, this exercise would be replicated for all commodities under study, using the findings from the quantitative assessment and those from interviews with stakeholders (more on this in later chapters).

The event time line discussed in the section "Constructing an Event Time Line" in chapter 4 is a useful tool for risk prioritization because it provides evidence about the intensity and frequency of major events that caused agricultural GDP to drop.

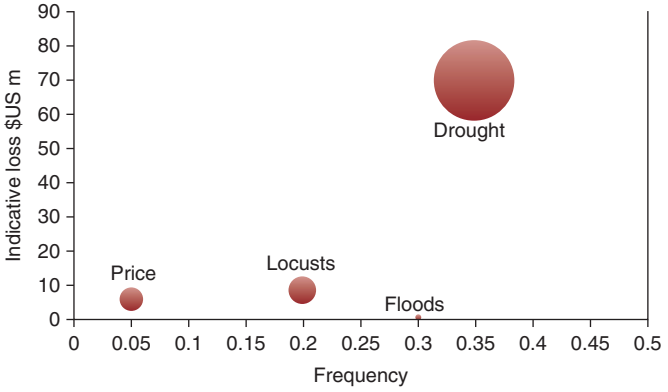
Bubble graphs are a good illustrative tool to use to compare and contrast different production risks relative to intensity (as indicated by losses) and frequency, where data are available. Figure 5.2 provides a visual representation of frequency and intensity using bubbles to denote the relative significance of various risks in Niger. In this case, drought is the biggest risk for Niger's agricultural sector.

TABLE 5.6. ASSESSMENT OF FREQUENCY AND INTENSITY OF RISK IN MOZAMBIQUE'S COTTON SUPPLY CHAIN

		Potential Severity of Impact				
Probability of Event		**Negligible**	**Moderate**	**Considerable**	**Critical**	**Catastrophic**
	Highly probable	Sudden change in orders for chemicals.		Farmers' credit default (chemicals).	International cotton price volatility.	Crop substitution.
	Probable	Port delays.	Weather (droughts, floods, and so on).	Ginners' credit default. Transaction tax default and payment delays by ginners.	Pests (aphids, worms, and so on).	
	Occasional	Carrying large quantities of cash. Sample testing delays.	Fire. Unreliability of transportation market.	Loss of soil fertility.	Exchange rate risk.	

Source: Cotton supply chain risk assessment for Mozambique. "Mozambique Cotton Supply Chain Rapid Risk Assessment": http://siteresources.worldbank.org/INTCOMRISMAN/Resources/MZ_CottonRiskReport_FINAL(Nov2010).pdf.

FIGURE 5.2. EXPECTED AVERAGE LOSSES FOR ADVERSE CROP PRODUCTION EVENTS IN NIGER



Source: World Bank 2014a.

A NOTE ON LIVESTOCK

Livestock activities are very important for a vast proportion of rural households. Shocks that affect livestock production can be devastating in many developing countries, particularly in Sub-Saharan Africa where entire communities depend on pastoral activities for their livelihoods. For other households, livestock are valued not just for their products in terms of meat and dairy products but also because they represent the accumulation of savings and capitalization of productive activities.

Assessing risks to livestock production is a complex technical challenge, and no unique method exists for conducting such a risk assessment. Therefore, it is suggested that an experienced expert on livestock is incorporated as part of the risk assessment team, and that local expertise is sought out and relied on as much as possible.

In general, the following steps could be followed to conduct a risk assessment for livestock:

1. *Identification of the various supply chains.* Livestock production and marketing could be organized along different and particular supply chains. Examples are livestock pastoralists, intensive livestock production, silvo-pastoralists systems, intensive dairy production, artisanal cheese channels, and so on. The exposure and vulnerability to risks might be very different in many countries. Understanding how these supply chains work, what stakeholders are involved and who they are, and their turnover is the starting point for a risk evaluation.
2. *Identification of threatening events (hazards and shocks).* The objective is to have a qualitative understanding

of the risks (historically present and potential) for each identified supply chain, noting the following:

a. *Types of risks*. What are the major risks for each supply chain associated with losses that are recorded or remembered by stakeholders?
b. *Historical events*. What shocks (production risks, market risks, enabling environment risks) have affected the supply chains during the past 20 years?
c. *Severity and frequency*. How frequently are stakeholders exposed to shocks and how severe are they? How long do the shocks last?
d. *Degree of dispersion*. Were all supply chains affected equally? What stakeholders were affected most? What regions are more prone to losses?
e. *Characteristics of affected stakeholders*. What are the socioeconomic profiles of the most affected stakeholders?

3. *Assessing losses*. For each of the value chains in the livestock subsector, it is practical to catalogue assets and income levels. The following questions can serve as guidance:
   a. What is the average herd per household in each supply chain?
   b. What is the estimated income from livestock production?
   c. How are income levels affected by different shocks?
   d. How is production affected per hazard and how long does it take to recover to the pre-event position?
4. *Capacity to manage*. This step aims at identifying and assessing the capacity to manage risks for each group of stakeholders active in the supply chain. Relevant questions include the following:
   a. *Before the event*. Are households applying mitigation practices that would lower the impact of negative shocks? How widespread is the use of good practices?
   b. *During and after the event.* How do households cope with losses—selling assets, borrowing, selling labor, migrating, lowering consumption? What are the most common coping strategies?

To answer these questions, qualitative and quantitative analysis will be needed. Stakeholders' risk perceptions could be obtained by interviews, secondary literature, focus group discussions, surveys and questionnaires, discussions with stakeholders, and expert opinions.

The outcome of a livestock risk assessment would in principle include the following:

- Estimation of potential losses per level of hazard and stakeholders for each supply chain
- Impact on investment, income, debt, employment, and export earnings due to risks
- Analysis of vulnerability for groups of stakeholders and comparison under different types of risks and geographic location

There are many ways how to organize and analyze the information gathered via the steps described above. But the common variables of the analysis for each identified risk are intensity to cause losses, frequency of occurrence, and capacity to manage. Analyses of those variables are the inputs for risk prioritization in the livestock subsector. Using a prioritization table similar to that shown for crops can capture the results of these analyses. Table 5.7 presents an illustration of a risk assessment for livestock in Rwanda. A practical advantage of expressing the results in this table is that the prioritization of livestock risks can be consolidated with those for crops to complete the sector dimension.

An additional challenge for the risk assessment team is how to assess risks that have never occurred in the country's livestock subsector but have the potential to cause severe losses if they do happen. For instance, an outbreak of FMD in any country in Central America would have severe consequences given the weight that beef exports play in the economy and the fact that these countries are FMD-free (without vaccinations), which allows them to export to any country without restrictions. The risk is ever present. To address this challenge, a livestock expert estimated the impact of such an outbreak in Honduras using losses from outbreaks in other countries. For the prioritization of solutions in Honduras, the team relied on institutional assessments done by the Regional Sanitary Organization (OIRSA) that revealed weaknesses in prevention.

TABLE 5.7. ILLUSTRATION OF RISK PRIORITIZATION IN LIVESTOCK FOR RWANDA

Impact and Probability of Event	Negligible	Moderate	Considerable	Critical
Highly Probable (1 in 3)		• Milk contamination	• Disease outbreak(s)	
Probable (1 in 5)		• Drought • MCC (milk collection center) power cuts		
Occasional (1 in 10)	• Glut (price risk)	• Drug and livestock inputs contamination and adulteration risk		
Remote (1 in 20)	• Aflatoxins • Maize production shortages			

Source: World Bank 2014c.

QUANTIFYING MARKET RISKS—PRICE VOLATILITY

Market risks are generally related to issues that affect price, quality, availability, and access to necessary products and services. Of these, price risks are typically volatile, particularly in commodity markets where both local and global supply and demand conditions constantly change. Price uncertainty has a direct impact on decision making related to the selection of crops and enterprises and investments with the intent of maximizing profit.

Quantifying price risk could become a complex exercise with no straightforward way to assess volatility. For the risk prioritization process, the team needs to distinguish between internationally traded export commodities (that is, cocoa, cotton, coffee, soybean) and those that are mostly traded domestically (that is, food crops). **For internationally traded export commodities,** provided the country is not a price giver but a price taker, domestic stakeholders are generally exposed to price volatility. The volatility of these commodities has been thoroughly studied in the academic and business community. As the complexities of those calculations can go beyond what is reasonably needed for the ASRA, the team can assume that if a country relies heavily on export earnings from export commodities, it is exposed to international price volatility. The focus should thus be geared toward identifying who is exposed and who is mostly affected within the sector, as well as those stakeholders' capacity to manage volatility.

For domestically traded commodities, price volatility is usually intimately related to supply conditions. Price volatility is not necessarily autonomous, but the effect or symptom of realized production risks. Analyzing time series data on production and correlating price spikes with corresponding realized production risks is a practical way to confirm this assumption. Managing price risk of this nature is handled by public policy, a topic addressed in chapter 8.

The methodology for quantifying losses associated with price volatility could potentially mirror that used for quantifying production losses. In the former case, it applies to losses to producers when price drops below a given threshold. Though it can be interesting to quantify the magnitude of the price effect, the results should be interpreted carefully as (i) price volatility, whether a spike or drop, can differentially affect different stakeholders (farmers, supply chain actors, consumers, government) and financial losses are difficult to quantify because each episode of volatility is associated with some stakeholders losing and others gaining; (ii) complexities arise in isolating price movements from supply responses; and (iii) absorption of price shocks is strongly linked to market structure (that is, storage facilities, commercialization, players). Because of these complex factors, ASRAs generally rely on qualitative measures to evaluate price volatility.

Similarly, enabling environment risks by their nature do not lend themselves to empirical observation and direct

attribution. Qualitative measures are thus usually deployed to compare and contrast the effects of enabling environment risks with those of other agricultural risks.

LIMITATIONS

Quantifying losses is often difficult because of the scarcity of time series data on the occurrence of events and the associated losses. Assessment teams must rely on proxies or qualitative rather than quantitative measures to assess impacts and compare risks. For instance, in countries with a single crop that accounts for a great portion of total exports and GDP (for example, soybeans in Paraguay or cocoa in Ghana), the reduction in exported volume may be a good proxy for roughly estimating losses associated with events such as droughts or floods.

Whereas the methods and examples provided above cover production risks (drought, flood, pests and diseases, and so on), it is more difficult to quantify losses related to market and enabling environment risks. Income losses derived from price drops are very difficult to isolate from variations in supplied volumes. However, it is possible to analyze price volatility and transmission and then estimate the domestic supply chain's exposure to external shocks and the vulnerability of specific stakeholders (as discussed in the following chapters).

Finally, although many production, market, and enabling environment risk shocks have longer-term consequences and losses, for simplicity's sake, it is helpful to restrict the calculation only to the immediate direct losses. Identifying the net multiplier effects in the economy requires general equilibrium models that go beyond the scope of the ASRA.

By the time the desk study is complete, the team should have produced (i) a time line of major shock events that have caused volatility in the country's agricultural GDP; (ii) a long list of past risk events with a relatively good approximation of their frequency; (iii) a quantification of losses for each commodity because of those risks in terms of yield losses (volume) and value losses (monetary value); (iv) an assessment of the importance of price volatility of export commodities in terms of the magnitude of shock to the sector; and (v) an assessment of major current interventions by the public and private sectors addressing risk. The findings of the deskwork serve as the basis for formulating preliminary hypotheses regarding risk prioritization and the potential solutions to identified risks.

CHAPTER SIX
STEP 3: FIELDWORK

For illustrative purposes, one can imagine deskwork as a "top-down" approach, which means that the starting points are the sector statistics, programs, and assessment of value chains risks and commodities. The fieldwork, by contrast, can be considered the "bottom-up" side of the exercise, where the team seeks to have direct one-to-one discussions about risks with key stakeholders of major agricultural supply chains.

PURPOSE

The purpose of fieldwork is not just to corroborate the findings of the desk assessment, but to help the team identify the story line. The team seeks to (i) corroborate the time line of events; (ii) test the causality of risks identified; (iii) test whether the losses can be validated against what happened in reality; and (iv) assess stakeholders' capacity to manage risks. Box 6.1 shows an example of the line of enquiry that needs to be discussed by team members as part of the background research and prior to arriving in country for the ASRA fieldwork.

FIELDWORK ACTIVITIES

Fieldwork consists of a limited number of activities, but these require remaining in the field for at least two weeks to conduct interviews with key stakeholders of main supply chains. Organizing the timing and logistics of the visit is particularly important when the assessment is done in a large country with difficult access to remote areas and limited overnight accommodations. It is advised to plan the trip logistics well in advance, including details of appointments, transportation, and interviews. Having a consultant with local knowledge who can assist with making arrangements prior to the arrival of the risk assessment team has proven to be an indispensable element.

The main activities typically covered during the fieldwork include the following:

(i) *Data mining*. This is a valuable opportunity to fill gaps in the information needed. Some pieces of information exist only in hard copy and only by visiting institutions can the team access them. For example, commodity boards' annual reports have valuable information about supply chain dynamics reported on an annual basis, including causes for drops in volume and logistics and market issues.

BOX 6.1. PRODUCTION RISK: A BOTTOM-UP APPROACH TO FIELDWORK

What is the story line? Line of enquiry:

- Identify the causes of losses and their attribution (single or multiple causes).
- Assess how losses affected various members of the supply chain.
- Find out how shock was absorbed.
- Establish how different stakeholders managed risks.
- Determine whether losses were evenly distributed by area or by farmer groups.
- Identify differences by sex, age, or size of producers, processors, and so on.
- Corroborate the frequency of those events.
- Establish the persistence of the impact of events (short term or medium term).
- Get a sense of long-term threats to supply chain.
- Determine whether any stakeholders went out of business.
- Understand how small, medium, large farms managed in terms of mitigation, transfer, and coping mechanisms.
- Obtain evidence from stakeholders: reports, publications, evaluations, and so on (about losses and frequency of events).
- Test whether magnitude of losses estimated from the top-down approach are correct.
- Assess capacity to manage risks by existing institutions managing risks (formal and informal).
- Analyze government's current strategies to respond to shocks.
- Elicit stakeholders' perceptions of risk priorities.
- Identify stakeholders' suggested solutions.

(ii) *Interviews*. The team interviews at least one representative of each level of value chain actor for each supply chain under assessment. This means a high volume of interviews, because the ASRA will cover farmers, processors, input suppliers, government agencies, financial intermediaries, service providers, traders, and exporters. Some value chains have a regional concentration and it is possible to meet most stakeholders by travelling to the region. Most government agency representatives can be met in the national or provincial capital cities.

(iii) *Focus groups and gender analysis.* Group discussions are particularly useful for addressing large, homogenous groups (that is, small farmers producing cotton). Focus groups facilitate identification of the group's capacity to manage risks and discover how they cope with risk as individuals and as a community. An early gender analysis by supply chain will show where it will be more critical to interview women versus men. Risks may have differential impacts on men and women, depending on their level of participation in certain supply chains. Similarly, gendered differences in access to resources and markets may influence the strategies men and women use to manage risks. Appendix D describes the methodology for conducting focus group interviews with farmers.

(iv) *Validation workshop*. At the end of the fieldwork, the team holds a workshop with key stakeholder representatives to discuss the findings and facilitates a group exercise to prioritize risk management solutions. The group exercise consists of filtering a long list of potential solutions to the identified risks into a prioritized short list to reduce volatility and therefore losses in the agricultural sector.

THE ASRA TEAM

Based on the World Bank's experience conducting various ASRAs, a team of between three and five members can easily conduct an ASRA. The actual number of team members depends on the size of the country and the transport facilities to cover interviews with relevant supply chains actors at various levels. Team members should preferably be seasoned agricultural specialists with broad agricultural sector experience (agricultural sector review specialist, agricultural supply chain specialist, and so on) rather than experts or specialists in narrow fields (animal health, integrated pest management, and so on) as an unbiased view is critical for risk prioritization and identification of solutions. Appendix G provides an example of terms of reference for risk assessment experts. Experts in narrow fields will be needed at the solutions assessment phase to assist the government in targeting the most appropriate risk solutions.

It is practical to prepare a package of information with some guidelines for the team prior to its engagement in fieldwork. A simple PowerPoint presentation discussed in a videoconference or over Skype can clarify the scope of the field mission and the expected deliverables from each team

member. Appendix F contains an example of guidelines discussed with team members prior to a field assessment.

Prior to starting the fieldwork, the team leader should assign responsibilities for specific commodities and regions to each team member based on spatial considerations. A team of four specialists can plan four different routes to meet the relevant stakeholders related to a commodity. Supply chains are typically located in spatial clusters and team members should be able to cover the interviews by following a well-planed route. Other commodities, such as many food crops (maize, cassava), are virtually everywhere. Depending on country circumstances, the team will agree on how to share responsibilities to cover all commodities and their stakeholders.

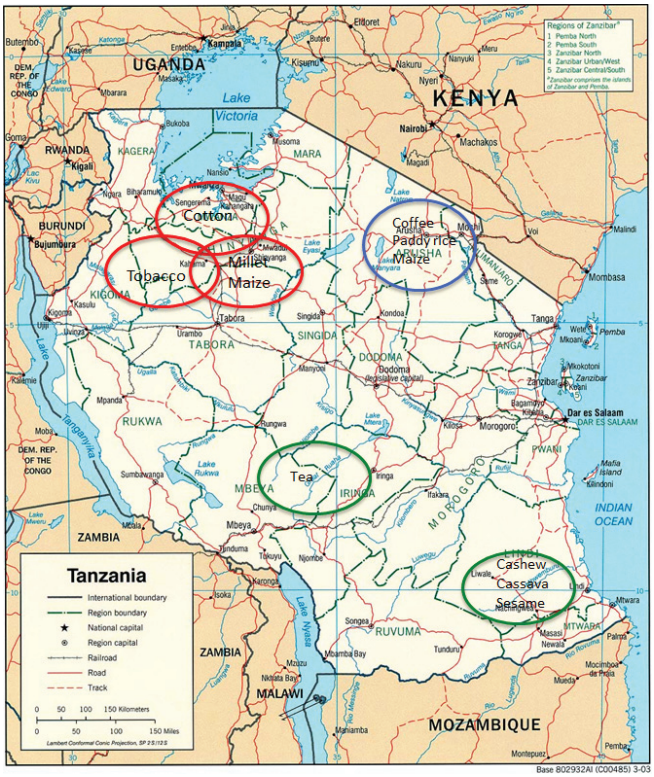
For instance, analyzing risk to livestock activities can take three dimensions: (i) farmers' focus groups can be used to evaluate systems in which livestock (ruminants) are permanently a part of a rural household's production system and food security; (ii) for more extensive cattle production systems, particularly common in Sub-Saharan Africa, the team will need to secure appointments with groups of pastoralists potentially gathering at cattle markets around towns; and (iii) for more intensive cattle production systems where participants are active in some type of related supply chain (milk, cheese, industrial processing, and so on), the team will need to interview stakeholders individually, as with any other commodity supply chain.

The simple map in figure 6.1 shows the responsibilities for three subteams that conducted interviews for key agricultural crops in Tanzania. Each subteam covered a particular area with specific responsibilities to interview supply chain participants for specific commodities. Each team member planned a well-prepared itinerary route and made appointments for interviews in advance.

FIELDWORK DELIVERABLES

The field mission is the culmination of the ASRA. Each team member has only a partial view of the risk process because he or she has focused on analyzing specific commodities in selected territories. The next step is thus to integrate the findings through a process of aggregation to achieve a sector perspective. It is imperative that team members allow enough time after coming back from the field to assess their findings, organize them into standardized formats, and discuss them as a group. The aggregated sector risk perspective is shaped in these team deliberations. At the end of the field mission, the team presents its findings at a stakeholder workshop to (i) obtain feedback on the risk prioritization and vulnerability exercise; and (ii) engage stakeholders in prioritizing risk solutions (the details of this process are addressed in chapter 7). Box 6.2 shows the expected outputs of the field assessment.

FIGURE 6.1. FIELD TEAM RESPONSIBILITIES FOR AN ASRA IN TANZANIA



BOX 6.2. OUTPUTS OF THE ASRA FIELDWORK

- Risk identification matrix
- Quantification of risks
- Detailed analysis of individual risks, interrelated risks, and associated commodities and regions
- Relative impacts of risk
- Vulnerability ranking and assessment
- Long list of potential solutions
- Stakeholder list of filter mechanisms to produce a short list of solutions for a solutions assessment

CHAPTER SEVEN
STEP 4: RISK PRIORITIZATION

As a result of the background research and fieldwork, the team has already undertaken a prioritization exercise for each commodity that shows the ranking of each identified risk in terms of (i) the frequency in which risk events occur; (ii) the severity of the impact (intensity); and (iii) stakeholders' capacity to manage the identified risk events.

VARIABLES FOR RISK PRIORITIZATION

Categorizing risk in terms of frequency and intensity can be confusing without the use of consistent definitions or guidelines shared with the team. Again, no magic recipes or standardized procedures exist for establishing these categories, but prior discussion with team members helps to harmonize an approach. As a general rule of thumb based on experience, table 7.1 provides some guidance on how to categorize risks based on probability of event (frequency) and severity of impact (intensity or capacity to produce losses).

Apart from the frequency of events and the severity of impact, a third variable will ultimately determine the ranking of risk: stakeholders' capacity to manage the identified risk (see figure 7.1). For example, if the team finds that stakeholders already have high capacity to manage a particular identified risk, this particular risk will not be ranked among the most important. As mentioned earlier, the capacity to manage each identified risk is assessed mainly during stakeholder interviews, but also by using secondary information collected during the background work prior to the field visit. Chapter 9 addresses the concept of vulnerability and capacity to manage risk in greater depth.

PRIORITIZATION MATRIX

The use of a prioritization matrix helps enormously in categorizing risks in terms of frequency and intensity. If team members use this table in a standardized manner, results can be shared and discussed among stakeholders and team members in an easy-to-understand fashion, and corrections can be made accordingly and quickly. (Recall

TABLE 7.1. RISK CLASSIFICATION EXAMPLE

Probability of Event	Indicator	Severity of Impact	Indicator
Highly probable	Within 2-year interval	Catastrophic	More than 50% losses
Probable	Within 5-year interval	Critical	Between 30% and 50%
Occasional	Within 10-year interval	Considerable	Between 15% and 30%
Remote	Within 20-year interval	Moderate	Between 5% and 15%
Improbable	Within 40-year interval	Negligible	Less than 5%

FIGURE 7.1. THREE KEY VARIABLES FOR RISK PRIORITIZATION

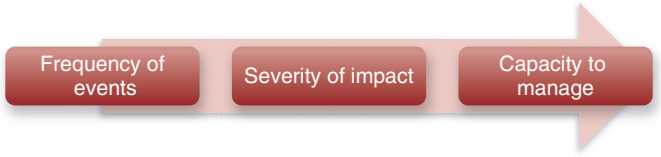


table 5.6, which showed an example of a risk prioritization matrix for cotton in Mozambique.)

FROM COMMODITY RISK TO SECTOR RISK

Translating individual commodity risk prioritization into an aggregated sector risk prioritization is a collective exercise, because prior to this stage team members have assessed risks for individual commodities, but a broader sector perspective has not yet been established. After completing an individual prioritization matrix for each commodity, the team proceeds to reclassify those risks in terms of frequency, severity of impact, and capacity to manage from a sector perspective. This involves choosing only the risks located in the upper right-hand corner of each commodity's risk prioritization matrix and relocating them in a single aggregate risk prioritization matrix.

This process involves not just familiarization with the risk assessment done for each commodity, but a change in perspective from the commodity supply chain to a holistic agricultural sector perspective. For instance, the risk of "erratic rainfall" could have a potentially severe impact for stakeholders participating in the bean supply chain, but might not have such a high impact on the sector as a whole. Figure 7.2 illustrates the process of risk aggregation and reprioritization.

FIGURE 7.2. REPRIORITIZATION OF RISKS FROM COMMODITY TO SECTOR LEVEL

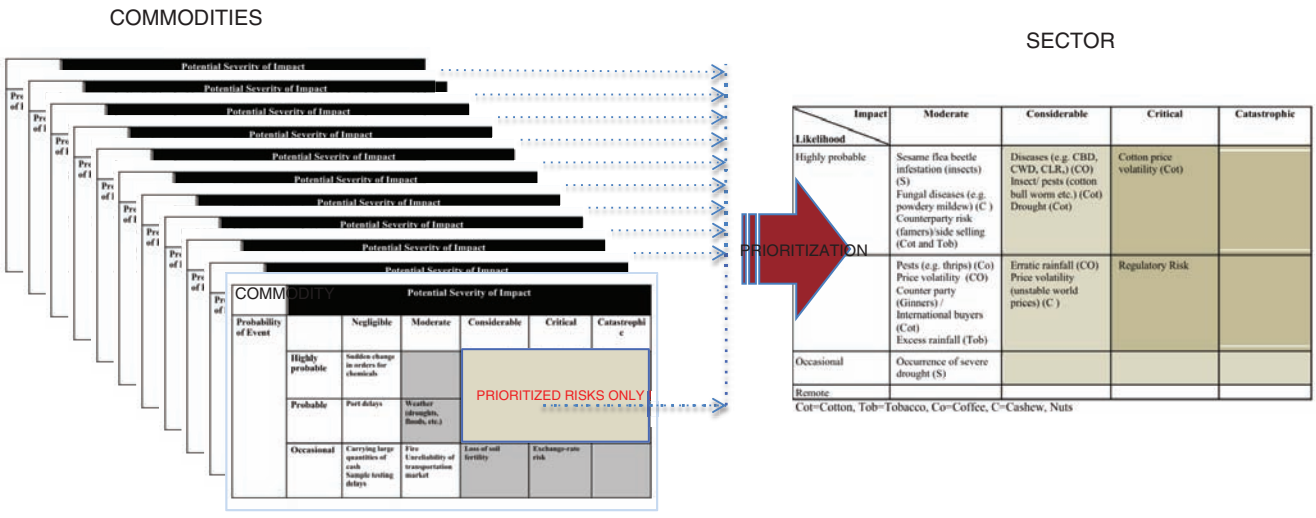


TABLE 7.2. RISK PRIORITIZATION MATRIX FOR CASH AND EXPORT CROPS IN TANZANIA

Likelihood \ Impact	Moderate	Considerable	Critical	Catastrophic
Highly probable	Sesame flea beetle infestation (insects) (S). Fungal diseases (for example, powdery mildew) (C). Counterparty risk (famers) and side-selling (Cot and Tob).	Diseases (for example, CBD, CWD, CLR) (CO). Insect/pests (cotton bull worm, and so on) (Cot). Drought (Cot).	Cotton price volatility (Cot).	
Probable	Pests (for example, thrips) (Co). Price volatility (CO). Counter party (Ginners) and international buyers (Cot). Excess rainfall (Tob) .	Erratic rainfall (CO). Price volatility (unstable world prices) (C).	Regulatory risk.	
Occasional	Occurrence of severe drought (S).			

Source: World Bank 2013b.

Note: (S) = Sesame, (C) = Cashew nuts, (Cot) = Cotton, (Tob) = Tobacco, (CO) = Coffee, (CBD) = Coffee berry disease, (CWD) = Coffee wilt disease, (CLR) = Coffee leaf rust.

Tables 7.2 and 7.3 show the prioritization matrices completed for Tanzania (cash and export crops) and Malawi (all crops), respectively. The dark areas (upper right-hand corner) represent the most significant risks because of their potential to cause the greatest losses and the high frequency of their occurrence. The lighter dark boxes represent the second level of importance, whereas the clear boxes represent identified risks that either have low potential to cause damages or their frequency of occurrence is low, or both.

Note that existing losses can be a useful proxy for capacity to manage risks. On the one hand, if existing losses are low (low impact) despite frequent occurrence of risk, then the capacity to manage risk is supposedly high and vulnerability low. On the other hand, if existing losses are

TABLE 7.3. RISK PRIORITIZATION MATRIX FOR ALL CROPS IN MALAWI

Likelihood \ Impact	Moderate	Considerable	Critical	Catastrophic
Highly probable (1 in 3 years)	Hailstorms. Untimely distribution of inputs (cotton). Theft (sugarcane, tea, food crops). Damage from wild animals. Power outage (sugarcane, tea). Exchange rate (risk mainly for smallholders).	Pests and diseases (food and export crops). Price volatility and uncertainty (tobacco, tea, cotton, sugar). Unpredictable regulatory environment for traders.	Drought events, including – False start of, or shorter than normal, rainy season; – Extended dry spells; – Higher-than-average temperatures.	
Probable (1 in 5 years)	Side-selling (cotton). Excess of rainfall increasing harvesting and processing cost (tea, sugar). Floods (food crops).		Unpredictable maize market interventions causing price volatilities in the maize market (recent).	
Occasional (1 in 10 years)		Export shipments rejected (tobacco).		

Source: World Bank 2014b.

substantial (high impact), even for low frequency events, then vulnerability is assumed to be high.

The final outcome of the aggregated risk prioritization process is a list of key priority risks that explain the causes of agricultural GDP volatility and need to be addressed to reduce losses in the agricultural sector. The highest priority risks are those located in the boxes in the upper right corner of the aggregated risk prioritization matrix. The next step is to identify solutions for those prioritized risks.

CHAPTER EIGHT
STEP 5: PRIORITIZATION OF RISK MANAGEMENT SOLUTIONS

In this step the team and stakeholders identify a short list of solutions that they agree will make up the optimal strategy for managing risk in the agricultural sector. As defined in chapter 2, risk management strategies (solutions) fall into three categories: risk mitigation, risk transfer, and risk coping. The long list of solutions, categorized into these three types of strategies, provides the starting point for this step (figure 8.1).

LONG LIST OF SOLUTIONS

If the line of enquiry was followed during the field visit, the team has identified a list of potential solutions that are meant to contribute to the management of identified risk. Once the sector risk prioritization matrix is complete (recall table 7.3), the team analyzes the long list of potential solutions for the prioritized risks in the matrix and divides those potential solutions into the three categories of risk strategies. The initial long list is often not exhaustive and might not provide concrete next steps, but it does provide a menu of options from which to choose. Table 8.1 shows the long list prepared for an ASRA in Tanzania.

In conducting Paraguay's ASRA, the team came up with more detailed long list of solutions organized by subsectors, because a huge gap exists between family agriculture and commercial agriculture, such that Paraguay is considered to have a dual agricultural system. The team adapted the methodology to devote special attention to family agriculture, the subsector with the vast majority of poor small producers, for whom the government identified separate policies, including separate risk management strategies.

FIGURE 8.1. RISK SOLUTIONS PRIORITIZATION PROCESS

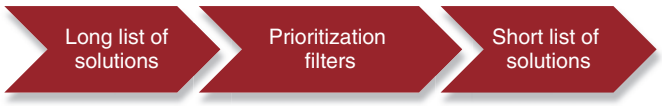


TABLE 8.1. LONG LIST OF SOLUTIONS FROM TANZANIA'S ASRA

Risk	Mitigation	Transfer	Coping
Drought	Drought-tolerant varieties Water harvesting and irrigation Improving early warning systems Reforestation and afforestation Land and water management Agronomic practices for on-farm drought management Crop diversification	Insurance	Food reserves Food imports Social safety net programs Risk financing
Price volatility	Managing food stocks Reform maize trade policy Increased domestic processing Improved quality to access stable niche markets Improved market information systems and transparency Contract farming Improved storage facilities Infrastructure development Foster competition in markets	Hedging	Imports Trade policies Social safety net programs
Diseases	Scale-up disease-tolerant varieties On-farm agronomic practices Early warning systems Integrated pest management Quarantines measures Improved phytosanitary laboratory systems Improved extension services		Quarantine measures On-farm agronomic practices Integrated pest management (IPM)
Pests	On-farm agronomic practices Early warning systems Integrated pest management Quarantines measures Improved phytosanitary laboratory systems Improved extension services		Quarantine measures On-farm agronomic practices Integrated pest management
Regulatory risks	Improved efficacy of commodity councils Promote proactive rather than reactive policies Develop long-term commodities policies Improved transparency in policy decision making		

Source: World Bank 2013b.

Thus, Paraguay's ASRA presented a set of solutions for each main subsector (that is, commercial agriculture, family agriculture, and livestock). Although the ASRA team should generally follow the standardized risk assessment approach presented herein, it can be adapted to each country's particular characteristics and requirements.

RISK SOLUTIONS FILTERS

The screening process for identifying a short list of prioritized solutions through agreed filters can be done by the team alone or in a workshop involving stakeholders. It is preferable to involve stakeholders, not only to gain their support for the process and outcomes but also to take advantage of participants' knowledge.

Using decision filters in a participatory environment to evaluate and prioritize the risk management proposals helps the team make rational choices in a context of qualitative and subjective assessments. Tables 8.2 and 8.3 show decision filters that have been used while prioritizing solutions for some countries. (See appendix K for a

TABLE 8.2. DECISION FILTERS FOR PRIORITIZATION OF RISK SOLUTIONS

Applicability to current agricultural policy and programming or business objectives	Public sector: Is the proposed solution in line with current and existing agricultural policy and programs and priorities, and so on? Private sector: Is the proposed solution in line with current and existing business objectives?
Feasibility of implementation	Is the proposed solution "easy" to implement in the short to medium term?
Affordability of implementation	Is the proposed solution affordable to put into action and implement?
Scalability of implementation	Is the proposed solution easy to scale-up and make available to an increased number of beneficiaries?
Long-term sustainability	Is the proposed solution sustainable in the long term?

decision filter used in Niger, Mozambique, and Ghana.) The filters in these tables are shown for illustrative purposes only and are not exhaustive. The team should choose filters depending on the circumstances or introduce other filters that stakeholders find more appropriate.

SHORT LIST OF SOLUTIONS

The outcome of the long-list prioritization exercise is a short list of solutions that will be further assessed by experts in those topics to ultimately inform the action plan that will be part of the government's policies and strategies. Box 8.1 shows the short list of solutions developed from the solutions prioritization process carried out in Tanzania's ASRA. The next step is to recruit experts for each solution to develop a detailed action plan for the short to medium term that will be incorporated into government strategies and investments or will inform donors' formulation of development projects.

Finally, the team combines the analysis from all steps and produces a report. Appendix J provides the table of contents from an ASRA conducted in Kenya as an example.

TABLE 8.3. ILLUSTRATION OF DECISION FILTERS FOR PRIORITIZATION OF RISK SOLUTIONS

	Applicability (1-5)	**Feasibility (1-5)**	**Affordability (1-5)**	**Scalability (1-5)**	**Sustainability (1-5)**	**TOTAL SCORE (Maximum 25)**
Solution 1						
Solution ...						
Solution ...						
Solution ...						
Solution ...						
Solution ...						
Solution n						

BOX 8.1. FINAL PRIORITIZATION OF RISK SOLUTIONS IN TANZANIA'S ASRA

The short-list areas for deepening the risk solutions are, in brief, the following:

Highly drought- (pest-) tolerant seeds. There are weaknesses in the supply chains for delivering drought-tolerant seeds, disease-resistant seeds, and planting material and inefficiencies in seed markets that need to be addressed. In principle, it involves food crops such as maize and rice and export crops such as cotton and coffee. This would imply the need to effectively intervene in the short to medium term to make the seeds supply chains work more effectively along the range of stakeholders involved, from breeders to seed producers and to farmers, as well as to clearly define the roles of the public and private sectors in developing this market.

Good agricultural practices to address drought and pests and diseases. Widespread, improved agricultural risk mitigation practices can have a very significant impact in reducing risks derived from irregular or insufficient rainfall as well as from diseases and pests. This implies a need to strengthen the existing disconnected technology systems through effective coordination between research, extension, and training, including the effectiveness of information and communication outreach to farmers.

Balanced maize trade policy. The export and import policy has to be predictable and stable and at the same time allow for a transparent market. Policy predictability, market transparency, and fewer nontrade barriers would result in greater incentives for farmers to invest in technology that increases productivity and reduces production volatility in a sustainable way. This would create a better balance between the short-term food security goal and the long-term productivity growth aim.

Risk management strategies for key export crops with high price volatility (in principle, coffee and cotton). The way these supply chains are organized bears upon which stakeholder is exposed to price risk. By analyzing the physical and financial flows on current transaction arrangements for exports, a set of options on how to reduce exposure to risk can be explored. This would imply a need to deepen institutional arrangements and clarify current roles of the public and private sectors.

Whereas there are already interventions of various temporal and spatial natures in Tanzania on these short-list solutions, the key issue is to focus on identifying the gaps of current interventions and designing a package of solutions that address the main underlying causes of risk. A risk management solutions assessment will be planned as a follow-up to current risk identification. The coming assessment will have the task of linking the risk management interventions to the Agricultural Sector Development Program by developing concrete proposals (policy solutions, investment solutions, and TA solutions) for better managing the risks identified in the short list. In particular, the mission will identify the risk management gaps in existing interventions; and, propose a set of interventions for incorporating them into the medium-term ASDP, which could be financed by the public sector and donors.

Source: World Bank 2013b.

CHAPTER NINE
UNDERSTANDING VULNERABILITY TO RISK

As vulnerability is used to prioritize risks and to design and target risk management interventions, assessing vulnerability is an important part of the ASRA. The concept of vulnerability can be applied at different levels (that is, farmer, household, community) and over various areas (that is, farm, district, province, region), which can lead to confusion. For the purpose of these guidelines, vulnerability is defined as **the capacity of stakeholders to manage agricultural risk and recover from external shocks.** The capacity to manage risk is assessed during the background work prior to the field visit and during the field visit through stakeholder interviews.

Using the methodology outlined in previous chapters provides the team with a good overview of the risks with the biggest impacts on the agricultural sector and the overall economy. Depending on the size of the sector, the magnitude of the impacts, and the variability of their incidence across regions, however, the assessment of aggregate losses can sometimes mask the distribution and scope of impacts on specific groups of stakeholders. The vulnerability assessment is therefore an important tool for more fully analyzing the distributional impacts of risks and developing more efficient risk management mechanisms.

STAKEHOLDERS' RISK PROFILE ASSESSMENT

Understanding risk profiles entails analyzing the roles of different stakeholders across the agricultural sector, including the three principal groups (producers, commercial sector stakeholders, and the public sector) but also subgroups, and understanding their risk management capacities. For example:

- Who is involved in the value chain analyzed (different stakeholders, segments of population, gender, and so on)?
- How does the identified risk affect different stakeholders (for example, farmers vs. processors vs. traders and exporters; consumers vs. producers; regional

differences; landowners vs. farm workers; men vs. women)?

- What are the current management practices? How do different stakeholders manage risks and are these instruments effective? Why or why not? What are the limitations of current practices? Why are some risks not being managed?
- What is the management capacity of stakeholders and supporting institutions to manage a given risk and how effective are the practices and strategies employed by various stakeholders to mitigate, cope, or share the risk with others?

Vulnerability variation between households can be seen as the function of three factors: sensitivity, adaptive capacity, and exposure. **Sensitivity** is the degree of impact of the initial shock. Sensitivity can be thought of as the elasticity of household welfare (that is, consumption levels) in response to a shock. **Adaptive capacity** is the ability of the household to access ex post coping strategies that help it return to preshock welfare levels. **Exposure** is the probability of a given shock materializing and affecting the household's assets.

Whenever possible, the analysis of these three aspects should be done at the local level using available welfare indicators. Except for poor smallholder farmers, most stakeholders along the commodity supply chain can discuss their vulnerability to risks during interviews. For poor smallholder farmers, who are often the most vulnerable, focus group discussions are an important technique to discuss their risks, mitigation strategies, and coping mechanisms after a disaster.

A vulnerability matrix can map stakeholders and the way they manage different agricultural risks. A vulnerability table can provide an overview of all stakeholders, stakeholders along individual supply chains, or stakeholders associated with a particular commodity. For example, in an ASRA for Mongolia, the vulnerability matrix lists the impacts of risk and risk management instruments for herders with different herd sizes. Table 9.1 shows the vulnerability matrix used to map stakeholders throughout the agricultural sector in the Brazilian state of Paraiba.

INCORPORATING THE VULNERABILITY ASSESSMENT IN THE ASRA

The vulnerability assessment's findings can be used in the ASRA to (i) prioritize risks; and (ii) propose risk management instruments. Figure 9.1 maps different perils in Ghana's cocoa sector according to their impacts and stakeholders' capacity to manage them. The figure clearly shows that black pod, smuggling, and virus diseases (CSSVD) are the risks with the highest impacts and the lowest stakeholder capacity to manage.

TARGETING WOMEN

In some cases, certain risks may have relatively low impacts on the sector or a geographic region, but relatively high impacts on a particularly vulnerable group of the population. Targeting this group with risk management mechanisms may be a priority. For example, losses in Region A may outweigh those of Region B in terms of monetary value, but if the majority of the country's food insecure lives in Region B and is dependent on crops prone to risk-related production losses, policy makers may want to prioritize risk management interventions in Region B, particularly targeting the food insecure. Similarly, finding out that a particularly vulnerable part of the supply chain is predominantly run by women may, because of the country-specific cultural context, influence the design of the relevant risk management policy. Box 9.1 discusses Brazil's ASRA, in which the vulnerability assessment influenced the risk management policy priorities.

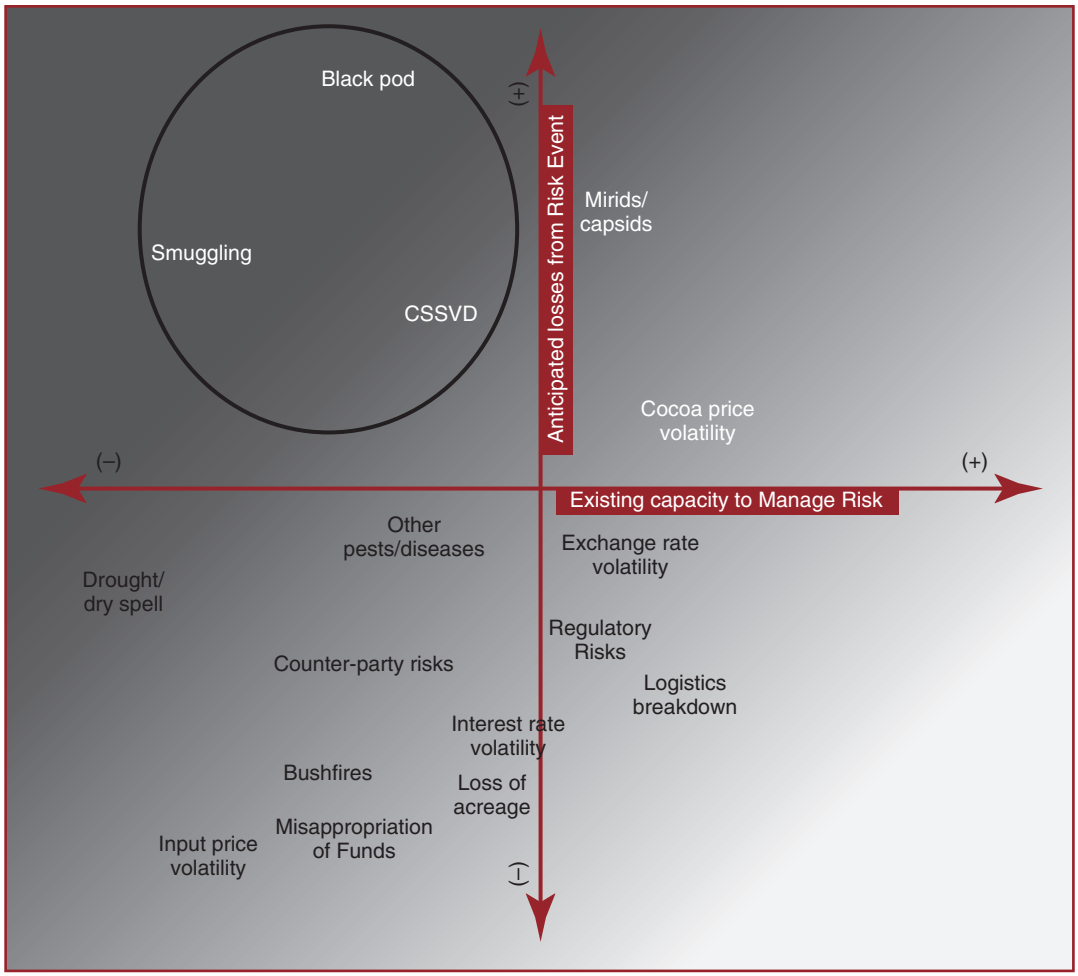
In countries where the initial diagnosis shows that women in certain communities or regions are in a vulnerable position, analysis needs to be deepened with the auxiliary of secondary research or information that can identify vulnerable households more precisely and target interventions designed to assist those households—even when at sector level those impacts appear marginal. Even small shocks to the livelihood of vulnerable groups can have a catastrophic impact for large groups of households, impacts that are usually masked at the broader cumulative sector level.

TABLE 9.1. VULNERABILITY MATRIX FOR AN ASRA IN PARAIBA, BRAZIL

Stakeholders	Most Important Risks	Significance of Risk	Current Capacity to Manage Risk
All farmers	Unexpected irregular precipitation and severe drought events.	Crop and animal losses. Reduced quality of products: fruits, sugarcane. Family farmers: greater exposure to food insecurity.	Drought-tolerant varieties and variable crop cycles.
Smallholders	Insect pests (caterpillars), diseases (viruses, rots), nematodes, mealy bug. Animal diseases: exotic diseases (FMD, BSE, HPAI), prevalent diseases.	Pests represent an important risk to production if not properly controlled. Elimination of infected animals and losses of production of meat, milk, honey. Restriction to the marketing of products. Public health risk from zoonosis.	Only a minority of the growers adopts mitigation practices, such as pest control or resistant varieties. Deficiencies in the provision of TA services and insufficient supply chain coordination prevent family agriculture farmers to access appropriate technologies to control pests and diseases. FMD vaccination.
Livestock producers	Drought. Animal diseases: exotic diseases (FMD, BSE, HPAI); prevalent diseases of economical and public health importance (brucellosis, tuberculosis, classical swine fever).	Loss of animals, decreased production. Quarantine and restricted movement and trade of animals. Public health risk for the transmission to humans. Food safety compromise caused by contamination of meat and milk. Financial loses. Reduced exports.	Some financial aid by the government—government programs such as *Garantia Safra* e *Bolsa Estiagem*. FMD vaccination. Federal and state control, prevention, eradication, and contingency programs in operation.
Sugarcane processing plants	Drought.	Less raw material available to process. During severe droughts, sugar processors experience increase in production cost because plants operate at lower capacity.	Plants accrue financial losses.
Consumers	Foodborne diseases.	Important food safety problems.	Federal and state meat and milk control and inspection programs. Planned: State Food Security and Safety System.
Government (national)	Drought. Animal diseases: exotic and prevalent diseases. Food safety.	Social instability. Budget implications.	Budget provisions for risk coping programs (drought support programs, contention and emergency funds, compensation funds).

Source: World Bank 2014a.
Note: BSE = Bovine spongiform encephalopathy; HPAI = Highly pathogenic avian influenza.

FIGURE 9.1. MAPPING PERILS ACCORDING TO VULNERABILITY IN GHANA'S COCOA SECTOR



Source: World Bank 2011.

BOX 9.1. TAKING INTO ACCOUNT THE SOCIAL DIMENSIONS OF AGRICULTURAL RISK IN BRAZIL

In Paraiba, Brazil, sugarcane and fruit (especially grapefruit) are the greatest determinants of agricultural output. Losses of these two commodities could be considered a priority in the risk management strategy, as indicated in the graph below.

The conclusion would be rather different if instead of prioritizing risk in terms of the commodities' economic weight, the ASRA primarily accounted for the social dimensions of agricultural risk. In Paraiba in 2006, family farmers numbered 148,047 out of a total 167,272 farmers. Prioritizing risk according to the number of people affected led to different results: severe rainfall (estimated to occur 1 in 10 years), irregular rainfall (1 in 5), and pests and diseases (with lower expected impact than the other risks) were the main risks in Paraiba under these criteria for prioritization. This scenario is one of much higher impact but of lower probability. The solutions scenario involved strong actions directed toward introducing innovative technology and improving agricultural practices.

FIGURE B9.1.1. RISK INCIDENCE BASED ON LIKELIHOOD, EXPECTED IMPACT, AND RELATIVE ECONOMIC RELEVANCE OF SUBSECTORS

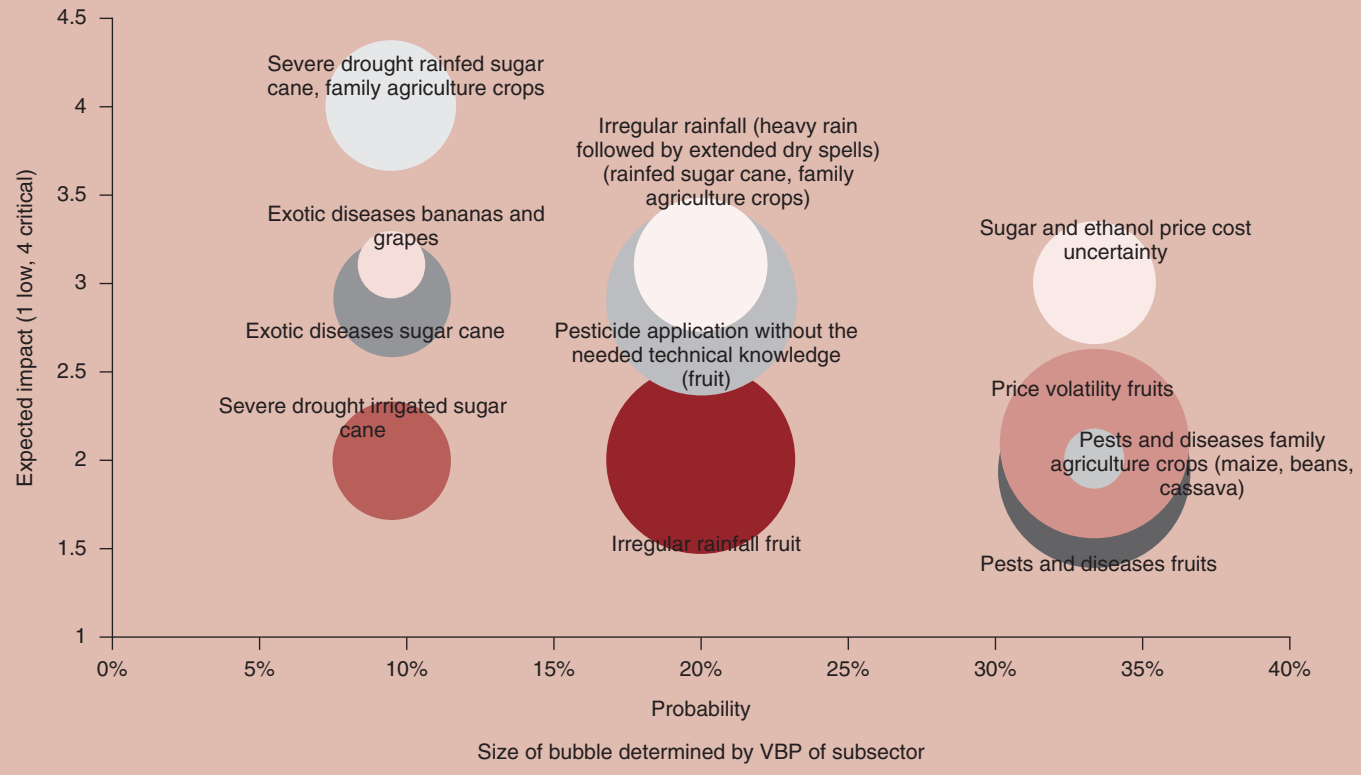
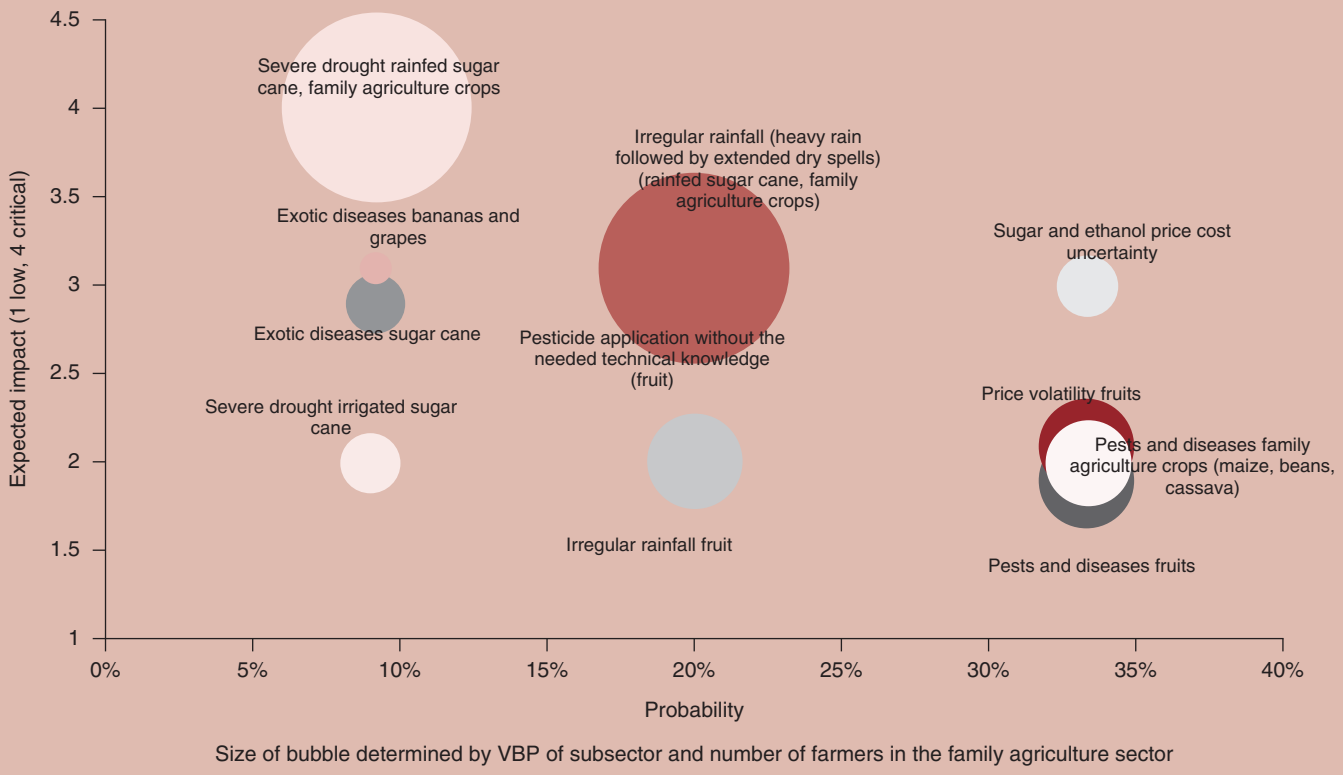


FIGURE B9.1.2. RISK INCIDENCE BASED ON LIKELIHOOD, EXPECTED IMPACT, AND RELATIVE ECONOMIC RELEVANCE OF SUBSECTORS WEIGHTED BY THE NUMBER OF FAMILIES IN THE FAMILY AGRICULTURE SECTOR



Size of bubble determined by VBP of subsector and number of farmers in the family agriculture sector

Source: World Bank 2014a.

CHAPTER TEN
TOWARD A RISK MANAGEMENT STRATEGY

Whereas the ASRA steps detailed in the preceding chapters can be standardized to some extent, the incorporation of risk solutions into government policies and plans is a highly country-specific process that cannot be standardized. Each country has its own decision-making process that takes place in a unique political economy. Chapter 10 discusses different approaches for how the risk solutions identified in the ASRA can be developed into action plans incorporated into stakeholders' strategies to reduce agricultural risks.

ACTIONS AND STAKEHOLDERS

Effective risk management typically requires a combination of measures, some designed to remove underlying constraints and others designed to address risk directly. Resource availability will often determine what is possible. Whatever the case, integrated risk management programs are more effective than stand-alone programs. Translating the risk management strategy (whether mitigation, transfer, or coping) into concrete action requires the use of several kinds of implementation instruments. These instruments fall into three categories: agricultural investments, TA, and policy support. Some examples of risk management measures are highlighted in table 10.1.

Risk management activities involve action by either individual or multiple stakeholders. Examples of activities that involve action by a single stakeholder include a farmer adopting agricultural practices to manage weather, pest, or disease risk or a trader using a back-to-back trading strategy or hedging to manage price risk. Other risk management strategies necessitate collaboration between two or more actors in the supply chain. These include sharing market information to manage price risk or establishing better contractual relationships and information sharing to manage counterparty risk.

The private sector can play an important role in managing the types of risk that can be handled through market tools such as insurance and futures markets. Futures contracts can be used to hedge price risk, for example. Besides private sector stakeholders, actions by public institutions, which potentially benefit many private actors, may be critical for successful risk management. These include strategies such as developing early warning

TABLE 10.1. EXAMPLES OF RISK MANAGEMENT MEASURES

Action	Example
Reduce the likelihood of event (mitigation)	Vaccination programs, mass spraying programs, good agricultural practices, physical infrastructure (spillway, reservoir, dams, and so on)
Lead to adaptation (mitigation)	Drought- and flood-resistant varieties, changing crop composition, agriculture diversification, and so on
Reduce the losses (mitigation)	Application of pesticides, insecticides, agricultural practices, management practices
Reduce the spread of risk (mitigation-coping)	Quarantine programs, early warning and information dissemination, management approaches
Compensate the actor (transfer-coping)	Agricultural insurance, buying futures and options for hedging, social safety net programs, and so on

systems, developing and disseminating information about effective risk management, investing in agricultural extension systems, conducting research and development on weather- and disease-resistant crop varieties, and investing in infrastructure. When governments assume a holistic approach and improve their ability to assess risks and their interlinkages, they can more effectively help farmers manage their risks by providing targeted information and training where they are most needed.

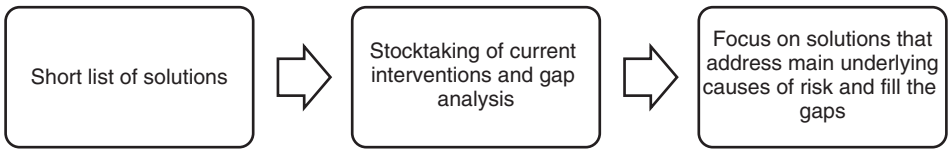
Risk management actions can be implemented at both the micro and macrolevel. Microlevel actions are undertaken by individual producers or a community, with the risk management decisions tailored to protect assets and improve resiliency. Macrolevel actions are implemented at a national level whereby ARM strategies are incorporated into sectoral growth and investment and policy decisions. To illustrate, mitigation strategies to minimize the effects of drought on crops may require producers to plant drought-resistant cultivars, whereas development of an early warning system is pursued at the government level. Both actions seek to address the same risk, but are more effective when implemented together.

KEY ELEMENTS OF THE RISK SOLUTIONS PROCESS

A standardized risk solutions assessment is not feasible because of the diversity of risks, approaches to manage them, supply chain contexts, and country contexts. Despite this diversity, some generic actions can be taken while the government engages in the process of developing a risk management strategy and action plan.

1. **Assistance of experts.** Different from the ASRA team that identified the short list of solutions, a "new" team led by experts specialized in each topic related to the short list of solutions can be formed.
2. **Discussion with stakeholders.** Extensive consultations and broader and more formal stakeholder discussions can be held in which the team shares the preliminary proposals with stakeholders, including universities and specialized nongovernmental organizations (NGOs).
3. **Evaluation of action options.** The ASRA often results in a "laundry list" of possible activities that could be undertaken to manage the identified risks. During the risk solutions assessment, an exhaustive list of all possible actions to manage the priority list should be developed. This should be followed by detailed evaluation of the selected options and the current management practices and supporting programs and policies (in addition to the stocktaking of projects and programs carried out during the first phase). This exercise will help to consolidate the initial proposal and bring forth operational issues, trade-offs, possible overlaps, and technical complexities. Along with this, it is important to analyze underlying policy or institutional bottlenecks that could hamper the achievement of desired objectives and to suggest measures to overcome bottlenecks.
4. **Creation of a risk management strategy.** On the basis of this evaluation, the next step is to identify the strategic actions, objectives, and institutional implications. Rather than a stand-alone

FIGURE 10.1. SOLUTIONS ASSESSMENT STEPS



strategy, this should be an integral part of the broader sector development strategy.

5. **Development of an implementation plan.** A detailed implementation plan, with clear milestones, time lines, sequencing of activities, and outcomes, is required to operationalize the strategy. This implementation plan should have clear action items for the public and private sector and should be developed with broad consensus.
6. **Implementation.** The government will lead implementation of the plan, which will require a coordinated effort from all stakeholders. The process will involve generating and allocating resources, allocating responsibilities for implementation, monitoring regularly to track progress, and developing indicators to measure the sector's reduced vulnerability to risks.

RISK MANAGEMENT INTERVENTION AREAS

Based on the ASRA results, this step identifies and evaluates possible action options and then selects a strategy or combination of strategies to reduce the risks and their negative effects on income and welfare. Generally following the risk prioritization, the solutions assessment will follow three steps (figure 10.1).

STOCKTAKING AND GAP ANALYSIS

The gap analysis is based on a stocktaking of current projects and programs that, intentionally or not, address the risk management issues identified in the short list of solutions. The final result is a package of interventions designed to lower volatility, increase resilience in agriculture, and protect vulnerable stakeholders.

The stocktaking of projects and programs should incorporate all the information needed to diagnose current interventions related to the short list of solutions. Table 10.2 illustrates a useful way to summarize the findings.

Table 10.3 illustrates the gaps analysis done for Tanzania's ASRA to start narrowing specific solution areas that tackle the key risk issues. The table contains a number of projects and programs that were already addressing some of the risk factors identified. The table indicates their connection with the ASRA results and the potential gaps to be covered with specific risk management actions in addition to the existing ones.

The solutions should be assessed by a team of specialized experts to develop full proposals for the risk management actions that will make up the core of the risk management

TABLE 10.2. ILLUSTRATION OF PROJECT STOCKTAKING

Name of Project or Program	Time Frame (Start-Terminate) or Pipeline	Objective, Target Group and Area (Region, District, and so on)	Components and Key Activities (Indicate any Specific Risk Management Activity)	Executing Unit and Main Institutional Arrangements	Cost by Components (US$)	Financing (US$) (Government, Grant, Loan, Donors, and so on)	Comments

TABLE 10.3. GAP ANALYSIS CONDUCTED FOR TANZANIA'S ASRA

Risk and Grading	Solution	Current Projects or Programs	Statement on Risk-Solving Perspective	Gap?	Additional Activities Proposed
Drought—critical or considerable and probable or highly probable risk.	Irrigation systems, land and water management.	ASDP: A total of 353 irrigation schemes were upgraded, rehabilitated, or newly developed. TAFSIP: Irrigation development, sustainable water and land use management. Feed the Future Program: Increase area under irrigation by 15.5% through the development of 7 smallholder irrigation schemes in Morogoro and Zanzibar.	Prospective sector risk reduction impact is small because nonmassive type of investment.	Expansion of coverage to build up from current projects' experiences.	None.
	More extensive use of drought-resistant cultivars.	There are available drought-tolerant cultivars in Tanzania (for example, maize) and there is research under way (for example, coffee), but there is low adoption.	Reduction of yield variability and crop losses but learning required for optimal balance between risk reduction and high productivity.	Planting materials and research results are available, information and promotion are missing.	Specific program to be included in set of specific proposals.
Pests and diseases—critical or considerable and probable or highly probable risk.	Good agricultural practices to address drought and pest and diseases.	ASDP: Strengthening agricultural research and training. Feed the Future Program: Agricultural support services and capacity building including research and development and financial services.	Existing research results need to be disseminated to farmers. Specific knowledge is required to address pest and disease prevention and control.	To build up from the ASDP subprograms.	Redesign current programs and expand geographically to cover the entire country or new, more specific technology transfer program.
	Introduce disease-resistant cultivars and planting material.	No comprehensive program in place. There are available disease-resistant cultivars (coffee, and so on).	Reduction of yield variability and crop losses, depending on the crop.	Progress in coffee, for instance, but no program covering most crops.	Specific program to be included in set of specific proposals.
Price volatility—moderate to critical and probable and highly probable, mostly cotton, cashew nuts, and coffee.	Improved understanding of price risk management, market information, and hedging. Trade policies. Contract farming. Improved storage. Infrastructure development.	Agricultural Marketing Systems Development Program: (a) Agricultural marketing policy development; (b) small producers' empowerment by building their entrepreneurial and organizational capacity and improving their links to markets; (c) introducing a warehouse receipt system.	Project-related interventions can have good results in terms of targeted stakeholders but massive and sustainable achievements require nationwide policies and institutional buildup.	No hedging instruments and institutional framework available at the producer and primary cooperative levels.	Reforms needed to deal with price volatility and to deepen into institutional arrangements and current roles of public and private sector.

TABLE 10.3. *Continued*

Risk and Grading	Solution	Current Projects or Programs	Statement on Risk-Solving Perspective	Gap?	Additional Activities Proposed
	Improved efficacy of commodity councils.	Allowing the small farmers using the warehouses to obtain loans for the period between harvest and sale; and (d) the development of rural marketing infrastructure, including storage facilities, marketplaces and roads. ASDP: marketing and private sector development. Improving overall sector policy, regulatory and legal framework.			
Maize short-term policy variability—considerable and probable risk.	Develop clear, long-term, efficient, and transparent commodities and sectoral development policies.	USAID Tanzania's Sera Policy Project (launched in 2011), which focuses on advancing policy reforms that are critical to the agricultural sector.	Difficult to have impact from single projects if policy framework is weak.	Policy framework still suffering of great variability and discretionarily (because of food security goal) and therefore provides poor incentives to invest in production.	Find adequate policy equilibrium between the short-term food security goal and the long-term productivity growth aim.

Source: World Bank 2013b.
Note: ASDP = Agricultural Sector Development Program; TAFSIP = Tanzania Agriculture and Food Security Investment Program.

strategy. Ideally, a detailed and exhaustive cost-benefit analysis would inform the selection of the most appropriate intervention options. But conducting a cost-benefit analysis of a multitude of options can be costly and time consuming. Alternatively, the use of prioritization filters that can be discussed in workshops with stakeholders can go a long way, not just in ownership of the results but also in arriving at a set of solutions on which the stakeholders themselves agree.

STEPS TO PREPARE THE RISK MANAGEMENT STRATEGY AND ACTION PLAN

The ASRA's findings serve as the basis for identifying and designing an ARM strategy and corresponding action plan to be incorporated in government policies. To accomplish the stated objective, the solutions team consults available literature, diagnoses the issues, and conducts interviews with various stakeholders related to the risk solution under analysis. Most of the risk assessment work is done in the field and requires extensive teamwork and close cooperation with stakeholders and government at different levels.

To prepare a risk management strategy and action plan, this phase of the fieldwork requires that the team do the following:

1. Review the key ARM issues identified during the ASRA with respect to the specific relevant areas of analysis (in the foregoing Tanzania example, they would be utilization of drought-tolerant

seeds, appropriate agricultural practices, maize trade, and cotton and coffee price volatility. This assessment would include an in-depth review of aspects such as: nature of the risk problem, frequency and actual or potential impact of risks, longer-term sector trends, and fiscal and macroeconomic repercussions, as well as poverty and food security implications.

2. Revise and complete the stocktaking of existing programs or policies that in some way address the identified risk management issues contained in the ASRA.
3. Assess the related current regulatory and institutional framework and detect the main limitations that prevent local institutions (public and private) from performing effectively as vehicles for risk management instruments in the relevant areas.
4. For each relevant area, identify specific action options to address the risk management problem over the short to medium term, considering the potential for market-driven solutions and government interventions, while highlighting linkages with the current public policy framework. Assess the positive aspects and gaps in existing public policies to mitigating, transferring, or absorbing the concerned risks.
5. Share findings and proposals with the team to identify a set of solutions that may be aggregated in one or a few investment projects or program profiles. Work together in drafting the profiles of the proposed aggregated projects or programs and policies.
6. Bundle those recommendations into elements of a strategy, in terms of policy and regulatory framework issues, investments, capacity building and TA, and institutional reform, as appropriate.
7. Prepare a comprehensive plan of action, including the following information by strategic lines: activities, responsible institutions, period of execution, resources needed, and estimated cost.

CONTENTS OF THE RISK MANAGEMENT STRATEGY AND ACTION PLAN

The risk management strategy should contain the following elements at a minimum:

Risk management framework, including the following:

- Brief information about the concerned sector and the risks in the specific area of analysis
- Stocktaking of projects and programs
- Discussion of the possible risk management action options to approach the identified risks and justification of the chosen option

Description of the risk management strategy with respect to the specific areas of analysis, including as appropriate the following:

- Aim, scope, beneficiaries, main elements, institutional framework, connections with national policies, and so on (end goal of the recommendations or strategies, what or whom they are informing)

TABLE 10.4. EXAMPLE OF AN ACTION PLAN STRUCTURE

Strategic Line/Objective	Actions	Responsible Institution	Period (Quarter/Year)	Resources	Cost (US$)	Results Indicator
A.	**A1**					
	A2					
	A3					
B.	**B1**					
	B2					

- » Anticipated risk management gains
- » Concrete actions planned for the short and medium term

As the road map for the execution of the actions contained in the strategy, the action plan could be organized as follows: a detailed presentation of the actions and their objectives with indications of the implementation period, resources needed, and costs. This information may not be easily available but could be obtained by looking at similar programs or through discussions with staff from projects or the government. A second set of tables providing information about the short-term activities by executing unit could be most useful for discussions regarding individual responsibilities and for allocating budget resources at the institutional level, as illustrated in table 10.4.

The action plan can also contain complementary policy recommendations that may have been identified by the ASRA team or are part of the government pipeline.

CHAPTER ELEVEN
FINAL CONSIDERATIONS

Agricultural risk management is an issue of development effectiveness, not just a matter of kindness to farmers. The increasing presence of risk in the agricultural sector may not just exacerbate volatility, but may also become a major impediment to development, economic growth, and poverty reduction agendas. The nature and importance of risk issues affecting economic growth and poverty reduction vary from country to country. So, too, do stark differences exist in a country's capacity to manage agricultural risks. Disparities in risk vulnerability in the agricultural sector tend to be greater in lower-income countries, and, within countries, greater among poor than more affluent stakeholders along agricultural supply chains. Thus the need to tailor each ASRA to suit the particular realities of developing countries, as one size does not fit all. These guidelines should be considered a practical approach rather than a rigid "bulletproof" methodology.

THE OPERATIONAL EXPERIENCE

The World Bank has gained notable experience in integrating agricultural risk issues into country work and lending over the last decade. Attention to agricultural risk issues in Country Assistance Strategies (CAS) has also increased during the same period. Likewise, ASRAs' findings have informed various lending operations at the project level, either as stand-alone projects or as components of a larger intervention to increase sector productivity and resilience (box 11.1).

Much work still needs to be done to establish an enabling environment that will foster country-led, country-specific strategies for mainstreaming agricultural management risk measures into agricultural policies and investments. The opportunities for improving the development impact through risk mainstreaming include making development interventions more responsive to country risk conditions and commitments; making these interventions more strategic; and improving the alignment of policies, processes, and resources to support such interventions.

BOX 11.1. THE INFLUENCE OF ASRAS ON WORLD BANK OPERATIONS

The World Bank, in collaboration with Niger's 3N Initiative, a national food security strategy led by the president's office, conducted an ASRA in 2012 to help prioritize risks and solutions to building resilience in Niger's agricultural sector. The process resulted in the government of Niger developing the *Plan d'action pour la gestion des risques agricoles au Niger* (PAGRA). The 3N Initiative considers the PAGRA a critical tool for long-term planning in Niger, which suffers from frequent shocks and losses from agricultural risks. This 10-year action plan (2014–23) sets short-, medium-, and longer-term targets, with the overriding goal of strengthening the resilience of rural and semi-urban communities against the main agricultural risks. The World Bank is supporting the government's efforts to operationalize PAGRA with a US$116 million Climate-Smart Agriculture Support Project. The government of Niger is working toward implementing PAGRA, developing coordinating structures, identifying good practices, planning for scale-up of interventions, setting quantitative targets and identifying target groups, and sharing experiences at different levels of government. Niger's experience operationalizing risk management could help inform other countries' efforts toward building resilience.

In Kenya, the ASRA conducted by the World Bank resulted in a US$200 million lending operation on CSA and helped inform the government of Kenya's Climate-Smart Agriculture Program 2015-2030.

Paraguay's ASRA informed the World Bank Country Partnership Strategy (2015–18), which includes strengthening agricultural resilience and managing price volatility as one of its three pillars. It is expected that a lending operation based on agricultural resilience will follow.

The World Bank's Rwanda Economic Update of February 2015 focused specifically on agricultural sector risk assessment to highlight the vulnerability of Rwanda's agricultural sector.

The World Bank has conducted ASRAs in 14 countries across four regions since 2013. These have contributed to informed discussions, debates, and operations toward building agricultural sector resilience in these countries.

In some countries, it has proven effective to develop a basic process that involves working with stakeholders to

- Prepare an ASRA that analyzes the risk dimensions of development across major agricultural supply chains and identify key priority risk management actions that can inform (i) sector policy planning and development; and (ii) the country assistance program;
- Develop and implement, as part of the country assistance program, priority policy and operational interventions that respond to the ASRA; and
- Monitor the implementation and results of these policy and operational interventions.

THE IMPORTANCE OF AN ASRA

A key component of successful mainstreaming of risks into agricultural sector strategies is a sector-level risk assessment that identifies and prioritizes critical areas in which risk-responsive actions are likely to enhance growth, contribute to poverty reduction, and strengthen resilience to external shocks. In line with this aim, the methods to carry out an ASRA as established in this document need to be flexible and adapted to each country's circumstances. The ASRA may, for example, be a stand-alone document, a section of a country economic analysis, or part of agricultural development projects, programs, and strategies.

The basic process is to diagnose the risk conditions that inhibit growth, poverty reduction, and well-being in a particular country; based on this diagnosis, the risk-responsive development actions that would be strategic from the government's point of view can be identified. Where such actions involve donor assistance, risk considerations can be integrated into development assistance operations in interventions that the diagnosis suggests are critical for managing risk and therefore poverty reduction or economic growth, and quality and outcomes can be monitored.

ONE SIZE DOES NOT FIT ALL

A singular blueprint for a risk management roadmap is not feasible because of the diversity of risks, approaches to manage them, supply chain contexts, and country contexts. A roadmap for managing the risk of a pest and disease outbreak could be quite different from one for managing counterparty risk. Nonetheless, despite the diversity of approaches, some generic steps can be adopted by all risk management approaches.

This document, particularly chapters 7 through 9, presents many examples of risk management strategies that can be pursued by various groups of stakeholders. Similar to strategies pursued by the public and private sectors, these strategies can and should be pursued in parallel and are complementary. At the micro level, risk management decisions can be uniquely tailored to protect individual producers' or communities' assets and improve their resiliency. At the macrolevel, ARM strategies can be incorporated into sectoral growth and investment decisions.

CHALLENGES

In conducting agricultural sector or supply chain risk assessments, some challenges do arise. These challenges, primarily methodological, should be kept in mind while developing a risk assessment. They include the following:

- *Historical bias.* Assessments conducted to date have been structured to analyze risk from a historical perspective. This type of assessment provides limited opportunity for analyzing new risks that might occur in the future, whose frequency of occurrence is zero (as yet unrealized risks). If these events were to occur in the future, they could lead to catastrophic losses for the supply chain. The team should develop a mechanism to incorporate potential risks, and thus modify the framework described herein.
- *Data limitations.* Accessibility and reliability of good-quality, disaggregated, time series data on key variables (production, cropped area, yield, prices, major weather events, market events, policy decisions, and so on) are often very limited, which negatively affects the ability to conduct a thorough risk assessment.
- *Subjective bias.* Despite all efforts to bring objectivity and give clear analytic indicators, a broad ASRA is essentially a subjective tool and this is one of the more challenging aspects, especially during risk prioritization. Depending on the experience of the team leader and members, the tendency will be to push specific agendas. An entomologist will tend to prioritize insect pests as the biggest risk, a plant pathologist might highlight diseases, a weather expert may push for flood and drought, and a commodity price-hedging expert might tend to highlight price volatility, even in instances when these are not the biggest risks. An insurance expert will be biased toward risk transfer solutions, whereas an agriculture extension expert might be more inclined toward a risk mitigation solution. A good way to mitigate the bias is to use a process driven by data and empirical evidence and incorporate different perspectives while prioritizing risks.
- *Risk appetite.* It has been mentioned that poorer producers have fewer buffers and therefore tend to have a low risk appetite. Many of these households already engage in risk management strategies, whether through diversification of crops or income, but this may lead to a lower return on assets than households would otherwise enjoy. According to IFAD (2011), "Risk avoidance strategies thus have high opportunity costs: some studies estimate that average farm incomes could be 10 to 20 percent higher in the absence of risk."
- *Attribution.* Attribution and proving the counterfactual have always been challenging and particularly complex in social sciences, unless clear-cut data are available.[4] It is rare that one event leads to losses such that all losses can be attributed to it. In many cases, multiple risk events occur in a given year, which makes it difficult to attribute proportions to different risks. Furthermore, as many of these risk events are interlinked through the causal chain, it is difficult to isolate the losses from these events. For example, in Ghana in 2005/06, national production of maize dropped by 45 percent (350,000 tons). Deeper analysis indicated that in the 2005/06 season, some areas experienced droughts, there was an attack of armyworm, cross-border armed conflict arose in the north, and bush fire destroyed large areas of savannah. Establishing the proportion of losses and attributing them to these four separate, but perhaps interlinked, risks would have been quite challenging.
- *Client expectations.* An ASRA is an intermediate process for managing risk, not a final product. Government political will and commitment are necessary to translate the suggested solutions into concrete government strategies and budgeting.

[4] *Counterfactual* means to prove the fact that the loss would not have happened if the event had not occurred.

These are some of the major challenges that limit the assessment process and its application. Nevertheless, ways exist to deal with these challenges. One good practice is to be aware of and upfront in highlighting these issues and to be consistent and explicit about the associated assumptions.

A LAST WORD

This methodological guidance hopefully provides a systemwide approach to identify risks, risk exposure, the severity of potential losses, and options for risk management for the private and public sectors. Ultimately, the ARM framework is designed to inform and facilitate the integration of a stronger risk management focus into sector policy planning and development. In the face of multiple risks, the resilience of primary producers, agribusinesses, institutions, and other supply chain stakeholders for collective action, coordination, and public-private cooperation is a critical consideration. One cannot understand the current competitiveness and future potential of the agricultural sector in developing economies without understanding stakeholders' ability to anticipate and respond to shocks. An agricultural sector development strategy that focuses solely on productivity and removal of constraints is incomplete if it ignores risk and risk management considerations.

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APPENDIX A
GLOSSARY OF TERMS

Agricultural risk: Agricultural risk is a combination of the likelihood of the occurrence of a hazardous event or exposure(s) and the severity of losses that can be caused by the event or exposure(s). The three main attributes of risk are event hazard, uncertainty, and losses.

Climate change: Climate change refers to a statistically significant variation in either the mean state of the climate or its variability, persisting for an extended period (typically decades or longer). Climate change may be due to natural internal processes or external forces or to persistent anthropogenic changes in the composition of the atmosphere or in land use. In its Article 1, the Framework Convention on Climate Change (UNFCCC) defines climate change as a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods.

Climate: Climate in a narrow sense is usually defined as the average weather, or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. The classic period is 30 years, as defined by the World Meteorological Organization (WMO). These quantities are most often surface variables such as temperature, precipitation, and wind. Climate in a wider sense is the state, including a statistical description, of the climate system.

Constraints: These are conditions that lead to suboptimal performance. For example, low yields (symptom) might be caused by lack of access to inputs or poor technology.

Enabling environment risk: Sudden changes in the given scenarios where businesses take place that can lead to financial losses among agricultural stakeholders (for example, unexpected changes in government or business regulations, the macroeconomic environment, political risks, conflict, trade restrictions, logistics, and corruption).

Extreme weather event: An extreme weather event is an event that is rare within its statistical reference distribution at a particular place. Definitions of "rare" vary, but an extreme weather event would normally be as rare as or rarer than the 10th or 90th percentile. By definition, the characteristics of what is called extreme weather may vary from place to place. An **extreme climate event is an average of a number of weather events** over a certain period of time, an average that is itself extreme (for example, rainfall over a season).

Market risk: Market risk is related to issues that affect price, quality, availability, and access to necessary products and services. Prices for inputs and outputs can be highly volatile, particularly in commodity markets in which both local and global supply and demand conditions constantly change. Other risks include exchange rate and interest rate volatility and counterparty and default risks.

Production risk: This refers to risks that are present at farm level and affect yields. A large number of risks affect the volume of production of agricultural commodities. These include nonextreme weather events (too little rainfall, too much rainfall, hail, frost, low temperature, and so on). They also include less frequent but catastrophic weather events (severe floods, droughts, hurricanes, cyclones, and so on). Outbreaks of pests and diseases can also adversely affect yields, as can damage by animals, fire, and wind.

Resilience: It is defined as the ability to withstand, recover from, and reorganize in response to crisis so that all members of society may develop or maintain the ability to thrive.

Risk coping: This term describes actions that help affected households and the government absorb loss. They usually take the form of compensation (cash or in-kind), social protection programs, livelihood recovery programs (for example, government assistance to farmers, debt restructuring, contingent financing), safety net programs, buffer funds, savings, strategic reserves). Such interventions are often financially beneficial, and the ability to respond quickly to events often reduces losses.

Risk mitigation: This term describes activities designed to reduce the likelihood of an adverse event or reduce the severity of losses. It refers to activities leading to improved resilience to withstand external shocks, through ex ante preparation to sustain production and livelihoods following an event. Risk mitigation options are numerous and varied. Examples include crop and livestock diversification, income diversification, irrigation, use of disease- and stress-resistant cultivars, improved early warning systems, avoidance of risky practices, and adoption of improved agronomic practices such as soil drainage and mulching. It is often confused with mitigation to climate change, which refers to anthropogenic interventions to reduce the sources or enhance the sinks of greenhouse gases.

Risk transfer: These are tools and mechanisms for transfer of the potential financial consequences of particular risks from one party to another willing party, usually for a fee or premium. Although insurance and hedging are well-known forms of risk transfer, in developing countries the use of informal risk transfer within families and communities is also extremely important.

Risks: These are uncertain events that have the probability to cause losses. As a symptom, yield volatility might be caused by a drought, pest outbreak, or disease outbreak.

Trends: These are longer-term or "chronic" patterns (reversible or irreversible) that provide context. Here, the declining yield symptom might be caused by structural changes in agriculture or changes in climatic patterns.

Uncertainty: This is an expression of the degree to which a value (for example, the future state of the climate system) is unknown. Uncertainty can result from lack of information or from disagreement about what is known or even knowable. It may have many types of sources, from quantifiable errors in the data to ambiguously defined concepts or terminology, or uncertain projections of human behavior. Uncertainty can therefore be represented by quantitative measures (for example, a range of values calculated by various models) or by qualitative statements (for example, reflecting the judgment of a team of experts).

Volatility: This is a measure of the dispersion of observations from the trend value. Volatility can either be measured by using the standard deviation or the variance between observations. Commonly, the higher the volatility, the riskier the set of observations. The concept of volatility risk has been consistently applied in the financial literature as the risk of a change of price of a portfolio as a result of changes in the volatility of a risk factor.

Vulnerability: This is defined as the capacity of stakeholders to manage agricultural risk and recover from external shocks.

Weather: This is the current atmospheric condition in a given place; it includes variables such as temperature, rainfall, wind, and humidity.

APPENDIX B

AGRICULTURAL SECTOR RISK ASSESSMENTS CONDUCTED BY THE WORLD BANK

TABLE B.1. ASRA COUNTRY AND ASSESSMENT YEAR

Country	Assessment Year
1. Niger	2012
2. Ghana	2013
3. Tanzania	2013
4. Mozambique	2013
5. Paraguay	2014
6. Mongolia	2014
7. Kenya	2014
8. Senegal	2014
9. Malawi	2014
10. Rwanda	2014
11. Kazakhstan	2014
12. Tajikistan	2014
13. Kyrgyzstan	2014
14. Brazil (State of Paraiba)	2014
15. Brazil (State of Bahia)	2015

APPENDIX C
DATA REQUIREMENTS FOR AGRICULTURAL SECTOR RISK ASSESSMENTS

Access to disaggregated, reliable, good-quality time series (preferably 20–30 years) data is a precondition for conducting an agricultural sector risk assessment. It is preferable that all statistics and data be provided at the disaggregated *departmental or provincial level*.

1. **Agricultural structure of the country:**
   - *Composition of agricultural GDP,* highlighting major commodities and percent share of different commodities (crop, livestock, fisheries, and so on) in agricultural GDP;
   - *Time series data on acreage, production, yield of major commodities* (crops and livestock) that account for more than 80 percent of the country's agricultural GDP;
   - *Agricultural sector composition* (by landholding size of the country);
   - *Description of major production zones*: Brief description of major agro-metrological zones, crop production and animal husbandry systems, land use patterns, description of irrigated versus rain-fed agriculture, and so on;
   - *Agricultural census*: Past four to five agricultural censuses;
   - *Livestock census* numbers by class of animal or latest census by region;
   - *Rural household data*: Number of crop (and livestock) households per region, average farm size, and so on; and
   - *Cropping calendar* for key crops grown in each region, including for each season and major crop type, planting dates and harvest.
2. **Crop production data:** The following data are needed, broken down by crop season, summer and winter, and disaggregated by region or province. These data should be provided for those 7–10 agricultural commodities (including livestock and crops) that account for more than 80 percent of the country's agricultural GDP:
   - *Commodity production:* Total volume of commodity produced (MT);
   - *Commodity acreage:* Total acreage under the commodity in question (sown and harvested areas);
   - *Commodity yield:* Provincial yield data, distinguished by the nature of the production system;

- *Cropping calendar* of the commodity for each region, including planting dates and harvest dates for each season and major crop type; and
- *Brief description* of major agro-metrological zones, land use patterns, and irrigated versus rain-fed agriculture, and so on, for the commodity.

3. **Market data:** The following time series (30 years) data are needed, disaggregated by departments or regions of the country for all major commodities (7–10) that account for 80 percent of the country's agricultural GDP:
   - Retail prices;
   - FOB/export prices;
   - Farm-gate prices;
   - Input prices: for fertilizer (diammonium phosphate, urea, and so on), diesel, labor, major pesticides and insecticides, and so on;
   - Value and volume of commodity exported and imported;
   - Value and volume of commodity processed;
   - Details on cost of production and margins, breaking even along the chain;
   - Currency exchange rates of major importing and exporting countries; and
   - Interest rates.
4. **Enabling environment**
   - Time line of major political events/disturbances that might have affected the commodity;
   - Major policy changes/regulatory changes that could have affected the commodity (description of the change, as well as date of change);
   - Major changes in market regulations;
   - Major disruptions in the supply chain and the cause and effect thereof;
   - Time series inflation (general and food) data; and
   - Agricultural GDP growth rate data.
5. **Commodity risk assessment and production loss data:** It is hoped that the Ministry of Agriculture or another ministry records commodity damage on an annual basis for major events in each province and cause of loss. Data for the past 15–20 years are very useful for this assessment. These data should also include major occurrences of pest and disease outbreaks and their impacts on commodity production.
6. **Livestock mortality statistics:** It is hoped that the Ministry of Agriculture, Animal Health Department, or Veterinary Department records mortality data for livestock by type of animal and by cause of loss in each province. If so, as many years as possible should be accessed.
7. **Meteorological data (time series data for past 30 years):** Information about occurrence and impact of major natural hazards including droughts, floods, hurricanes, locust upsurges, major disease outbreak, and so on. Access to monthly/decadal data on rainfall, temperature, and other important weather variables.
8. **Government support to agriculture:** Government Disaster Relief Program? If yes:
   - Organization responsible for implementing;
   - Events for which compensation is paid;
   - Criteria for assessing losses and compensation levels;
   - Compensation payments by event (for example, earthquake, hurricane, drought, flood) for the past 10 years:
     - Input price subsidies: If yes, details;
     - Output price support: minimum prices: If yes, details;
     - Other forms of government support to crop and livestock producers (for example, taxation policy); and
     - Insurance subsidies: If yes, details.
9. **Trade data:** Time series data (past 15–20 years) of
   - Major import crops—volumes, price data (delivery prices/retail prices), country of origin, and so on;
   - Major export crops—volumes, price data (FOB and farm-gate prices), major destinations; and
   - Domestic crops—volume of interregional trade, farm-gate prices/retail prices.
10. **Risk management intervention landscape:** A number of ongoing government, development partner, and private sector-supported initiatives/programs may exist in the area of ARM (mitigation, transfer, or coping). Please provide a brief description of the interventions (nature of intervention, coverage, budget, implementing agency, and so on).

APPENDIX D
GUIDELINES FOR FOCUS GROUP DISCUSSIONS WITH FARMERS

Basics. A *focus group* comprises people who have attributes in common and who are able to provide information and opinions about the topic or subject that is the focus of discussion. Focus groups may be homogeneous or heterogeneous depending on the purpose of the focus group meeting (for example, to identify a pattern, a homogeneous group is more appropriate, whereas to ascertain perceptions of risks affecting a whole supply chain, a heterogeneous group is more appropriate).

Although the Ministry of Agriculture counterparts select the focus groups for an ASRA, the assessment team should

- Be careful that no significant power differentials exist among group members, as this often results in influential people (often men, or better-off individuals) dominating the discussion.
- Aim to cover a mixed sample of representative farming entities covering (i) small and (ii) medium farmers.[5] Within this continuum, considerable differentiation may still exist within groups and should be accounted for. For example some small farmers (possibly in different regions) may have low input use (for example, limited inputs, family labor) versus high input use (for example, higher input use, hired labor). The level of commercialization may also vary among medium and large enterprises and regions in the country.
- Keep the size of the focus group manageable. A focus group is most effective with 10–15 participants.

All three field teams will conduct as many farmer focus group discussions as possible: on the major cash crop, on all food crops, and one more cash crop at the discretion of the field team member.

[5] Large-scale farmers will be interviewed separately (key informant interviews).

Purpose. A focus group discussion is one tool (alongside literature review, secondary data collection, key informant interviews, and so on) to help assess risk. Its purpose is to help the team:

- Identify risks (three principal types of agricultural risk: production, market, and enabling environment risk);
- Analyze and quantify risks (primary stakeholders; losses; frequency; underlying causes; risk transmission);
- Prioritize risks (frequency of occurrence and severity of impact); and
- Identify current management practices (that is, sale of assets, borrowing, sale of labor, reduced consumption, government handouts, migration).

The purposes of the focus group discussions are to assess farmers' perceptions of the risks they face in the supply chain and to examine how these risks and negative impacts could be managed more effectively.

! Remember:
Agricultural risk is defined as a combination of the likelihood of an occurrence of a hazardous event or exposure(s) and the severity of losses that can be caused by the event or exposure(s). The three main attributes of risk are event hazard, uncertainty, and losses.

A *constraint* is a bottleneck, a condition that hampers the smooth functioning of the supply chain. The main characteristics of a constraint include condition, certainty, and suboptimal performance.

Agricultural risks ordinarily vary from season to season, whereas longer-term trends and conditions are more often attributable to constraints.

! Remember:
Agricultural risks can be artificial or natural, and can be idiosyncratic (affecting individual supply chain participants), covariate (systemic) within the chain (affecting multiple supply chain participants), or covariate outside the chain (affecting chain participants and the broader economy). The focus here is on unexpected, adverse, systemic events.

Stage One: **Preparing for a Focus Group Discussion**

Prior to engaging in a focus group discussion, the field team needs to:

- Memorize the key purpose of this discussion and key questions (please see guide and script below);
- Appoint a facilitator or moderator (international field team member) who will guide the content and process of the discussion;
- Appoint a note taker (local field team member) to record the focus group feedback (the facilitator or moderator can take notes too, but should be careful that this does not negatively affect the flow of the discussion if he or she stops to write things down);
- Develop a facilitator's or moderator's guide or script;
- Confirm whether a translator is needed (local field team member should be able to assume this responsibility); and
- Have sufficient stationery, including copies of all report formats (to be developed), notebooks, clipboard (for drawing, writing, or posting), tape, pens, pencils, markers, and sticky notes.

Developing a facilitator's or moderator's guide or script. The script is a guide for the facilitator to explain to participants the purpose of the group, review the focus group rules, and provide other important information. *Suggested script and guide template for all field teams to follow*:

Opening (10 minutes):
"Hello. I will introduce myself and then I would like each of you to tell us your name, what you do, and whether you have participated in a similar discussion before. My name is (. . .). *[Have the focus group members introduce themselves.]* Today we would like to have a conversation with you about agricultural risks in your community. The World Bank has been asked by the government to assess the risks affecting the agricultural sector. We have selected major food and cash crop supply chains across the country, and just like we are here today with you, there are two other teams in other parts of Tanzania doing the same with farmers in *[list some commodities and some of the other regions]*. What we are trying to accomplish before we leave here today is to get a better understanding of the risks that you

face in the supply chain, and to examine how these risks and negative impacts could be managed more effectively. We plan that this will take us approximately two hours. Are there any questions?" *[Respond to participant questions.]*

"Before we continue, let's agree on the rules of the discussion *[Decide together on whether you want focus group members to participate by raising their hands to speak; write their ideas on a piece of paper.]* I would like to tell you that everything we discuss here will be kept confidential. We are not here to check on licenses or for tax collection purposes. We will summarize the things you tell us and combine it with other focus groups we are meeting across Tanzania. My job here today is to make sure we discuss all of the issues we planned to discuss, and my colleague here will help us by taking notes."

"Let's begin." (40 minutes)
[All discussions should cover five main areas: (i) livelihood profile; (ii) risk exposure; (iii) risk transmission along the supply chain; (iv) risk management; and (v) gaps and opportunities to address risk; and be structured: first a question, then a probe. Please see Stage Two.]

Closure (10 minutes)
"Are there final questions? *[Respond to questions.]* Let me reiterate what I think we heard the risks that you face in the supply chain are, and how these risks and negative impacts could be managed more effectively *[reiterate]*. Thank you for participating in our focus group today. We will be collecting feedback from all the focus group discussions undertaken across Tanzania, and together with other analysis, will include it in our discussion with the government."

Stage Two: Conducting a Focus Group Discussion

Because the aim is to understand what, who, how, where, and when are the greatest expected losses, it might be worthwhile *at the beginning of the discussion to have focus group participants engage in a wealth breakdown*: the group can be asked to consider four (usually) wealth groups of equal size, ranging from the poorest 25 percent to the richest 25 percent (or small, medium, and large farmers). Visually this is represented with piles of rocks, marbles, or crops (maize, rice, beans), or can be drawn on the earth or a clipboard. This differentiation may help at the end of the process to more easily identify the significance of expected losses for different participants in the chain relative to their assets, livelihood and enterprise strategies, and performance outcomes.

Proceed with the opening *according to the script* and start the discussion with the agreed method of participation.

All field teams should *be prepared to discuss the five main areas* identified above as *(i) livelihood profile; (ii) risk exposure; (iii) risk transmission along the supply chain; (iv) risk management; and (v) gaps and opportunities to address risk.* The accompanying table includes indicative questions under each area. This is not a questionnaire to be strictly followed and completed. It is meant to help the facilitator or moderator (international field team member) keep the discussion organized. Questions asked should generally be open ended to stimulate both individual contributions and group interaction. Questions should not elicit "yes or no" answers.

Livelihood Profile	
Question: What are the main crops you produce for own food consumption? For cash? For export?	Probe: Percentage of the area of value, total area farmed and owned (ha), ranked in order of importance.
Question: Is livestock important for you?	Probe: Do you consume livestock products that you produce? Do you derive income from livestock products? What percentage of income?
Question: What percentage of your household income is from crops, livestock, other? What is your average level of production and revenue in a given year? What has been the trend in recent years?	Probe: Try to find out what role agriculture plays in the household livelihood.
Question: What inputs do you use? Where do you source inputs from?	Probe: Fertilizer, seeds, pesticides. Check for reliability, quality, utilization.

Livelihood Profile	
Question: Is there any type of irrigation used? What types?	Probe: Furrow, drip, overhead, and so on.
Question: What factors motivate the planting of crops? What are the alternatives?	Probe: Returns to assets vs. risk management, substitute, complementary goods.
Question: What access do you have to local markets and traders? What is the distance to the nearest trading center?	Probe: Formal vs. informal markets.
Question: What access do you have to financial resources?	Probe: Formal vs. informal finance (credit, trade finance, personal).
Question: Are you a member of a cooperative or organization? What are the primary benefits of this relationship?	
Risk Exposure	
Question: In broad terms, what are the main sources of risk you face in: • Sourcing inputs? • Production? • Sales and marketing of goods?	Probe: Nature of risk (production, market, enabling environment). Probe against specific risk factors having an effect on farm level (for example, weather, price, environment, labor standards, logistics, operational, trade policies).
Question: What are the direct negative impacts that potentially arise from these risks?	Probe: Direct impacts of enabling environment (policy) risks include competition from subsidized companies.
Question: What crops are more vulnerable to risks?	Probe: Probe against specific production risks (weather, SPS [sanitary and phytosanitary]), market risks (prices), and enabling environment.
Question: What are the three main sources of risk that most concern you?	Probe: Ranking of potential problem "areas."
Question: What are the key transaction points and types of interaction associated with risk and uncertainty?	
Question: Of the risks identified, what is their frequency?	Probe: Often or seldom, seasonal, annual. Temporal impacts?
Question: How would you describe the potential severity of impact and expected losses arising from major risks?	Probe: Expected loss—minimal, low, medium, high, very high.
Question: Overall, have underlying conditions in the supply chain, and your position in particular, deteriorated or improved in recent years? Have you kept any records to track this?	Probe: Get a sense of long-term threats or opportunities to supply chains. Check for available records and request.
Note: You may wish to probe specific risk aspects related to seasonality dimensions, contracting arrangements, direct impact of weather, and environmental factors. You are trying to corroborate frequency of risk events; identify the causes of losses; could be single cause, or multiple causes (percentage).	
Risk transmission Along The Supply Chain	
Question: Do you have regular input procurement arrangements? With whom? How effective are existing input arrangements?	Probe: Timely provision of inputs, cost factors, logistics issues. Formality of arrangements.
Question: Do you have fixed selling (contract) arrangements with processors or other intermediaries? How often are these negotiated?	Probe: Formality of contracting, length of trading relationships. Logistics.
Question: How are transport requirements met? How effective are transport facilities?	Probe: Availability, affordability (petrol prices), dependability.
Question: What feedback mechanisms or interactions (if any) exist with traders and retailers?	Probe: Shared concerns related to environment, labor, food safety.
Question: What spillover effects (that is, linked impacts) do farm-level production problems have on the wider supply chain? Which entities are most affected?	Probe: Impacts of production or supply shortfalls, labor constraints, unexpected events; are there perceptions of equitably or inequitably shared risks within the chain?
Note: You are trying to understand how losses affect various members of the supply chain and if losses are evenly distributed by area or by farmer group.	

Risk Management	
Question: What is done to address problems in advance of a risky event? How long have these actions existed?	Probe: Ex ante risk management strategies—investments in infrastructure, technology, management practices, financial instruments, organizational arrangements.
Question: What is done to address problems after a risky event?	Probe: Ex post risk management strategies—reallocation or sale of assets (livestock), seek employment or migration, transfers, resort to savings, borrow from friends or family, and so on.
Question: How effective have these actions been? What actions have been most effective? Least effective? Why?	Probe: Ex ante and ex post risk management strategies
Question: Who typically provides these actions?	Probe: Self-made decisions, decisions by farmer organizations, formal vs. informal mechanisms.
Question: What interventions have been supported by public sector "agents" (including donors and NGOs) to manage problems?	Probe: Role of public sector and government agencies vs. market-based actions vs. community level. Ex ante vs. ex post risk.
Question: How effective have public interventions been? Which are more or less effective?	Probe: Timing, targeting, delivery aspects.
Question: What has recent experience illustrated about farmer capacity to withstand major deviations, disruptions, and disasters in the supply chain?	Probe: Ability to manage risk on own vs. need for external "partners."
Question: What information sources, if any, are used to predict or assess the potential frequency, magnitude, and severity of problems?	Probe: Early warning information, price tracking, local knowledge.
Question: How would you describe overall access to credit and insurance? What are the benefits and costs from credit and insurance?	Probe: Availability and affordability of credit and timely and "fair" payment of insurance.
Note: You are trying to understand the impact of events (short term, medium term); how losses are transmitted upstream and downstream along the supply chain; how different stakeholders manage these risks; how small, medium, and large farmers manage in terms of mitigation, transfer, or coping; how shock was absorbed; and whether any stakeholders went out of business.	
Gaps and Opportunities to Address Risk	
Question: What are the main lessons learned from experience in risk management?	
Question: What options could be explored to better manage risks affecting farmers?	Probe: Production, market, enabling environment. Opportunities and constraints.
Question: What are the perceived potential options for managing problems jointly with other supply chain entities?	
Question: What roles could others play?	Probe: Community, public sector or government, private sector, NGOs, donors.

! Remember:
You are taking time out of focus group members' busy schedules. Keep it within the time limit you promised it would take!

Ending a Focus Group Discussion

Proceed with the closure *according to the script*, and debrief with focus group discussion participants immediately after each focus group when information is fresh. It is a good opportunity to double-check major findings, and also identify patterns and themes at the forefront.

***Stage Three*: Reporting a Focus Group Discussion**

As soon as possible after ending a focus group discussion (ideally, that same evening with the team), proceed with reporting the results of the focus group discussion, using this format (copies of the report format will be provided to all field teams).

Focus Group Discussion No. _____

Region Name: _____ City/Village Name: _____

Livelihood Zone: _____

Date: _____ Team Member Names: _____

Livelihood profile

Main Food Crop Production (Rank Importance of Contribution to Diet)	***Small Farmers***	***Medium Farmers***	***Comments***
1			
2			
3			
4			
5			

**Rank from 1: Most important to 5: Least important*

Main Cash Crop Production (Rank Importance of Contribution to Income)	***Small Farmers***	***Medium Farmers***	***Comments***
1			
2			
3			
4			
5			

Livestock (Types and Size Held)	***Small Farmers***	***Medium Farmers***	***Comments***

Narrative description of supply chain segment interviewed: Explain main characteristics of supply chain segment (participants, interactions) and general trend.

Risk Exposure

Food Crop (Rank Exposure to Risk)	*Small Farmers*	*Medium Farmers*	*Comments (Impact: Moderate, Considerable, Critical, Catastrophic)*
1			
2			
3			
4			
5			

**Rank from 1: Most exposed/Most vulnerable to risky event to 5: Least exposed/Least vulnerable to risky event*

Food Crop (Rank Frequency of Risk)	*Small Farmers*	*Medium Farmers*	*Comments (Impact: Moderate, Considerable, Critical, Catastrophic)*
1			
2			
3			

**Rank from 1:High Probability to 3: Low Probability*

Cash Crop (Rank Exposure to Risk)	*Small Farmers*	*Medium Farmers*	*Comments (Impact: Moderate, Considerable, Critical, Catastrophic)*
1			
2			
3			
4			
5			

**Rank from 1: Most exposed/Most vulnerable to risky event to 5: Least exposed/Least vulnerable to risky event*

Cash Crop (Rank Frequency of Risk)	*Small Farmers*	*Medium Farmers*	*Comments (Impact: Moderate, Considerable, Critical, Catastrophic)*
1			
2			
3			

**Rank from 1: High Probability to 3: Low Probability*

Risks for food crops	*Frequency*	*Impact*	*Risks for Cash Crops*	*Frequency*	*Impact*

Note: It is hoped that this can lead to building a risk prioritization of the sector assessment.

QUANTIFICATION TABLES
PRODUCTION LOSSES
MARKET LOSSES

Narrative description: *List the causes of losses; could be a single cause or multiple causes (percentage)*

Risk transmission along the supply chain

Schematic representation of supply chain; indication of segments and transactions vulnerable to risk and direction of risk transmission.

Current risk management practices

Cash Crop Risk Event *(for Example, Drought, Output Price)*	***Mitigation*** *(for Example, Drought-Tolerant Seed Varieties)*	***Transfer***	***Coping*** *(for Example, Borrowing)*	***Comments (It Would be Good to Have these from Small and Medium Farmers)***

Food Crop Risk Event *(for example, drought, output price)*	***Mitigation***	***Transfer***	***Coping***	***Comments (It Would be Good to Have these from Small and Medium Farmers)***

Suggested Gaps and Opportunities to Address Risk

Cash Crop Risk Event	*Gaps*	*Opportunities for Public Sector and Government*	*Opportunities for Private Sector*	*Opportunities for NGOs and Donors*

Food Crop Risk Event	*Gaps*	*Opportunities for Public Sector and Government*	*Opportunities for Private Sector*	*Opportunities for NGOs and Donors*

Narrative description: *A sense of prioritization?*

APPENDIX E

EXAMPLE OF RAINFALL ANALYSIS AND CROP PRODUCTION IN GHANA

Whenever data and time allow, it is useful to conduct an analysis of the relationship between rainfall and agricultural yields for main crops and for various regions. An example of such analysis is hereby shown for Ghana.

BACKGROUND

An analysis of rainfall data provides useful information on the level and distribution of rainfall by region and the impact of various rainfall characteristics on crop yields.

Ghana has 99 weather stations located throughout the country, although some regions have a higher density than do others. Analysis was based on daily rainfall data from 1981 to 2010. Figure E.1 shows the distribution of the weather stations (orange dots).

As the weather stations do not have information on the region to which they belong, distance from the centroid of each region (i) was calculated for each station (j) using the Euclidean distance formula:

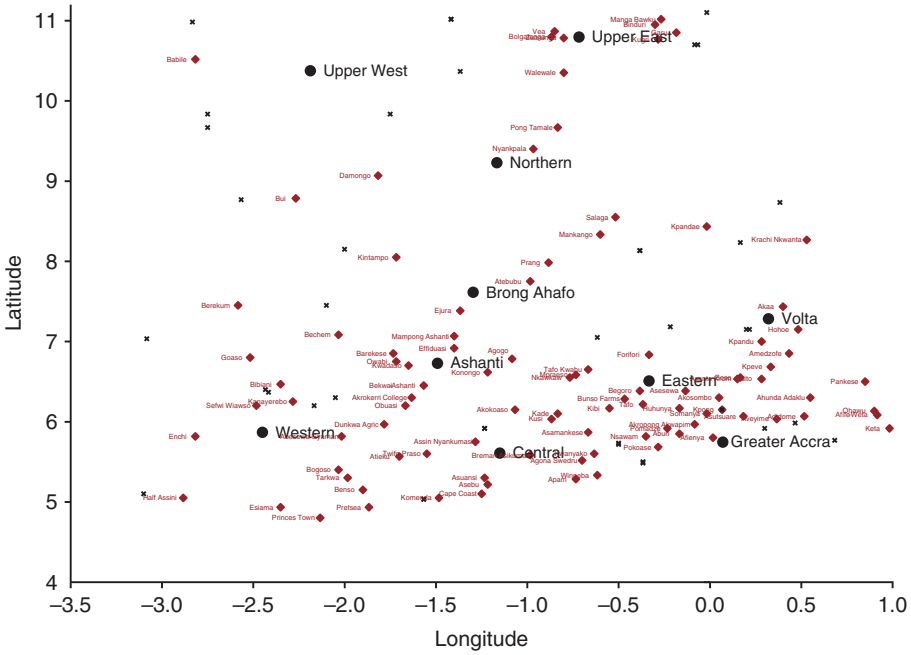
$$Dist = \sqrt{\left(x_i - x_j\right)^2 + \left(y_i - y_j\right)^2}$$

Where:

$Dist$ = Euclidean distance
x_i = longitude from region i's centroid
x_j = longitude from station j
y_i = latitude from region i's centroid
y_j = latitude from station j

Each station was assigned to the region whose distance to the centroid was the smallest. Reference marks for the centroids of each region are indicated by the blue dots in figure E.1.

FIGURE E.1. WEATHER STATION DISTRIBUTION WITH REGION CENTROIDS



Source: World Bank 2011.

RAINFALL DISTRIBUTION

Most rain occurs during the summer months from June to September, followed by a dry winter from November to March. In the south, it is also common to find a dry period during August, usually referred to as the "dog days of summer" because of its relationship to the Dog Star of Sirius in the Canis Major constellation. A unimodal rainfall pattern is thus observed in the lower rainfall northern regions and a bimodal pattern in the central and southern regions. Figure E.2 shows the monthly distribution of rainfall for each region.

As shown by these charts, most rainfall occurs in the March–October period, with an average of more than 100 mm per month, followed by a dry season from November to February. The ensuing analysis focuses on observed rainfall during the period March to October.

DROUGHT AND EXCESS RAINFALL

Cumulative rainfall for all stations was calculated for the March–October period and the average of all stations within a region was used as the basis for analysis. To determine whether a year was dry or humid, a standardized cumulative rainfall variable was calculated for each region, according to the formula:

$$StdRain_i = \frac{\left(\sum_{i=mar}^{oct} \int Prec_i - \mu_i\right)}{\sigma_i}$$

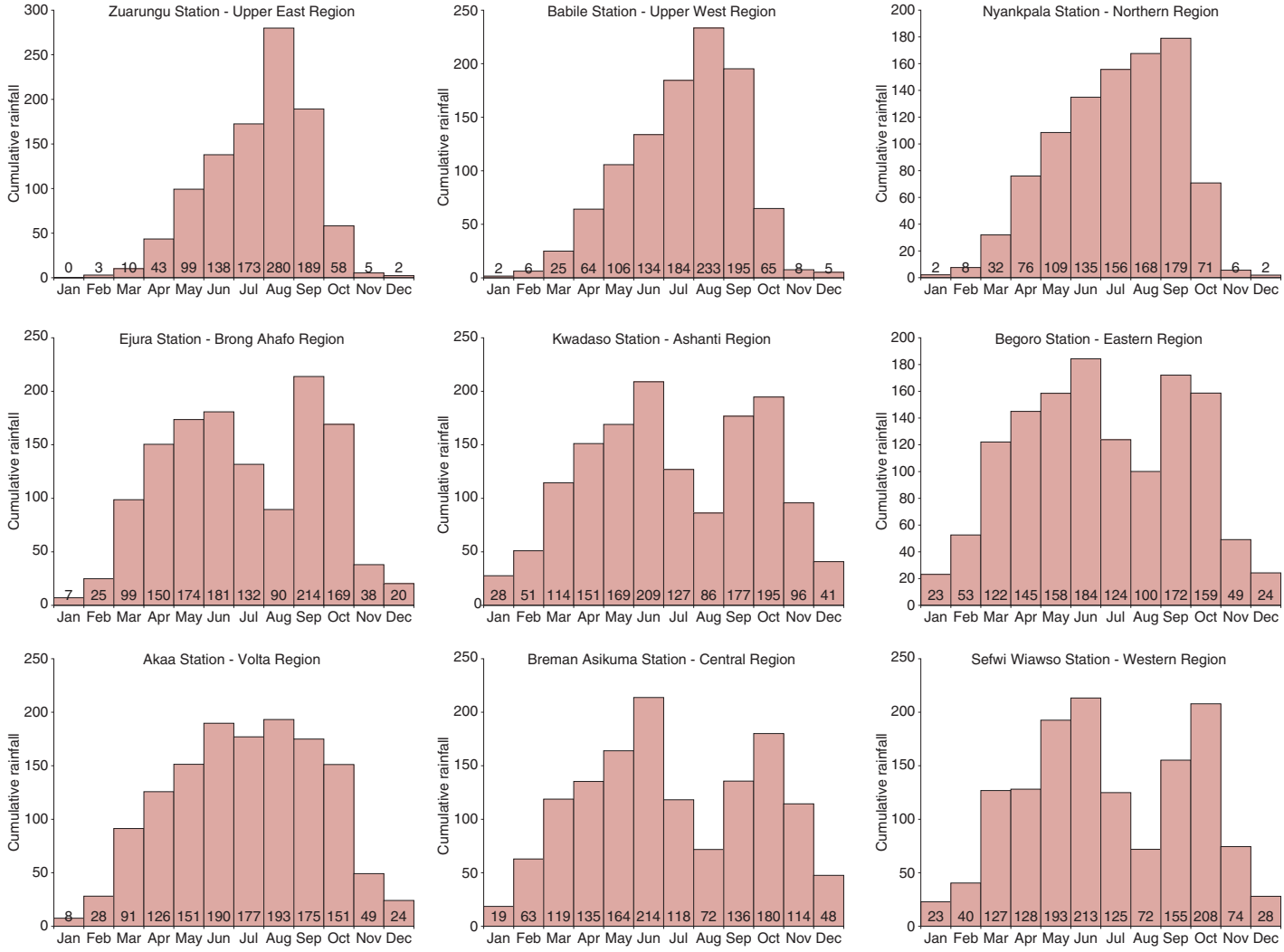
Where:

$StdRain$ = standardized cumulative rainfall
Pre = daily rainfall
μ = mean yearly rainfall
σ = standard deviation of yearly rainfall
i = year

This variable makes it easier to discern drought and excess rainfall events. Table E.1 shows the standardized cumulative rainfall by year and region, with red signifying a drought event and green an excess rainfall event.

This analysis shows that drought typically affects numerous regions simultaneously.

FIGURE E.2. MONTHLY RAINFALL PATTERNS BY REGION



Source: World Bank 2011.

Drought years: 1982, 1983, 1986, 1990, 1992, 1998, and 2005. During these years, rain was more than one standard deviation below average in at least three regions. Drought was particularly severe and widespread in 1983, with nine regions affected—including several with cumulative rainfall more than two standard deviations below the average. The most recent dry year was 2005, when the Eastern and Volta regions suffered from very low rains. These data suggest that there is a 23 percent probability (7 out of 30 years) that drought will occur in at least one region.

Excess rainfall years: 1987, 1989, 1991, 1995, 1999, 2002, 2007, and 2010. Rainfall was more than one standard deviation above average during these years, meaning that it was more than adequate. The most humid year occurred in 2007, affecting six regions—with rainfall in the Upper East region more than two standard deviations above the average.

THE IMPACT OF RAINFALL ON CROP YIELD

RAINFALL PARAMETERS

Crops are sensitive to rainfall in different ways. Low cumulative rainfall is the main determinant of yield, but crops can also be affected by late onset of the rainy season or early cessation of rains. Prolonged periods without rain can also reduce yields, as can excess rainfall. The following variables were thus calculated for each weather station

TABLE E.1. STANDARDIZED CUMULATIVE RAINFALL

Year	UpEast	UpWest	North	Brong A	Ashanti	Eastern	Volta	Central	Western	G Accra	Dry Regs	Exc Regs	Conclusion
1981	−1.56	−0.75	0.01	−0.50	0.27	0.10	0.17	1.03	0.55	0.52	1	1	Neutral
1982	−0.03	−0.07	−0.78	−1.33	−1.73	−1.77	−1.83	−0.05	−0.98	0.62	4	0	Dry
1983	−0.81	−3.07	−1.55	−1.24	−1.99	−1.90	−2.09	−2.57	−1.58	−2.39	9	0	Dry
1984	−1.53	−1.91	−0.26	−0.17	1.78	0.77	0.95	0.50	1.72	0.84	2	2	Neutral
1985	−0.98	−0.09	0.28	0.57	0.85	0.74	−0.20	−0.14	−0.04	0.50	0	0	Neutral
1986	−0.42	0.69	−0.66	−0.26	0.73	−1.07	−0.88	−1.79	−1.31	−1.18	4	0	Dry
1987	−0.46	0.11	−0.27	0.75	0.83	1.38	0.49	1.40	2.15	0.86	0	3	Excess
1988	−0.20	−0.57	0.29	−0.35	−0.90	−0.06	0.47	−0.06	−0.12	0.40	0	0	Neutral
1989	1.39	0.12	2.23	1.35	0.25	0.40	1.30	0.80	0.92	0.80	0	4	Excess
1990	−1.22		−1.00	−0.86	−1.51	−1.02	−0.30	−1.38	0.06	−0.68	5	0	Dry
1991	0.58	−0.38	2.06	0.14	−0.26	1.85	1.03	1.62	−0.17	2.45	0	5	Excess
1992	0.57	−0.23	−1.20	−1.27	−0.86	−0.85	−0.97	−0.91	−1.05	−0.96	3	0	Dry
1993	−0.31	0.28	0.04	−0.26	−0.35	1.16	−0.09	−0.35	−0.31	−0.42	0	1	Neutral
1994	1.18	0.22	0.05	−1.51	−0.46	−0.04	−0.41	0.24	−1.64	−0.88	2	1	Neutral
1995	−0.72	1.19	0.31	0.37	0.48	1.71	1.76	0.77	0.03	0.47	0	3	Excess
1996	1.07	−0.81	0.60	0.01	−0.71	−0.46	−1.00	0.21	0.66	0.92	0	1	Neutral
1997	−0.18	0.62	−0.01	0.36	−0.42	−0.58	0.09	0.28	−0.31	0.91	0	0	Neutral
1998	0.45	−0.52	−2.08	−0.01	−0.51	−0.30	0.16	−1.01	−1.28	−1.17	4	0	Dry
1999	1.78	1.45	1.43	0.63	1.50	−0.09	0.74	0.52	−0.11	0.51	0	4	Excess
2000	−0.09	1.85	0.01	−0.07	−0.56	−0.35	0.71	−1.07	0.07	−1.53	2	1	Neutral
2001	0.10	−0.57	−0.94	−0.61	−0.34	−0.46	−1.39	−0.71	0.19	0.08	1	0	Neutral
2002	−0.68	0.36	−0.13	1.03	1.22	0.44	0.49	0.62	1.76	0.65	0	3	Excess
2003	0.45	0.45	0.05	−0.88	−0.35	0.00	0.58	0.08	−0.03	−0.31	0	0	Neutral
2004	−1.07		−0.24	0.93	−0.75	−0.19	−0.66	−0.30	−0.74	−0.98	1	0	Neutral
2005	−0.42	0.46	−0.72	0.02	−0.71	−1.97	−2.04	−1.07	−0.60	−0.99	3	0	Dry
2006	−0.19	1.01	−0.62	−0.44	0.73	−0.21	0.22	0.61	0.06	−0.09	0	1	Neutral
2007	2.62		−0.39	0.80	1.84	1.47	1.25	1.44	1.13	0.83	0	6	Excess
2008	−1.05		1.49	−0.25	1.39	0.90	1.02	0.85	0.98	0.54	1	3	Neutral
2009	1.00	0.10	0.50	−0.51	0.36	−0.12	0.46	−0.55	−1.17	−0.89	1	1	Neutral
2010	0.72	0.06	1.51	3.59	0.19	0.52	−0.04	0.98	1.16	0.56	0	3	Excess
Dry Years	5	2	4	4	3	5	4	6	6	4			
Exc Years	6	4	5	3	5	5	5	4	5	1			

Source: World Bank 2011.

per year as the basis for closer analysis of the relationship between rainfall and crop yield:

1. Cumulative rainfall (cumrain). The sum of rainfall from March to October, it measures the total amount of rain that accumulates yearly from March to October. It is expressed in millimeters.
2. Onset date (onset). The time of year in which the rainy season starts, defined as the first day of the year with 20 mm or more of rain. It is measured as the number of days from the start of the year.
3. Cessation date (cessation). The day the rainy season ends is defined as the day on which 90 percent of total rainfall period occurs. It is measured as the number of days from the start of the year.
4. Length (length). The length of the rainy season is defined as the difference between the cessation date and the onset date, measured as number of days.
5. Rain days (events). The number of days in the period when rainfall was higher than 1 mm.
6. Dry spell (drysp). The longest number of consecutive days without rain.
7. Extreme excess rainfall (max10days). The yearly maximum amount of cumulative rainfall in any 10 consecutive days.

The influence of rainfall on yield was examined using regional production data for maize, rice, millet, groundnuts, cassava, and yams for 1992–2009.

REGRESSION ANALYSIS

The rainfall parameters described above were averaged across the weather stations in each region and regressed on yield, as described below.

$$Yield = \beta_0 + \beta_1\, cumrain$$
$$Yield = \beta_0 + \beta_2\, onset$$
$$Yield = \beta_0 + \beta_3\, events$$
$$Yield = \beta_0 + \beta_4\, cessation$$
$$Yield = \beta_0 + \beta_5\, length$$
$$Yield = \beta_0 + \beta_6\, drysp$$
$$Yield = \beta_0 + \beta_7\, max10days$$

Results are reported in Table E.2 for those crops and regions where the regression coefficient was statistically significant (at 5 percent). The coefficient of determination, which measures the proportion of the variability in yield explained by each rainfall variable, is reported (in brackets) to indicate the magnitude of this impact. The short time period for analysis and limited variability of some of the data limited the explanatory power of these regressions, although some general trends are apparent.

The impact of individual rainfall parameters is most apparent for the production of rice and groundnuts in Upper East region. Excess rainfall is the major risk, rather than drought, as shown by the negative signs for the impact of cumulative rainfall, number of rainfall days, and the maximum rainfall in any 10-day period. Groundnut yields respond positively to the earlier onset of rain in both Upper East and Upper West regions.

The impact of rainfall in other regions is limited. Maize and yam yields are vulnerable to drought in BrongAhafo, yam yields are vulnerable to drought in Central, and maize yields are vulnerable to excess rainfall in Ashanti. This suggests that factors other than rainfall may be more important determinants of yield in these regions.

PRINCIPAL COMPONENT ANALYSIS

As the variables used for analysis are all different attributes of the same weather phenomenon (rainfall), some will be correlated. Figure E.3 shows the correlation matrix for the first six variables.[6]

Some variables are closely related, such as the length of the rainy season (durac) and the cessation date (ces90): the higher the cessation date, the longer the rainfall period. These correlations can also be highly negative—such as the correlation between the length of the rainy season (durac) and the onset date, because the later the rainy season starts, the shorter its duration.

Because of this high correlation, principal component analysis was used to further analyze the impact of these parameters on crop yield. Table E.3 shows the first three eigenvalues and the corresponding proportion of variance explained.

[6] The excess rainfall variable was not used in the principal component analysis because it was introduced at a later stage.

TABLE E.2. IMPACT OF RAINFALL PARAMETERS ON CROP YIELD

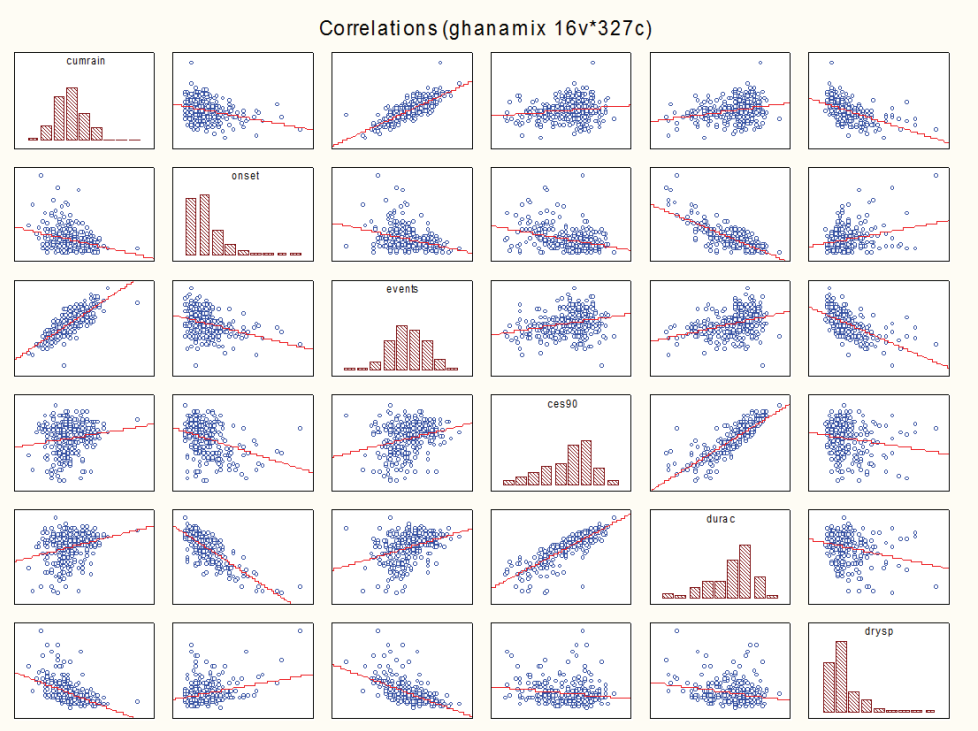
Parameter	Upper East	Upper West	Northern	BrongAhafo	Ashanti	Eastern	Volta	Central	Western
Cum rain	Rice (−) (32%) GNuts (−) (35%)			Maize (+) (24%) Yams (+) (23%)					
Onset of rain	GNuts (+) (27%)	GNuts (+) (39%)							
Number of rainfall days	Rice (−) (26%)								
Cessation date									
Length of rainy season									
Dry spell								Yams (−) (46%)	
Max days	Rice (−) (42%) GNuts (−) (28%)				Maize (−) (26%)				

The first component explains 52 percent of the total variance accounted for by the six variables, and the second component explains an additional 25 percent of the variance—so that the cumulative variance explained is more than 77 percent. This reduces the dimensionality of the original problem from six variables into two components with a reduction in variability of only 23 percent (100 percent to 77 percent). A third component would add another 10 percent of the variability explained. The usual practice is to retain as many components as eigenvalues are higher than one, which suggests retaining the first two components. Table E.4 shows the correlation (factor loadings) of each component with each of the variables in the two-factor solution (retaining the first two components, meaningful loadings marked in red):

Figure E.4 shows that the length of the rainy season (durac), cessation date (ces90), and onset date (onset) are highly correlated amongst themselves, and so constitute the first factor together with the negatively correlated onset date. This factor can be taken to represent the length of the rainy season given that the length is high, the onset date is low, and the cessation date is high as well. Hence when this factor is large, the rainy season is very long.

Factor two consists of cumulative rainfall (cumrain), number of rainy days (events), and length of the dry spell (drysp), which are positively correlated, together with dry spell, which is negatively correlated. This means that when the dry spell is very long, cumulative rainfall and

FIGURE E.3. CORRELATION MATRIX PLOT



Source: Authors' analysis.

TABLE E.3. PRINCIPAL COMPONENTS ANALYSIS: THREE EIGENVALUES AND PROPORTION OF VARIANCE EXPLAINED

	Eigenvalue	% Total Variance	Cumulative %
1	3.1297	52.16	52.16
2	1.5165	25.27	77.44
3	0.6384	10.64	88.08

TABLE E.4. CORRELATION OF COMPONENTS

Variable	Factor 1	Factor 2
cumrain	0.114	0.893
onset	−0.746	−0.263
events	0.228	0.895
ces90	0.861	0.053
durac	0.984	0.174
drysp	−0.113	−0.777

number of events will be low. This second factor represents the intensity of rainfall during the year.

These two factors (or principal components) by definition are orthogonal, meaning that they are independent between themselves. They suggest that rainfall in Ghana has two main attributes: the length of the rainy season (factor 1) and the intensity of rainfall (factor 2).

Based on this two-factor solution, it is possible to derive factor scores, which are the transformation of the original six variables into the two new variables (factors). These scores are standardized so that the mean is equal to zero and the standard deviation is equal to one. Figure E.5 shows the mean scores for each factor by region.

The length of the rainy season is shorter than normal in the Upper East and Upper West regions, as their mean factor scores are smaller than −1. By contrast, the Ashanti region has the highest mean score for factor one, meaning that the season is usually longer. For the intensity factor, the Volta and Western regions seem to have the most

FIGURE E.4. FACTOR LOADINGS PLOT

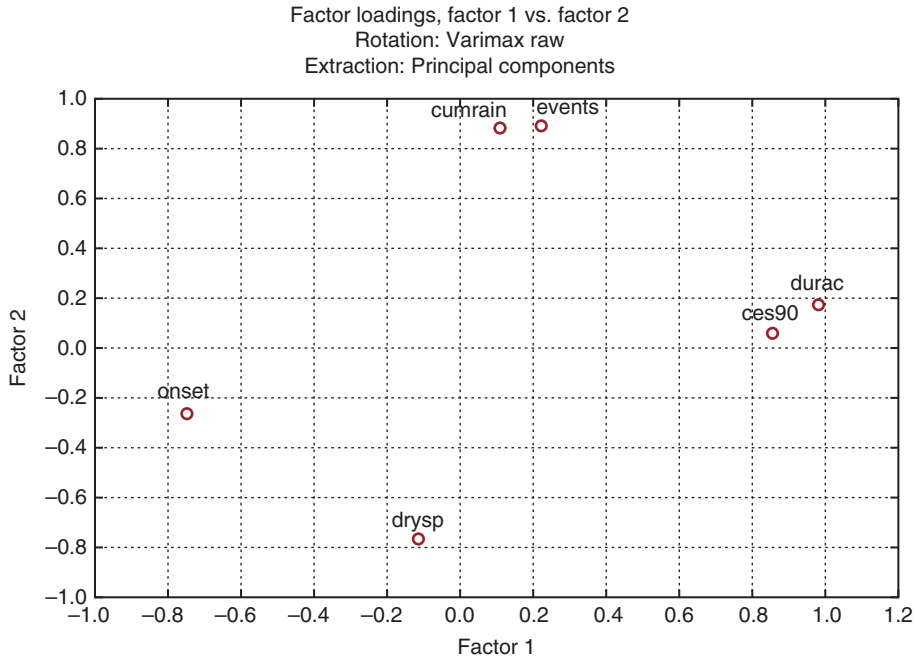
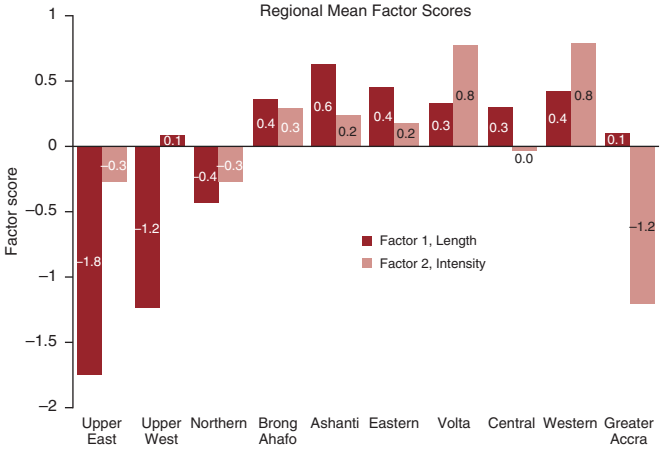


FIGURE E.5. MEAN FACTOR SCORES BY REGION



intense rainfall because their mean score is almost one standard deviation above the mean (0.8), whereas the Greater Accra region has the lowest intensity of rainfall. BrongAhafo, Ashanti, Eastern, Volta, and Western regions have similar rainfall conditions.

- Cereal and groundnut yields are affected by adverse patterns and events in both the length of the rainy season and the intensity of rainfall. Moreover, yields can be adversely affected when the rainy season is either too long or too short. Both high and low intensity rainfall can reduce yields, but excess rainfall appears to pose the highest risk. Together, these results confirm the vulnerability of cereal and groundnut yields to a range of adverse rainfall patterns and events in the lower rainfall zones in which they predominate.
- Cassava and yam yields are vulnerable to shorter rainfall seasons and lower intensity rainfall, although neither set of factors had a substantive impact. This may result from the higher and more reliable rainfall patterns in the transition and forest zones where these crops predominate.

The impact of both sets of factors was higher in the drier savannah zones, particularly Upper East and Upper West, as would be expected.

APPENDIX F
GUIDELINES FOR CONSULTANTS

PRIOR TO MISSION

In the ARMT's experience, team members on missions who are unprepared spend time in stakeholder meetings trying to understand the structure of the sector and supply chains instead of focusing on the risks to the sector. This is not the purpose of the mission! Consultants should therefore:

- Read up on ARMT's previous work and the methodology applied in risk assessments.
- Read the preparatory work already conducted by ARMT on the country (in Dropbox).
- Prepare background notes on relevant crops of livestock (see table F.1).

During mission: Make sure you take notes! ARMT's experience is that it is useful to start writing during the mission while thoughts are still fresh and to get a better sense of where the information gaps are before leaving the country. ARMT understands that this is not always feasible given the workload during missions, but you are strongly encouraged to think through what you have and what information you need to support the risk story that emerges for your commodities. It is so much more difficult to get the information once out of the country, and in ARMT's experience, this significantly delays production of these reports. Additionally, you will need this information for your stakeholder presentation.

Post mission (approximately two staff weeks depending on the number of commodities): *Please ensure timely submission of your inputs*! The lead author depends on your work to do his or her job, and the ARMT will spend additional time on the report once it is received. After that, it is reviewed in the World Bank before it is sent to the client. Hence, the process is long and it is important to avoid delays. Guidelines on writing follow.

Writing for ARMT: Because every country is different, the risk story will vary between countries and commodities, so no fixed format exists for ARMT's reports. Nevertheless, certain standards are needed to ensure quality work. Additionally, in ARMT's experience, substandard deliverables from team members (including poor

TABLE F.1. TEMPLATE FOR COMMODITY SUPPLY CHAIN PROFILE

Production (including geography)
Processing
Markets, domestic (including price and so on)
Markets, export
Logistics
Main stakeholders (private and public)

writing) significantly delay completion of ARMT reports and are both costly and time consuming to correct. Thus ARMT requests that any deliverables comply with the following:

- When you write your text, critically ask whether it would be clear to an audience that is not familiar with the topic.
- ARMT's audience is rather time constrained—make sure the text is easy to follow.
- Allocate one or two paragraphs for each topic, unless it is absolutely necessary to expand beyond that. Make sure that the message of each paragraph is clear and that messages are not repeated.

- Use numbers to back up your arguments. ARMT's audiences are aware of the agricultural risks in their countries; ARMT's value added is that it quantifies those risks.
- When referring to fluctuations in prices, exchange rates, and so on, demonstrate them in figures and graphs.
- If policies are considered a risk, back up the argument with a timetable with past regulatory changes and time series figures that demonstrate the impacts of these regulatory changes in specific months or years.

APPENDIX G

SAMPLE TERMS OF REFERENCE FOR CONSULTANTS

BACKGROUND

Risks are inherent, ubiquitous, and varied in agricultural systems, perhaps more so than in any other area of economic endeavor. They enforce poverty traps and pose serious consequences for all stakeholders. The apparent increase in the frequency of commodity price spikes and crop failures, added to concerns over climate change and food security, have increased global interest in ARM. The prevalence and complexity of the multiple risks facing agricultural systems and the failure to address them on an ex ante and integrated basis continue to leave countries and their agricultural supply chains at risk. The realization of these risks leads to a perpetual cycle of "shock-recovery-shock," which endangers the sustainability of ongoing initiatives and remains a major impediment to the development of most agricultural sectors.

With the objective of mainstreaming agricultural risk management into national sector development strategic planning and promoting more resilient and sustainable agricultural systems, the World Bank's Agriculture Risk Management Team provides TA that helps clients evaluate agricultural risks and put in place requisite systems for improved risk management. ARMT's ARM framework looks comprehensively at the risks to the agricultural sector and comprises (i) risk assessment and prioritization; (ii) stakeholders' assessments; (iii) analysis of risk management strategies; and (iv) screening of potential risk management instruments.

This activity has the potential to inform agricultural development strategies and investment plans as well as the agricultural development programs of development partners or donors. By quantifying risk and providing an evidence-based prioritization of risk management interventions, it can facilitate objective policy and programming dialogue and help focus design and delivery of TA activities. In the end, however, integration of risk management practices into development strategies will reduce the short- and medium-term volatility in the agricultural sector and improve resilience in the longer term, thus reducing vulnerabilities among agricultural sector stakeholders

and increasing the potential success of agricultural investment strategies.

CONSULTANT 1: CROP SPECIALIST

The consultant will act as the ASRA's key focal point in the field and will be expected to take the lead in planning, organizing, and facilitating the mission. In particular, participation in this assessment will consist of the following responsibilities:

- Liaising directly with key governmental and non-governmental partners at all levels to increase awareness and support for the activity
- Providing the team with mission-critical local perspective and sectoral context related to risk and risk management
- Spearheading and coordinating information and data collection efforts before, during, and after the mission
- Taking the lead in identifying key stakeholders for informational interviews and focus groups, as appropriate, and developing mission itineraries and meeting schedules
- Performing data analysis of crop production and estimated losses, and other types of analytical work as determined by the task team leader (TTL)
- Managing activities of other local consultants to ensure that all efforts are well coordinated and appropriately focused, per the TTL's direction
- Coordinating field visits and interviews and independently leading some portion of the consultations with stakeholders
- Participating in team discussions at the end of the field visits to synthesize stakeholder input and assisting with organizing a workshop (and identifying participants) to share the preliminary findings with key counterparts
- Contributing independently to key sections of the final report (in English) and performing any other activities as instructed by the TTL

SELECTION CRITERIA

For providing assistance in designing and conducting national agricultural sector risk review, the World Bank is recruiting a consultant with the following characteristics:

1. More than 25 years of experience designing, implementing, and analyzing agricultural development programs in (specify region)
2. Broad-based experience in one or more relevant fields, including agricultural and rural investment, policy planning, sectoral analysis, food security, agricultural marketing, or institutional development
3. Experience with value chain methodology and approaches a plus
4. Experience with rice, groundnuts, sorghum, or other major crops relevant to the study
5. Relevant analytical skills, operational experience, training, and credentials to perform the technical tasks required for the risk assessment mission
6. Fluency in spoken and written (specify language)

CONSULTANT 2: LIVESTOCK SPECIALIST

The consultant will provide technical expertise on the livestock sector, related supply chains (meat, dairy, poultry), and production systems. The consultant's participation in this assessment will consist of the following:

Phase I:

- Conducting research and compiling, organizing, and analyzing primary and secondary data relevant to risks in the subsector;
- Identifying relevant stakeholders to participate in consultations and assisting with the development of an appropriate mission agenda; and
- Participating in team discussions in preparation for fieldwork.

Phase II:

- Coordinating with other consultants and ASRA team members;
- Facilitating interactions, including focus group discussions, with sector stakeholders to collect data;
- Analyzing production, market, and enabling environment risks to the livestock sector, including meat, dairy, and poultry supply chains and risk impacts on livelihoods;
- Assessing levels of vulnerability and risk management capacity across pastoralist and agro-pastoralist livelihood systems;

- Performing quantitative or qualitative analysis of frequency and severity of losses to the livestock subsector and related supply chains;
- Participating in the quantification and prioritization of risks, using AMRT's methodology;
- Analyzing the existing risk management (mitigation, transfer, coping) landscape across the livestock subsector at micro- (rural), meso- (market), and macro- (institutional; policy) levels;
- Recommending measures and interventions for improved risk management using ARMT's methodology; and
- Participating in a stakeholders' roundtable to validate and share initial findings.

Phase III:

- Conducting follow up as necessary to address knowledge and data gaps;
- Contributing key sections to the final report; and
- Performing any other relevant technical task required by the TTL.

SELECTION CRITERIA

For providing assistance in designing and conducting the ASRA, the consultant should have

1. A minimum of 10 years of experience working in and studying animal health and husbandry, livestock management, feed and fodder management, processing technologies, livestock extension systems, and related activities, preferably in (specify region);
2. Minimum of a master's degree in animal husbandry, livestock management, animal health, veterinary services, dairy food technology, or a related field;
3. Proven experience in conducting rapid assessments and in working effectively in multidisciplinary teams;
4. Excellent communication, analytical, and report writing skills, with fluency in spoken and written English and (specify language);
5. Experience with value chain methodology, approaches, and concepts a plus; and
6. Relevant analytical skills, operational experience, training, and credentials to perform the technical tasks required for the ASRA mission.

CONSULTANT 3: VALUE CHAIN SPECIALIST

The consultant has experience with value chain development, postharvest, food safety, marketing, training and extension, and project management. The consultant's participation in this assessment will consist of

- Independently leading parts of the ASRA;
- Assisting in identifying relevant supply chain actors to participate in stakeholder consultations;
- Organizing, planning, and managing independent meetings with a range of agricultural sector stakeholders;
- Collecting, organizing, analyzing, and sharing quantitative and qualitative data on agricultural risks and risk management activities with the assessment team;
- Identifying and reviewing existing resources on agricultural risks in the country;
- Coordinating with other teams and consultants;
- Performing quantitative analysis of the frequency and severity of losses from agricultural risk;
- Analyzing existing and potential risk management measures (mitigation, transfer, coping);
- Prioritizing risks and risk management measures using ARMT's methodology;
- Participating in a stakeholders' roundtable to validate and share initial findings;
- Authoring specific sections of the assessment report and providing input to refine, finalize, and disseminate it; and
- Performing any other relevant technical tasks required by the TTL.

SELECTION CRITERIA

For providing assistance in designing and conducting the ASRA, the World Bank is recruiting a Consultant per the following:

1. More than 20 years of experience designing, implementing, and analyzing agricultural development programs in (specify region)
2. Broad-based experience in one or more relevant fields, including agricultural and rural investment, policy planning, sectoral analysis, food security, agricultural marketing, or institutional development

3. Experience in one or more relevant subsectors, including staples, cash crops, horticulture, or livestock
4. Experience with value chain methodology and approaches a plus
5. Relevant analytical skills, operational experience, training, and credentials to perform the technical tasks required for the risk assessment mission
6. Written and oral fluency in local language a plus

APPENDIX H

EXAMPLE OF A COMMODITY RISK PROFILE IN GHANA

COMMODITY RISK PROFILE: YAMS

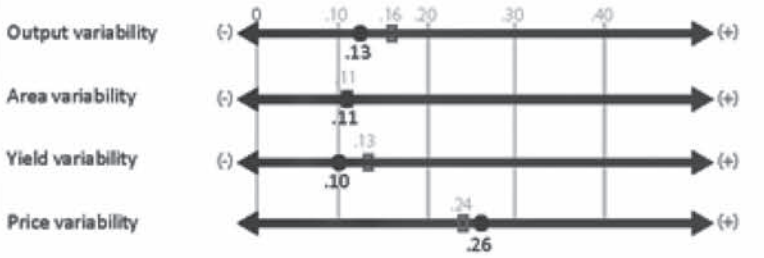
A leading staple, yams are an important source of calories and protein in Ghana. The starchy tubers are widely produced across the country for household consumption, primarily within the transitional, deciduous forest, and rainforest zones where agro-climatic conditions are most favorable. Yams account for only 6% of land under cultivation but contribute approximately 23% to agricultural GDP. With excellent storability, yams are also critical to food security. Per capita consumption of more than 295 kcal/day is second only to Benin and Cote d'Ivoire. After Nigeria, Ghana is the second biggest producer in the world as well as a leading exporter.

Like cassava, yams exhibit a relatively low level of production variabiliy, but with a higher level of indicative loss. Yam crops face considerable pressure from a range of insect pests (e.g., leaf and tuber beetles, mealybugs, scales), fungal (e.g., anthracnose, leaf spot, leaf blight, tuber rots), and viral diseases. As vectors for contagion, nematodes are also a constant threat. All contribute to substanital yield loss and higher levels of post-harvest losses. In the late 90s, a research team concluded that approximately 40% of output was lost annually due to pest and diseases. A decade later, IITA estimates that yields remain a mere 14 percent of potential harvests. Given many pests and pathogens are known to spread via planting material, management efforts have focused on improving farmers' access to affordable and disease-free seeds. During the 21-year period of analysis, yams was subject to only one relatively severe production shock (1994). Following a 5-year period of high price volatility ending in 1999 when associated losses amounted to an estimated 1.07% of GAO, real prices for yams have remained relatively stable.

KEY CROP FACTS

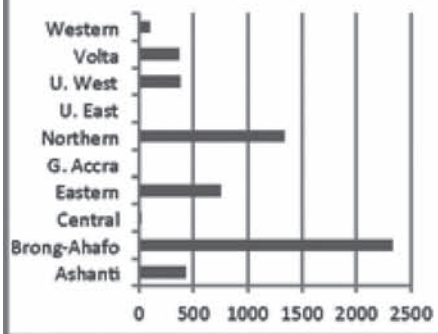
- Total output (2011) - 6.29 million MTs
- Gross output value (2011) - $1.6 billion
- Share of Agricultural GDP (2011) - 23%
- Output growth (1990-2011) - 243%
- Area planted (2011) - 403,798 Ha
- Share of total area planted - 6%
- Area growth (1990-2011) - 125%
- Yield (2011) - 15.6 MT/ha
- Achievable yield - 28.3 MT/ha
- Yield growth (1990-2011) - 63%

MEASURES OF CROP VARIABILITY (1990-2011)*



*Coefficients represent the degree of inter-anual variation against 9-crop average during the period 1990-2011; see Figure 3 and 8 of the report.

OUTPUT BY REGION, 2009 (in '000s MT)

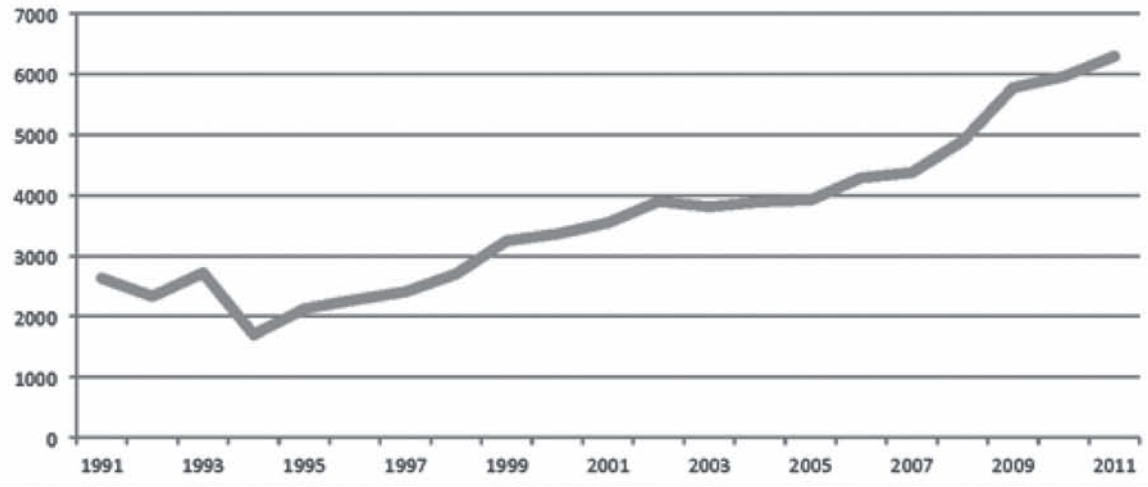


SHARE OF AGICULTURAL GDP, 2011

KEY RISKS

1. Fungal diseass (e.g., anthracnose, leaf spot, leaf blot, tuber rots)
2. Pests (e.g., nematodes, leaf/tuber beatles, mealybugs, termites)
3. Flood/excessive rain
4. Price volatility
5. Excessive heat

YAM PRODUCTION, 1990-2011



APPENDIX I

EXAMPLE OF A REGIONAL RISK PROFILE IN UPPER WEST REGION OF GHANA

REGIONAL RISK PROFILE: UPPER WEST

With over 18,480 square kilometers, the Upper West region covers about 7.7 percent of Ghana's total land area. It's population amounts to 678,000, implying a very low population density. The region falls within the country's sudano-sahelian zone with an average rainfall of approximately 1022mm. Agriculture dominates the regional economy. Main crops include maize, groundnuts, millet, sorghum and rice. The livestock sector has traditionally made a major contribution to the rural economy; at the time of the last national census, some 23% of the nation's cattle herd were found in Upper West.

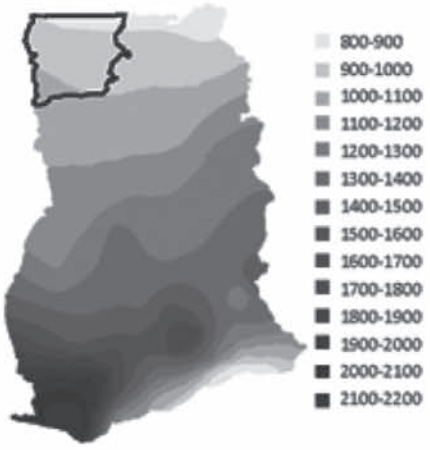
The percentage of organic matter in soils is lower in Upper West than in Ashanti or West regions so that over 30% of north savannah households use inorganic fertilizer, compared to 15% in the Coast and Forest zones. There is deemed to be little to no irrigation potential in Upper West Region.

In 2008, average regional household incomes were the lowest among all ten regions: GHc 106, compared to the national average of GHc397. Typical production constraints reported by households include low soil fertility and limited access to agro-chemicals. Key risks highlighted were uncertain rainfall, price volatility, crop pests and diseases, livestock diseases, flooding/excessive rainfall, and uncertain availability of inputs.

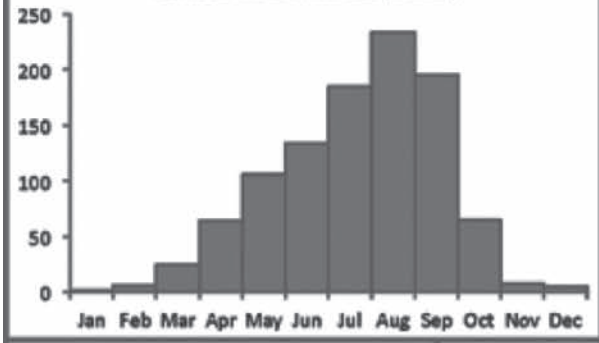
During the 1992-2012 period, the region experienced single or combined crises during 13 years, including 8 years of general or localized drought (1 catastrophic, 3 severe and 4 moderate). Others crises included national instability, ethnic conflicts, bush fires, and localized flooding.

AGRO-ECOLOGICAL ZONES

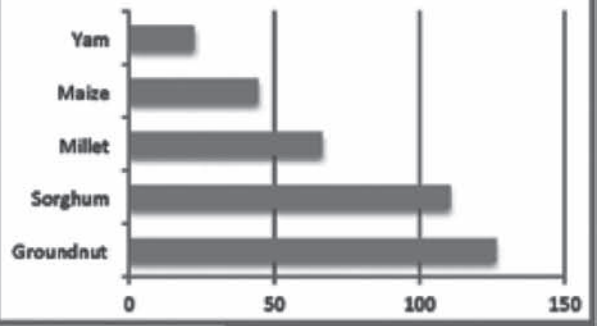
ANNUAL RAINFALL (in mm)



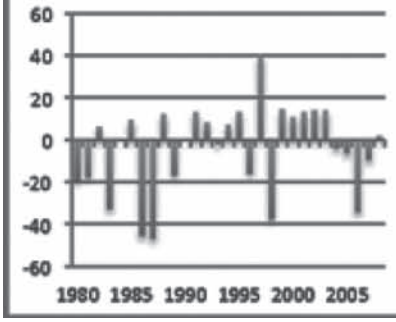
CUMULATIVE RAINFALL (in mm)



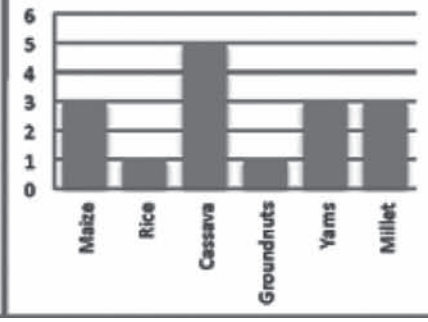
TOP CROPS (acreage in 000's of Ha)



INCIDENCE OF RAINFALL EVENTS, 1990-2008



INCIDENCE OF CROP LOSS EVENTS, 1992-2008



KEY RISKS

1. Drought/uncertain rainfall
2. Price volatility
3. crop/livestock pests and diseases
4. Excessive rainfall/rainfall
5. uncertain input supply (i.e., quality, availability, prices)

APPENDIX J

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APPENDIX K
PRIORITIZATION OF RISK MANAGEMENT MEASURES IN NIGER—A FILTERING APPROACH

Many risk management measures are complementary in nature and will contribute to improved risk management in the short, medium, and long term. In a resource-constrained environment, however, decision makers are compelled to find the quickest, cheapest, and most effective measures among a myriad of possibilities. Ideally, a detailed, objective, and exhaustive cost-benefit analysis will help in selecting the most appropriate intervention options. But conducting a cost-benefit analysis of a multitude of options can be costly and time consuming. As such, using decision filters to evaluate and prioritize among a list of potential interventions can help in making rational resource allocation decisions in lieu of a detailed cost-benefit analysis. The Agriculture Risk Management Team conducted a filtering exercise in Niger to prioritize risk management interventions using some simple criteria as filters (see table K.2).

- **Relative benefits:** The most beneficial interventions were those that reduced the hazards, exposures, and losses associated with the various identified risks. Further, if the intervention could lead to additional benefits (for example, yield or efficiency improvements or cost reduction), it was rated highly. Table K.1, taken from the 2013 "Niger Agricultural Sector Risk Assessment" (World Bank 2013c), shows the "relative benefits" filter in actions.
- **Relative cost:** Without detailed assessments, it may be difficult to estimate the cost of some interventions. ARMT's experience is that the "relative cost" of interventions can be assessed more readily. For example, the cost involved in a large-scale irrigation project is usually much higher than the cost involved in setting up a system for seed distribution.
- **Scalability:** Owing to a required prerequisite some interventions may benefit a small group of stakeholders, but other interventions may have much greater potential to be scaled-up and benefit a much larger group of stakeholders.

TABLE K.1. RELATIVE BENEFITS OF RISK MANAGEMENT MEASURES

Type of Intervention	Reduces the Hazard	Reduces the Exposure	Reduces the Losses	Compensates after the Loss	Yield or Productivity Improvements	Addresses Multiple Risks
Drought-tolerant seed varieties (M)	No	Yes	Yes	No	Yes (in a drought, not otherwise)	No
Soil and water conservation/ NRM (M)	No	Yes	Yes	No	Yes	Yes
Irrigation (M)	No	Yes	Yes	No	Yes	No
Early detection and destruction of locust (M)	No	Yes	Yes	No	Yes	No
Community-level food and fodder banks (M and C)	No	Yes	Yes	No	No	No
Vaccination programs (M)	No	Yes	Yes	No	Yes	No
Insurance (T)	No	No	No	Yes	No	Yes
Shortening emergency response time (C)	No	Yes	Yes	No	No	Yes
Strategic de-stocking (C)	No	Yes	Yes	No	Yes	No
Contingent financing (C)	No	Yes	No	Yes	No	Yes

Source: World Bank 2013c.
Note: (M) = Mitigation; (T) = Transfer; (C) = Coping. NRM = Natural resource management.

- **Ease of implementation:** The technical complexity of an intervention and local stakeholders' capacity to implement it is another filter that can be used in prioritization. Simpler interventions might be more readily accepted by stakeholders and therefore easier to implement.
- **Return time:** Some interventions have a long gestation period, whereas others yield quick results. Risk management requires short-, medium-, and long-term perspectives, but quick wins are often a high priority for decision makers.
- **Adverse impact on the environment:** Some risk management interventions (for example, large-scale spraying of chemicals for locust destruction) could have catastrophic long-term consequences for the environment. Hence, it is important to scrutinize the potential adverse impacts of a given intervention on the environment.
- **Potential impact on poverty alleviation:** Although some interventions directly contribute to improved income and poverty alleviation, others do so indirectly. Using this filter helps in identifying risk management interventions that might yield the largest poverty alleviation dividends.

Based on prioritization of risk and intervention measures, six interventions offered the greatest risk management benefits in Niger: (i) drought-tolerant crop varieties;

TABLE K.2. DECISION FILTERS AND INTERVENTION CLASSIFICATION

Type of Intervention	Scalability	Relative Cost	Ease of Implementation	Return Time	Adverse Impact on Environment	Potential Impact on Poverty Alleviation
Drought-tolerant or improved seed varieties (M)	High	Medium	Medium	Short	Low	High
Soil and water conservation and NRM (M)	High	Medium	Medium	Medium	Low	High
Irrigation (M)	Low	High	Low	Short-Med	Moderate	High
Early detection and destruction of locust (M)	High	Medium	High	Short	Moderate	Low
Community-level food and fodder banks (M and C)	High	Medium	Medium	Short	Low	High
Vaccination programs (M)	High	Medium	Medium	Medium	Low	High
Contingent financing (C)	High	Low	High	Short	Low	Low
Shortening emergency response time (C)	Medium	Low	Medium	Short	Low	Low
Strategic destocking (C)	Low	Medium	Low	Medium	Low	Low
Insurance (T)	Low	Low	Medium	Medium	Low	Low

Source: World Bank 2013c.
Note: (M) = Mitigation; (T) = Transfer; (C) = Coping. NRM = Natural resource management.

(ii) soil and water conversation and NRM interventions; (iii) expansion of small-scale irrigation; (iv) support to community-level food and fodder banks; (v) continuous support to early detection and destruction of locusts; and (vi) livestock vaccination programs. Stakeholders could choose other criteria as filters, but it is important to ensure clarity, consistency, and objectivity while using them to evaluate decision options.

APPENDIX L
EXAMPLES OF AGRICULTURAL RISK MANAGEMENT SOLUTIONS

	Mitigation	Transfer	Coping
Production			
Drought (crop)	Sustainable land management (SLM)	Macro- (government) level crop insurance	Use of weather index for triggering early warning and response
	Conservation agriculture	Farm-level crop insurance	Food-for-work programs
	Natural resource management	Weather-index insurance	Cash-for-work programs
	Strengthen early warning systems	Community risk pooling	Promoting household and community savings
	Water harvesting		Establishing and managing strategic grain reserves
	Irrigation expansion and development		Contingent financing and other financial instruments for financing coping strategies
	Investment in small-scale irrigation (dry season farming) to improve nutrition and food diversity		Decentralized disaster contingent fund for rapid response to local emergencies
	Development & dissemination of drought-tolerant seed varietals		Cash payments
	Safety net interventions		Migration for work
	Crop diversification		Emergency food distribution to affected communities
	Improved water and soil management		Informal credit
	Improved farming techniques (for example, intercropping, conservation tillage)		Formal and informal borrowing
			Savings for consumption smoothing
			Sale of livestock and other assets

	Mitigation	Transfer	Coping
Drought (livestock)	Interventions for improving livestock feed and fodder availability (pasture improvement and forage production)	Sovereign agricultural risk financing	Facilitate early destocking of livestock
	Community-level fodder and forage banks	Public-private partnership in livestock insurance	Livestock food and forage delivery
	Modifying transhumance patterns		Emergency food aid
	More strategic destocking		Cash- and food-for-work programs
	Health interventions (improving access to deworming medicines and salt licks)		Fodder banks
	Invest in livestock sector infrastructure		Contingent financing and other financial instruments for financing coping strategies
	Hay making and storage, irrigated fodder production		Cash payments
	Livestock microfinance		Migration for work
	Institutional reform		Use of weather index for triggering early warning and response
	Reserve grazing pastures and standing pasture		Building water pans
	Controlled livestock movement		Exceptional livestock movements
	Conditional parks grazing, wildlife, and livestock coexistence		
	Increase water conservation pans		
	Intensification and strengthening of disease surveillance		
	Community peacekeeping programs		
	Strengthening community customary governance		
	Capacity building (for farmers and local officers)		
Pest and disease outbreaks (crop)	Development and dissemination of pest-and disease-resistant seed varietals		
	Improved and sustained support for early detection and destruction of locusts		
	Fumigation (storage)		
	Promoting hermetically sealed sacks or silos (on farm)		
Pest and disease outbreaks (livestock)	Increased vaccination campaigns		Quarantine measures
	Improving veterinary services and access to services		Livestock vaccination

	Mitigation	Transfer	Coping
Excessive rainfall and floods	Improved land management practices (for example, retain and store potential flood water) Micro- and small-scale irrigation development Irrigation rehabilitation Terracing	Flood index insurance	Public disaster relief payments Flood detection and early warning Social protection programs
Windstorms	Introduce vegetative barriers and crosswind ridges Development of stronge and resistant varietals and grafting techniques Climate-smart farming		
Bushfire	Introduce and strengthen legislation governing bush burning Community education and environmental awareness Improved land management to prevent the invasion of grasslands by trees and shrubs		
Market			
Consumer price volatility	Community-level price stabilization Improved use of existing market information for earlier response to food price spikes Upgrade market information systems Lower barriers to trade Increase production		Improving efficiency of emergency grain reserve Shortening emergency response time
Commodity price volatility	Commodity exchange Use of forward contracts Strengthening management information systems (MIS)	Hedging Forward contracts Warehouse receipts	
Interest rate volatility			
Exchange rate volatility		Hedging Forward contracts	
Counterparty risk and default	Strengthening regulatory and legal framework Use of contracts		
Logistical risks	Improving the efficiency of private storage (lower losses, and so on) Marketing (road, storage) infrastructure development		

	Mitigation	Transfer	Coping
Input price volatility	Lower barriers to trade More transparent government support policy Strengthening import financing Use of forward contracts Infrastructure development		
Enabling Environment			
Regulatory risk (domestic and int'l)	Promote food safety and quality standards Diversify market destinations and trading partners		
Erratic gov't intervention and policy	Development of long-term, transparent policy		
Institutional risk and failure	Strengthen land tenure systems		
Political instability	More inclusive, broad-based policy-making process, reinforcing traditional mechanisms and creating joint customary and formal mechanisms		Social protection programs

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WORLD BANK GROUP REPORT NUMBER 100320-GLB

WORLD BANK GROUP

1818 H Street, NW
Washington, D.C. 20433 USA
Telephone: 202-473-1000
Internet: www.worldbank.org/agriculture
Twitter: @WBG_agriculture

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