AGRICULTURE GLOBAL PRACTICE TECHNICAL ASSISTANCE PAPER

TAJIKISTAN

AGRICULTURAL SECTOR RISK ASSESSMENT

Sandra Broka, Åsa Giertz, Garry Christensen, Charity Hanif, and Debra Rasmussen

World Bank Group Report Number 103077-TJ

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Abbreviations

CAREC	Central Asia Regional Economic Cooperation
CLARA	Cash-flow Linked Agricultural Risk Assessment
CV	coefficient of variation
EU	European Union
FAO	Food and Agriculture Organization
FMD	foot and mouth disease
GAO	gross agricultural output
GBAO	Gorno Badakhshan
GDP	gross domestic product
GIZ	German Agency for International Cooperation
HACCP	hazard analysis and critical control point
IFAD	International Fund for Agricultural Development
IFC	International Finance Corporation
IMF	International Monetary Fund
ISO	International Organization for Standardization
LEWS	livestock early warning system
LHESP	Livestock Health Extension Services Project
LSIS	Living Standards Improvement Strategy
MOA	Ministry of Agriculture
NBT	National Bank of Tajikistan
NGO	nongovernmental organization
OFFS	on-farm food safety
OIE	International Office of Epizootics (World Organization for Animal Health)
PES	payment for environmental services
PPR	pestes des petits ruminants
PUA	pasture user association
RRS	Region of Republican Subordination
TEU	20-foot equivalent unit
TJS	Tajik Somoni
WTO	World Trade Organization

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Executive Summary

Agriculture is among the most risk-prone sectors in the economies of Central Asia. Production shocks from weather, pests and diseases and adverse movements in agricultural product and input prices not only impact farmers and agri-business firms, but can also strain government finances. Some of these risks are small and localized and can be managed by producers. Others are the result of more severe, exogenous shocks outside agriculture or outside the country, which require a broader response. Failure to respond adequately to these more severe risks leads to a perpetual cycle of "shock-recovery-shock", which reinforces poverty traps and compromises long-term growth.

The agriculture sector's exposure to production and price risk is increasing. Climate change is increasing production risks in the short to medium-term by increasing the frequency and severity of droughts and floods and in the longer-term by reducing the availability of water for irrigation due to accelerated glacial melt. The modernization and commercialization of agricultural production and processing, which is critical for sector growth, also raises the sector's exposure to price risk at a time of high volatility on international markets for agricultural commodities.

An effective response to these risks requires a broader, more integrated approach to risk management than the current system of ex-ante, public sector activity associated with crop and livestock disease and ad hoc, ex-post emergency responses to local disasters. Measures to strengthen risk mitigation will need to be mainstreamed into sector development and investment programs, additional human and financial resources will need to be allocated to the public institutions responsible for ex-ante and ex-post risk management, and the potential for transfer (insurance) mechanisms will need to be clarified and developed where feasible. Given the limited human and financial resources available for public sector activity, a clear sense of the priorities for agriculture risk management is also required, together with a balanced view of the respective roles of public and private sector stakeholders.

In response to these issues, the World Bank Group (WBG) initiated an agricultural sector risk assessment in Tajikistan in 2014, as part of a three-country study to improve agricultural risk management at both national and regional level (the reports for Kazakhstan and the Kyrgyz Republic are also available). Based on a framework developed by the Bank's Agricultural Risk Management Team, this work consists of three phases. Phase I identifies, analyses and prioritizes the systemic risks affecting production, markets, the enabling environment, and public sector support to agriculture. The second phase focuses on solutions and strategies, and on the instruments that will be most effective in reducing major risks, including technical assistance, investments by local governments and development agencies - and how these instruments can best be scaled up. Phase III of the national agriculture sector risk assessment, which is not covered in this report, involves support for the public sector to develop a systematic agricultural risk management plan. The ultimate objective of this body of work is to reduce short and medium term volatility in the agricultural sector while improving resilience over the longer term, thereby reducing vulnerabilities among all stakeholders and increasing the potential success of agricultural investment and development strategies.

For purposes of discussion and analysis, risks to agriculture are defined as an uncertain or unpredictable event with adverse consequences for the volume or value of agricultural output. Risk

thus differs from constraints to agriculture, which are permanent impediments to sector output. Sudden shocks to production (droughts, floods, locusts), prices or the enabling environment (sudden policy changes or sharp, unexpected exchange rate movements) are thus considered risks; while factors such as low productivity, poor access to credit, lack of land and lack of information are viewed as constraints. Analysis is based on the risks that led to significant shocks to agricultural output, at both aggregate and commodity level, for the 20 year period from 1992-2012.

The agriculture sector in Tajikistan faces two different types of risk: high-cost low-frequency risks associated with sector-wide events such as the onset of civil war in 1993 and a generalized price shock in 2007; and low-cost, medium-frequency, commodity-specific risks associated with drought and price volatility. The low frequency of major, sector-wide shocks is attributed to the high level of diversification at both farm and sector level, and access to irrigation. No single commodity accounts for more than 10 percent of total output, and most farms produce a diverse mix of (irrigated) crop and livestock commodities. Drought is the main production risk at commodity level, with cotton as the most vulnerable crop. Inter-annual price volatility is a greater source of risk than drought, however, affecting more commodities, and resulting in a higher frequency and severity of commodity-level losses.

These results show that public and private sector initiatives to support the current high level of diversification within the sector, and to maintain the physical and institutional infrastructure for irrigation are the foundation for agricultural risk management. At commodity level, future agricultural sector development will need to place more emphasis on responding to price risk for all commodities, as opposed to the traditional emphasis on production risks for cotton. As government is very aware of the need for diversification and irrigation, and sector investment programs already support these imperatives, Phase II of the study focused on the development of more specific recommendations for risk management grouped under two "Solution Areas": the *creation of market opportunities* and the *improvement of livestock production*.

Many of the price risks facing specific commodities can be significantly reduced by measures to create more market opportunities in both domestic and regional markets. Wider, deeper markets reduce price risk by improving the capacity for spatial and temporal arbitrage. Improving the competitiveness of Tajik agricultural commodities is the basis for deepening and stabilizing agricultural markets, however, starting with an increase in on-farm productivity. Associated market-related initiatives include continued investment to strengthen market information systems, storage capacity, transport infrastructure and supply chains. Market stability will also benefit from the establishment and expansion of export markets in Kazakhstan, Pakistan, and Russia, provided that Tajik products are competitive on these markets. Specific recommendations to increase sectoral efficiency and competitiveness are developed in three areas: (1) market knowledge and training, (2) investment promotion and business enabling environment, and (3) trade facilitation.

The second Solutions Area involves improving livestock productivity by strengthening the resilience of production systems and rangelands in Tajikistan. The recommended interventions under this rubric include measures to: (i) reverse water and soil degradation and improve vegetation cover, (ii) strengthen livestock services such as veterinary health, feed and fodder supply, and (iii) ensure

sustainable access to grazing lands. This sustainable access will rely on measures that ensure the long-term viability of rangeland ecosystems. Livestock producers will also benefit from timely weather and market information that enables them to manage their resources better and to protect their assets in times of drought.

The recommendations developed under these two solution areas continue the underlying emphasis on mitigation as the foundation for risk management. They also highlight the mutually reinforcing benefits of measures to improve crop and livestock productivity, the competitiveness of agricultural commodities and the depth of agricultural markets for both risk management and sector growth.

Table ES.1 summarizes the Agriculture Risk Management Actions Plan for Tajikistan, based on the Risk Identification and Proposed Solution Sections of the report.

Table ES.1 Agriculture Risk Management Action Plan Summary

Main program and subprogram	Expected outcome	Proposed monitoring indicators
Market Knowledge and Training		
Timely regular reporting of public sector market information	Improved market information; increased market efficiency	Reports complete and timely
Training and market development for private market intelligence products	Increased end market diversity for production	Survey access and utilization of market intelligence products by producers
Investment Environment and Business Enabling Environment		
Regular public/private consultative dialogue to promote ag sector investment and improve BEE	Increased private sector downstream investment; improved competitiveness of Tajik products domestically and abroad	Value of downstream investment in Ag Sector
Matching Grant Fund for Investment in Innovation and Technology Upgrades in Ag Sector	Increased efficiency and competitiveness of Tajik ag sector; Increased value addition of products (packing, grading and sorting, and/or processing)	Value of downstream investment in Ag Sector;
Trade Facilitation		
Food Safety Regulatory Reform	Increased diversity of exports	Value and diversity of export products
Community-based pasture management	Improved pasture management and increased pasture productivity	Number of pasture installations; biomass and biodiversity measures
Pasture monitoring and LEWS	Climate resilience; improved emergency preparedness	Ongoing monitoring; functional LEWS; biomass and biodiversity measures
Feed sector development	Increased supply of high-quality	Area of feeds (hectares); amount of manufactured

	nutritionally balanced livestock feeds; improved feed use on-farm	feeds (metric tons); average livestock growth rates (average daily grain); average milk yields (liters per lactation)
Irrigation management	Rationalization of irrigation infrastructure and technologies; improved water management by water user groups	Area under improved irrigation; irrigation costs per hectare; number of water user groups
Domestic animal health	Improved animal health status that supports exports; improved rural livelihoods	% coverage of vaccine programs; laboratory evaluations by OIE; % coverage of animal identification tags
Animal health: regional trans-boundary control	Reduced incidence of trans-boundary disease	Reported incidence
Indexed-based livestock insurance	Increased use of insurance products by livestock producers	% of producers participating
Conditional loans and grants	Increased investment in productivity and risk management approaches	Number of loans and % of producers participating; number of grants and % of producers participating

Introduction

Agriculture is among the most risk-prone sectors in the economies of Central Asia. These risks lead to a perpetual cycle of "shock-recovery-shock", which endangers the sustainability of ongoing initiatives and is a major impediment to the development of agriculture. These risks can lead to and reinforce poverty traps and pose serious consequences for all stakeholders. Adverse movements in agricultural commodity and input prices, together with production-related shocks (e.g from weather, pests, and diseases) not only impact farmers and firms active in agricultural sector, but may also put severe strains on a government's fiscal position. The prevalence and complexity of multiple risks facing agriculture systems and the failure to address them on an ex-ante and integrated basis, continues to leave countries and their agricultural sectors less competitive, at best, and more often extremely vulnerable.

Risks in agricultural production have become more pressing after independence with the increased reliance on local food production for livelihoods and food security. Previously managed through redistribution systems between sectors and regions in the Former Soviet Union, such risks are now left to the individual Governments to deal with.

The mainstreaming of agricultural risk management, and thereby development of medium term resilient and sustainable agricultural systems requires:

- An integrated operational approach to agricultural resource management, which is embedded in country development and investment planning;
- Expertise and capacity in the field of agricultural risk management;
- Interaction and knowledge exchange by stakeholders and practitioners, to break down the often existing siloed approach to products, strategies and risks.

In light of the above, the World Bank Group (WBG) initiated an agricultural sector risk assessment in Tajikistan, using in part the agricultural risk management framework developed by the World Bank's Agricultural Risk Management Team (ARMT) as described below in the Methodology Section.

This study is the first step towards a comprehensive agricultural risk management dialogue in Tajikistan and developing the investment program. The report is part of a three-country study (the reports on Kazakhstan and the Kyrgyz Republic are also available at this time), and also covers the regional dimension given the proximity of the countries, which leads to sharing of some of the same risks across more than one country. The analysis draws on time-series data from FAOSTAT, the World Bank's World Development Indicators, the national statistical agencies of each country, and other sources of secondary data.

Methodology

The World Bank's Agricultural Risk Management Team (ARMT) has developed an approach for a comprehensive and coherent Agricultural Sector-Wide Risk Management Framework, which covers the following:

Pillar I: Risk Assessment and Management includes a number of Technical Assistance activities to help clients evaluate agricultural risks and establish systems for improved risk management.

Pillar II: Capacity Transfer offers a range of training products on various aspects of agricultural risk management.

Pillar III: Knowledge and Networks includes production of a number of knowledge products on agricultural risk management, which, among other things, facilitates dialogue and knowledge exchange among the practitioners and stakeholders.

The ultimate objective of such assessments is to reduce short and medium term volatility in the agricultural sector while improving resilience over the longer term, thereby reducing vulnerabilities among all stakeholders and increasing the potential success of agricultural investment strategies.

National Agricultural Sector Risk Assessment (NASRA) Methodology

Phase 1: Based on a holistic framework for risk analysis and management, the agricultural sector risk assessment will identify, analyze, quantify, and prioritize systemic risks (i.e., production, market, enabling environment risks) that adversely impact the functioning and growth of the bulk of a country's agricultural commodities. The risk assessment will also evaluate existing and potential risk management strategies (i.e., mitigation, transfer, and coping) to understand if interventions are in line with the magnitude of existing risks and where gaps may exist. The ultimate objective is to optimize the use of available public resources for improved agricultural risk management and to build risk management capacity among local private and public stakeholders. The study assesses aggregate trends and risks in agricultural production, but focuses on the three major crops grown in the region (wheat, cotton, potatoes,), as well as the most important high-value vegetable crop (onions) in Tajikistan to illustrate the main risks. Together, these four crops constitute 47 percent of the country's gross agricultural output and 58 percent of total area cultivated.

Phase 2: Once the risk assessment has been conducted through desk review and in close consultation with relevant stakeholders, and the most appropriate risk management instruments have been identified, a solutions assessment will be conducted. This phase involves a mapping of: 1) prioritized risk management instruments already in place; 2) responsible institutions (including gaps and overlaps); and 3) potential needs (e.g., TA, investments, policy support) for scaling up risk management approaches to more effectively manage prioritized risks.

Phase 3: A third phase involves supporting Government efforts to: 1) develop an integrated and systematic Agricultural Risk Management Plan that appropriate responds to priority risks; and 2) and to identify and allocate resources.

Agricultural Sector Risk Assessment Study in Tajikistan

This study is limited to Phase 1 and Phase 2 of the NASRA methodology, due to time and resource considerations. Therefore, further work is needed to develop a broader, integrated agricultural risk management framework in the country, including the recommendations proposed in the Solutions part of this study. As part of report preparation, fieldwork was undertaken multiple times during the risk identification and solutions identification phases of work.

Summary of Recommendations

This analysis shows that future agricultural sector development will need to place a much greater emphasis on responding to price risk for all commodities, as well as responding to the risks of drought, flood, and water scarcity for irrigation. The recommendations in this report are targeted to encourage diversified production, create better market opportunities in response to price risks, and strengthen the resilience of production systems and rangelands. Action should be taken to:

1. **Continue support for a diversified agricultural production base and assure access to irrigation**. These are fundamental components of effective risk management.
2. **Improve productivity and competitiveness and deepen domestic markets**. These market-related measures include better market information systems, more effective supply chains, better access to storage and improved transport infrastructure;
3. **Establish export corridors from Tajikistan to export markets in Russia, Kazakhstan and Pakistan.** This will help reduce market instability for export products and improve availability of imported farm inputs.
4. **Seek guidance on how to provision public financial resources for significant periodic shocks such as locust attacks, outbreaks of trans-boundary livestock disease, droughts and floods**. The financial resources of line ministries to respond to these shocks are minimal.

Specific Recommendations for Creation of Market Opportunities

To increase sector efficiency and competitiveness, policymakers should design and implement interventions that create new market opportunities. These recommendations focus on widening and deepening agricultural markets by increasing market knowledge and training, promoting agribusiness investment, and facilitating trade.

- **Improve market knowledge by designing and implementing a market information structure**. Existing market information and forecasting tools should be inventoried, and in collaboration with the private sector, a new structure should be designed to provide timely reporting of market information.
- **Develop and implement, with the private sector, training in the use of market information and market intelligence for producers and small- and medium-size agribusinesses and traders**. These trainings may be specific to the value chain and should occur at the oblast or rayon level. Training may be leveraged to facilitate market linkages and develop business relationships.
- **Review the existing regulatory reform and investment promotion public-private consultation meetings to assess the focus on agribusiness investment and development promotion.** Ensure that all stakeholder groups are represented, and use other country experiences to devise a best-practice consultation framework in consultation with existing organizations.
- **Develop a business plan for, and create a matching grant fund to spur critical investment in new technology and encourage innovation to improve competitiveness and efficiency**. Consider risk within the framework and governance of the fund to avoid incentivizing extremely high-risk investments.
- **Create a logistics roadmap to include regulatory reform to support the development of a leasing industry and incentives to support expanded logistics services and**

businesses within Tajikistan. Develop the roadmap in consultation with the private sector, particularly financial services.

- **Undertake a food safety regulatory environment reform aimed at achieving compliance with international best practices in food safety**. Design and structure the project to address both public and private sector needs and work collaboratively with existing commodity and value chain groups.

Specific Recommendations for Improvement of Livestock Production

The interventions identified below would strengthen the resiliency of livestock systems and rangelands in the Tajikistan by i) reversing degradation of water, soil, and vegetation cover; ii) ensure sustainable access to grazing lands; and iii) strengthening livestock services, enabling farmers to manage their resources more effectively.

- **Strengthen drought cycle management and community preparedness.** Early warning indicators should be used to trigger community drought preparation and/or response interventions within the parameters of an effective national drought management framework.
- **Implement Community-based Pasture Management.** The program envisioned in the Pasture Law should be implemented with three components i) legal and regulatory policy ii) institutional strengthening, and iii) environmental management.
- **Formalize a pasture monitoring program.** The program would include components on policy and regulatory development, institutional strengthening, and development of a regional Livestock Early Warning System (LEWS) with Kazakhstan and the Kyrgyz Republic.
- **Promote supplementary feed production and pasture rehabilitation**. A livestock feed sector development project should be implemented to address feed policy, particularly feed production emphasizing drought-resistant varieties, manufacturing, testing, and use. In cropping regions, introducing more sustainable crop rotations in the grain sector can significantly increase the supply of supplementary feedstuffs, provided there is suitable market incentive for crop producers to do so.
- **Support economically viable and environmentally sustainable irrigation systems to improve productivity and adapt to climate change.** Review and reform existing institutional arrangements for water management, and develop sustainable water use groups.
- **Strengthen the country's animal health systems**. A national animal health and food safety program is needed to address various issues contributing to higher risks to human and animal health, food safety, product quality, and market access.
- **Establish a regional animal health program with Afghanistan and the Kyrgyz Republic to control transboundary diseases.** Diseases with the potential to affect trade and threaten public health, including FMD, PPR, brucellosis, tuberculosis, should be targeted.
- **Tajikistan could consider introducing index-based livestock insurance, which has been introduced in Mongolia with the assistance of the World Bank, or pasture insurance.** Any consideration of agricultural insurance should be done on the basis of a solid feasibility analysis, livestock and/or pasture, insurance.

- **Improve access to seasonal credit.** Develop season credit products that allow producers to invest in risk mitigation inputs.
- **Increase public expenditure on agriculture and funds allocated specifically to innovation and climate change adaptation at a level at least equivalent to that of other countries in the region (2.2 percent in the Kyrgyz Republic)**. Establish an innovation council and give research into livestock feeds, feeding, and feed efficiency high priority.
- **Clearly define eligibility for participation in disaster relief programs in advance**. Instead delivering relief ad hoc after a disaster occurs, rules-based mechanisms for assessment, compensation, and distribution of funds should be established within the framework of drought cycle management and community preparedness.

Country Context

With 23 percent of gross domestic product (GDP) and 51 percent of employment, the agriculture sector is a significant component of Tajikistan's economy. Crop production accounts for approximately 80 percent of agricultural output. Cereal and cotton predominate in arable areas, with cotton as the major agricultural export. Fruit and vegetable production is increasing for both domestic and export markets. Cattle and sheep are raised for milk and meat, but herds are small. Livestock are wintered on the farm and then grazed in the mountains during summer and autumn. Local (near-village) pastures tend to be overgrazed, as there is limited land for grazing relative to the number of livestock. Mountain pastures are underused due to their distance from villages and lack of water.

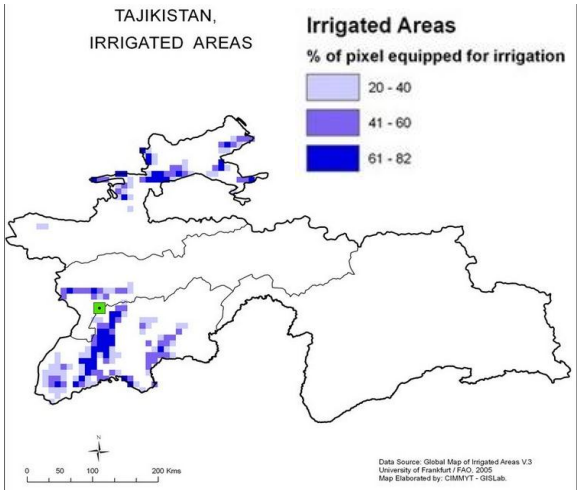
Agricultural land, especially arable land, is scarce due to the country's mountainous terrain. Of the total land area of 14 million hectares, only 35 percent (4.855 million hectares) is classified as agricultural land. Approximately 20 percent of this agricultural land is arable (980,000 hectares), and the remaining 3.875 million hectares are pasture. Small-scale, mixed farms predominate, averaging 5–10 hectares of arable land per farm. Land and labor productivity are low relative to other Central Asian countries.

Rainfall is low, and irrigation is critical for agriculture (figure 1). Approximately 70 percent of arable land is irrigated (700,000 hectares), and this irrigated land accounts for most of Tajikistan's crop production. Of the irrigated area, 60 percent is gravity fed and the rest is pump irrigation.

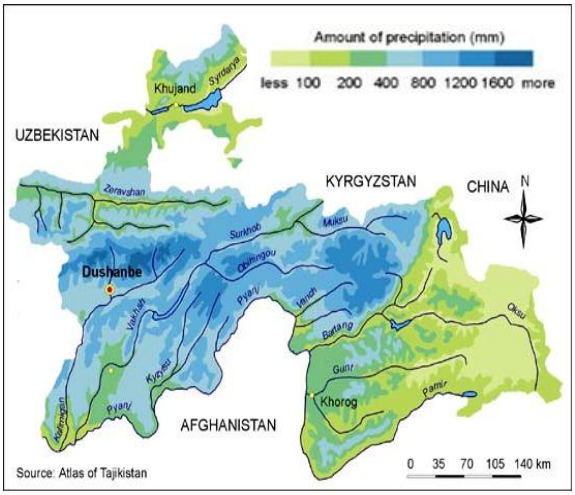
The current system for managing irrigation water is inefficient, and much of the physical infrastructure is in poor condition. Despite substantial water resources, around 20 percent of irrigated land (for example, in Kulyab, Istravshan, and Gissar regions) faces water shortages due to poor regulation of river flows (MIWMRT, UNDP, and IFSAS 2006). Inadequate funding for the maintenance and operation of infrastructure exacerbates these water shortages. These constraints are highest for pump irrigation systems, which are the most expensive to maintain and operate. As most of the irrigation systems were constructed for cotton production, areas near cotton-growing regions have better access to water for agricultural and household use.

Figure 1 Irrigated Areas and Mean Annual Rainfall in Tajikistan

a. Irrigated areas



b. Mean annual rainfall

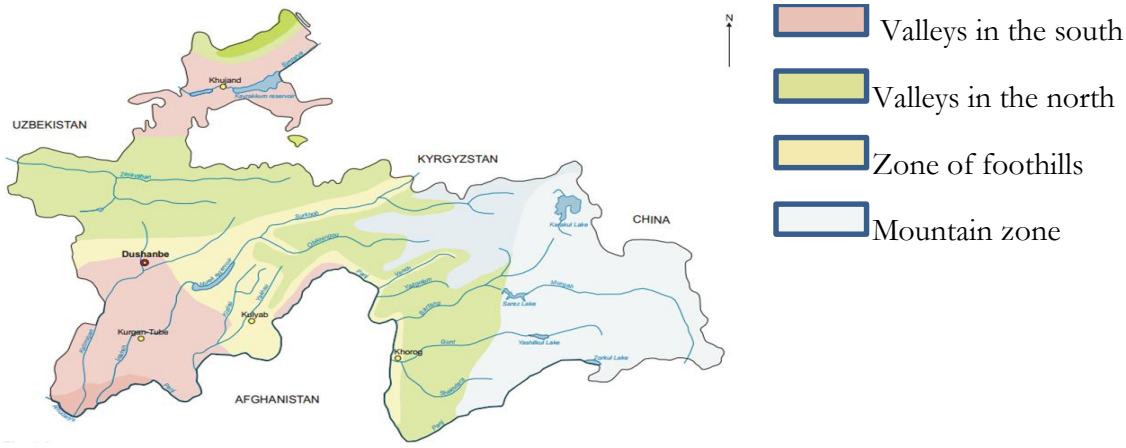


Source: University of Frankfurt and FAO 2005; CIMMYT, Atlas of Tajikistan

Agro-Climatic Conditions

A warm, dry continental climate predominates. Approximately 80 percent of crop and livestock production occurs in the irrigated river valleys in northern and southern Tajikistan, where climate, soil-type and irrigation are well suited to cotton, cereal, and horticultural production. Dryland production of cereals, potatoes, and livestock is prevalent in foothill areas throughout the country. This diversified production base combined with access to irrigation reduces production risk. Nevertheless, assured access to irrigation is vital given the low rainfall levels.

Figure 2 Agro-Ecological Zones in Tajikistan



Source: Safarov 2003.

Tajikistan has four main agro-ecological zones (figure 2). Of these, three (excluding the mountain zone) are important for crop and livestock production. These zones are characterized by different production systems due to their differing geography, climate, and natural resource base (Safarov 2003), as summarized in table 1.

Table 1 Characteristics of Main Agro-Ecological Zones of Tajikistan

Zone	*Location*	*Precipitation (millimeters)*	*Agricultural land use*
Southern river valleys	Khatlon, RRS	150–250	Cotton, wheat, rice, vegetables, alfalfa, citrus, grapes, livestock
Northern river valleys	Sughd	150–250	Cotton, wheat, vegetables, alfalfa, stone fruit, livestock
Foothill areas	Khatlon, Sughd, RRS	200–650	Cereals, potatoes, alfalfa, livestock
Mountain areas	GBAO, Sughd, RRS	> 200	Livestock, limited cereal production in valley areas

Sources: Muminjanov 2008; Lerman and Sedik 2008.

Note: RRS = Region of Republican Subordination; GBAO = Gorno Badakhshan.

The southern valleys, which are 350–800 meters above sea level, are characterized by moderate winters and hot summers, with annual precipitation of 150–250 millimeters. Crops include cotton, rice, lucerne, wheat, vegetables and maize as well as subtropical fruit (lemons, oranges). This zone covers most of Khatlon, including large cotton farms in the west and south. Approximately 320,000 hectares are irrigated. Irrigation water comes from the Kofarnihon, Vaakhsh, and Pyanj rivers, which originate in the glaciers of the Hissar mountain range and the Alai and Pamir mountain chains.

The northern valleys, which are 270–800 meters above sea level, are characterized by cold winters and very hot summers, with annual precipitation of 150–250 millimeters. Most of this zone is in Soghd oblast, with cotton grown widely in the irrigated areas. Other crops include wheat, rice, lucerne, vegetables, maize, and sorghum. This zone also accounts for most of the stone fruits that are a traditional export to Central Asia and the Russian Federation. The Syrdarya River is the main source of water for irrigation in the northern areas, and the Zarafshon River is the main source in the west. High-lift pumps are needed to supply irrigation water in the northeast.

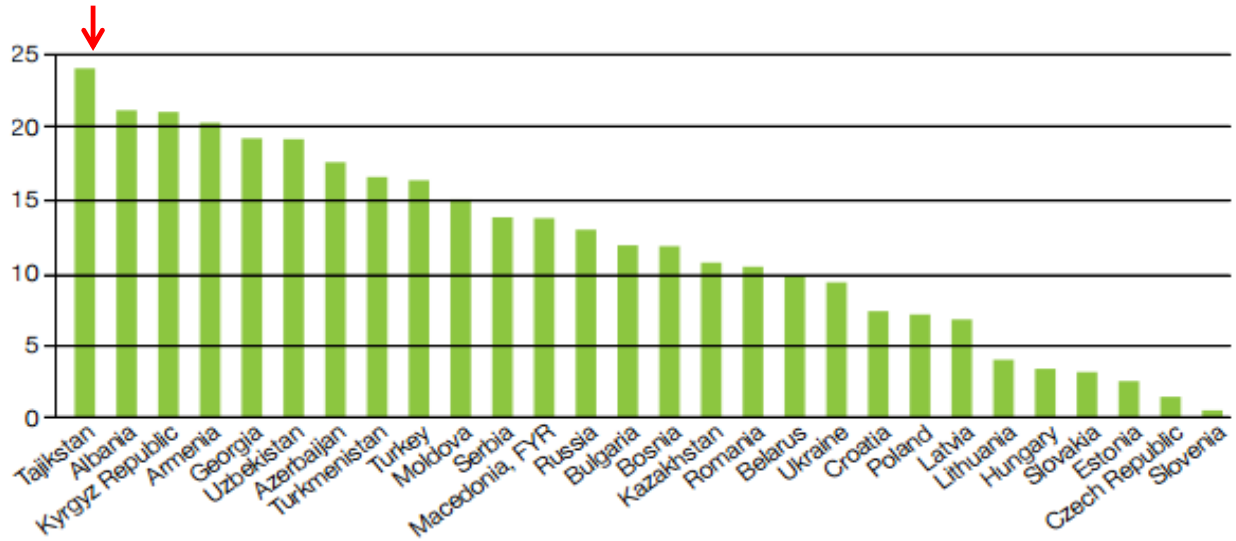
The foothill zone is located 800–2,000 meters above sea level and includes foothill areas throughout Tajikistan. It is characterized by very cold winters and hot summers; annual precipitation averages 200–650 millimeters. This zone includes the foothill regions of Khatlon and Soghd oblasts as well as the Region of Republican Subordination (RRS) and some parts of Gorno Badkhshan (GBAO). The main crops include cereals, potatoes, fruit, vegetables, lucerne, and melons and gourds. Livestock production is very important. Irrigation is limited to small areas and often relies on high-lift pumps.

The mountain zone includes regions higher than 2,000 meters above sea level, mostly in the GBAO, where winters are long and extremely cold, summers are warm, and average annual precipitation is 200 millimeters. Agricultural output is minimal. Livestock production predominates, as the short growing season and small amount of arable land limit the scope for crop production. Wheat, barley, oats, potatoes, and lucerne are the main crops.

Vulnerability to Climate Change

Tajikistan is vulnerable to numerous sources of risk, including food insecurity and climate change. According to Fay and Patel (2008), it is the most vulnerable of all 28 countries in Europe and Central Asia to climate change (figure 3).

Figure 3 Vulnerability to Climate Change in Europe and Central Asia, by Country

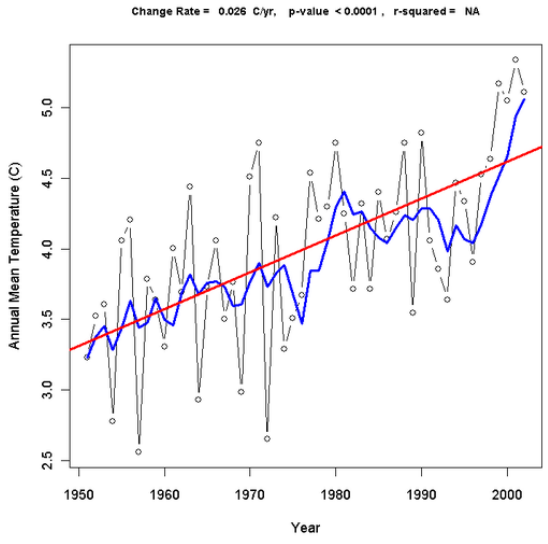


Source: Fay and Patel 2008, from World Bank 2009a.

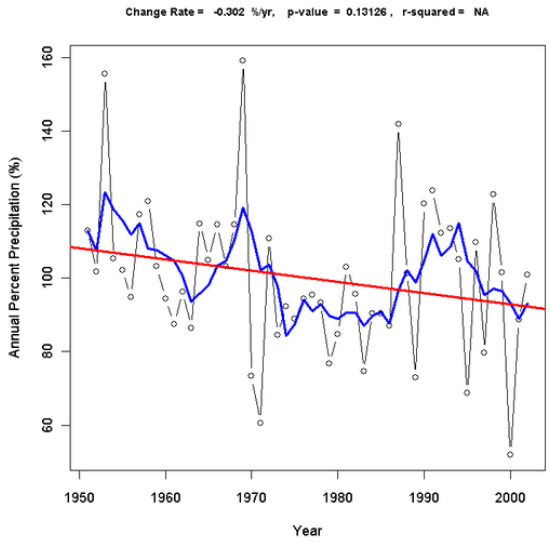
Historic and projected trends in temperature and precipitation (figure 4) show that agriculture is particularly vulnerable to climate change, with rising temperatures and falling precipitation—both in the medium and long term. Rising temperatures will increase the rate of glacial melt and the associated risks of flooding and storms in the medium term. Together with falling precipitation, these trends will reduce the availability of water for irrigation in the long term. Rising temperatures will also increase the risks of locust attacks and plant disease.

Figure 4 Annual Mean Temperature and Change in Precipitation in Tajikistan, 1950–2000

a. Annual mean temperature



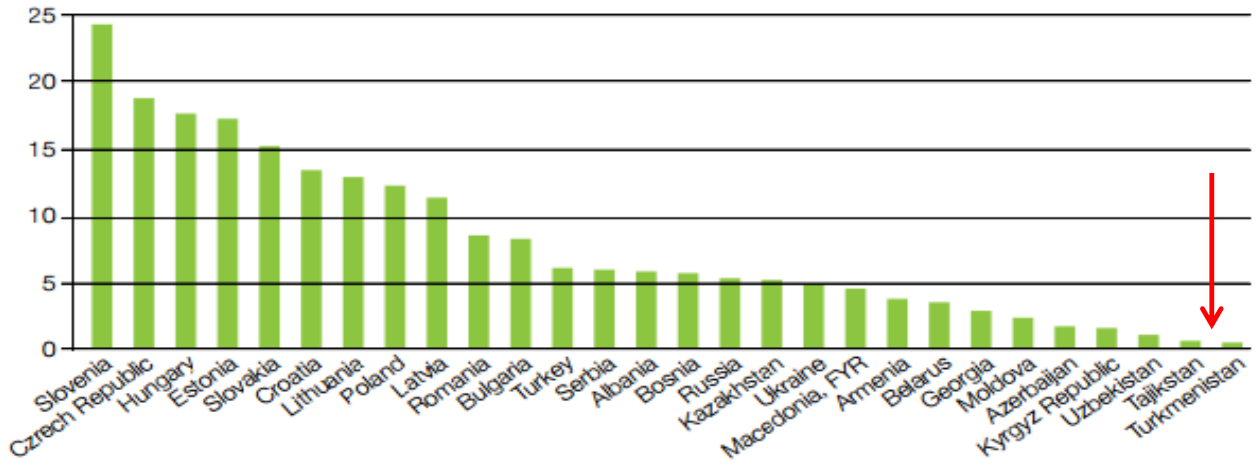
b. Mean annual percentage change in precipitation



Source: ClimateWizard.org.

Although Tajikistan clearly needs to respond to climate change, its adaptive capacity is extremely low, ranking second to last in Europe and Central Asia (figure 5).

Figure 5 Capacity to Adapt to Climate Change in Europe and Central Asia, by Country



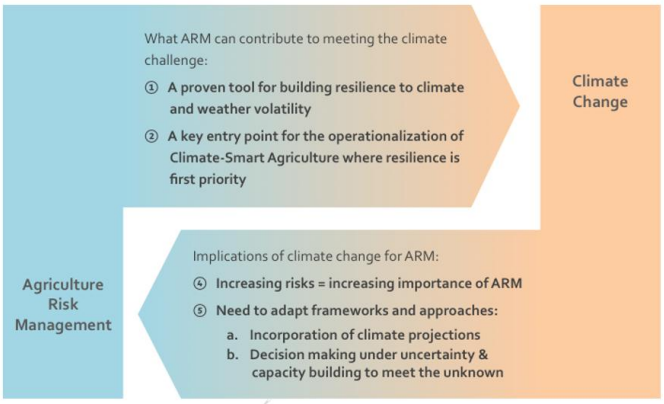
Source: Fay and Patel 2008, from World Bank 2009.

Implications for Agriculture Risk Management

Climate change will have important implications for agriculture risk management in that (i) it will change the context in which the sector operates in, and (ii) it will likely change the patterns of the risks that have occurred in the past in terms of frequency and impact. A changing climate is in itself not considered a risks but rather a trend as it is a shift that occurs over a longer term and thereby is predictable. Instead, agriculture risk assessments look at risk events that takes place as a result of unpredicted and/or extreme weather events (among other risks). Globally, most climate change models, and indeed already occurring events, point however at more volatile and unpredictable weather patterns emerging as a result of this change in climate, and with them new and/or more frequent/severe pests and diseases – i.e. more risks.

Important for policy makers is also that the context in which the sector operates may over time not be what it was in the past. Climate projections also indicate a shift in the average growing conditions. This means that policies have to adapt to the new context and longer-term agriculture risk management investments (e.g. in research and irrigation infrastructure) should take climate change projections into account. Nevertheless, agriculture risk assessments will remain important as a tool to prioritize and quantify current risks to the sector and to make optimal risk management decisions in the short to medium term (figure 6).

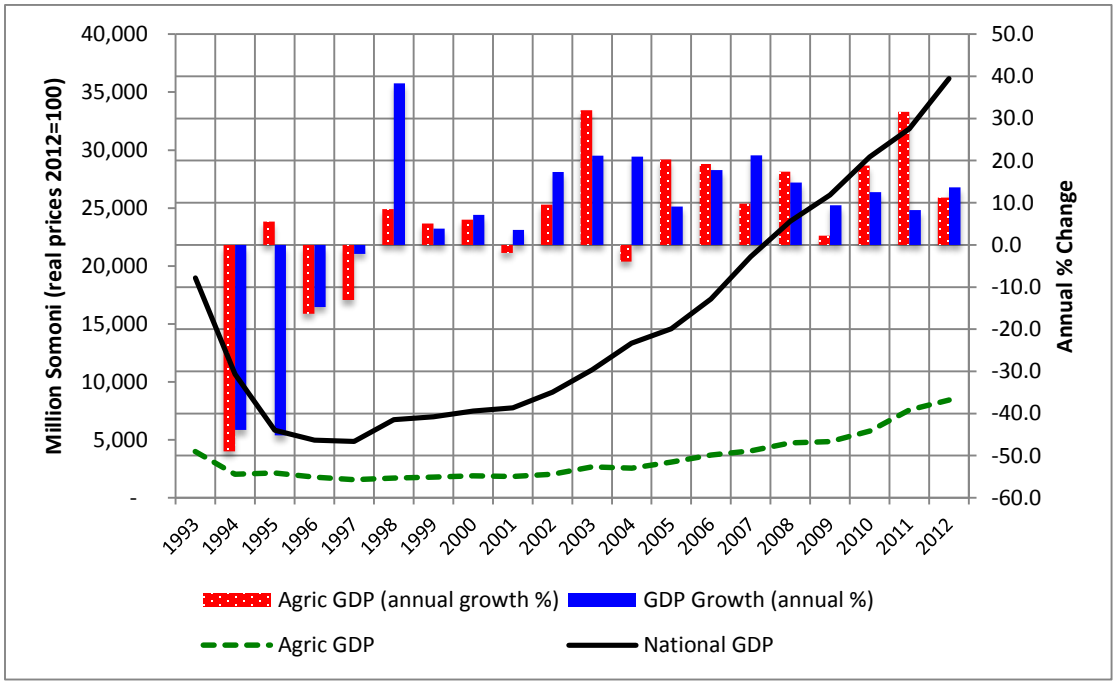
Figure 6 Implications of climate change for agriculture risk management



National and Agriculture Sector Growth

Economic output contracted sharply after the end of central planning in 1989. The initial collapse from 1990 to 1992 was due to the abrupt termination of Soviet support. Subsequent economic transition and recovery were then slowed by a prolonged civil war from 1993 to 1997. The economy has grown steadily since 1998 (figure 7) in response to progressive reform and large remittance flows.

Figure 7 National and Agricultural GDP in Tajikistan, 1993–2012



Source: World Bank various years.

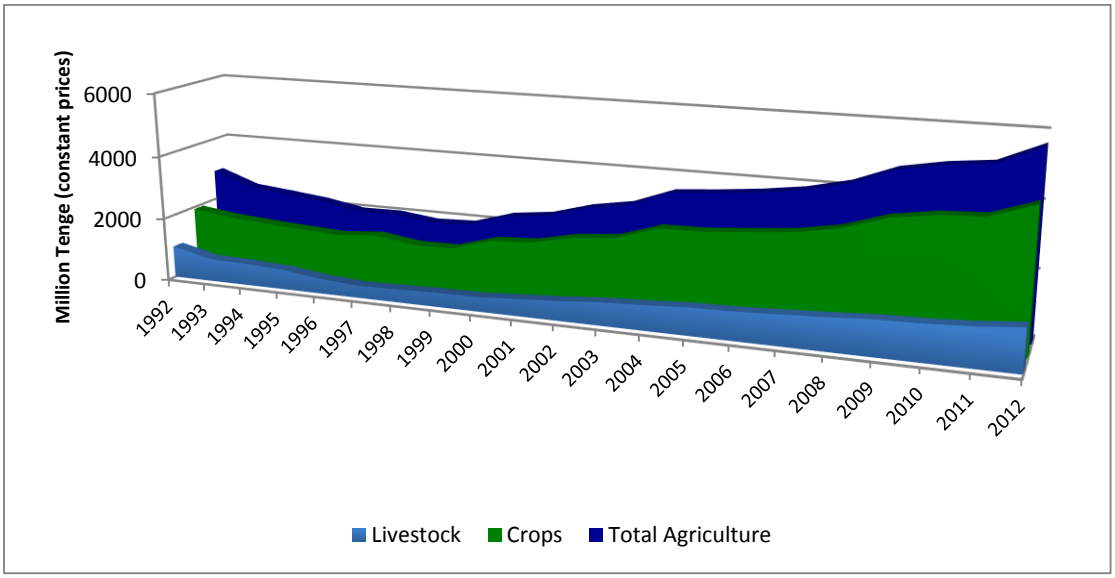
Both crop and livestock production fell after independence, with a 6 percent fall in the area cropped from 1990 to 1995 and a 30 percent fall in livestock numbers (measured in livestock units) from 1990

to 1998. Slow reform limited the initial recovery after 1998, but sector growth quickened after the acceleration of land reform and farm privatization in the mid-2000s. Agricultural GDP had recovered to pre-independence levels by 2008 and has grown in most years since then.

Aggregate Crop and Livestock Production

Analysis of gross agricultural output (GAO) in constant (2004–06) prices for the period 1992–2012 shows the contribution of crop and livestock production to overall GAO and to the variability of physical production (figure 8). Crop production accounts for around 80 percent of sector output in most years. It is also less variable than livestock production, with a low adjusted coefficient of variation (CV) of 0.15* versus 0.27* for livestock.1 The higher variability in livestock production during this period is attributed to the sharp losses in livestock experienced after independence and during the subsequent civil war.

Figure 8 Components of Gross Agricultural Output in Tajikistan, 1992–2012



Source: FAOSTAT.

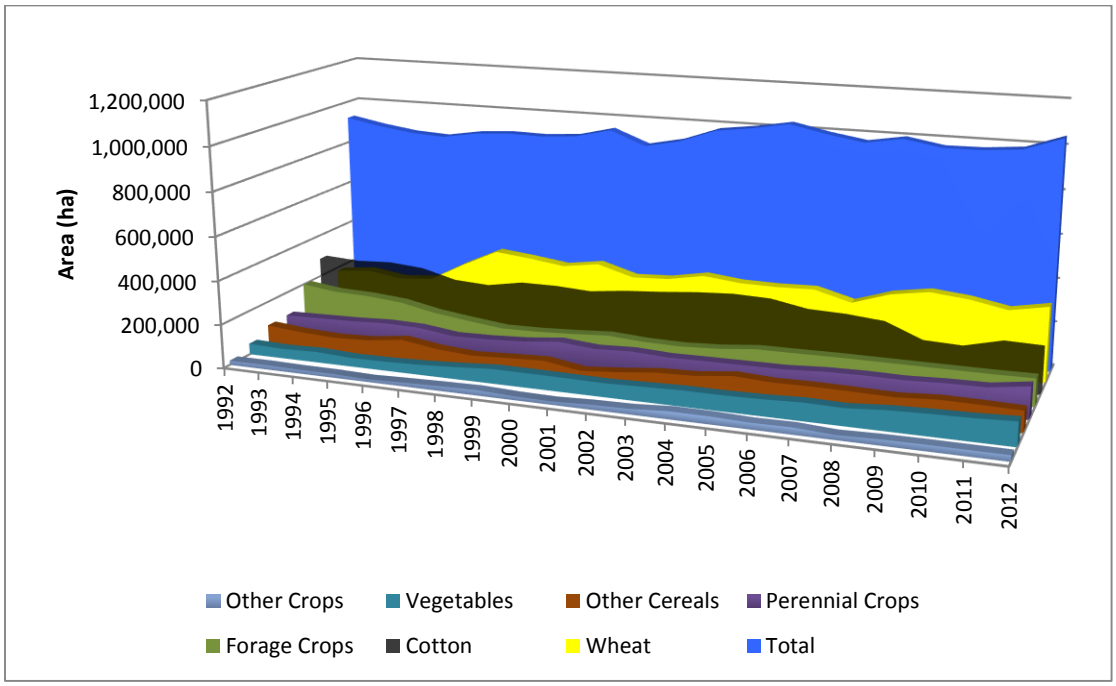
A similar pattern emerges when GAO is measured in real prices, although there is much less variability in livestock GAO, as data are only available for the period 2000–11. The adjusted CVs were 0.14* and 0.17* for real crop and livestock GAO, respectively. The variability of total GAO is also lower, with an adjusted CV of 0.14* for real price GAO since 2000, versus 0.18* for constant price GAO since 1992. This lower variability is more indicative of current levels of risk.

The reduced variability of aggregate output is attributed to increased crop diversification (figure 9) as a result of increased production of wheat after the civil war, a gradual increase in vegetable and fruit production, and a reallocation of less-productive land from cotton to wheat after the cotton debt crisis

[1] Coefficient of variation adjusted for trend using the Cuddy Delle-Valle index.

of 2008. In addition to lower levels of variability, increased crop diversification has also resulted in higher overall returns to land and labor. The area allocated to forage crops has fallen markedly, from 200,730 hectares in 1992 to 126,240 hectares in 2012. Livestock numbers increased 35 percent during the same period (measured in livestock units). This 37 percent reduction in the area allocated to forage crops has contributed to the high levels of overgrazing observed in near-village pastures and the low levels of livestock productivity.

Figure 9 Composition of Crops in Tajikistan, 1992–2012



Source: FAOSTAT.

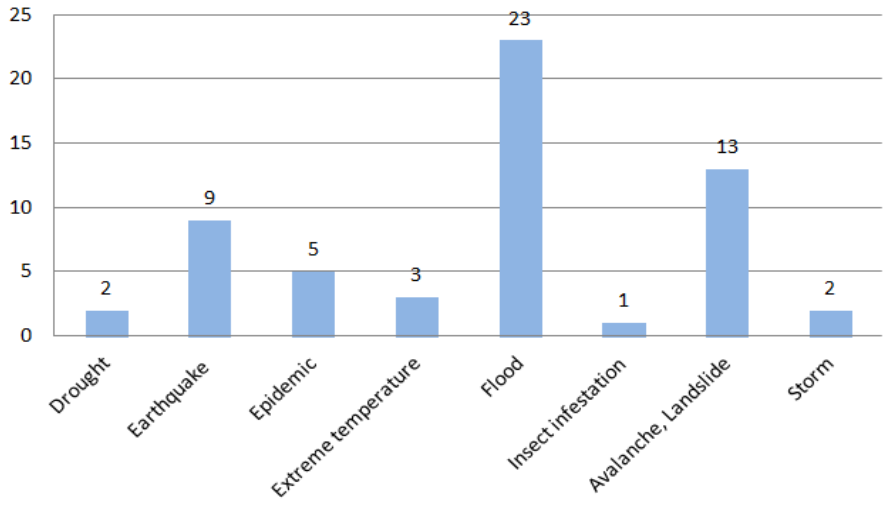
Country Risk Identification and Quantification

This section reviews the natural disasters that occur in Tajikistan and assesses their impact on agriculture. It then reviews the risks associated with the production of Tajikistan's main agricultural commodities: wheat, cotton, potatoes, tomatoes, onions, watermelons, cow's milk, beef, mutton, and eggs. These commodities account for approximately two-thirds of Tajikistan's total GAO.

Natural Disasters and Their Impact on Agriculture

Tajikistan is highly prone to natural disasters due to its mountainous terrain, climatic extremes, and location on a seismic rift. Records from the EM-DAT International Disaster Database show that Tajikistan experienced numerous natural disasters from 1985 to 2015, with floods, landslides, avalanches, and earthquakes being the most frequent (figure 10). Glacial melt and bouts of intense rainfall in the spring lead to floods, mudflows, avalanches, and landslides,[2] winter brings severe storms, and summer brings the risk of drought and extreme temperatures.

Figure 10 Incidence of Natural Disasters in Tajikistan, 1985–2014



Source: EM-DAT (www.em-dat.net).

In most cases, the impact of these natural disasters on agricultural production has been highly localized and relatively limited in scale (table 2). Food insecurity can increase, however, particularly in response to complex disasters that lead to increased food prices. Closer analysis also shows that assessment of

[2] See the Government of Tajikistan's National Disaster Risk Management Strategy for 2010–2015.

the economic impact of these disasters on agricultural production is based on forecasts and estimates made in the immediate aftermath of the disaster. Once the emergency is over and actual production data are collected and collated, the impact often turns out to have been significantly overstated.

Table 2 Reported Agricultural Losses from Natural Disasters

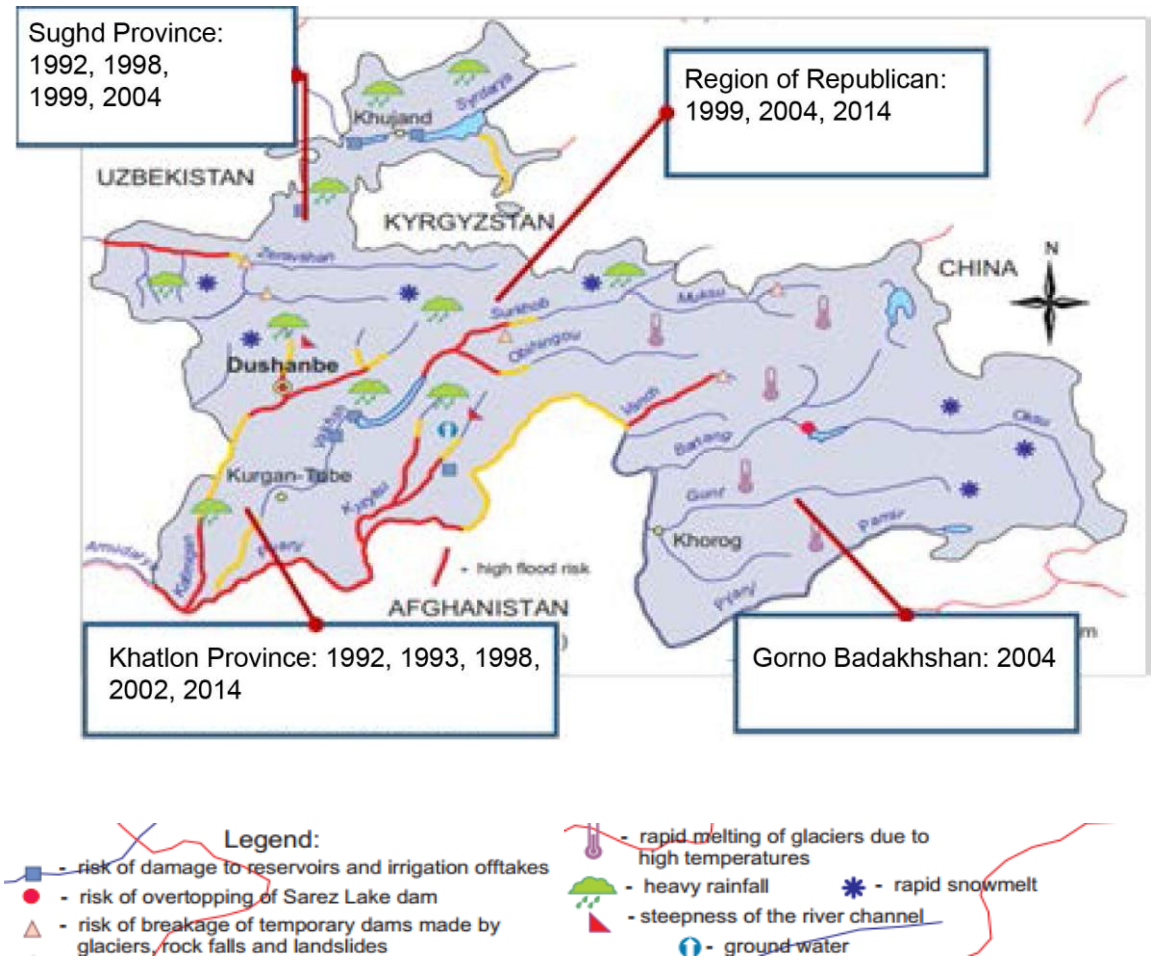
Disaster and year	*Area affected*	*Agricultural losses*
1999: flood	Sughd, RRS	624.5 hectares of agricultural crops were damaged[a]
2000–01: drought	Khatlon, Sughd	Rain-fed and approximately 30–50 percent of irrigated crops failed; aggregate 2000 cereal output forecast was 236,000 tons, which is 46 percent less than in 1999[b]
		Cereal crops failed on 112,600 hectares (causing US$87.4 million of damage), and pastures dried up entirely on 199,000 hectares (US$22.5 million of damage). Food supply became sufficiently insecure to warrant relief aid for 3,011,786 persons (58% of the rural population);[c] quality and quantity of drinking water were reduced, along with capacity for hydro-power generation
2003: hurricane	Sughd	1,386 hectares of land were damaged; large sections of concrete channel and pipes were completely washed away, and boreholes were blocked with mud and silt[d]
2004: floods and mudslides	RRS, GBAO, Sughd	200 hectares of cotton fields and other crops were damaged; 160 livestock were killed[e]
2007–08: complex disaster[g]	Nationwide	40,000 hectares of land in 40 out 58 districts in the country were lost. The total economic loss was estimated at US$100 million this year[f]
2014: flood	Khatlon, RRS	1,031 livestock were lost, 786 hectares of agricultural land were damaged, 44 beehives were destroyed[g]

a. UN OCHA 1999, 2000.
b. World Bank 2006.
c. UN OCHA 2003.
d. UN OCHA 2000.
e. Explained in detail in box 1.
f. UN OCHA 2009
g. Rapid Emergency Assessment and Coordination Team, Tajikistan REACT.

Floods, Mudslides, Avalanches, and Storms

While floods occur relatively frequently (figure 11) and devastate the communities they hit, the resultant loss of crops and livestock is limited in comparison to total land cultivated and total livestock numbers (table 2). This is also true for mudslides, avalanches, earthquakes, and severe storms. Localized disasters such as these can be managed effectively by a well-organized national emergency response agency working with local government authorities.

Figure 11 Location and Risks of Major Floods in Tajikistan, 1985–2014



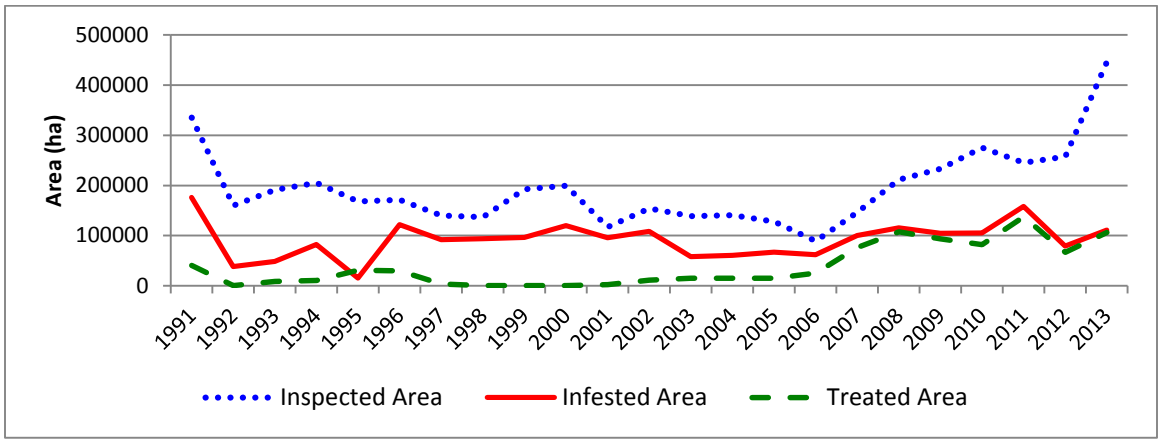
Source: Tajik Met Service (Yablokov and Johnson), Global Active Archive of Large Flood Events, Dartmouth Flood Observatory, University of Colorado.

Locusts

Locusts are a permanent threat to agriculture in Tajikistan, infesting approximately 100,000 hectares of agricultural land every year (figure 12). Due to an effective control program, actual agricultural losses are minimal, however, with only one major attack during the 30 years from 1985 to 2014 (EM-DAT). This occurred in 2007, with the loss of approximately 35,000 hectares of crops. The major determinants of loss are the location of the attacks (pasture versus cropland) and the extent to which

control measures cover infested areas. Locusts usually feed on mountain pastures and forests, only attacking crops when there is no pasture.

Figure 12 Detection, Infestation, and Treatment of Locusts in Tajikistan, 1991–2013



Source: Ministry of Agriculture.

Two locust species are found in Tajikistan: the Moroccan locust and the Italian locust. They breed in mountain areas along the borders with Afghanistan, Uzbekistan, and the Kyrgyz Republic (figure 13), which makes them difficult to detect and control. Control was minimal from 1997 to 2007, but was boosted in 2008 following the attack in 2007. Support from FAO has further strengthened this program since 2011, but this support will end in 2015. Most of the budget for the control program is used to spray locust breeding grounds in the mountain border areas.

Figure 13 Areas Most Frequently Infested by Locusts in Tajikistan

Source: FAO 2012b.

Drought

Two major droughts are reported by EM-DAT for the 30-year period from 1985 to 2014, in 2000–01 and 2007–08. Lesser, localized droughts are reported nationally for 1995, 1999, 2005, 2010, and 2012. Each of the two major droughts (2000–01 and 2007–08) led to forecasts of major crop losses and a national food security crisis, described in box 1.

In reality the resultant food security crises were due more to rising food prices than to the impact of drought on agricultural production. The losses in crop production were overestimated, and higher producer prices offset the impact of these losses on the value of agricultural output. In the 2000–01 drought, actual cereal production fell only 12 percent. Moreover, drought only explains some of this fall in cereal production, as many farmers shifted land from cereals to cotton in response to favorable cotton prices (cotton production increased 35 percent). Agricultural GDP fell only 2 percent in 2001, as higher producer prices offset the impact of the loss of 30,000 hectares of cropland. For the 2007–08 drought, actual cereal production was constant in 2007 and 2008 (903,000 tons and 906,500 tons, respectively), up from 893,000 tons in 2006. The decline in area planted was offset by an increase in yields in 2007, while lower yields were offset by an increase in area planted in 2008. Agricultural GDP also increased 17 percent in real terms from 2007 to 2008 due to higher producer prices, negating the forecast loss of US$100 million (box 1).

Box 1 The Forecast Impact and Scale of Major Droughts in Tajikistan

2000–01 drought in Sughd and Khatlon oblasts. In the Sughd region, low rainfall led to the failure of rain-fed and approximately 30–50 percent of irrigated crops. Aggregate cereal output of 236,000 tons was 46 percent lower than the previous year (UN OCHA 2000). Khatlon in the south faced a similar reduction, with the most affected areas being Kabodiyon, Shartuz, Jilikul, Gozimalik, Kumsangir, and Pyanj. Agricultural losses amounted to 30,000 hectares. By autumn 2001, 3 million people were expected to be affected by drought, with 2 million possibly facing a critical food shortage.

2008–09 drought combined with other natural calamities (nationwide impact). Agricultural losses amounted to 40,000 hectares of land in 40 out 58 districts in the country. The damaged lands included 22,000 hectares of cotton, 8,000 hectares of cereals, 3,000 hectares of fruit and vegetable gardens, 960 hectares of vegetable fields, and 221 hectares of potato fields. The total economic loss was estimated at US$100 million (UN OCHA 2009).

Hence while these droughts were major disasters for food security and severely compromised agricultural production in many areas, they did not have a "disastrous" impact on the aggregate value of agricultural production. They were also low-frequency events, occurring only twice in 30 years.

Complex Disasters

The worst disasters for agricultural production and food security have been complex disasters: the result of either multiple shocks in a short time period or a sequence of shocks over an extended time period. In most cases, these disasters have involved some combination of shocks that are exogenous to agriculture and others that are endogenous. For example, the combination of economic transition and civil war from 1992 to 1997, interspersed with adverse climatic conditions from 1994 to 1996, resulted in a substantial fall in agricultural production, causing severe hardship for rural people. More recently, a succession of adverse events from 2007 to 2009 also had a major impact on agricultural output and food security, as described in box 2.

Box 2 The Complex Disaster of 2008–09

Tajikistan experienced a series of economic, environmental, and social shocks in 2007–09, which severely affected production and reduced the capacity of the most vulnerable to deal with further shocks. Beginning in 2007, rising fuel prices led to higher transportation and food costs, followed by continued drought in the spring and summer of 2007 and a locust invasion in 2008.

Against the backdrop of increased food insecurity in early 2008, Tajikistan experienced the worst winter in 44 years. Heavy snowfall isolated communities, and severe weather hampered travel. Temperatures ranged from -15°C to -25°C for extended periods. The exceptionally cold weather caused breakdowns in the country's aged energy infrastructure and water supply systems, affecting irrigation and food production.

Source: UN OCHA 2008.

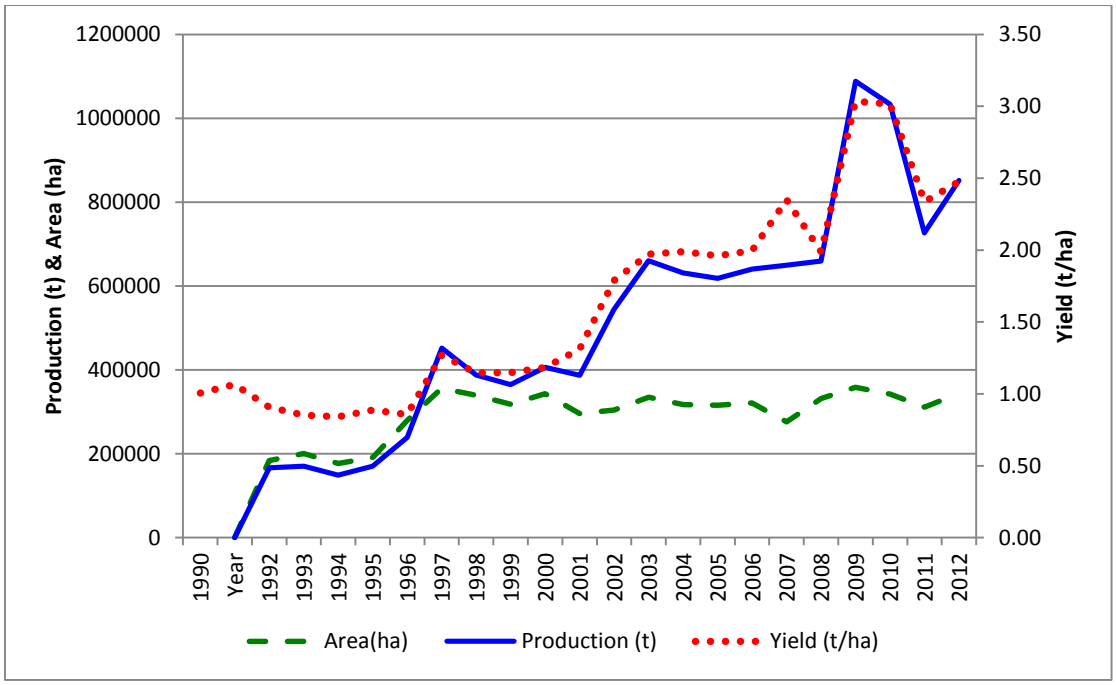
Crop Production

The crops analyzed below were chosen on the basis of their importance to sector output and because they reflect different types of production, price, and policy risk.

Wheat

With approximately 10 percent of GAO and 33 percent of total cultivated area, wheat is a major source of agricultural output in Tajikistan. It is also one of the most stable components of sector output, with an adjusted CV of 0.20* for production and 0.18* for yield. Production has grown steadily since 1998 in response to increased area and yields (figure 14). Approximately one-third of all wheat is grown on household plots.

Figure 14 Wheat Production in Tajikistan, 1990–2012



Source: FAOSTAT.

As figure 14 shows, inter-annual variation in yield explains most of the variation in wheat production. Rainfall variability is the major source of yield and production volatility, as around 50 percent of wheat is unirrigated. For the period 1992–2012, one major drought occurred in 2008, with lesser droughts in 2001, 2005, 2010, and 2012. The sharp fall in production and yields in 2011 was due to a marked switch from wheat to cotton, with the associated reallocation of land and other resources and a return to long-term yields following two years of above-average yields in 2009 and 2010 in response to high rainfall. There was no production "shock" as such, although the impact on commodity prices was quite marked.

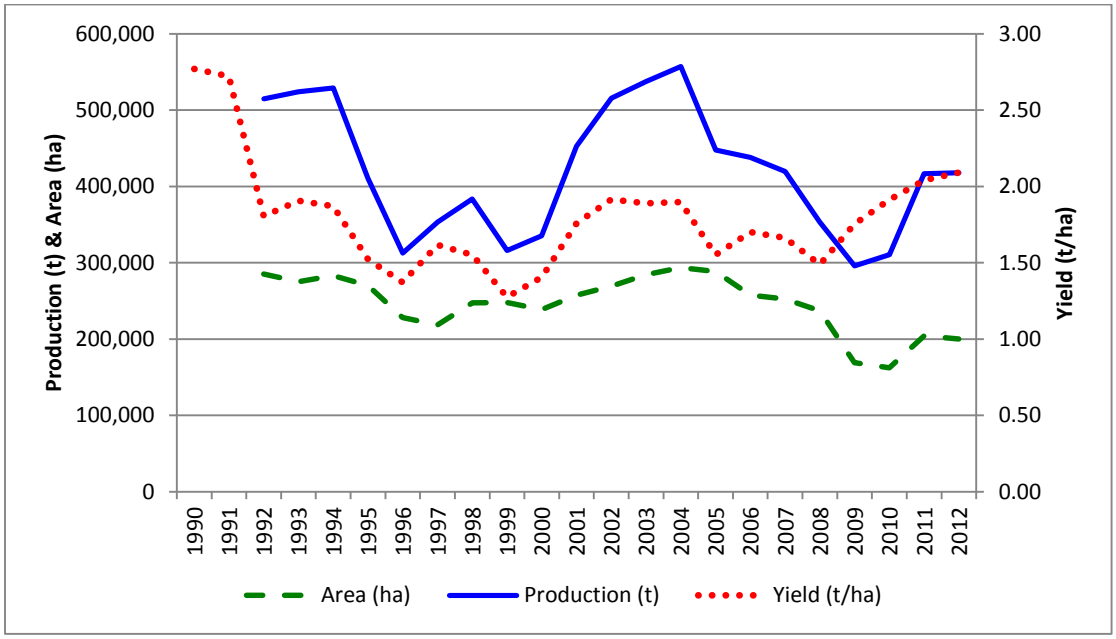
Locusts and crop disease (especially rust) are further sources of production risk for wheat. Locust swarms resulted in the loss of approximately 35,000 hectares of wheat and other crops in 2007.

Although devastating at the local level, this loss was small relative to the total cultivated area of 970,000 hectares. A small, but highly experienced crop protection program operates in the Ministry of Agriculture (MOA), but its capacity to intervene is limited by scarce budget resources. Farmers receive advice about how to manage outbreaks of crop disease, but little direct support. A locust control program established in 2008 has received FAO support since 2011, but this support will end in 2015. Most of the budget for this program is used to spray locust breeding grounds in mountain areas along the borders with Afghanistan, Uzbekistan, and the Kyrgyz Republic.

Cotton

Cotton is the second most important crop, with 9 percent of GAO and 20 percent of total cultivated area. The adjusted CVs for cotton yield and cotton production are both moderate at 0.20*. Irrigation reduces the climatic risks to production, although low rainfall in 1999–2000, 2004–05, and 2008–09 resulted in lower yields (figure 15). A 40 percent fall in cotton area cultivated from 2004 to 2009, in response to the cotton debt crisis, also shows that policy has a major impact on production. Government views cotton as a highly strategic crop and intervenes actively to protect the high cash and export revenues generated. However, not all of its interventions are appropriate. Crop protection programs implemented by the MOA mitigate disease and insect risks.

Figure 15 Cotton Production in Tajikistan, 1990–2012



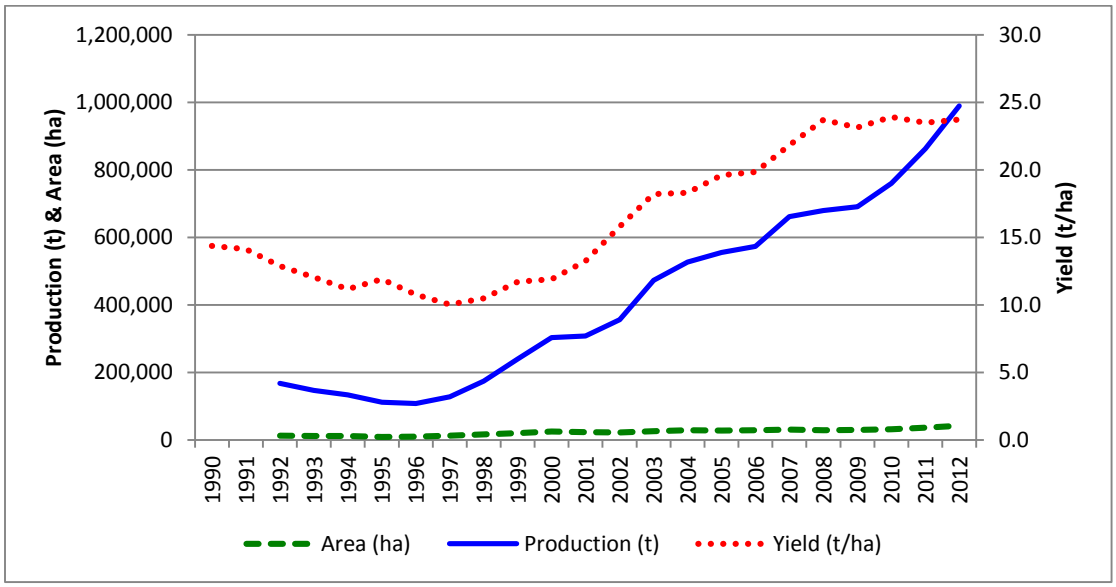
Source: FAOSTAT.

Potato

Potato production is also important, with approximately 10 percent of GAO and 35 percent of the area planted to vegetables. Potatoes are produced in all regions, with approximately 50 percent of total output grown on household plots. Production has grown steadily since 1998 in response to increased area and yields (figure 16). Production risks are relatively low, with adjusted CVs of 0.17* for

production and 0.16* for yield, with no major yield or production shocks since 1995. Drought, disease, and insect pests are the main production risks.

Figure 16 Potato Production in Tajikistan, 1990–2012

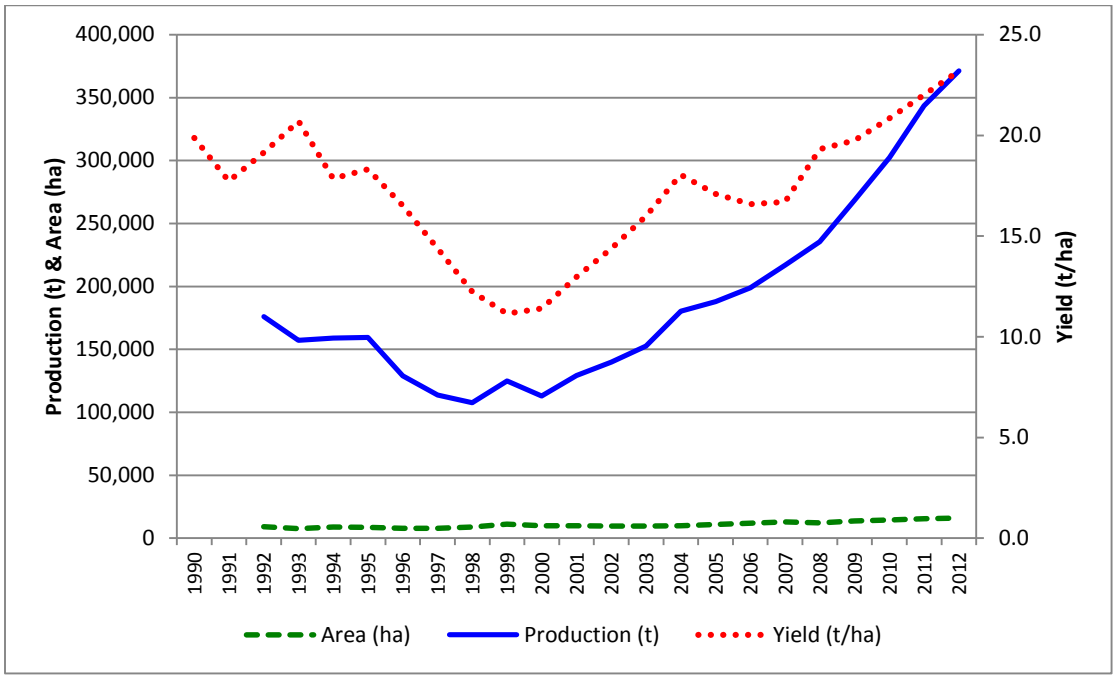


Source: FAOSTAT.

Onions

Onion production accounts for 7 percent of GAO and 15 percent of the area planted to vegetables. Approximately 60 percent of vegetables (excluding potatoes) are produced on household plots. Output has more than tripled since 1998, driven by steady increases in both yields and area (figure 17). Production risks are low, with a CV of 0.26 for production and an adjusted CV of 0.19* for yield, with no major shocks since 2000.

Figure 17 Onion Production in Tajikistan, 1990–2012

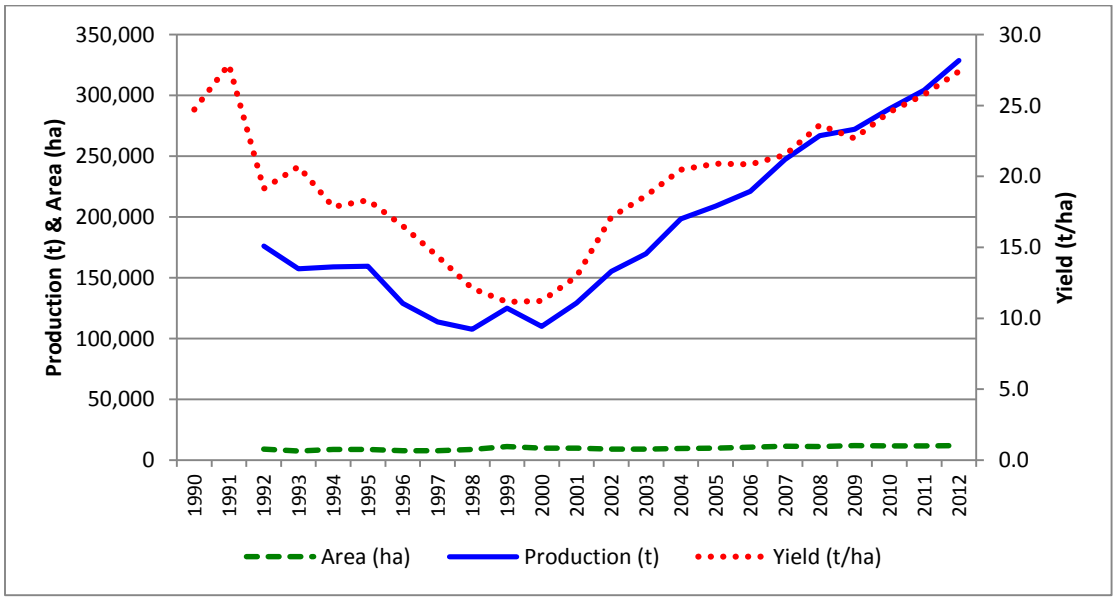


Source: FAOSTAT.

Tomatoes

Tomato production accounts for 6 percent of GAO and 11 percent of the area planted to vegetables. Output has more than tripled since 1998, driven by steady increases in both yields and area (figure 18). Production risks are low, with a CV of 0.21 for production and an adjusted CV of 0.21* for yield, with no major production shocks since 2000.

Figure 18 Tomato Production in Tajikistan, 1990–2012

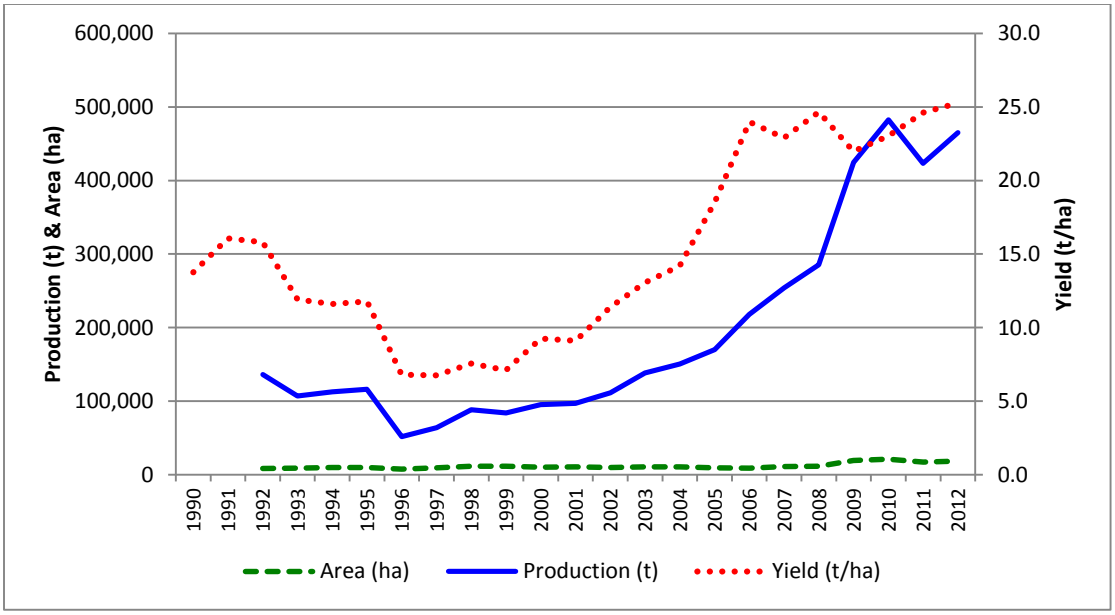


Source: FAOSTAT.

Watermelons

Watermelons account for 2 percent of GAO and 17 percent of the area planted to vegetables. Output has increased more than four times since 1998, driven by increases in both yield and area (figure 19). Production variability is high, with adjusted CVs of 0.40* for production and 0.31* for yield. This is due in part to vulnerability to moisture stress. Producers also vary the area planted from year to year in response to changes in market conditions.

Figure 19 Watermelon Production in Tajikistan, 1990–2012

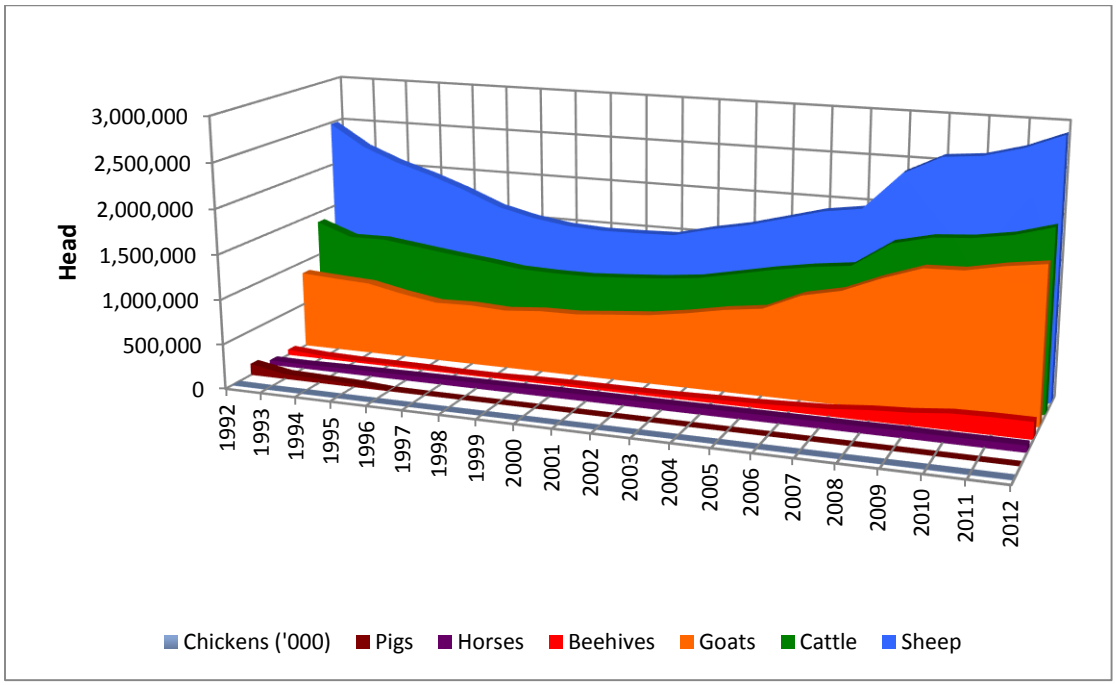


Source: FAOSTAT.

Livestock Production

Livestock numbers fell for the first 10 years after independence due to the combined impact of economic transition and civil war (figure 20). Numbers increased significantly after 1998, except for pigs, for which there is minimal demand. Growing domestic demand for livestock products has driven the increase in livestock numbers. Livestock numbers rose sharply following resolution of the cotton debt crisis in 2008, as farmers were able to allocate more land to pasture and fodder crops and had more freedom to choose their preferred production systems.

Figure 20 Livestock Numbers in Tajikistan, 1992–2012



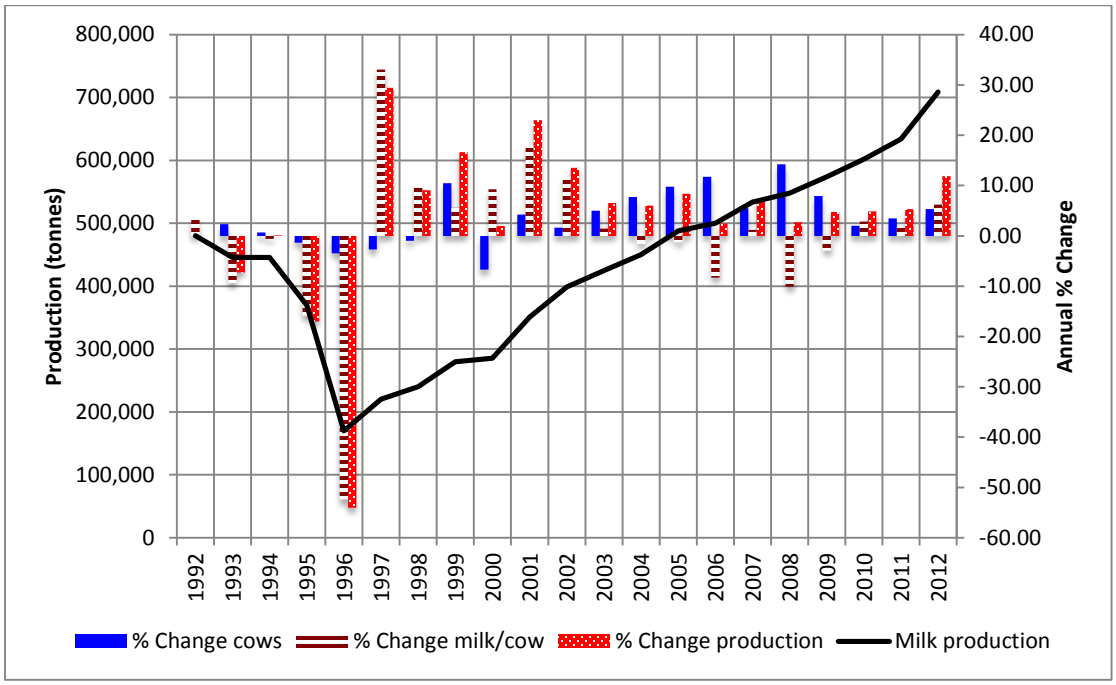
Source: FAOSTAT.

Livestock production is important in all regions, providing an important source of food and cash income on the small, mixed farms that predominate in Tajikistan. It also helps to stabilize rural household incomes when crop production or crop prices fall. Cattle are the most important form of livestock production, followed by sheep and goats, but most farms own some combination of all three. Most herds are small, and productivity is low, as farmers prioritize the allocation of land and labor to crop production—except in mountainous and upland areas.

Milk Production

Cow's milk is the most important livestock commodity, with 9 percent of GAO. Figure 21 shows trends in production from 1992 to 2012 and the impact of changes in the number of cows and production per cow. Economic transition and civil war led to the high, observed fall in production, due mainly to the decline in production per cow. Production has increased more than threefold since 1996, due mainly to the increase in the number of cows. Milk yields increased initially until 2003 and then fell until 2008 during a period when forage production fell, as many farmers were coerced into growing cotton. Yields began to rise again after cotton debt was resolved, although they still remain very low, at approximately 700 kilograms per cow.

Figure 21 Cow's Milk Production in Tajikistan, 1992–2012



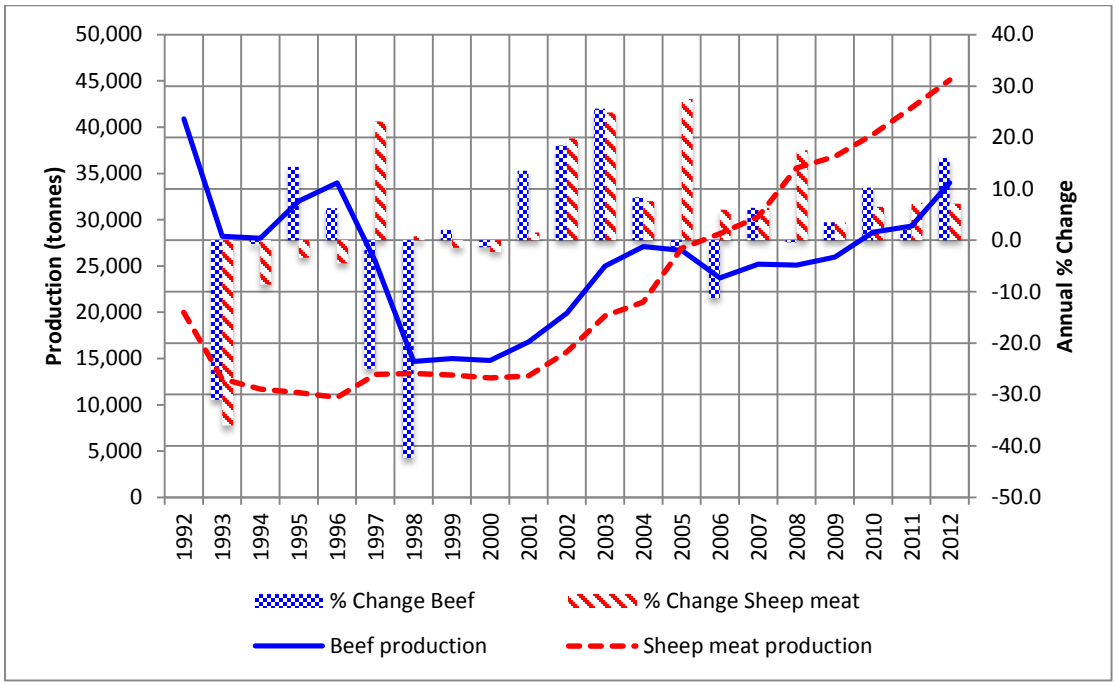
Source: FAOSTAT.

Overall production is relatively stable, with an adjusted CV of 0.24*. Most of the observed variation reflects the sharp reductions in yield until 1996. Milk yields also fell moderately in 2006 (for unknown reasons) and in 2008 due to lower rainfall.

Beef and Mutton Production

Mutton accounts for 6 percent of total GAO and beef for 2.5 percent. Both experienced sharp falls during the period of economic transition and civil war and were slow to recover (figure 22). Mutton production has increased significantly since 2000, but beef production has recovered more slowly.

Figure 22 Meat Production in Tajikistan, 1992–2012



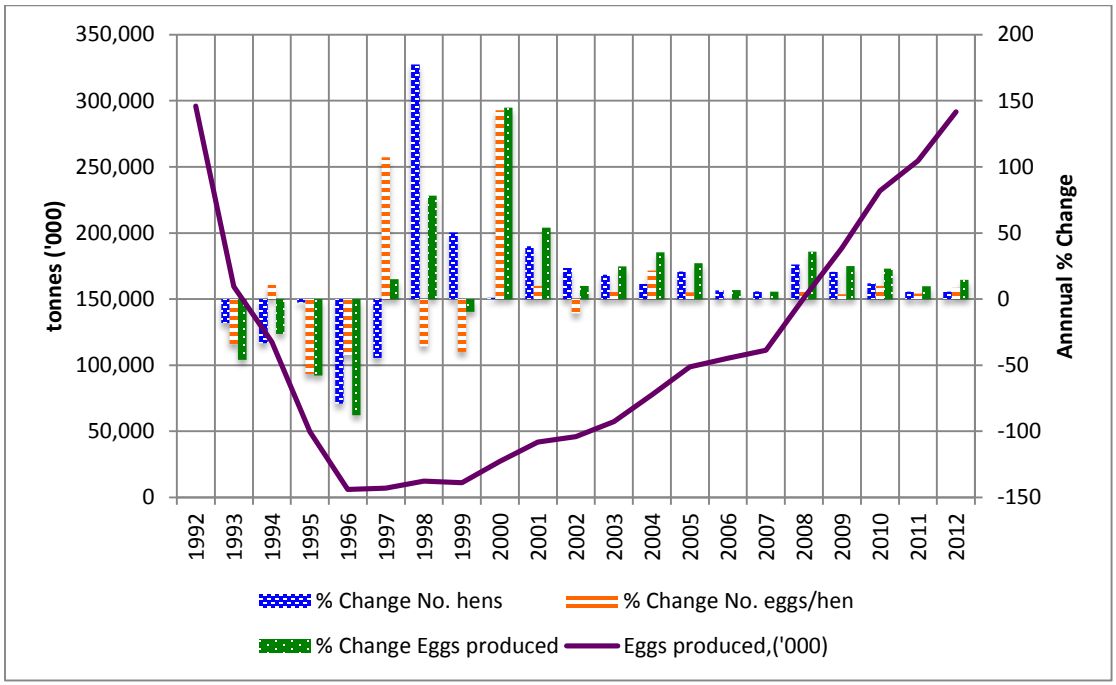
Source: FAOSTAT.

Production volatility has been minimal since 2001, apart from a moderate decline in beef production in 2006 due to a reduction in cattle numbers. The moderately high adjusted CVs, 0.26* for beef and 0.24* for mutton, reflect the impact of economic transition and civil war.

Egg Production

Eggs account for approximately 1 percent of total GAO. The trend in egg production, as for other commodities, saw a massive decline in production associated with economic transition and civil war, followed by strong growth since 1999 (figure 23). This growth is due to a significant increase in the number of laying hens and a smaller increase in egg production per hen. The adjusted CV for egg production for the period 1992–2012 is very high, at 0.85*, due to the impact of transition and civil war. The variability of output since 1999 has been very low.

Figure 23 Egg Production in Tajikistan, 1993–2012



Source: FAOSTAT.

Livestock Disease

The main livestock disease risks for Tajikistan are brucellosis, anthrax, foot and mouth disease (FMD), pestes des petits ruminants (PPR), Newcastle disease, and tuberculosis. Official reports to the International Office of Epizootics (OIE) for the period 2005–13 indicate a low incidence of these diseases, with brucellosis as the main risk. Brucellosis was reported every year from 2005 to 2013, although the reported cases represent less than 1 percent of cattle and small ruminants. Actual brucellosis infection rates are probably higher, as demonstrated by an FAO vaccination program in southern Khatlon from 2003 to 2009 that reduced infection rates from 10 percent to 2.5 percent.

Anthrax was reported in all years from 2005 to 2013, with annual losses of less than 10 animals (all animals included). One case of FMD was reported to the OIE during 2005–13, with the loss of 31 goats and 14 cattle. Newcastle disease was reported in 2005 and 2006, with no information on the losses incurred. Human infection from livestock disease ranges from 650 to 1,500 cases per year for brucellosis and 15–50 cases per year for anthrax.

Apart from FMD and anthrax, vaccination against these diseases is low (World Bank 2014b). Vaccination rates for FMD are estimated at 100 percent and are reported to be "high" for anthrax. For other diseases, including brucellosis, vaccination rates are low. Yet recent analysis shows that vaccination costs are very low relative to livestock value (World Bank 2014b).

This limited apparent interest in protecting livestock health is variously attributed to farmers' expectations that the government will pay for vaccination programs,3 mistrust of vaccine quality, inadequate understanding of the costs and benefits of improved livestock health, and limited cash to pay for vaccinations. It may also indicate that farmers view livestock disease as a low source of risk and prefer to accept limited losses rather than pay for vaccines. This perception may change as livestock production grows in importance and larger, more specialized livestock operations emerge.

Many of the major livestock diseases in Central Asia are highly contagious, trans-boundary diseases that are impossible to control at the national level (for example, FMD, brucellosis, and PPR). These diseases are transmitted by domestic animals, wild animals, people, and vehicles along 3,650 kilometers of border, including 2,030 kilometers along the border with Uzbekistan and the Kyrgyz Republic.

Price Risks

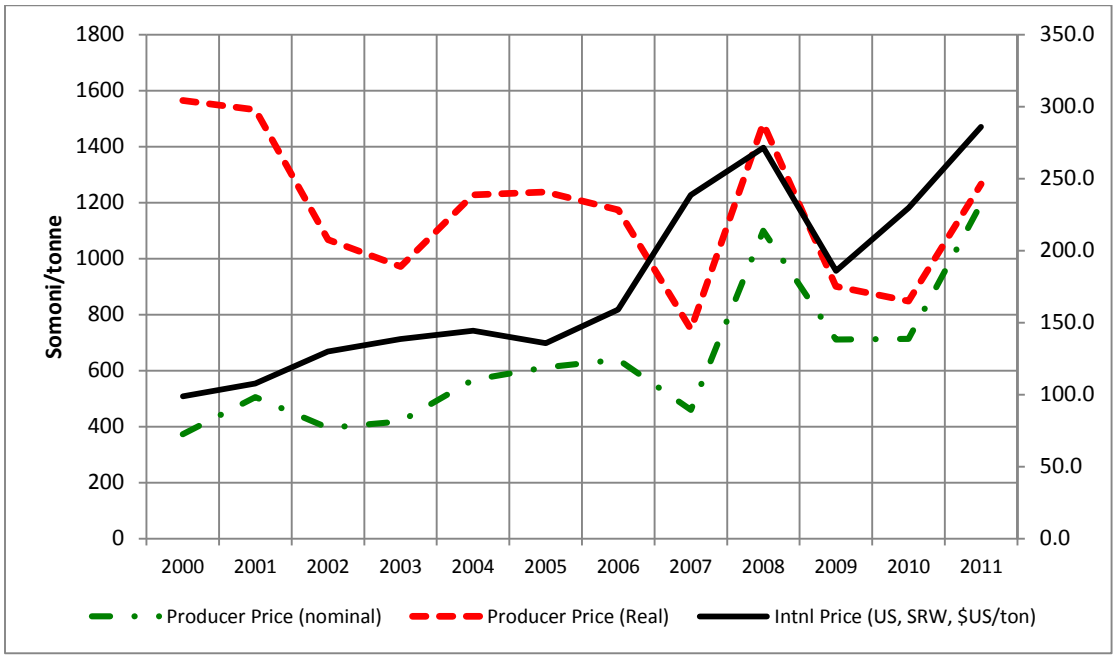
Producer price data are available for the period 2000–11 only.

Wheat Prices

Tajikistan produces approximately half of its total wheat requirement, importing the rest from Kazakhstan and Russia as wheat and flour. Trends in real prices reflect the combined influence of domestic production, international prices, and inflation (figure 24). Real prices are thus somewhat variable, with a CV of 0.23 versus adjusted CVs of 0.24* and 0.27* for nominal wheat prices and 0.17* for international soft wheat prices, respectively. Measured in real prices, major price shocks occurred in 2002 due to a significant increase in domestic production, in 2007 due to a generalized fall in nominal and real prices, and in 2009 due to a major increase in domestic production.

[3] Under current law, government is obliged to provide vaccines for eight major livestock diseases—at a cost of SM 7 million to SM 8 million (somoni) relative to its budget of SM 2 million. Lacking the resources to meet this demand, the Veterinary Service allocates the vaccines it purchases to state-owned livestock farms first and then to high-risk zones. The remaining vaccines used by farmers are imported and sold commercially.

Figure 24 Wheat Prices in Tajikistan, 2000–11

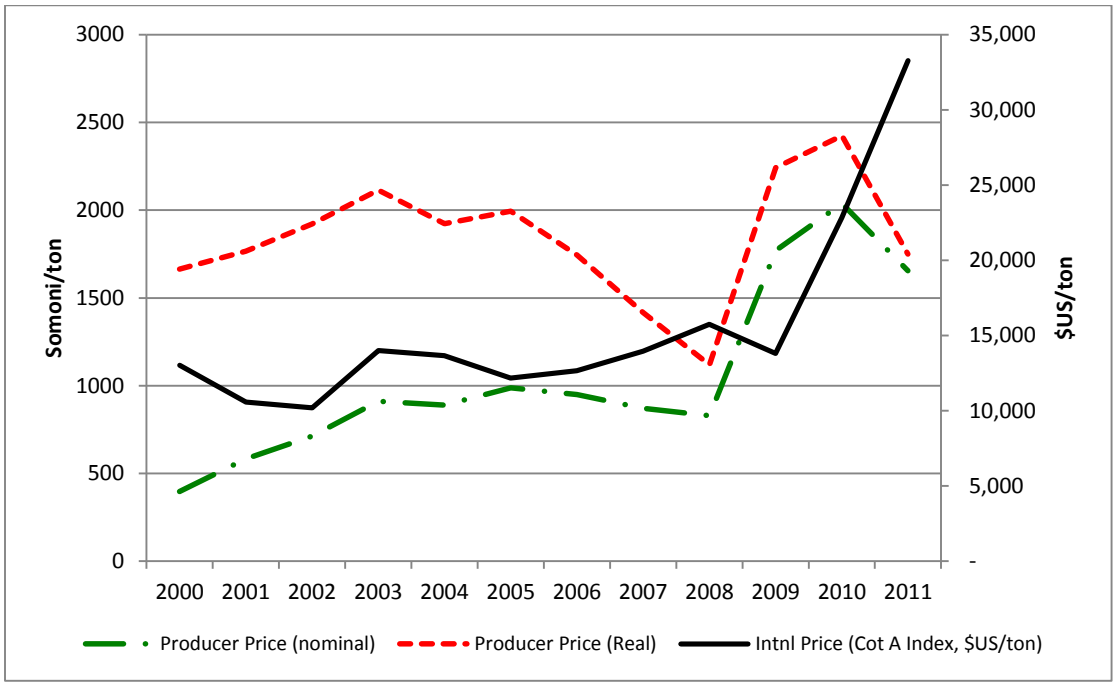


Source: FAOSTAT; World Bank Commodity Prices.

Cotton Prices

Trends in world markets are the major determinant of cotton producer prices, as all production is grown for export (figure 25). Government policy also has an impact, as shown by the steady decline in real producer prices from 2003 until resolution of the cotton debt crisis in 2008. Both world prices and real domestic prices have increased since 2008. Real producer prices are less variable than world prices, with an adjusted CV of 0.26* versus an adjusted CV of 0.30* for world prices.

Figure 25 Cotton Producer Prices in Tajikistan, 2000–11



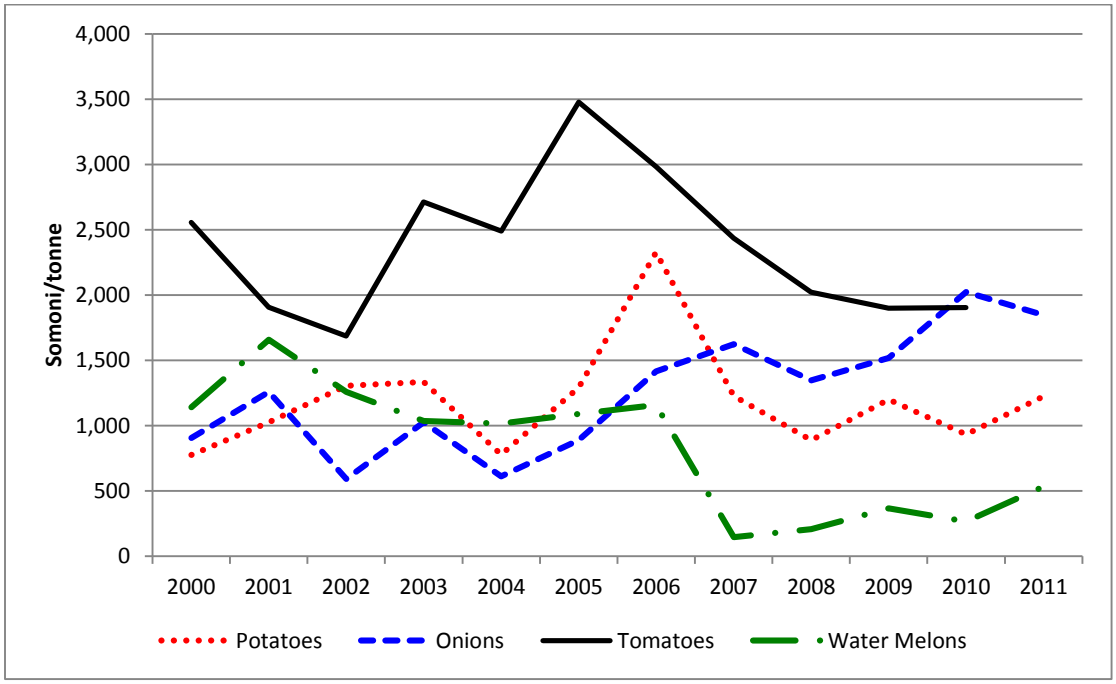
Source: FAOSTAT; World Bank Commodity Prices.

Vegetable Prices

Real prices for vegetables are highly variable (figure 26), with unadjusted CVs of 0.23 for tomatoes and 0.35 for potatoes and adjusted CVs of 0.24* for onions and 0.36* for watermelons. As production of all four crops has increased steadily since 2000, this instability is attributed to the weakness of domestic markets and the limited capacity for export in years when marketed surplus is higher than normal. Domestic markets are easily saturated, especially for perishable, seasonal crops such as watermelons and tomatoes. The impact of this latter risk was particularly evident in 2007.

Figure 26 Real Producer Prices for Vegetables in Tajikistan, 2000–11

2012 = 100

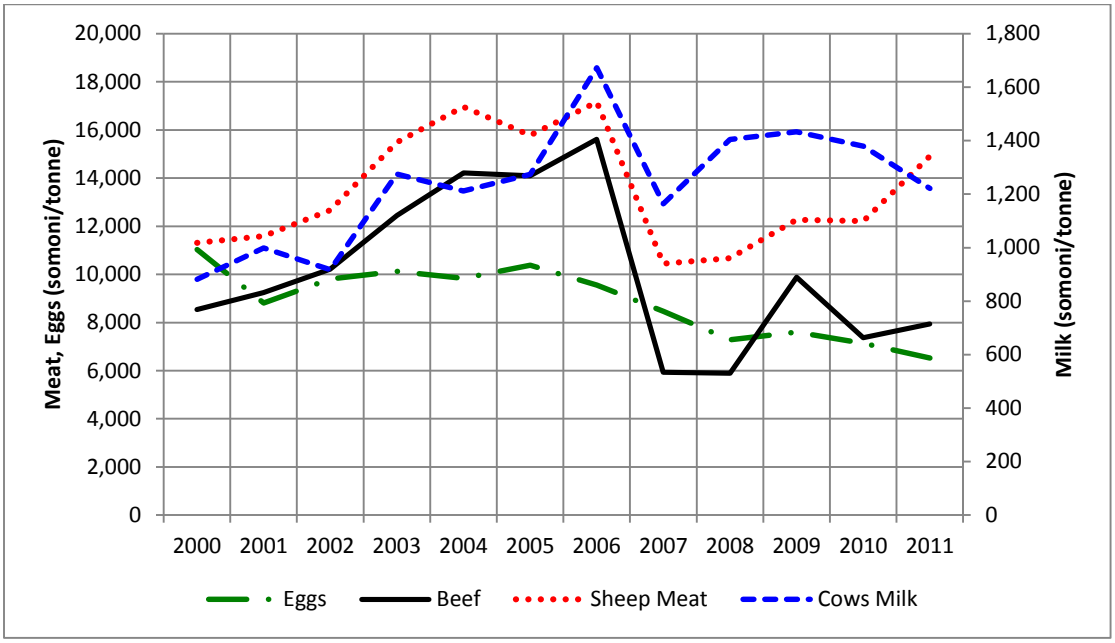


Source: FAOSTAT.

Livestock Commodity Prices

Livestock commodity prices are analyzed for the period 2000–11. Real prices increased steadily from 2000 to 2006 in response to growing incomes and increased demand (figure 27). All prices then fell sharply due to the generalized price fall of 2007, as for crop commodities. Meat and milk prices have risen somewhat since 2008, while egg prices have continued to fall.

Figure 27 Real Producer Prices for Livestock Commodities in Tajikistan, 2000–11



Source: FAOSTAT.

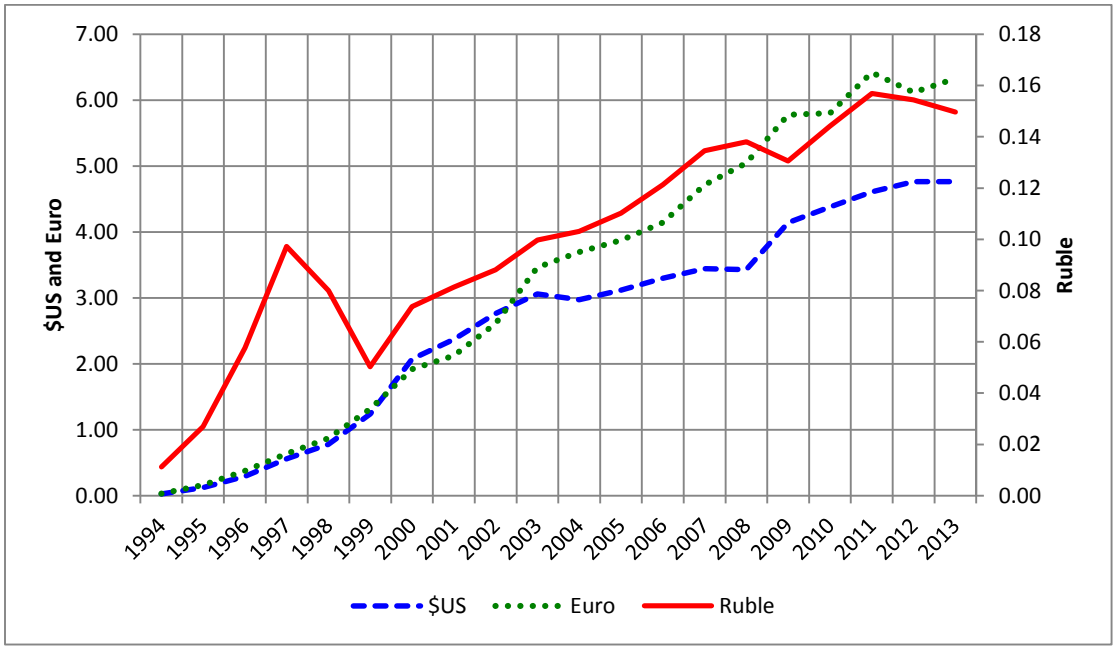
Price stability varies. Real egg prices are the most stable with an adjusted CV of 0.09*, followed by cow's milk, with an adjusted CV of 0.15*, and sheep meat, with a CV of 0.18. Real beef prices are much less stable, with a CV of 0.33. Beef prices fell sharply in both 2007 and 2010, with the more recent fall due to the adjustment of prices following the global food price crisis of 2009–10.

Enabling Environment Risks

Exchange Rates

In an open economy like Tajikistan, exchange rate movements can have a wide-ranging impact on economic activity, affecting export revenues (aluminum, cotton, fruit, and vegetables), the price of imported agricultural commodities, and the purchasing power of remittances. Government introduced a flexible exchange rate policy in 2000, with minimal intervention in foreign exchange markets. This policy has resulted in a gradual depreciation against all major currencies since 2000 (figure 28), with minimal exchange rate volatility. The adjusted CVs are correspondingly low, at 0.08* for the euro, 0.12* for the U.S. dollar, and 0.14* for the ruble.

Figure 28 Nominal Exchange Rates, 1994–2013

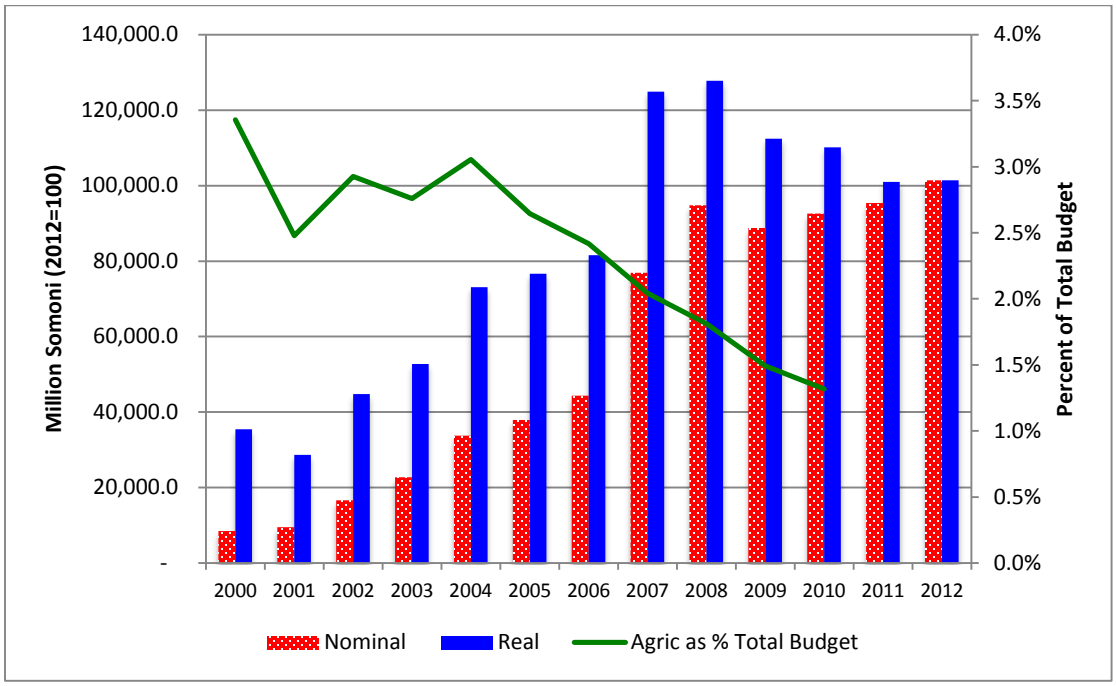


Source: World Bank various years; EUROSTAT.

Agricultural Policy and Budget Support

While public expenditure for agriculture has increased significantly in real terms since 2000, it remains low in both absolute terms and relative to overall public expenditure (figure 29). Current budget expenditure for the Ministry of Agriculture is less than 2 percent of the total government budget and is barely enough to cover basic regulatory activities. Programs for crop and livestock disease protection are thus underresourced. Less than 1 percent of this budget is used for subsidies. Additional public expenditure, outside the MOA budget, is also provided for irrigation and occasional directed lending programs for agricultural credit, but data on this expenditure were not available for analysis.

Figure 29 Current Expenditure in the Agriculture Budget of Tajikistan, 2010–12



Source: Ministry of Finance.

Agricultural policy has traditionally focused on measures to support cotton production, through direct intervention, subsidized credit for inputs, and higher budget allocations for crop protection and seed production programs for cotton. Government recognized the need for more broad-based support for agriculture following resolution of the cotton debt crisis in 2008 and is now allocating more MOA budget resources to other crops and to livestock.

The Cotton Debt Crisis

Tajikistan's cotton debt crisis is the most important policy-related adverse event. It began in 2000 following privatization of the "cotton investors" who controlled cotton input supply, processing, and marketing. Once privatized, the larger "investors" contrived with local government authorities to create local and regional monopsonies, through which they provided cotton producers with inputs on credit at inflated costs and purchased raw cotton at below-market prices. Unable to grow cotton profitably under these conditions, producers accumulated debts to the cotton investors and their partner financial institutions. The low profitably of cotton was further aggravated by government insistence that 70 percent of all arable land should be used for cotton, forcing farmers to grow cotton on land that was inherently unsuitable. Local government benefited from this setup by meeting official production and sales targets and cotton investors benefited by having an assured supply of raw material at highly favorable prices. Producers faced lower incomes and high levels of poverty; and as their debts grew, they became even more vulnerable to exploitation by the cotton investors.

As a result of this situation, farmer cotton debt grew from an estimated US$180 million in 2004 to US$550 million when these debts were frozen at the end of 2007. Government made numerous requests for donor assistance to refinance this debt, but to no avail. The donor community was

unwilling to assist in the absence of a strong government commitment to reform the policies and structures that had led to the crisis and was unconvinced as to the actual level and nature of the debt. Resolution of this crisis was eventually catalyzed in late 2007 when the National Bank of Tajikistan (NBT) revealed that it had taken out undisclosed loans to finance the cotton campaign, thus breaching an International Monetary Fund (IMF) agreement. The NBT was also at risk of defaulting on these loans, which were secured by its foreign exchange reserves.

Faced with the loss of IMF support and loan default, government ordered investors and their partner financial institutions to write off the debts owed by farmers and initiated a comprehensive set of reforms. The monopsony powers of cotton investors were curtailed through debt write-off, increased competition, and the provision of alternative sources of credit to reduce producer dependence on investors for input supply. Local government authorities were no longer permitted to force farmers to grow cotton, allowing producers to grow and sell whatever crops they chose (known as Freedom to Farm). Cotton production contracted initially because input supply fell and less productive cotton land was allocated to other crops. Output has now stabilized around a smaller, more sustainable base of land and producers, and cotton remains a major element of Tajikistan's agricultural economy.

These policies incurred major costs, not all of which were borne directly by the agriculture sector. The cotton investors and their partner financial institutions incurred the major losses through debt write-off. Given that the debt write-off was based on accumulated farmer debt rather than on actual operating losses by cotton investors, the amount of this loss was probably much less than the US$550 million written off. (The offsetting monopsony profits earned by cotton investors were never measured.) Losses were incurred by the agriculture sector, nevertheless. Producer prices and production fell, particularly during the final stages of the cotton debt crisis from 2006 to 2008.

Agricultural Insurance

The Tajik insurance industry is small, with a penetration rate of 0.34 percent in 2012.[4] The insurance industry is growing quickly, however, with annual growth of 18 percent for the period 2008–12 (Timetrics 2013). There are 16 insurance companies, of which 2 are state owned and 14 are private. Mandatory insurance products, which are tightly regulated by government, account for approximately 75 percent of the market. A 2010 government decree that 70 percent of profits from state insurance companies should revert to the budget has weakened the capacity of state insurance companies to build reserves and expand.

Agricultural insurance is provided by the state-owned company Tajiksugurta. There are relatively few clients for this insurance, even though it is officially mandatory. Private insurance companies also show little interest in agricultural insurance, citing the higher regulatory requirements, weak statistical base for risk assessment, and low perceived profitability of agriculture. Despite this limited interest, government is trying to develop a public-private partnership for weather-index crop insurance.

[4] Ratio of total insurance premiums (in U.S. dollars) to gross domestic product.

There are opportunities for commercial agricultural insurance in Tajikistan, beginning with the insurance of high-value crops against frost and hail. The expected losses from these risks are moderate, increasing the incentives for private insurance companies to offer suitable products and for farmers to buy them. Beyond this, any expansion to broad-based insurance for cereal and industrial crops and for livestock or livestock production will require a major investment in the development of a market-based program of agricultural insurance with considerable government financial participation. Inter alia, such a national program will have to rely on commercial reinsurance, adequate pricing and underwriting of risks and professional claims management. In addition, the government will have to clearly demonstrate its commitment to the program through budgeting for the cost of program subsidies in the annual national budget. Therefore, a comprehensive feasibility study is required to consider any agricultural insurance. In the meantime, there is a need to focus on animal health, improving crop yields, knowledge transfer to farmers and other measures to reduce production risks and thus, the cost of insurance in the future.

Costing and Prioritizing Agricultural Risks

The frequency, severity, and costs of adverse events are analyzed in this section to provide an empirical basis for prioritizing different sources of risk. Official information on losses due to adverse events is derived in different ways and is invariably approximate. Hence, in order to provide a consistent basis for comparison, analysis was based on estimates of the "indicative" value of losses, as defined below. While these estimates draw on actual data as much as possible, they represent indicative, not actual, losses.

Conceptual and Methodological Basis for Analysis

Risk is defined as exposure to a significant financial loss or other adverse outcome whose occurrence and severity are unpredictable. It thus implies exposure to substantial losses, over and above the normal costs of doing business. Agriculture is inherently variable, as producers incur losses every year due to suboptimal climatic conditions at different times in the production cycle or departures from expected prices. For the purposes of this study, risk refers to the more severe and unpredictable adverse events that occur beyond these smaller events, measured as the inter-annual variation in the value of agricultural output. A loss threshold was set to distinguish major adverse events from smaller, inter-annual variations in output. Drawing on the results of agricultural risk analysis in other countries, this threshold was set at 10 percent.

This definition also distinguishes between risks, which are unpredictable, and constraints, which are known and so predictable. Sudden shocks to production (droughts, floods, locusts), prices or the enabling environment (sudden policy changes or sharp, unexpected exchange rate movements) are thus considered risks; while factors such as low productivity, poor access to credit, lack of land and lack of information are viewed as known, predictable constraints to sector output.

Indicative losses were calculated as follows:

For production risks, the value of GAO "lost" for each adverse event was first calculated in somoni as the difference between the actual change in output and the threshold change in output, using constant producer prices (2004–06). The resultant value was converted into U.S dollars at 2012 exchange rates and also expressed as a percentage of the value of GAO. The same methodology was used to derive the combined impact of production and price shocks, based on actual production and real prices. This captures the joint impact of price and production shocks, which is the reality that the sector faces.

As shown by the identities derived in appendix A, the losses due to the joint impact of production and price shocks (as derived above) can be disaggregated into production impacts and price impacts. These identities were used to calculate the indicative losses associated with price shocks alone for individual commodities. While this analysis is disaggregated by subsector and commodity, it does not show the different risk characteristics of the four agro-climatic zones due to lack of suitable data.5

[5] Measuring the impact of producer price risks on the economy poses several other challenges. Producer prices and retail prices or international prices do not always move together, which can decrease the impact on the economy as a whole. Seasonal price movements (not measured) may be a greater risk than annual price changes. Finally, lower commodity prices

The two main agro-climatic zones have similar characteristics, however, and account for around 80 percent of production.

Application of this methodology requires a consistent set of data on both production and prices, for an extended time period. Of the various sources of data available, FAOSTAT's data series (1992–2012) on the value of gross agricultural production and producer prices was considered the most suitable. These data allowed the analysis of risk over a 19–20-year period for all products for constant prices and for 2000–11 for real prices (statistics for many variables were not collected during the civil war). The various shocks derived from this analysis were attributed to specific events on the basis of interviews with officials in national and regional government, farmers, and traders, plus information from published reports and Internet sites. A chronology of these adverse events is presented in appendix B.

Aggregate Production Risks

The impact and causes of the major shocks to aggregate output since 1992 for constant prices and since 2000 for real prices are summarized in table 3, first for total GAO and then for livestock and crop GAO. Results in both constant and real prices are presented to show the impact on production alone (constant prices)6 and the joint impact of shocks to production and prices.

will, all other things equal, be beneficial for consumers and thus may have a positive impact on the overall economy. Nevertheless, estimating the severity of commodity price risks gives an idea of sector volatility stemming from price risk and indicates which commodities are most vulnerable to price risk.

[6] FAOSTAT: Constant producer prices calculated as average for 2004–06.

Table 3 Impact and Causes of Adverse Events for Aggregate Agricultural Output

		Indicative loss value (2012 [b]			
Item	*Year*	*Somoni (million)*	*US$ (million)*	*% GAO*	*Causes*
Aggregate GAO					
Constant prices	1993	-288	-60.8	-5.7	Civil war
Real prices	2007	-1,754	-370.3	-31.0	Generalized fall in nominal and real producer prices
Crop GAO					
Constant prices	1998	-17	-3.6	-0.4	Post–civil war impact
Real prices	2007	-1,322	-279.0	-23.3	Generalized fall in nominal and real producer prices
Livestock GAO					
Constant prices	1993	-358	-75.6	-7.1	Civil war
	1996	-186	-39.3	-4.6	Civil war
	1997	-78	-16.5	-1.9	Civil war
Real prices	2007	-433	-214.0	-7.6	Generalized fall in nominal and real producer prices

Source: FAOSTAT.

a. Calculated as the inter-annual change in GAO minus the threshold change in GAO. 2012 values are based on real somoni prices (2012 = 100) and US$-somoni exchange rates for 2012.

The main conclusions from these results are as follows:

- The onset of civil war in 1993 resulted in a significant fall in agricultural output, due to a sharp drop in livestock numbers and crop and livestock productivity.
- The combination of increasing crop productivity, reallocation of land from cotton to other crops, and growing food imports led to the saturation of domestic agricultural markets in 2007, a generalized fall in nominal and real producer prices, and a sharp drop in real GAO. Both crop and livestock commodities were affected.
- These shocks to aggregate GAO show first that the sector's diverse production base combined with irrigation limits the frequency of production shocks at the aggregate level. The major shocks

that do occur are due to severe, countrywide adverse events (for example, civil war, generalized price shocks).

Crop Commodity Risks

Indicative losses for Tajikistan's main crops are presented in table 4. Shocks identified for the constant price (production) analysis cover the period 1992–2012, and shocks for the real price analysis cover the period 2000–11.

Table 4 Impact and Causes of Adverse Events for Main Crop Commodities in Tajikistan

		Indicative loss value (2012)[a]			
Crop	*Year*	*Somoni (million)*	*US$ (million)*	*% of GAO*	*Causes*
Wheat					
Constant prices	1994	-5	-1.2	-0.1	Civil war
	1998	-23	-4.9	-0.6	Post–civil war
	2011	-247	-52.2	-2.4	Switch to cotton
Real prices	2007	-191	-40.3	-3.4	Generalized price shock
	2010	-6	-1.3	-0.1	Post–global food crisis price fall
Cotton					
Constant prices	1995	-120	-25.3	-2.6	Civil war
	1999	-33	-7.0	-0.8	Drought
	2005	-22	-4.6	-0.3	Drought
	2008	-49	-10.4	-0.6	Drought
	2009	-83	-17.4	-0.9	Drought
Real prices	2005	-71	-15.0	-1.0	Drought
	2006	-40	-8.4	-0.5	Cotton debt crisis
	2007	-94	-19.8	-1.7	Cotton debt crisis
	2008	-140	-29.5	-2.3	Cotton debt crisis; drought
Potatoes					
Constant prices	1993	-5	-1.0	-0.1	Civil war
	1995	-14	-2.9	-0.3	Civil war
Real prices	2004	-159	-33.5	-2.5	Price volatility
	2007	-390	-82.4	-6.9	Generalized price shock
	2008	-126	-26.5	-2.0	Price volatility
	2010	-35	-7.4	-0.4	Post-global food crisis price fall

Tomatoes					
Constant prices	1993	-4	-0.8	-0.1	Civil war
	1996	-44	-9.3	-1.1	Civil war
	1997	-7	-1.5	-0.2	Civil war
	2000	-7	-1.5	-0.2	Localized drought
Real prices	2001	-6	-1.4	-0.2	Real price falls
	2008	-3	-0.6	**	Price volatility
Onions					
Constant prices	1993	-2	-0.5	**	Civil war
	1996	-14	-3.0	-0.4	Civil war
	1997	-1	-0.3	**	Civil war
Real prices	2002	-64	-13.4	-1.4	Price volatility
	2004	-29	-6.2	-0.5	Price volatility
Watermelons					
Constant prices	1993	-15	-3.2	-0.3	Civil war
	1996	-58	-12.2	-1.4	Civil war
	2011	-13	-2.8	-0.1	Drought
Real prices	2002	-4	-0.9	-0.1	Price volatility
	2007	-191	-40.3	-3.4	Generalized price shock
	2010	-12	-2.5	-0.1	Post–global food crisis price fall

Source: FAOSTAT.

[a] Calculated as the actual inter-annual change in GAO minus the threshold change in GAO. 2012 are values based on real somoni prices (2012 = 100) and US$-somoni exchange rates for 2012.

** Less than 0.1% of GAO.

The results reflect the impact of the shocks identified in table 3, plus further commodity-specific shocks due to drought and price volatility. The main results are as follows:

- At the commodity level, the indicative costs associated with all shocks are small in both absolute terms and relative to agricultural GDP.
- The civil war from 1993 to 1997 resulted in production shocks for all major crops.
- Drought is the main cause of production (constant price) shocks, with cotton most susceptible to drought.
- Cotton output suffered a further series of shocks from 2005 to 2008 due to the combined effects of drought and the cotton debt crisis.
- Price volatility is the major cause of shocks since 2000, with the strongest price shocks observed in 2007 in response to the saturation of domestic markets.

Livestock Commodity Risks

Indicative losses for the main livestock commodities are presented in table 5. As for crops, the shocks identified for the constant price (production) analysis cover the period 1992–2012, while shocks for the real price analysis cover 2000–11.

Table 5 Impact and Causes of Adverse Events for Main Livestock Commodities

		Indicative loss value (2012)[a]			
Item	*Year*	*Somoni (million)*	*US$ (million)*	*% of GAO*	*Causes*
Cow's milk					
Constant prices	1995	-44	-9.3	-1.0	Civil war
	1996	-231	-48.7	-5.6	Civil war
Real prices	2007	-132	-27.9	-2.3	Generalized price shock
Beef					
Constant prices	1993	-127	-26.9	-2.5	Civil war
	1997	-77	-16.2	-1.9	Civil war
	1998	-122	-25.7	-3.2	Post–civil war
	2006	-5	-1.0	-0.1	Post-drought (2005)
Real prices	2007	-183	-38.6	-3.2	Generalized price shock
	2010	-21	-4.4	-0.2	Price volatility
Mutton					
Constant prices	1993	-88	-18.5	-1.7	Civil war
	1997	-109	-23.0	-2.6	Civil war
Real prices	2007	-123	-26.0	-2.2	Generalized price shock
Eggs					
Constant prices	1993	-60	-12.7	-1.2	Civil war
	1994	-13	-2.8	-0.3	Civil war
	1995	-32	-6.7	-0.7	Civil war
	1996	-21	-4.5	-0.5	Civil war
Real prices	—	—	—	—	—

Source: FAOSTAT.

Note: No indicative losses for the real prices of eggs.

a. Calculated as the actual inter-annual change in GAO minus the threshold change in GAO. 2012 values are based on real somoni prices (2012 = 100) and US$-somoni exchange rates for 2012.

The 1993–97 civil war is the main cause of production (constant price) shocks, due to both an increase in animal losses and a reduction in animal productivity. The generalized price shock in 2007 also had a strong impact on livestock commodities.

Commodity Price Risks

Price shocks were analyzed for the livestock and crop commodities examined above, using real prices as the basis for analysis (table 6). The analysis focused solely on price shocks associated with an overall loss above the threshold for the period 2000–11. Price falls that were offset by production increases were not included.

Table 6 Impact and Causes of Adverse Events for Commodity Prices in Tajikistan

	Indicative loss value (2012)[a]				
Crop and year	*Somoni (million)*	*US$ (million)*	*% of GAO*	*Price loss as % of total loss*	*Cause*
Wheat					
2007	-277	-58.5	-4.9	100	Generalized price shock
2010	-54	-11.5	-0.6	100	Post–global food crisis adjustment
Cotton					
2006	-109	-23.1	-1.3	100	Cotton debt crisis
2007	-138	-29.2	-2.4	100	Cotton debt crisis
2008	-105	-22.2	-1.7	75	Cotton debt crisis
Potatoes					
2004	-293	-61.9	-4.7	100	Price volatility
2007	-729	-153.8	-12.9	100	Generalized price shock
2008	-229	-48.4	-3.7	100	Global food crisis
2010	-202	-42.6	-2.4	100	Post–global food crisis adjustment
Tomatoes					
2001	-84	-17.7	-2.2	100	Price volatility
2008	-111	-23.3	-1.8	100	Global food crisis
Onions					
2002	-93	-19.7	-2.1	100	Price volatility

2004	-74	-15.7	-1.2	100	Price volatility
Watermelons					
2002	-44	-9.4	-1.0	100	Price volatility
2007	-257	-54.3	-4.5	100	Generalized price shock
2010	-48	-10.1	-0.6	100	Post–global food crisis adjustment
Cow's milk					
2007	-271	-57.2	-4.8	100	Generalized price shock
Beef					
2007	-244	-51.5	-4.3	100	Generalized price shock
2010	-72	-15.1	-0.9	100	Post–global food crisis adjustment
Mutton					
2007	-203	-42.9	-3.6	100	Generalized price shock
Eggs					
	—	—	—	—	—

Source: FAOSTAT.

Note: There were no adverse events for egg prices.

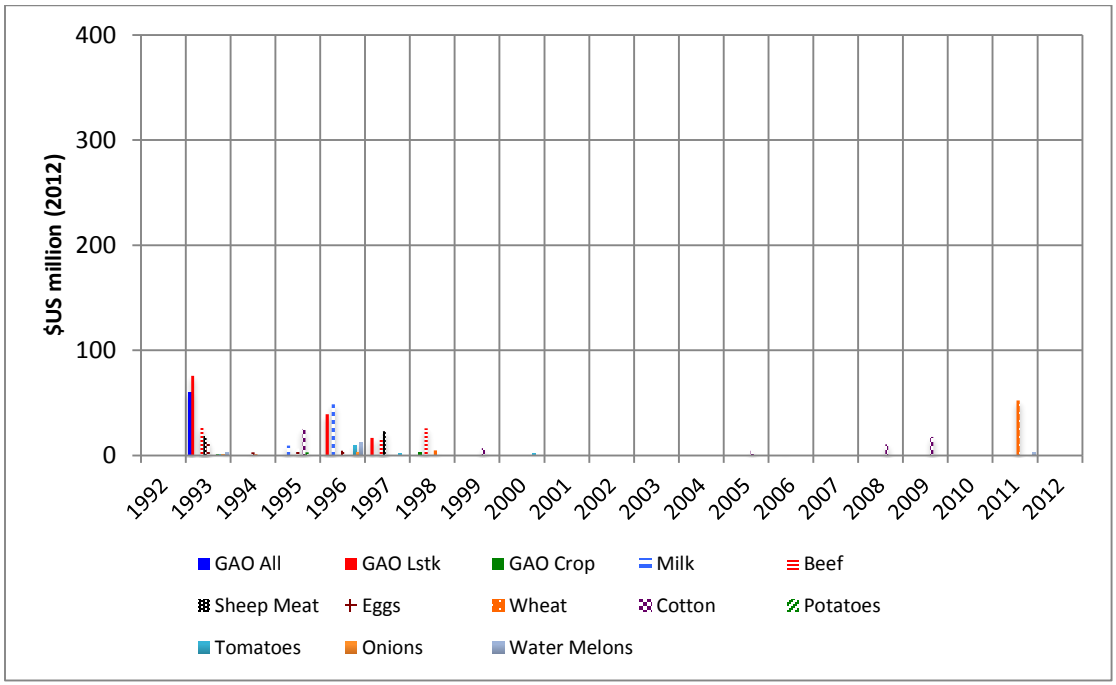
a. Calculated using the identities in appendix C. 2012 values are based on real somoni prices (2012 = 100) and US$-somoni exchange rates for 2012.

The frequency of price volatility is high, with one or more commodities subject to price shocks in 7 of the 12 years analyzed. But in most cases the losses incurred were moderate. The exception is the generalized market saturation in 2007, which caused sharp price falls for most commodities. Crops are more prone to price volatility than livestock commodities, with real prices for cotton and vegetables the most volatile. Cotton price shocks reflect the impact of the cotton debt crisis, as world prices rose steadily from 2005 to 2008. The high volatility of vegetable prices is the result of short-term imbalances between supply and demand and the weakness of domestic markets.

A Timeline of Agriculture Sector Shocks: 1992–2012

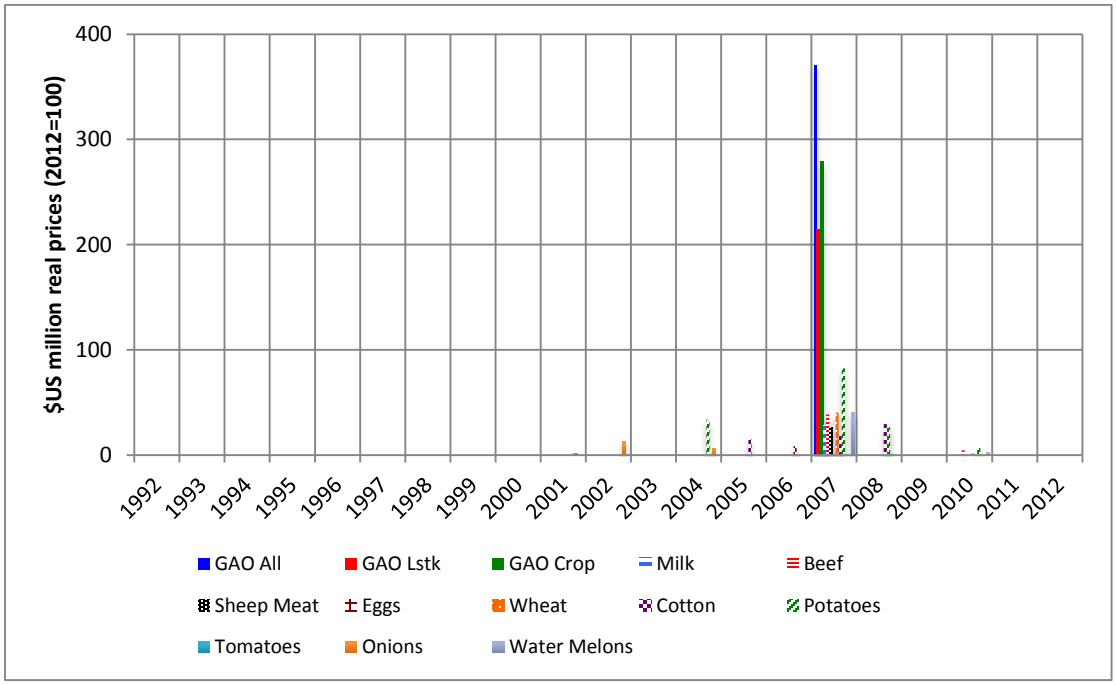
Figures 30 and 31 provide further insight into the incidence and magnitude of agriculture sector shocks during the last 20 years. The two figures are drawn to the same scale to allow comparison of the magnitude of production shocks alone versus joint production and price shocks.

Figure 30 Indicative Losses in Constant Prices in Tajikistan, 1993–2012



Source: FAOSTAT.

Figure 31 Indicative Losses in Real Prices in Tajikistan, 1992–2012



Source: FAOSTAT.

The prolonged impact of the civil war on production alone is apparent in figure 30. No equivalent production shocks occurred until the drought of 2010–11, further confirming that the frequency and severity of production shocks is significantly reduced by access to irrigation and the diverse production base.

Although the analysis of real price shocks only covers the period 2000–11, the greater impact of price versus production shocks on the value of agricultural output is evident nevertheless. The indicative losses associated with the generalized price shock of 2007 were six to seven times greater than those observed at the beginning of the civil war and affected more commodities. Smaller, price-related shocks are also more frequent than production shocks alone.

Comparison of figures 30 and 31 also shows the need to measure the impact of shocks on both production and prices. The impact of many production shocks on GAO is offset by a corresponding increase in producer prices, which tend to rise when production falls. The worst shocks typically occur when production shocks coincide with an exogenously driven fall in real prices.

Ranking and Prioritizing Agriculture Sector Risks

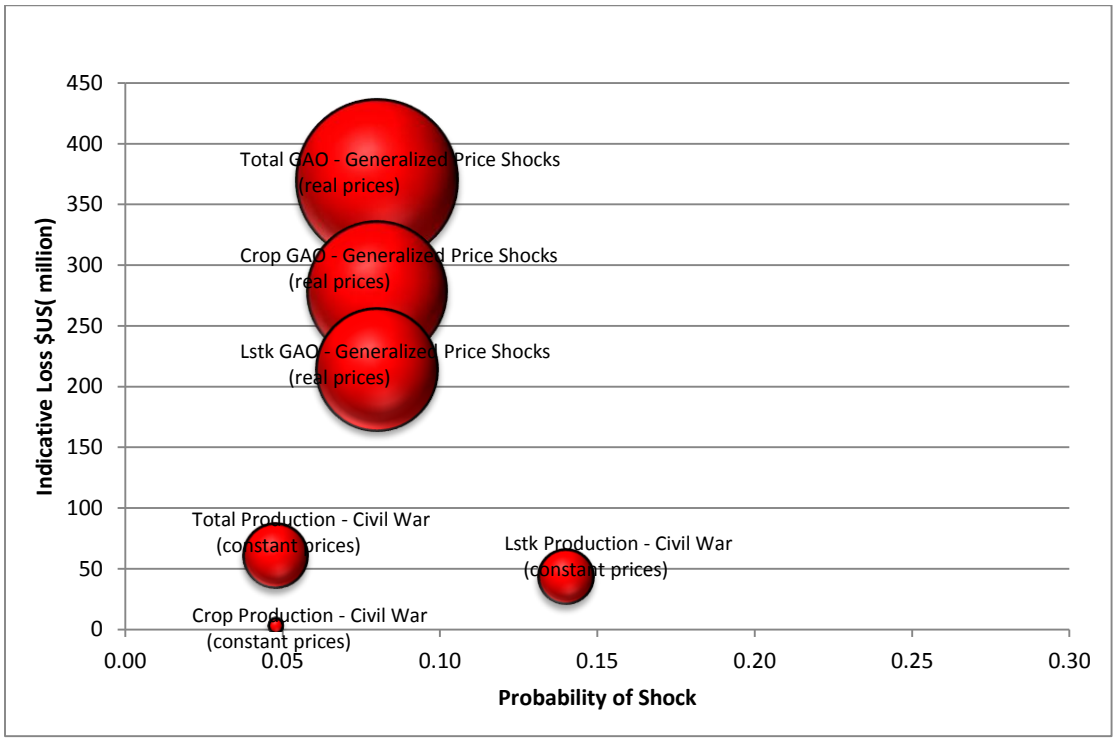
The preceding analysis shows that the agriculture sector faces two different types of risk: high-cost, low-frequency risks associated with sector-wide events, such as the civil war and the generalized price shocks of 2007, and low-cost, medium-frequency, commodity-specific risks associated with drought and price volatility. These two sets of risks are examined in this section to elucidate approaches to risk management.

Each category of risk is quantified according to two parameters: (a) the average indicative cost of the observed shocks above the loss threshold during the relevant time period and (b) the frequency of these shocks, expressed as the number of events during the relevant time period (for example, 3 events in 21 years: frequency = 0.14). Results are presented for both production shocks (in constant prices) and joint production-price shocks (in real prices). Due to lack of price data, production shocks are analyzed for the period 1992–2012 and joint production-price shocks are analyzed for the period 2000–11. While this limits the number of data points for analyzing joint production-price shocks, the economic and political conditions since 2000 are more representative of future conditions in the agriculture sector. At the commodity level, price volatility is likely to become an increasingly important source of risk.

Sector-wide Risks

Major shocks to aggregate agricultural output are less likely to occur in a diversified agriculture sector with reasonable access to irrigation, such as Tajikistan. When they do occur, however, such shocks typically result from extreme events that affect production or prices of a wide range of commodities. The impact of such shocks can be high, as occurred during the generalized price shock of 2007, which incurred indicative losses equivalent to 23 percent of GAO (table 3). Figure 32 shows the characteristics of these shocks.

Figure 32 Sector-wide Shocks to Production and Gross Agricultural Output in Tajikistan

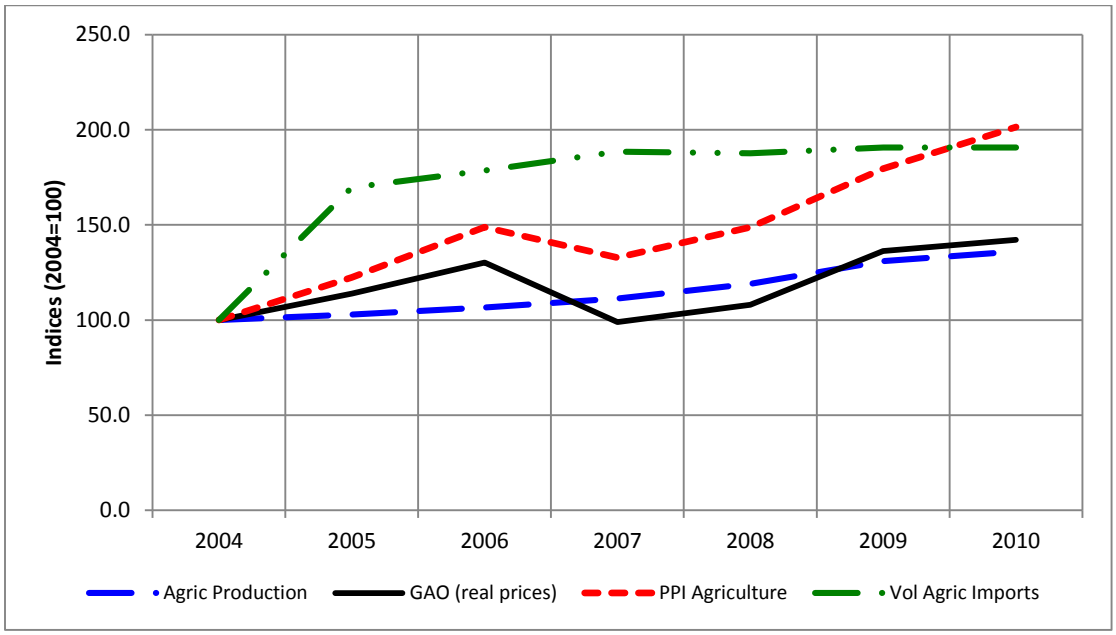


Source: FAOSTAT.

The sector-wide shocks reported for the civil war are production shocks, as there are no price data prior to 2000. The sharpest production shock occurred in 1993 in response to falling livestock numbers and livestock productivity (table 3), but further production shocks occurred for all of the commodities analyzed, throughout the war period (table 4). As in other Former Soviet Union countries, this contraction of production is also attributable to the economic collapse that followed independence from the Soviet Union in 1991. But civil war was the overriding influence on political and economic conditions from 1993 to 1997 and into 1998. The lack of price data precluded analysis of the impact of any concomitant fall in producer prices during the civil war.

Various factors combined to cause the generalized price shock observed in 2007. The postwar increase in agricultural production due to improved crop and livestock productivity was accentuated after 2005 by the reallocation of land from cotton to food and forage crops (for livestock) in response to the cotton debt crisis. This increased the supply of agricultural commodities sold on domestic markets. Food imports also rose in response to economic growth and high remittance income. These supply-side factors inevitably led to the saturation of domestic markets for a wide range of agricultural commodities and a broad-based fall in producer prices. Weak markets and limited producer understanding of market dynamics exacerbated the drop in nominal prices, with the producer price index for agricultural products falling 25.6 percent in 2007. High inflation exacerbated the impact on real prices. This constellation of factors and its impact on real GAO are shown in figure 33.

Figure 33 Agricultural Production, Imports, and Producer Prices in Tajikistan, 2004–10



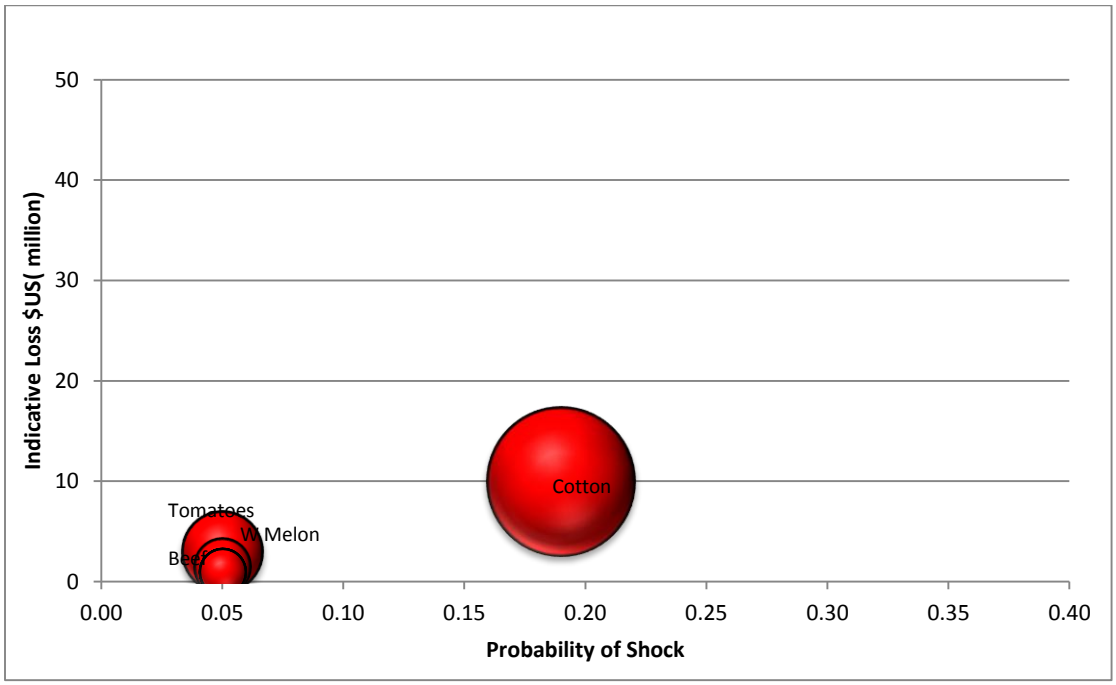
Source: FAOSTAT.

Despite its magnitude, the public response to this price shock was muted. In part this was due to the sector's preoccupation with the cotton debt crisis, which reached its controversial apex in late 2007. The direct impact of the generalized price shock on producers was also reduced by their limited reliance on commercial agriculture and the self-consumption of much of their output. Cash incomes fell, but subsistence requirements were not compromised. The impact of the generalized price shock is noteworthy nevertheless, because it demonstrates the vulnerability of sector output to broad-based price volatility and the need to strengthen agricultural markets.

Commodity-Level Risks

Analysis by commodity includes production risks, (real) price risks, and the impact of joint production and price risks. Aside from civil war, drought is the main cause of shocks to physical output (measured in constant prices for 1992–2012), although its incidence and impact are heavily mitigated by access to irrigation (figure 34). Cotton is most vulnerable to drought, although access to irrigation minimizes its impact, with indicative costs of less than 1 percent of GAO (table 4). Tomatoes, watermelons, and beef production exhibit a low-frequency, low-cost exposure to drought. There were no major drought-related production shocks for the other commodities.

Figure 34 Drought Shocks to Physical Output in Constant Prices by Commodity

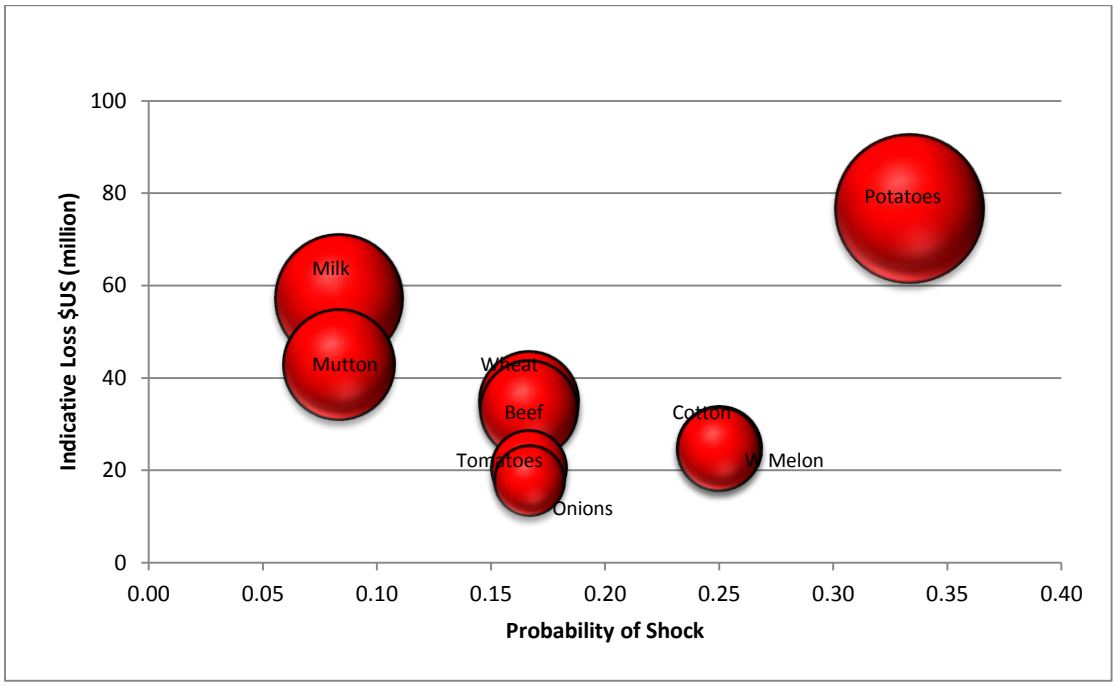


Source: FAOSTAT.

Analysis of the frequency and cost of (real) price shocks was based on adverse events caused partly or solely by a decline in real prices, using the identity in appendix A. Price shocks that were offset by increased production were not included in the analysis. The results are shown in figure 35.

Price volatility is a greater source of risk than drought. Almost all of the main commodities experienced (real) price shocks during the period 2000–11, with varying levels of severity. Potatoes are most vulnerable to price shocks, in terms of both frequency and severity. Cotton and watermelon also experience price shocks with medium to high frequency, but the average costs of these shocks are moderate. The cotton price shocks occurred during the cotton debt crisis, at a time when world cotton prices were rising, demonstrating the adverse impact of inappropriate policy. Of the remaining commodities, price volatility is a low-frequency, medium-cost risk for milk and mutton and a medium-frequency, low-cost risk for wheat, beef, tomatoes, and onions. There were no price shocks for eggs.

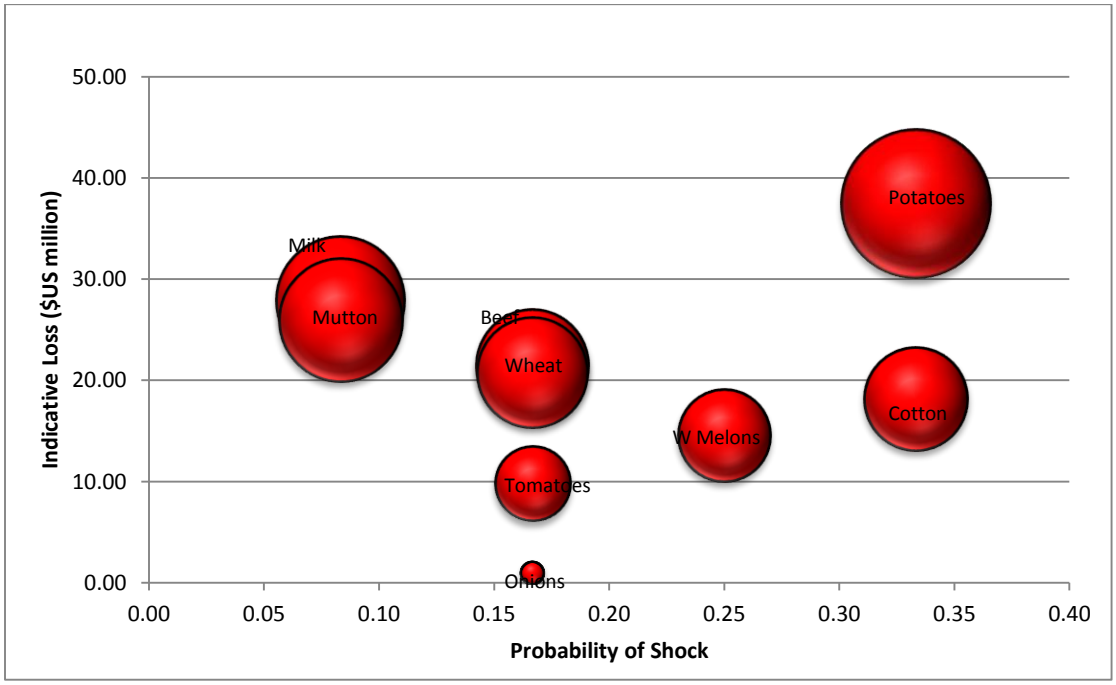
Figure 35 Commodity Price Shocks in Real Prices in Tajikistan, by Commodity



Source: FAOSTAT.

The pattern of joint production-price shocks by commodity follows a similar pattern to that observed for price risk (figure 36). This is to be expected, given that price risks are larger and more prevalent than observed production (drought) risks.

Figure 36 Joint Production and Price Shocks in Real Prices in Tajikistan, by Commodity



Source: FAOSTAT.

Potatoes and cotton are most vulnerable to joint production and price risk, followed by watermelon. Beef and wheat have a similar (medium-frequency, medium-cost) risk profile, while milk and mutton have a low-frequency, medium-cost risk profile. The risks for tomatoes and onions are low, and there are no observed production-price shocks for eggs. The average indicative costs of these joint production-price shocks also tend to be much lower than for price shocks alone, as would be expected. A fall in producer prices is generally associated with higher production levels, reducing any loss in the value of agriculture output.

Implications for Risk Management at Aggregate and Commodity Level

These results confirm that agricultural risk is low at aggregate level due to the sector's diversified production base and access to irrigation. Sector-wide losses can be high when they do occur, however, as occurred in response to the generalized price fall in 2007. Public and private sector initiatives to continue this diverse production system and maintain the physical and institutional infrastructure for irrigation are thus the foundation for agricultural risk management.

At commodity level the analysis shows that future agricultural sector development will need to place much more emphasis on responding to price risk as compared to the traditional focus on production risk. Although cotton is the commodity that is most vulnerable to production shocks, when combining production and price risks, potatoes rather than cotton emerge as the commodity most vulnerable to risk. Most major commodities are vulnerable to price shocks, although the indicative costs of these commodity level shocks tend to be small in both absolute terms and relative to gross agricultural output. By showing the risks associated with cotton versus other commodities, the analysis also highlights the need to take a broader approach to risk management as opposed to the traditional emphasis on the risks associated with cotton production.

These conclusions also highlight the implications for risk of the continued shift towards commercial agriculture – and the increasing associated vulnerability to market shocks. Improved management of price and market risks will require deeper, stronger markets, a better understanding of market behavior by producers and market agents and better access to market information.

Risks Specific to Foothill and Mountain Zones and Small-Scale Farms

As Khatlon and Sughd dominate agricultural production (with 80% of arable land and livestock numbers), the preceding results mask the risk characteristics of agriculture in the foothill and mountain zones. Farmers in these zones rely much more on livestock production, both as a source of income and as a means to manage production and price risks. Dryland farming prevails, increasing the vulnerability to drought. The more rugged terrain and climatic extremes also increase exposure to floods, mudflows, landslides and severe winters. Colder winter temperatures reduce the risk of crop pests and diseases, but market risks may be higher due to poor market access and limited market information.

Small-scale farms are particularly exposed to risk7 due to their low resource base and heavy reliance on agriculture (especially crops). Their ability to manage risk is also weaker as they have limited access to risk transfer, adaptation or mitigation techniques. They are thus highly vulnerable to both market shocks (such as the one in 2007-08) and adverse climatic events (droughts, floods, weather variability, pests and diseases etc). Price risks are especially high as their bargaining power is weak and they lack timely information. Recent survey evidence shows that such small-holder farmers seek the following kinds of support to address these risks:

- Drought tolerant, pest resistant, high yield crop and planting material
- Soil water conservation and natural resource management techniques
- Expansion and improvement of irrigation facilities and adoption of on-farm water-use efficiency
- Appropriate land use and agricultural diversification
- Support for risk transfer mechanisms (insurance), credit facilities, provision of markets and information
- Provision of better animal breeds, health and improvement in pasture management

Ultimately, the priorities identified by these small-holder farmers are relevant to most Tajik farmers – large or small. This suggests that although small-holder farmers are highly vulnerable to risk, the risks they face are in fact similar to those faced by other farmers.

The main recommendations of the report are as follows:

- Continued support for a diversified agricultural production base and assured access to irrigation will remain fundamental to effective risk management;
- Similarly, continued measures to improve productivity and competitiveness and deepen domestic markets will address many of the price risks for agricultural commodities. These market-related measures include better market information systems, more effective supply chains, better access to storage and improved transport infrastructure;
- Continued efforts to establish export corridors from Tajikistan to export markets in Russia, Kazakhstan and Pakistan will also help to reduce market instability for export products and the markets for imported farm inputs;
- Government may also benefit from guidance on how to provision public financial resources for significant periodic shocks such as locust attacks, outbreaks of trans-boundary livestock disease, droughts and floods. The financial resources of line ministries to respond to these shocks are minimal.

The following risk management recommendations were selected for in-depth review and form the Solutions part of the report:

Solutions Area 1: Creating market opportunities

Solutions Area 2: Improving livestock productivity.

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[7] Zvi Lerman and Bettina Wolfgramm. The Hebrew University of Jerusalem. Discussion Paper No. 8.11 Vulnerability to risk among small farmers in Tajikistan: results of a 2011 survey

Solutions Area 1: Create Market Opportunities

In agriculture, different layers of risks are based largely on the frequency and magnitude of risk events (OECD 2011). The interconnected nature of supply chains and agriculture sector actors and stakeholders requires a holistic, systems approach that emphasizes transparency and predictability from the public sector. Aggregate sector efficiency, diversity, and competitiveness underpin any strong risk management strategy.

Phase I of the risk assessment concluded that Tajikistan's agricultural risk at an aggregate level is relatively low due to a highly diversified base of production, which has grown since the 2007 agricultural reform. The Tajik agriculture sector is fairly resilient as a result of this strong diversification and access to irrigation. Normal risks are high frequency and low magnitude, affecting only a single commodity or handful of value chains at a time. They have minimal effects at the national level. With diversity of production already contributing to resilience, the risk management solutions presented here prioritize practical policies, programs, and investments to increase efficiency and competitiveness across the agriculture sector, without focusing on any one commodity.

Recommendations to increase sectoral efficiency and competitiveness are offered in three areas: (1) market knowledge and training, (2) investment promotion and business enabling environment, and (3) trade facilitation.

While each value chain or commodity may have fairly unique constraints on efficiency or competitiveness related to technology, seasonality, handling and perishability, or markets, overemphasis or investment in a particular subset of crops or products may increase the aggregate risk profile by decreasing diversity. Government needs to achieve a balance between efficiency, diversity, and competitiveness in all policies and interventions.

Risk Management: Background

Normal risk variations, which are high-frequency, low-magnitude (or low-cost) events in production, prices, markets, and weather, do not typically require any specific policy response and are managed directly by farmers and other sector stakeholders as a part of their everyday business strategy. Catastrophic risks, which are low-frequency, high-magnitude extreme events that affect many or all producers or sector stakeholders, are usually beyond the capacity of producers or markets to cope.

Between the extremes of normal and catastrophic risks are marketable or transferable risks. Government policy can ensure a predictable and equitable operating environment to encourage the development of market-based risk management tools, such as investment and financing, insurance, and marketing contracts.

This agriculture sector risk assessment differs from previous work by considering aggregate risks at the national level instead of at the supply chain level or from the perspective of a particular set of actors, such as producers. A systemic approach considers both the long-term and short-term effects

of adverse events across the entire sector. A systemic approach empowers agriculture sector actors to manage normal risks by formulating strategies and policies that balance sector efficiency, diversity, and competitiveness with growth.

Phase I also identified the risk to Tajikistan's agriculture sector as low due to its diversified base of production and access to irrigation. Sector-wide losses, such as generalized price drops, can be high when they do occur, but are the result of the country's being a small, largely isolated market and the poorest country in Central Asia. The domestic market can become saturated, with bumper production of either highly perishable crops, such as tomatoes, or even less perishable crops, such as potatoes, due to a lack of sufficient handling and storage capacity. As a landlocked country, Tajikistan must rely on its neighbors as potential destination markets or for transit. Government can support the ability of supply chains and key stakeholders, including producers, to cope with these normal risks by strengthening agricultural services, encouraging private investment and competition, particularly in trade and postharvest ventures, and satisfying specific infrastructure requirements.

Tajikistan's Agriculture Sector

Tajikistan is the poorest of the Central Asian countries. More than half of GDP in 2013 came from migrant remittances, and most migrant laborers work in Russia (World Bank 2014a). As presented in the phase I analysis, agriculture is an important sector for the Tajik economy, representing 23 percent of GDP and 51 percent of employment. Crop production accounts for approximately 80 percent of agricultural output. Sector performance can have a significant impact on poverty reduction, as 77 percent of the poor live in rural areas.

A significant agricultural reform initiative—commonly referred to as Freedom to Farm—was launched in 2007 to reduce government intervention in farming decisions and allow farmers to diversify away from cotton. While the phase I risk assessment found that this crop diversification, which relies largely on access to irrigation, underpins the relatively low aggregate risk profile of the Tajik agriculture sector, the land reforms also launched the shift toward more commercial production and farm decision making, both of which are still very new. On the one hand, this reform created a greater opportunity for producers to respond to market signals and mitigate their risk by diversifying their production base; on the other hand, market linkages and an active trade, particularly in the Khatlon area in the south, are not yet in place to provide those market signals to producers. The reform also resulted in the breakup of larger farms into much smaller individual farms, which works against economies of scale and increases the cost of aggregating attractive volumes for market.

The 10 agricultural products with the largest share of Tajikistan's GAO together represent only 63 percent of total GAO (table 7). Two staple food crops, wheat and potatoes, each account for 10 percent of GAO. Cotton is now only 9 percent of GAO, with production falling 40 percent between 2004 and 2009 in response to the cotton debt crisis. The main vegetable crops—onions, tomatoes, and watermelons—together represent 15 percent of total GAO. Animal products, milk, beef, mutton, and eggs represent about 19 percent combined.

Table 7 Most Important Crops and Commodities within Gross Agricultural Output

Product	*% of GAO*	*% of cultivated area*
Wheat	10	33
Cotton	9	20
Potato	10	35
Onions	7	15[a]
Tomatoes	6	11[a]
Watermelons	2	17[a]
Milk	9	—
Beef meat	3	—
Sheep meat	6	—
Egg	1	—

Source: Based on FAOSTAT.

Note: — = not available.

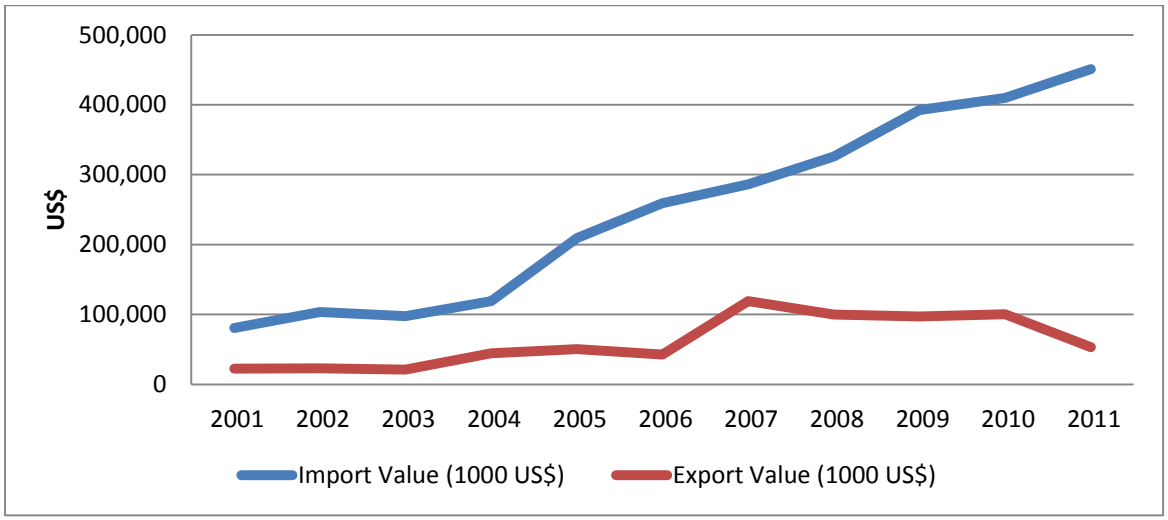
a. % of vegetable cultivation.

The diversity of types of crops within the most significant 10 crops and the limited contribution that each makes to the total demonstrate the diversity within Tajikistan's agriculture sector. Every one of these top 10 crops, with the exception of cotton, has experienced growth in overall volume of production.

While Tajikistan's production base has become more diverse and food production has steadily increased as hectares move away from cotton, Tajikistan remains a net importer of food. In fact, growth in food imports have significantly outpaced growth in exports, as shown in figure 37.[8]

[8] Unfortunately, neither FAOSTAT nor United Nations Comtrade had data after 2011. The TajStat website only had data through 2008.

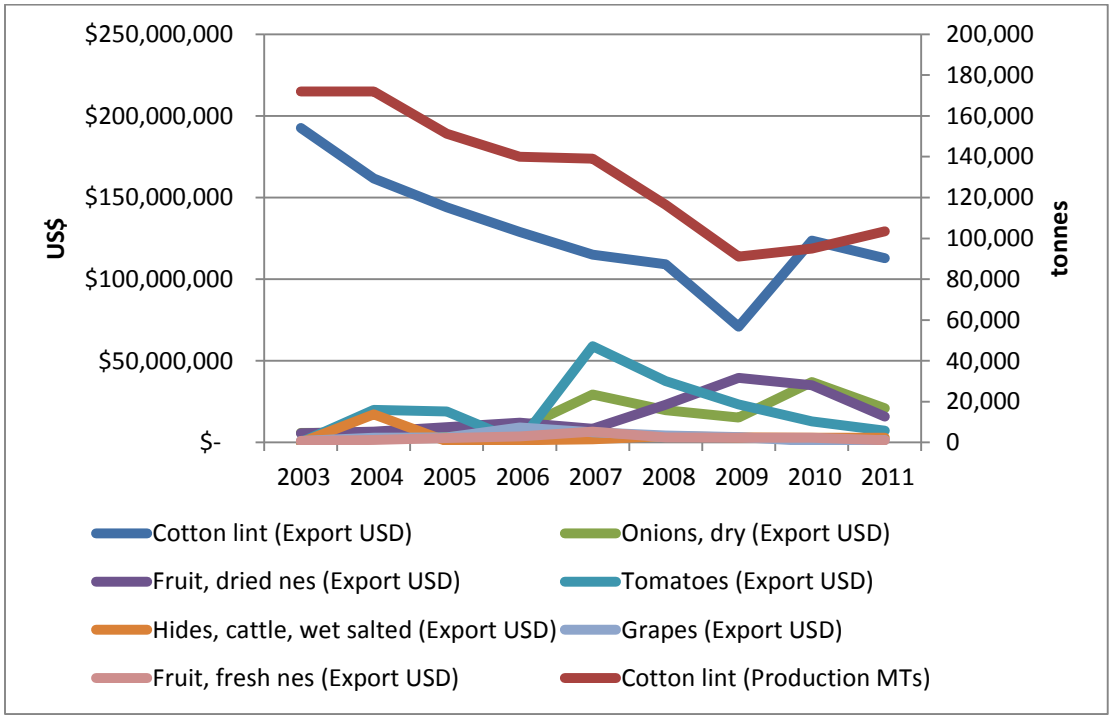
Figure 37 Trade in Food and Livestock in Tajikistan, 2001–11



Source: FAOSTAT.

Imports are dominated by wheat, vegetable oils, and sugar. Tajikistan's food and animal exports equaled only about 4 percent of total production by value in 2011 (figure 38). This confirms the importance of the domestic market for Tajik producers. Even as cotton production has fallen dramatically, cotton continues to be the most significant agricultural export. The other export crops are higher-value products, including onions, dried fruit (particularly apricots), tomatoes, wet hides and skins, and fresh fruit, including grapes.

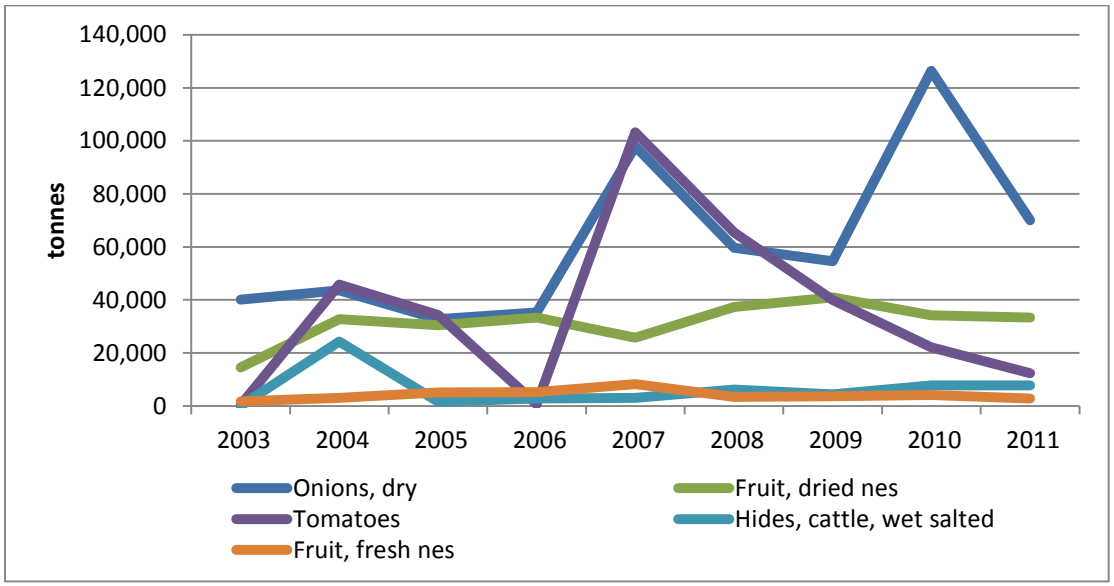
Figure 38 Main Exports of Tajikistan, Including Cotton Production, 2003–11



Source: FAOSTAT.

And while the overall production of each of these crops (except cotton) has increased steadily, particularly since the agricultural reform initiative launched in 2007, the volume and position of each as exports have been extremely volatile, as shown in figure 39. Onions have been a significant export each year, but the quantity has varied widely. Dried fruit, fresh fruit, and wet hides and skins have been largely steady over the years. Tomatoes, much more perishable than onions, experienced significant volatility in the quantity of trade and in price.

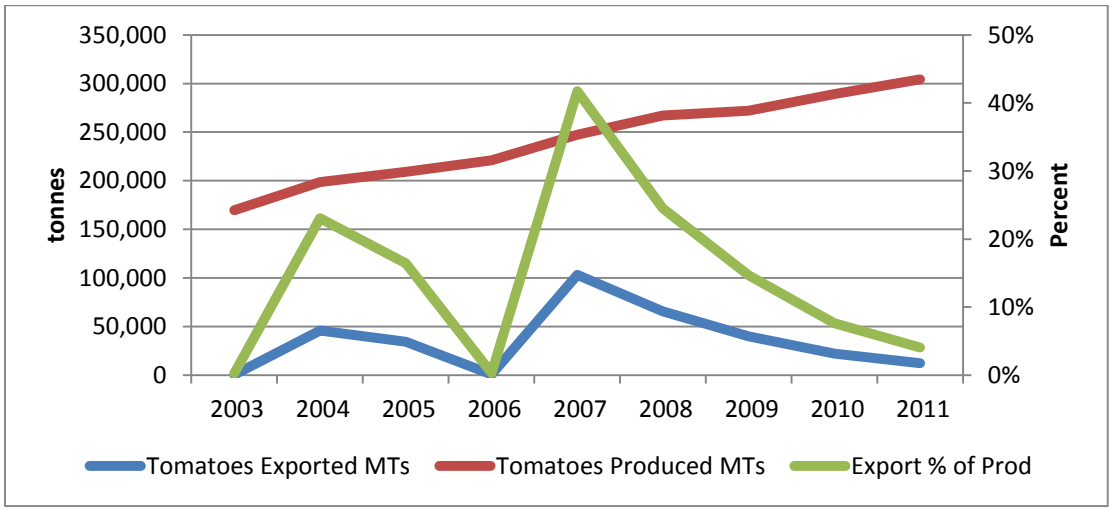
Figure 39 Top Agricultural Exports Excluding Cotton, 2003–11 in Metric tons



Source: FAOSTAT.

Looking at overall production alongside exports, figure 40 shows how insignificant export markets are to the overall tomato industry in Tajikistan. Exports had two very sharp peaks, with exports dropping to nearly zero before and after the reform, with no resulting impact on overall production. Exports represented 41 percent of total production in 2007 and 25 percent in 2008, dropping to only 4 percent in 2011. These market signals were either not sufficiently communicated back through the value chain to producers, thus affecting production decisions, or the domestic market grew to absorb the excess production. Production continued to grow steadily.

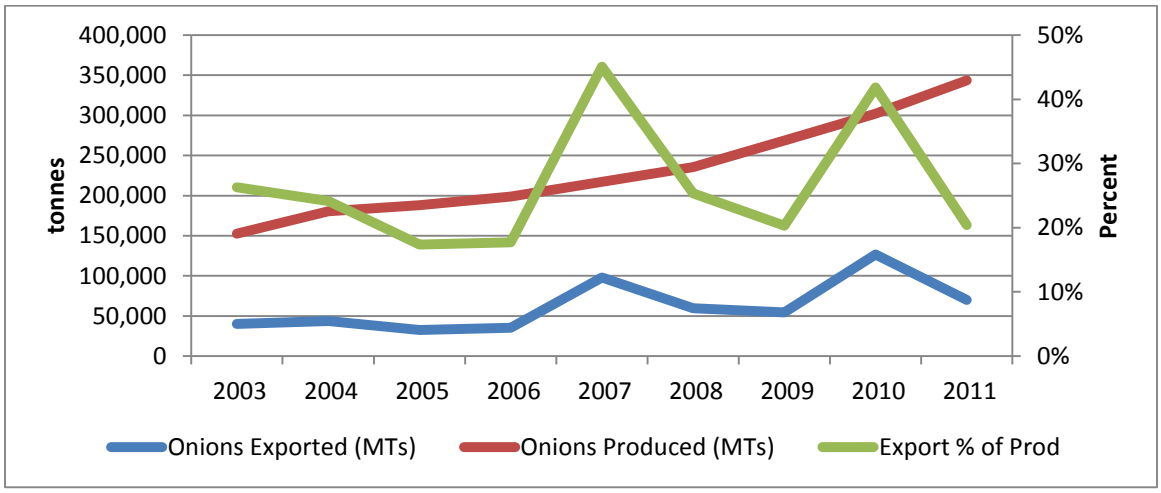
Figure 40 Tomato Production and Exports in Tajikistan, 2003–11



Source: FAOSTAT.

Onion exports, in contrast, have represented at least 20 percent of total onion production (figure 41). Exports peaked at 45 percent of total production in 2007 and 41 percent in 2010. Khatlon oblast is able to overwinter onions, producing an early onion crop in May and early June, prior to Sugd and other latitudes to the north. Similar to tomatoes, when onion exports fall from 40 percent to 20 percent, production does not contract. Production continues to grow steadily.

Figure 41 Onion Production in Tajikistan, 2003–11

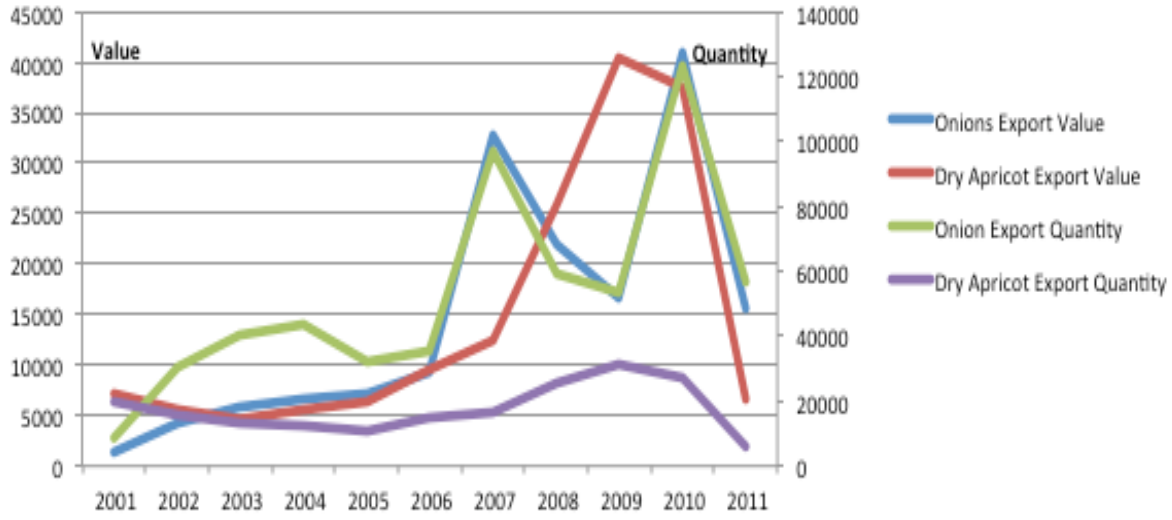


Source: FAOSTAT.

Agricultural exports are limited by the undeveloped trade and entrepreneurial segment of the agriculture sector and by the logistical challenges of getting products out of Tajikistan. Russia is the largest traditional export market for food products. Russian agricultural exports totaled US$75 million (figure 42). Onions were the second most significant export, after cotton. More than 55,000 metric tons of onions were exported in 2011. But both the volume and value traded (of onions, dry apricots,

and other exports to Russia) have been variable due in large part to the uncertainty of access and cost of transporting by rail across Uzbekistan.

Figure 42 Value and Quantity of Onions and Dry Apricots Exported to Russia, 2001–11



Source: FAOSTAT.

Kazakhstan is the second largest food export market for Tajikistan. While the Kyrgyz Republic can be used as a transit country to reach the Kazakh and Russian markets, the most direct road routes are through Uzbekistan. Longer truck routes via the Kyrgyz Republic to Russia can be used, but only for the less perishable crops, and they increase cost and transit time. The Kyrgyz Republic also grows some of the same products as Tajikistan, particularly apricots, but it cannot compete on the seasonality of early onions. However, it does have lower transport costs to the same destination markets as Tajikistan.

In general, Tajik products are sold in Russia's second-tier cities, where Tajik traders have personal relationships or relatives, such as Chelyabinsk, Ufa, and Kazan. Tajik traders need working capital, market linkages, additional experience, and market information, as well as larger volumes of consistent product before they can access the larger, more formal markets, both within these second-tier cities and in the largest Russian markets. A niche exists for this spot commodity trade within the Russian and Kazakh markets, but they are less consistent and highly competitive.

While diversity of production underpins the country's relatively low risk profile, diversity of export products and reliable access to export markets can support resilience of the sector. There are some concerns that improved relations with Uzbekistan, which would improve reliability and reduce the cost of transit through Uzbekistan via rail to Russian markets, could open Tajik markets to more Uzbek agricultural products. Uzbekistan has a well-developed greenhouse horticulture industry, which grew thanks to subsidized gas (for greenhouse heat) and benefits from the diversion of subsidized fertilizer and inputs from cotton to the higher-value horticulture crops. Opening the Uzbek relationship could improve access to export markets, but runs the risk of displacing Tajik production on the domestic markets with cheaper Uzbek production of high-value horticulture products.

Tajikistan has been pursuing alternative trade agreements and transport routes to diversify market opportunities for its growing production base. Discussions for the Turkmenistan-Afghanistan-Tajikistan railway to bypass Uzbekistan as a rail link to the Middle East and Russian markets (and beyond) were launched in 2013. Scheduled for 2015, the railway is unlikely to be completed on time, but it is indicative of alternative opportunities to focus on alternative markets and transit routes. Southern markets, including the large urban population of Pakistan or its port for international markets, may be more difficult for Tajikistan because of continuing concerns about security and wariness to give market access to the well-developed and highly skilled Afghani and Pakistani traders. Improved relations between the Islamic Republic of Iran and the global community could also open up port access to Tajikistan for global trade. China has been investing heavily across Central Asia to improve transport routes and infrastructure along with the Asian Development Bank–supported CAREC program. The infrastructure investments must be combined with political and trade relationships at the national level and security confidence.

Aggregate market risk improves with efficiency, diversity, and competitiveness. Tajikistan has a strong diversity of products, which has risen largely since the 2007 agricultural reform. With this diversity of production and transition to more commercial agriculture, farmers have started to produce higher-value and more perishable products. There is limited diversity of markets. Most products are sold in the Tajik markets, which are still inefficient, lack investment and trade sophistication, and have limited capacity to absorb fresh produce during the main harvest seasons. The purchasing power of the Tajik market is also tied closely to the Russian and Kazakh economies due to the high dependence on remittances. Current export markets are unreliable due to closures, high costs, impoundments, and lack of available rail cars on the traditional logistical route (rail through Uzbekistan). Alternative markets and transit routes to the south suffer from insecurity and are difficult to access due to a lack of trade experience and sophistication.

Improving the risk profile of the agriculture sector requires increasing the diversity of market options and improving the efficiency and competitiveness of supply chains. Continuing to open the economy will bring higher risks from imported products alongside improved logistical access to foreign markets. The sector can be supported with improved access into these markets and improved efficiency in the domestic market (improved logistical infrastructure, marketing information, quality and standards capability and capacity, and trade facilitation will positively affect multiple products) and continued investments in improving competiveness in supply chains and products (including investments in upgrading technology along supply chains, access to affordable finance, and business enabling environment).

Risk Management: Areas of Priority

The Tajik agriculture sector has an overall low risk profile and largely normal market risks, including price volatility risk and market shifts that affect individual or groups of commodities rather than the entire sector. The domestic market is the most important market, accounting for more than 90 percent of GAO value. However, purchasing power in the domestic market depends on remittances from laborers in Russia and Kazakhstan. Unreliable access to foreign markets means that perishable products are dumped on domestic markets when logistics shut down or become too costly.

While various livestock products represent roughly 20 percent of total GAO, no single crop dominates. The sector has improved its risk profile through the diversification of crops. Tajikistan's agricultural reform, opening up production and therefore increasing opportunities in postharvest enterprises and trade, is still relatively new. It was only launched in 2007. The supply chains have not seen significant investment and cross-cutting growth in capacity and value added due to lack of access to affordable working capital and investments, unreliable access to markets with high absorptive capacity, use of old technology and antiquated handling, storage, and processing facilities, and lack of market intelligence. Risk management policies should support the capacity of producers and stakeholders in the entire sector to manage and respond to market shifts and events, without overemphasizing any particular crop or set of crops.

Tajikistan may have a seasonality advantage for some products in the traditional northern markets. However, continued focus on improving access to traditional markets (Russia and Kazakhstan) magnifies Tajikistan's risk exposure and vulnerability to the political and economic welfare of these countries. These countries not only are destination markets for the majority of Tajik food exports, but economic problems in those markets have a large impact on Tajik domestic markets. Tajikistan is in a geographic location to consider markets and transit to the south, including to and through Afghanistan, the Islamic Republic of Iran, Pakistan, and Turkmenistan.

Various donor projects and government programs are investing in projects to increase the efficiency and competitiveness of specific agriculture value chains and increase private sector investment across agricultural industries and supporting services, including financial and information services. This includes the World Bank's recently launched Agriculture Commercialization Project, which seeks to increase the efficiency and competitiveness of five value chains.9 These programs contribute to improving the capacity of stakeholders to manage and respond to normal agricultural risks.

It is important to balance agriculture sector investments and development efforts across the three risk management pillars of efficiency, diversity, and competitiveness. Diversity of production is the strongest aggregate risk mitigation characteristic of Tajikistan's agriculture sector. Practical programs and investments to increase efficiency and competitiveness of specific value chains are important to unlock their particular constraints. Diversity of markets, including nontraditional export markets, will be possible with greater efficiency and competitiveness and will contribute to decreasing sector risk. An overarching aggregate risk management strategy needs to balance pursuing narrow constraints or specific opportunities within particular commodity value chains with pursuing diversity of production and of market. Without this balance, the sector runs the risk of overemphasizing dependence on a smaller set of products, value chains, and end markets.

Other possible government interventions related to normal risk, such as the establishment of supported floor prices, may encourage producers and sector stakeholders to pursue more risky activities. Unintentionally incentivizing risky behavior, however, should be avoided. The public sector needs to ensure that all policies and activities are predictable and transparent. Uncertainty of

[9] The specific value chains for emphasis have not yet been selected.

regulations and interventions, including responses to both normal and catastrophic risks, can disincentivize private investment, savings, and an active commodity trade.

Risk Management in National Agricultural Strategy

Tajikistan's Living Standards Improvement Strategy (LSIS) 2013–15 highlights relevant objectives and activities for improving the risk management capacity of the agriculture sector as well as a few key challenges and risks relevant to the agriculture sector and more specifically to the market risks identified in phase I of this assessment. The LSIS outlines specific goals with regard to improving foreign trade policy and procedures; strengthening Tajikistan's contribution to global trade; facilitating regional cooperation; improving the business climate, in particular by strengthening its legal basis; supporting entrepreneurship development and attracting investment; and applying necessary reforms in the financial sphere. Work to strengthen these areas will improve the efficiency and competiveness of the agriculture sector and attract additional investment and businesses.

The agriculture sector focus within the LSIS gives priority to food security and continued gains in the effectiveness of producing agricultural goods, including cotton. However, focusing on food security at the national level runs the risk of promoting a narrower range of staple food crops where a comparative advantage is not possible, thus increasing risk to the agriculture sector. Specific objectives include the development of meat, milk, and poultry products for domestic consumption.

Market information, enabling environment, and dated technology are challenges to the Tajik agriculture sector. Tajikistan has joined the World Trade Organization (WTO), which was a specific trade facilitation and competitiveness activity noted by the LSIS. However, the LSIS did not focus specifically on risk. Tajikistan is also an active member in the Shanghai Cooperation Organization with China. Other important trade agreements and frameworks include the Commonwealth of Independent States Free Trade Area and the Pakistan-Afghanistan-Tajikistan Transit Trade Agreement. The Islamic Republic of Iran is the second largest investor in Tajikistan after China.

Potential Solutions

Therefore, recommendations to increase sectoral efficiency and competitiveness fall into three broad areas: (1) market knowledge and training, (2) investment promotion and business enabling environment, and (3) trade facilitation. An aggregate, systemic sectoral approach can support actors and stakeholders across the diverse products and value chains. Table 8 provides an overview over identified market risks and proposed responses.

Table 8 Market Risks and Proposed Responses for the Aggregate Agricultural Sector in Tajikistan

	Risk level and response strategy		
General risk area and specific targets for risk management	*Micro (idiosyncratic): affects individuals and households; reducing and mitigating risks*	*Meso (covariant): affects groups or communities; sharing, transferring, and pooling risks*	*Macro (systemic): affects regions or nations; coping with risks and recovering from disaster*
Market Information and Intelligence			
Reliable, consistent market datasets for correlation and trend analysis	Training in utilization and market development for market intelligence products		Inventory available market information sets and coordinate across Agencies through a single responsible body
Relevant international market intelligence on end markets and competing global production	Access available market information via publication, internet, or cell phone/SMS	Associations and industry groups facilitate access market information datasets to relevant international markets	Collate and publish market information in a timely and consistent reporting schedule
Business Operating Climate and Private Sector Investment			
Predictable and Transparent Legal and Regulatory Framework	Changes and implementation in local policy or regulations	Changes and implementation in local policy or regulations	Changes and implementation in regional or national policy and regulation, environmental law, agricultural payments
Consultative Legal and Regulatory Framework		Local and Regional Public/Private Sector consultations regarding agricultural sector investment	National consultative public/private dialogue
Access to finance for sector upgrades and innovation; including storage and processing	More consistent demand from value addition and downstream operating capacity	Increased efficiency and competitiveness through new technology and business ventures	Matching Grant fund
Market Access and Trade Facilitation			
Trade Agreements			Pursue trade agreements with diverse trade partners

Non-tariff trade barriers	Capacity to meet new market opportunities that offer market premiums	Adopt globally competitive processes and innovative technologies through upgrading downstream investment	Upgrade capacity and infrastructure to meet and certify global standards
			Food Safety Regulatory Reform
		Diversify end markets to reduce dependence on markets which may impose valid or suspect technical barriers to trade	
Transport Cost and Capacity			Upgrade key transport corridors
		Upgrade transport equipment to improve efficiency of product transport and logistics	Legal and regulatory framework for equipment leasing
Customs and Border Formalization			Technology, capacity, procedures, and infrastructure improvements to reduce time and cost
Exchange Rate Risk		Diversify end markets	

Note: — = not available

Market Knowledge and Training

Asymmetrical availability of and access to market information result in significant sector inefficiencies. Basic market information includes accurate historical data sets of market prices, timely indicative market prices, traded volumes through critical markets, and production data. Market intelligence is the analysis of basic market information for use in decision making. Market intelligence includes trend and correlation analysis, forecasting, and analysis of other relevant external business environment information, including political and macroeconomic factors. Basic market information is typically a public good and is necessary for the development of market intelligence. Market intelligence is most often a private sector product that stakeholders may develop and analyze themselves or may purchase as a service from a third-party specialist.

Active market actors, including producers, traders, and processors, track prices and trade trends across seasons and regions to predict market movement for the current season. Having publicly available, accurate data sets allows stakeholders, not only market actors but also financial institutions, to conduct trend and correlation analysis. Many larger actors are active in their local markets on a daily basis and are extremely well informed; however, they may be tangentially aware of the usual and expected correlations between their markets and the large regional markets but not monitor those regional markets with the same depth or focus. Smaller producers and actors are often only active in their local markets as harvest approaches and into the storage season. They likely do not have the same access or resources to obtain market information or generate their own market intelligence outside of the main marketing season.

The LSIS identifies lack of information on product markets and prices as a key challenge for agriculture sector development. In addition, the LSIS has noted widening of entrepreneurship and access to new Asian markets as part of ensuring an improved investment climate and private sector and entrepreneurship development. The public sector has some capacity for forecasting production using reports and statistics submitted by the oblasts to the central government. The strength and timeliness of this information are not clear. The National Statistics Bureau collects and publishes production and price data, but the information is not easily accessible and is not available in a timely fashion. Hard-copy reports are published periodically with rich data and information, but no soft copies are publicly available to other stakeholders, including financial institutions.

The International Finance Corporation (IFC) has developed tools specifically for the financial sector to assess loan risk. A web-based agricultural risk assessment, which is based on technology and cashflow cards, is being rolled out to Tajik financial institutions. This effort required and continues to require market information data sets. Neksigol is a private market information and intelligence organization that came out of an IFC project in 2002. It is a member-owned company with more than 1,000 member producers. Neksigol has some member-focused services and entities. Its main business is aggregated purchase and resale of inputs and agrochemicals (serving as agents for high-quality crop protection companies such as Syngenta).

It was founded within a cotton program and continues to be strongest with regard to cotton production. Recently the company has started to diversify into fruit (including dried fruit), and other horticulture. One unit serves as a microfinance institution. The extension and information unit was founded in 2008, reaching approximately 7,300 producers through a website, a text message service, two smartphone apps, and a self-published newspaper. More extension information appears to be shared than market intelligence, although basic price information is included in all mechanisms. Neksigol is active in pursuing new market linkages and serving as a broker for farmers. New markets include FairTrade certified dried fruit to Europe and Australia, dry beans into Afghanistan, and watermelon and onions along border areas with Afghanistan and Uzbekistan. Neksigol has approximately 3,000 subscribers and distributes information in the three main crop-producing regions of Tajikistan. The company continues to receive some donor support, particularly for providing extension and information services to producer households.

Other private agricultural advisory services are focusing mostly on linking extension information with input finance, with the business based primarily on cotton producers, with other production as ancillary. Some of these firms are also moving into market linkage and broker roles, but are new to that space. The Rural Investment Climate Assessment noted that more than half of farmers who market their production sell at the farm-gate. This is not uncommon, but it may weaken the access of producers to market information and market intelligence.

Equal and predictable access to reliable market information, accurate data sets, and market intelligence allows stakeholders, including producers, to make critical decisions to mitigate risk and cope with normal market risks.

A complementary set of market information, market intelligence, and training services and support can be developed between the public sector and the private sector. The public sector can strengthen its timely collection and reporting of production forecasts, market prices, and end-of-season commodity data. CAMIB in Moldova is an NGO agriculture market information and intelligence service that was launched within the Ministry of Agriculture and Processing Industry under a European Union TACIS program in 1997. In 1999, it became a nonprofit NGO, providing domestic food operators with information and marketing services fundamental to creating and maintaining market transparency. The program receives donor funding, which has helped to fund its publicly available market information as well as to underwrite market intelligence reports both on Moldovan and on target international markets.10

Private market intelligence services and commodity groups, such as the Neksigol, can use the publicly available data sets and political and economic analysis to provide useful market intelligence through a variety of fee-for-service mechanisms, including agricultural magazines and regular commodity- or market-specific subscription newsletters.11 They are already providing both public market information (largely donor funded or subsidized by other revenue streams) and private market

[10] See http://www.camib.com/eng/about_us.php.

[11] For an example of a private market intelligence subscription-based newsletter, see http://www.ciafrica.co.za/images/WeeklyReportExample.pdf.

intelligence for target markets. As noted, some private capacity exists within Tajikistan, but it is focused mostly on cotton, with other commodities and market focus still emerging. The market for services in other value chains is nascent, as there is limited investment in commercial agribusiness. At the same time, this market intelligence can support investment promotion and risk planning. Both the trade promotion agencies in the public sector and the specific export-focused commodity groups are well situated to contribute to meaningful market intelligence for market diversification and for the most relevant foreign markets.

Training is needed for key market actors, particularly producers, smaller traders, and agribusinesses, in the use of publicly available data sets and building capacity and interest (market development) in market intelligence services and products.

To improve market knowledge and training, the following next steps are recommended:

- Inventory existing forecasting and market information processes and reports within the relevant ministries and agencies, including the Ministry of Agriculture, the Ministry of Economy, and the National Statistical Agency. A wealth of information is collected, but it is not collated or made available in a useful, timely, and easily accessible and analyzed format. The information is collected and maintained in different ministries and agencies. Data are often only available in hard-copy reports. One agency or team needs to have clear responsibility for driving the process and ensuring progress.
- Design and implement a timely market information reporting structure in consultation with the private sector. Consider the use of appropriate information technology to facilitate access. Review other country experiences.
- Develop and implement, with the private sector, market information and intelligence utilization training for producers, agribusinesses, and traders to inform stakeholders of the availability of public information, to increase the use and effectiveness of information and reporting mechanisms, and to build a market for privately developed high-quality market intelligence. These trainings may be value chain specific and should occur at the oblast and district levels. They may be leveraged to bring together value chain actors, particularly traders, to facilitate market linkages and develop additional business relationships.

Investment Promotion and Business Operating Environment

Tajikistan has uneven investment in the postharvest, downstream end of the various commodity value chains. Even within the country, Sugd and the areas around Dushanbe have more agribusinesses and active traders than Khatlon, in the south. A significant agricultural reform initiative, which was launched in 2007, reduced government intervention in farming decisions and allowed for crop diversification away from cotton. This reform created opportunities for producers to respond to market signals and to mitigate risk by diversifying their production base, but farmers have limited experience and market channels are not yet in place to provide those market signals. The postharvest and downstream private sector does not yet have the experience or the time to build businesses around the new production and market opportunities.

The World Bank's Doing Business indicators rank countries and measure factors important for the business investment and operating environment. Tajikistan and other Central Asian economies are ranked among the poorest business operating environments in the world. In 2011, the Doing Business

report highlighted Tajikistan's progress and emphasized the need to continue improving the investment climate and enabling environment for entrepreneurs. Tajikistan was listed as one of the 10 most improved economies, climbing 10 places. The LSIS emphasized the need to continue building on that improvement. One result of the difficult investment climate and lack of access to affordable finance is the extremely old age of the few existing postharvest, downstream businesses within the commodity value chains.

With regard to processors, there are few dairy processors, food manufacturers, fruit drying companies, or any other agribusiness with modern, competitive equipment. In Khatlon in particular, few agribusinesses have access to "red-line" electricity, which is prioritized for 24-hour service. Old infrastructure and equipment are often still used, significantly below capacity, with low efficiency and high costs compared to equipment that could be imported. These operating and investment issues drag down the efficiency and competitiveness of the value chains. The lack of innovation is not only relevant to physical technology but also to processes and standards, such as the adoption and implementation of hazard analysis and critical control points and other food safety and processing best practices.

In 2011 Tajikistan was ranked 139 in the Doing Business list of 183 countries. Tajikistan was one of the countries cited for forming a regulatory reform committee, convening regularly, and focusing specifically on improving the Doing Business indicators. In 2015 Tajikistan's ranking is 166 (improved from 177 in 2014). The challenges have remained largely the same in the intervening years: dealing with construction permits, getting electricity, paying taxes, and trading across borders (discussed further in the next section). Transparency International ranked Tajikistan 152 on their Corruptions Perceptions Index. Transparent, predictable, and evenly applied regulations and a competitive business operating environment are risk variables considered for any investment.

A quarterly advisory council is convened at the presidential, regional, and district levels to continue pushing necessary regulatory reforms in a participatory manner with the private sector.

Increasing investment in agribusiness along the supply chain will improve the competitiveness of the Tajik agriculture sector. This will reduce exposure to some market risks, including the displacement of Tajik products in both domestic and export markets from competing producers and processors, and will improve market linkages. Improving the business enabling environment and promoting investment are cross-cutting activities within many donor projects, although they focus mostly on particular value chains, including the World Bank Agribusiness Competitiveness Project. The following are the key components of promoting investment and improving the business operating environment, specifically focused on aggregate sectoral risk rather than specific value chain constraints.

Private sector consultation should underpin all efforts to improve the enabling environment on the part of the public sector. Tajikistan has quarterly advisory committee meetings at the presidential, oblast, and district levels for consultation on regulatory reform and investment promotion. If agriculture and agribusiness investment is not a central convening focus, it may get sidelined among more general investment promotion or other public-private dialogue.

Upgrading technology and adopting innovations across the agriculture sector will improve competitiveness and efficiency of the sector. Existing finance has not been sufficient to encourage investment and implementation of new technologies and innovations. A competitive matching grant fund can encourage the sector to upgrade innovation and technology, particularly in postharvest marketing, handling, and processing. Existing enterprises can upgrade equipment, processes, and technology to improve the competitiveness of their existing product portfolio and develop and produce new products. Producers and traders can upgrade their handling capacity and reduce losses by upgrading their storage, handling, and packing facilities. A complementary activity can be combined with commodity value chain groups and chambers of commerce to facilitate information and exposure to international best practices and technological advances.

To strengthen the investment promotion and business operating environment, the following next steps are recommended:

- Review the existing regulatory reform and investment promotion public-private consultation meetings to assess the focus on agribusiness investment and development promotion. Ensure that all stakeholder groups are represented. Use other country experiences to devise a best-practice consultation framework and work with existing organizations. This platform could be used to raise critical issues across the entire sector with the aim of improving the capacity of the sector to cope with normal risks. The Ministry of Agriculture, Fishing, and Processing may be an appropriate co-chair to maintain an agribusiness focus.
- Define and develop a matching grant fund for spurring critical investment in upgrading technology and adopting innovation within the agribusiness sector to improve competitiveness and efficiency. Consider the example of Fundación Chile and others to incorporate previous experiences (box 3). It is important to consider risk within the framework and governance of the fund to avoid incentivizing extremely high-risk investments. Assess the feasibility of the matching grant fund in terms of scale and potential impact and develop a business plan for it. Prioritize value chains and postharvest enterprises that may not be the focus of other donor funding. Competitiveness and equal access to affordable finance are important to avoid incentivizing high-risk investments or concentrating market power.

Box 3 Innovation to Increase Investment in Agribusiness

In 1976, the Chilean government created Fundación Chile to add economic value to the country's products and services through innovation. As a private, non-profit corporation with funding from the state and an American conglomerate, Fundación Chile played a crucial role in technology transfer and incubation in target industries, including agribusiness, investing in research and development to overcome market failures. In the 1970s and 1980s, Fundación Chile supported innovation to encourage export diversification, initiating quality-improvement programs for salmon, aquaculture, meat, vegetables, and fruit. As a result, exports of salmon and trout increased from 300 tons per year to 24,000 tons a year in the 1990s. The "Boxed Beef" initiative introduced vacuum packing to the meat supply chain, creating new jobs and bringing more hygienic, better-quality packaged meat products to the market. Similar successes occurred in the oyster, berries, and asparagus subsectors.

Business Model

Fundación Chile identifies investment opportunities with high potential, based on technology innovation that is appropriate for local conditions. Once a new technology is developed (or acquired and adapted), private sector partners are brought in to create a company for the technology. Today, Fundación Chile is self-financing; it leverages competitive funds from Chile's Economic Development Agency, revenues from the sale of its products, and minority partnerships in each new company it creates.

Key Features of Fundación Chile

- Public-private alliance
- Private control
- Market orientation
- Use of networks for value creation and project scale-up
- Creation of companies that will spread innovations
- Self-financing

Source: World Bank 2014c.

Trade Facilitation

Trade facilitation seeks to make trade across borders faster, cheaper, and more predictable. Trade facilitation can make Tajik products more competitive both in domestic markets and as exports in foreign markets. Predictable and lower-cost trade procedures can also encourage private investment, including foreign direct investment, in the agriculture sector, particularly in postharvest handling and processing ventures. The four pillars of trade facilitation are transparency, simplification, harmonization, and standardization. Various literature reviews have estimated trade transaction costs to represent between 1 and 15 percent of the value of traded goods (for example, see ADB and UNESCAP 2013).

The World Bank's Doing Business ranking measures factors important for the business investment and operating enabling environment and ranks countries accordingly. The Trading Across Border factor considers the bureaucratic and logistical challenges of international trade, both imports and exports. This includes the financial and time costs of procedures and transport. Central Asian countries rank among the lowest in the world, a result of both their geographic location (since cost to an ocean port is an important component) and regional trade issues (which can strengthen or weaken their ability to reach critical ocean ports). Tajikistan ranks 188 of 189 in the Trading Across Borders factor. The cost to export a standard 20-foot equivalent unit (TEU) from Tajikistan is 63 percent higher than average, and the cost to import is the second highest in the world, more than double the cost to import 1 TEU into the Kyrgyz Republic.

Tajikistan is a central transport hub in the region. Three Asian highways connect through the country. AH 7 provides access through Afghanistan to South Asia, running north-south. AH 65 runs east-west, with Uzbekistan on the west and the Kyrgyz Republic on the east. The longest is AH 66, which connects Dushanbe with Kulma Pass, a critical link with China. Traditional Russian markets are

located at a significant distance from Tajikistan. Chelyabinsk is 2,500 kilometers from Dushanbe and relies on Uzbek transit and railway. Karachi, Pakistan, with a population of approximately 14 million consumers and international port access, is approximately 2,000 kilometers by road, which requires transit through Afghanistan. Tajikistan should continue to improve bilateral relationships with neighboring countries and to develop alternative transit routes to diverse end markets. It is well positioned to prioritize South Asia and its port as well as China as alternatives to its traditional markets and opportunities west, which require transit through Uzbekistan.

Tajikistan's trade facilitation needs to be broad based and requires investment in infrastructure, operations, and institutions (ADB 2009). Tajikistan is one of nine countries within CAREC, the Central Asia Regional Economic Cooperation. With funding from the Asia Development Bank, CAREC is using transit trade for development and linking Western China with Europe through Central Asia. The CAREC transport area has identified six transport corridors for investment and development to improve competitiveness of trade in, out, and through the Central Asian countries. Four of the six corridors include Tajikistan. CAREC identified a significant need to upgrade and invest in its road system along the key identified corridors. Continued investment and upgrading of roads themselves as well as the trucks and transit equipment across the industry will contribute to decreasing transport costs and increasing sectoral efficiency.

Nontariff barriers are among the most important trade-related concerns, and agriculture, in particular, can be affected by domestic subsidies, uneven implementation of sanitary and phytosanitary requirements, technical barriers to trade, export or import restrictions, and import or export licenses (ITC 2011). The lack of innovation and investment in Tajikistan within the private sector includes quality processes and the ability to meet international standards. The public sector lacks the capacity to certify export products, which is not as relevant for primary production but is necessary for investments in processing.

Improving trade facilitation requires the use of a regular platform for private sector consultation (for example, the proposed agribusiness public-private consultation dialogue outlined in the section on investment promotion). Tajikistan's trade facilitation needs to be broad based and requires investment in infrastructure, operations, and institutions.

Improving infrastructure inefficiencies requires the upgrading and maintenance of old railways and rail cars. Main roads need upgrading, particularly as trade continues to increase traffic along central roads. A lack of leasing facilities has kept the trucking fleet from needed investment. The logistical services available within the country are limited and lack significant trade experience. Investment promotion and business expansion in logistical services can decrease the cost and improve the efficiency of the agriculture sector.

A leasing industry can help logistics companies to refleet and expand transport fleets (box 4). Tajikistan can collaborate with the financial sector to ensure that a supportive regulatory framework is in place for banks to develop and offer leasing mechanisms to expand investment and upgrade trucking and rail equipment.

Box 4 Challenges to Establishing a Leasing Industry for Agribusiness: Lessons from Armenia

Leasing is mechanism that can provide Small and Medium Enterprises (SME) with the ability to invest in productive and logistics equipment. In credit-constrained environments, a lease provides access to finance, where the borrower (lessee) makes a monthly payment in exchange for use of a productive asset and the lender (lessor) retains legal ownership. This helps SMEs establish a credit history and gain access to the formal financial system. In the agriculture sector, a leasing industry can provide much needed access to term financing, allowing agribusinesses to use leased equipment as collateral.

The case of the ACBA Leasing Company in Armenia provides lessons in overcoming unexpected challenges to establishing a leasing industry. After starting up in 2006, ACBA encountered problems with the availability of equipment for import, lack of consumer understanding of how leasing works, and regulatory issues in the enabling environment. Since the type of equipment ACBA typically offers for lease was not previously imported in large quantities, ACBA hired a manager to analyze the lifespan, local capacity for operations and maintenance, and resale value of equipment being leased. To disseminate knowledge on leasing, ACBA provided training for staff and paid commissions to each of its branches for every new lease. Finally, ACBA successfully advocated for equipment imported for lease to be exempt from a value-added tax, if the equipment was already on the government's list of equipment exempt from VAT when imported for *use*.

Source: USAID 2007.

Both the public and the private sector lack the capability to control quality, and this weakness constrains access to certain markets and competitiveness with foreign products. Improved quality control capability is a cornerstone of investment promotion targeting export market opportunities. A collaborative approach between government and the private sector should be pursued. The IFC has supported successful food safety projects in transition countries, including the Ukraine and Belarus. Its extensive experience could be replicated and adapted to Tajikistan (box 5). The IFC Food Safety Toolkit provides extensive coverage of core building blocks and describes examples and models of food safety regulatory reform. Upgrades to the capacity of both the public and the private sectors are relevant to nontraditional markets and will increase the diversity of processed products and competitiveness into traditional markets.

Box 5. Stepwise Approach to Food Safety

For Indian agribusinesses, compliance with food safety standards is one of the key barriers to entering new markets. The upfront investment cost required for standard certification is too high for most smallholder farmers, and this limits their ability to market horticulture crops to supermarkets and regional exporters. To overcome this barrier, the Indian agribusiness Jain Irrigation System Ltd. partnered with the IFC to develop and pilot a "JAIN GAP" standard to apply to farmers within its supply chain. JAIN GAP – a simplified version of GLOBALGAP – introduces basic standards for pesticide use and worker safety without significantly increasing production costs

for farmers. GLOBALGAP recognizes the JAIN GAP standard as a "Primary Farm Assurance" Standard, providing a stepping stone for certifying small farmers to a higher standard in the future.

Source: IFC 2011.

To facilitate trade, the following next steps are recommended:

- Outline a logistics roadmap to include regulatory reform to support the development of a leasing industry and incentives to support expanded logistics services and businesses within Tajikistan. Develop the roadmap in consultation with the private sector, particularly financial services. Use the experiences of other countries to create a best-practice framework.
- Consider a food safety regulatory environment reform project aimed at improving compliance with international food safety best practice. Design and structure a reform and capacity-building project to address both public and private sector needs. Use a collaborative process, working with existing commodity and value chain groups.

Solutions Area 2: Improve Livestock Productivity

Introduction

This section builds on the Phase I recommendations for the livestock sector to identify and assess strategies to strengthen the resiliency of livestock systems and rangelands in Tajikistan. Interventions are identified that could (1) reverse degradation of water, soil, and vegetation cover; (2) safeguard the long-term viability of rangeland ecosystems, while ensuring sustainable access to grazing land; and (3) strengthen livestock services (veterinary, animal health, feed and fodder supply, destocking, water and grazing access, and weather and market information, among others), enabling farmers to manage their resources better, to respond to climate and market signals, and to protect their assets in times of drought.

Overview of the Risk Environment and Framework

The National Development Strategy, originally covering 2007–15, is now being developed for 2016–30. The three priorities of the national government are energy, communication, and agriculture. Yet agriculture receives less than 2 percent of the national budget, which barely covers basic staffing and operations and leaves little or no funding for programs. Less than 1 percent of the allocated budget is used for subsidies. On an ad hoc basis, funding may be provided for irrigation and directed credit from other parts of the national budget. The MOA budget is allocated mainly to wages (70–80 percent). The priorities for agricultural development are to (1) improve processing to avoid losses in production and ensure better export potential; (2) develop marketing linkages to meet international standards and requirements with competitive products; and (3) improve the efficiency of land use, preservation, and reclamation. In agriculture, 16 programs are being implemented, including the following.

The National Pasture Program is underfunded, receiving only TJS 200,000[12] a year. Locusts destroy 50,000–60,000 hectares of pasture and crops annually in Tajikistan. The MOA estimates that US$2 million a year is needed to control locusts if Afghanistan and Uzbekistan also take measures.

The Vaccination Program receives TJS 2.5 million, but an additional TJS 8 million is needed to cover the eight main diseases covered through national programs. Total vaccine coverage would require TJS 18 million a year. Donor projects on tuberculosis, FMD, and other diseases currently fill some of the gaps.

Government agriculture policy and programs previously focused on directed production of cotton. The government is in the process of refocusing on a broader range of products, including livestock. This major policy shift, known as "Freedom to Farm," began in 2008, following the cotton debt crisis.

The government is working with the World Bank on the Agrarian Reform Program (2012–20), which seeks to "develop a productive, profitable, and sustainable employment-creating agricultural system, based on ecologically sound use and management of natural resources, making agriculture one of the

[12] About US$31,000. Here and further in the text: US$1=TJS6.5

main pillars of the Tajik economy." Additional objectives are to (1) enable farmers to access land, (2) ensure access to irrigation, (3) allow farmers to develop organizations, associations, and cooperatives and to choose what to grow and how to market their products, and (4) develop financing mechanisms that are sustainable, affordable, and fair. While the program is a significant improvement over previous approaches, subprograms need further definition to be effective.

The Tajik government and the International Trade Center prepared a Food Safety Strategy with the World Health Organization and the FAO to ensure Tajikistan's compliance with OIE standards. The program was to be launched in early April 2015. The biggest constraint to implementation is that the program rests with Tajik Standard instead of a group that has the knowledge and linkages to support the mandate.

The IFC–Central Asia Agri-Finance Program (Tajikistan, Uzbekistan, and the Kyrgyz Republic) supports access to finance and business development for supply chains. It works with banks and microfinance institutions to build up the capacity of credit agents. The program has developed products on risk assessment and introduced innovative products from other parts of the world, including the use of warehouse receipts and asset-backed loans to overcome collateral problems. Raw materials qualify as collateral up to a certain ratio of total value. Processors are seen as the aggregators and catalysts of the system. They offer diagnostic services and recognize mismatches between available equipment and available raw materials. Diagnosticians look at technology, human resources, management, and other factors and provide an estimate of potential increases in productivity. The IFC provides advisory services. Projects cost approximately US$2 million, with costs shared 50:50..

For smaller enterprises, the Invest Program with IMON International supports project start-up. Five-year loans at 18 percent interest are provided for investments in equipment. In the broader area of financial capacity building, the IFC supports knowledge sharing to build creditworthiness.

The World Bank has implemented several projects related to agriculture. The most recent is the US$22 million Agriculture Commercialization Project to support commercialization of the agricultural sector. Other projects have addressed environmental management, transportation, land registration, and cadaster. A regional Climate Change Adaptation and Mitigation Project is at the concept stage, and implementation is planned for 2016–21.

The FAO is helping the government to coordinate the Agrarian Reform Program. The program involves restructuring the MOA and addressing issues related to water, land, and agricultural financing. The FAO has also been involved in conservation agriculture, the seed sector, dairy production, and integrated pest management, among others. The FAO has also worked with veterinarian service reform and capacity development for government and private veterinarians. The veterinary service and association are very proactive, but lack the funding to carry out their mandates. The FAO is developing a US$1 million project to support the institutional development of veterinary services at all levels.

The European Union (EU) Enhancing Competitiveness of Agribusiness Project is a four-year project (€32 million credit line, of which €6 million is designated for grants) that focuses on developing food value chains and enhancing farm production. Channel 1 provides small loans (up to €10,000 for 1.5

years) for an approved menu of equipment. Channel 2 provides larger loans, primarily to processors, in the range of €100,000 to €300,000 for equipment upgrades. Business plans are developed.

The United Nations Development Programme's Aid for Trade Project works with the Chamber of Commerce and the Ministry of Economic Development and Trade. The components include strengthening capacity for (1) trade policy, especially with regard to WTO compliance, (2) trade promotion, and (3) grassroots market information on trading platforms and prices, among others.

A local nongovernmental organization (NGO) hosts the market information platform and collects information, which it provides, for a fee, to farmers, businesses, and other users. It also has a messaging service with price information, updates, and alerts as well as a mobile application with "how to" information (agroinform.tg). The website was established in 2010 and by 2014 was receiving 80,000 visits monthly, mostly from Russia. The level of local use was not disclosed. Commercial farmers use the platform for buying and selling.

The project also runs a Business Challenge Fund, a revolving fund with affordable loans that charge interest in the range of 22 percent. Rates are high because agriculture is seen as risky and not profitable. The fund provides loans at 8–12 percent interest to women, green technology projects, and agribusinesses seeking to retool their operations. The purpose is to increase processing capacity for final, value added products. Import substitution is a focus.

The International Fund for Agricultural Development (IFAD) is implementing the Livestock and Pasture Development Project in seven districts of Khatlon oblast, one of the poorest areas of the country. The project has three components:

- *Community development and institutional strengthening.* This component provides equipment and training to pasture user associations (PUAs), which were created under the Pasture Law. The project works with the MOA at the national, regional, and local levels.
- *Pasture development.* The project has an 87-hectare demonstration site and will look at the economics of forage production. The medium-term plan is to cultivate 900 hectares in six or seven districts. The project seeks to strengthen the private sector, including veterinary services and facilities, and improve the production of fodder (seeds, minerals) and livestock by improving pastures. This includes work on community livestock and pasture development plans, with related subprojects, investments, and community grants for forage production and infrastructure (wells, bridges, roads, winter structures).
- *Income generation for women.* The project creates community groups for producing and marketing livestock products.

The German Agency for International Cooperation (GIZ) is implementing the Sustainable Pasture Management in Central Asia Project in Kazakhstan, the Kyrgyz Republic, Tajikistan, Turkmenistan, and Uzbekistan. The aim is to introduce sustainable land use approaches (pasture rotation, increased grazing mobility) to reduce overgrazing and degradation of pastures, especially in the vicinity of villages. This long-term project will run until 2015. It has established regional linkages and hosted the first pasture practitioner's conference in Bishkek in November 2014. The project is creating a regional platform to support continued learning and sustainability in pasture management in Central Asia.

Many other projects have been implemented in the agriculture sector. Aid needs to be coordinated if these many initiatives are to achieve aggregate results. Aid is coordinated by the Aid Coordination Council, which is under the Office of the President. However, turnover of representatives on the council has hampered its ability to provide long-term guidance for project coordination.

The Agricultural Risk Environment

Risks and their management approaches are multifaceted. The high-priority risks and proposed management approaches identified in Phase I were investigated in more detail to identify their component parts and related weaknesses or gaps in risk management. Phase I recommended continuing to diversify the sector by expanding irrigation and improving water management, developing markets, investing in storage and transport, creating export corridors from Tajikistan to Russia, Kazakhstan, and Pakistan, and improving planning and financing for emergency preparedness and response. Within this context, the analysis takes a supply-chain, value-chain approach and looks at input supply systems and services, feed and strategic forage reserves, animal health, medicines and vaccines, breeding stock, supplements, and market, agricultural, and weather information systems.

The analysis here looks at various types of risks that face livestock producers, including market risk, price risk, production risk, business risk, financial risk, and policy risk. Issues with any single risk or production problem will lead to suboptimal performance and profitability and ultimately decrease resilience to risk. This section draws heavily on stakeholder interviews conducted in April 2015.

Market and Price Risk

Tajikistan has unique advantages that position it well for agricultural development: water supplies are abundant, 11 agro-climatic zones allow for a wide range of products and a long period for production and marketing, labor is inexpensive, and domestic and export market opportunities are good. However, many of these opportunities are missed due to a lack of capacity on the part of both the public and private sectors to respond. Due to weaknesses throughout the system, farmers are not incentivized to respond to the market opportunities that exist around them.

Milk is a primary example of lost opportunities. There is a large unmet demand for milk. Large processors are establishing their own farms to secure a steady supply of reliable raw products. Small producers are not at scale for low-cost production or market aggregation. Even though the sale of unprocessed milk has been banned, small holders sell milk directly into the market at a price higher than is being paid by formal processors. Inspection and certification costs are frequent and high. Processors offer producers less than TJS 2 per liter. Without a system for recording dairy production, there is no basis for payment. At the same time, poor hygiene of raw milk poses a real cost to processors. Productivity must increase if the costs of production are to decrease.

Processors face several issues. Old plant and equipment are often mismatched in capacity with the actual supply of raw materials. Electrical shortages impede the implementation of quality control programs along the value chain, making it difficult to ensure the proper postharvest handling of products. The national budget has adopted a new program for cold storage of fruits and potatoes in various regions of the country, but much more storage capacity is needed for meat and milk. Exporters have gaps in their knowledge of international trade requirements and how to achieve them. Many

companies cannot satisfy sanitary and phytosanitary standards, hazard analysis and critical control point (HACCP) testing, International Organization for Standardization (ISO), and other requirements because of issues related to equipment, facilities, knowledge, capacity, packaging, labeling, nutritional labeling, and branding.

Shortages of raw milk affect the viability of milk processing. Low farm production (1–2 liters a day) and seasonality are factors. Very little has been done to improve the collection of milk, so the quality of milk is poor.

Animal Health Risk

The top priorities for strengthening veterinarian services are infectious disease control (FMD, PPR, contagious caprine pleuropneumonia), laboratory strengthening (technical equipment upgrading estimated at US$20 million), and implementation of the animal identification program (US$2 million for the database, central and decentralized network, and ear tags).

The most immediate need is to strengthen the vaccination program for infection diseases. The national budget of TJS 2.5 million covers only 20–25 percent of the funds required to implement the program fully. As a result, only eight zoonotic diseases are covered, and only anthrax has 100 percent coverage. Although 70 percent of the budget is spent on FMD, coverage for this disease is only 10–20 percent. The budget is often delivered late, when livestock have already been sent to pasture. The large, state-owned farms are 100 percent covered. Private producers who have the financial means to do so pay for their own vaccines. The main risk is from small holders who comingle livestock around the village and in pastures. If one or two farmers do not vaccinate their livestock, the entire local herd is exposed to the disease. The annual requirement for full implementation of the program would be TJS 18 million.

Vaccines for the eight main diseases are tested for quality, but other vaccines available on the open market may be of poor quality or fake. Cold chains for the vaccines are deficient. The FAO has supported cold chains in a few districts. This program needs to be replicated across the country. Another issue is that vaccines do not always match the strains of the prevalent disease. When mismatched, efficacy can drop to 40–50 percent. Local laboratories do not have the capacity to analyze to this level of detail, and samples must be sent to Russia for analysis.

The animal identification program has been approved by government resolution, but no budget has been allocated for its implementation. Activities that do not require money for implementation, such as regulations and the animal passport, have been completed and approved. The FAO is about to pilot the program in a limited area for one or two species. This pilot should be scaled up after its completion.

Laboratory capacity is inadequate. The central laboratory was assisted under an FAO–EU program and is functioning. All other laboratories are in poor condition, having been built in the 1940s and equipped in the 1960s. There are 22 labs in total, including 3 regional labs that a recent OIE assessment scored as 0 out of 4.

Veterinary inspection systems are more or less in place. In two international assessments, Tajikistan received the highest score in Central Asia, scoring 4 out of 5. Likewise the legal framework for

veterinary services is complete and received an international gold medal for regulation development in 2012.

A Risk Assessment Department has just been established as required by the OIE. Capacity building is required for staff, and key personnel should be sent abroad for training.

Veterinarians receive very low salaries. The FAO-EU project has trained nearly all veterinarians and assisted in the construction of private veterinary clinics. This project has improved the conditions for private veterinary services. Government veterinarians focus on supervision and disease prevention, as per OIE guidelines.

Feed Risks

Winter feed is lacking in all areas of the country. Only 50–60 percent of all nutritional needs are being met, indicating a 50 percent shortfall in feed supplies. The decrease in fodder crop production since the transition is a major factor in the shortage of winter feed. Limited irrigated areas are available for fodder production, as land has been transferred into crops that are more profitable.

Lack of access to remote pastures puts additional pressure on pastures around settlements. Fractured land ownership disrupts large swaths of herding routes between summer and winter pastures. In addition, widespread plowing of pastures reduces the amount of accessible pasture even more. Pasture degradation is common, and vegetation comprises a large proportion of unpalatable weeds, especially close to settlements. This process is partly due to increasing livestock numbers, exacerbated by the breakdown of migratory systems. The majority of animals are owned by unregistered household farms, which have no formal access to pasture.

The Pasture Law was passed in 2013, covering all aspects of community-based pasture management, including rotational grazing, associations, and empowerment. However, amendments are needed to make implementation effective at the grassroots. The Land Code needs to be harmonized with the Pasture Law to remove conflicting approaches to land allocation. The agency responsible for pastures has not yet been established, leaving responsibility for pasture management organizationally orphaned.

Financial Risks

Agricultural finance is scarce, making up only 1.5–2.5 percent of the commercial banks' lending portfolio. Remittances are an important source of agricultural funding, but the Russian ruble crisis has reduced this source, leading to a decrease in the use of fertilizers and inputs.

Many banks do not have branches in rural areas and do not have an agricultural credit line because they perceive agriculture to be a risky, unprofitable enterprise. Credit agents do not have enough knowledge of agriculture or the information needed to make informed lending decisions. AgroInvestBank is the largest agricultural lender in the country, and the Islamic Bank lends to agriculture. Large enterprises use private finance, when needed.

Between 130 and 140 microfinance agencies are operating in Tajikistan. The Association of Microfinance Institutions in Tajikistan has terms for lending of 18 months at 26 percent interest, but when all fees and commissions are considered, the effective interest rate can be as high as 50 percent. Some projects provide subsidized credit lines. TAFF provides loans at 8–12 percent interest for

women, green technologies, and agribusinesses seeking to retool their operations. Loans are in the range of US$10,000.

Human Resource Risks

Gaps in knowledge are evident throughout the agriculture sector, including among researchers and enterprise managers, technicians, advisers, and farmers. Land redistribution created many new farmers with little knowledge of agriculture, especially of new technologies and crops. Pasture users know little about environmental management. Further, there are few pasture specialists in the country to support programs for pasture management. Veterinary training is mostly theoretical, and few young veterinarians opt to stay in the field after their training is complete.

Diversification Risks

While diversification is a core risk management tool, undertaking diversification introduces its own set of risks. In Tajikistan, many of the potential alternative crops have no established markets. Farmers and specialists do not know how to grow alternative crops optimally, and there are limited sources of seed and other inputs required to produce them. Several stakeholders noted that small holders do not have the desire to increase productivity, primarily because there is no market for livestock products.

Aggregating land and hay-making areas could help farmers to mechanize their production and to use inputs. The mechanisms for collaboration are limited (the Cooperative Law is weak and PUAs do not have clear responsibilities), and producers are hesitant to work collaboratively. Some collaboration is emerging, with producers aggregating up to 50 hectares of land.

Information on productivity levels is scarce, especially for households and small farms that fall outside the regular reach of government statistical programs. Establishing a process for measuring productivity across the functional groups of producers and regions of the country would support improved farm management, policy development, and agricultural lending.

Smallholders, Poverty, and Organizational Risk

Most livestock products (60 percent) are produced by households. The mountain areas dependent on livestock production are very poor, and many are still based on a barter economy. Wealth is measured by the number of livestock owned, which inhibits farmers from switching to holding fewer, more productive animals.

Most agriculture is done by women because young men have left the country to find employment. Women have difficulty obtaining land use title and are not empowered to do business. This issue needs to be addressed in policy, program design, organizational capacity building, and lending programs.

Before the Russian ruble crisis, more than 1 million Tajiks were working abroad and sending remittances home. Since the crisis, 400,000 to 600,000 of these workers have returned to Tajikistan. The flow of funds into the country has stopped, constraining agricultural credit and creating the need to provide local employment and livelihoods for returning workers.

Organizational structures that could improve the access of small holders to the market and to power are poorly developed. Water user groups have been piloted, but they have not been sustained after project completion. The Cooperative Law is in place, but it is not well used because of lingering post-Soviet distrust of collective actions and tax issues related to cooperatives. PUAs are permitted by the Pasture Law, but the regulatory framework to give them authority is not yet in place.

Policy and Program Risks

Stakeholders cited numerous policy and program risks, including the following:

- Agriculture is chronically underfunded, making it impossible for the MOA to carry out its mandate. This includes a shortage of funds for national programs and a lack of budget for district agriculture agencies to deliver frontline services.
- The business environment is very difficult. As a result, the World Bank's Doing Business rankings place Tajikistan near the bottom of all countries. The Tax Code was reformed in June 2013, and the various types of taxes were reduced from 34 to 17, but all of the old taxes were retained within the 17 remaining categories. Certification is difficult and costly, requiring as many as 9 certificates. Unofficial fees (bribes) commonly cost US$50 per truck crossing the border.
- Corruption and lack of transparency are common, especially in the certification process and at border crossings.
- Standards are not enforced. Antibiotic and pesticide testing equipment is in place, but standards are ignored. Dangerous products, such as DDT (dichloro-diphenyl-trichloroethane), are imported from Uzbekistan and China.
- Government and donors both lack long-term commitment to change. Many donors are working on value-chain development, but consistent and coordinated priorities are needed if donors are to influence government to adopt successful models. The 2008 Joint Country Partner Strategy for donor coordination was effective, but has been implemented inconsistently.

The Risk Management Framework

Pasture Management Systems and Oversight

Under the Land Code of Tajikistan, pastures may be privatized for long-term or inheritable use, which has led private farms to annex pastures, further constraining access. The Pasture Law of 2013 allows for community-based management by pasture user groups, but individual use remains allowable under other sections of the law. This impedes the ability of livestock owners without a registered farm to access pasture and makes access dependent on the interpretation and application of the law by local authorities.

Numerous weaknesses in the Pasture Law and its implementation need to be addressed. First, the Pasture Law and the Land Code need to be harmonized to clarify access rights. Second, regulations and mechanisms for implementing the Pasture Law need to be developed. This effort should include the registration of user groups and the development of pasture management plans. A mechanism is needed to allow for the use of trans-boundary pastures. Currently, the responsibility for pastures is

fractured over several institutions. Linkages need to be developed between the local authorities and pasture users. Pasture user groups need to be established, and pasture maps need to be updated.

The Pasture Law allows user fees to be deposited into a pasture fund for infrastructure, but the fee goes into general revenues and cannot be earmarked for pasture improvement. To date, 70 percent of pasture area is not covered by PUAs. The World Bank and IFAD are implementing a large project to establish pasture associations in nearly every village, as per the law. All livestock owners (households and farms) are included. The associations exist mostly on paper because their rights and obligations have not been clearly established. They require the clear right to limit the number of animals, rotate pastures, issue fees and fines, and undertake other paster management actions. There should be a separate committee for pastures, similar to what forestry has under the Forest Code. The Forest Code places the committee directly subordinate to the central government, which is responsible for supervision.

The Pasture Law says that a responsible authority for pastures should be established, but this has not been done yet. Once the committee has been established, it can be given the power for better management. Without an appropriate responsible agency, there is no mechanism with which to implement the law.

Taxes for pastures should be differentiated. Government help is needed to analyze pasture conditions and set proper fee structures.

Pasture Monitoring and Remote Sensing

A methodology has been adopted for pasture monitoring (express method), but it is not being implemented in an orderly manner. The government body responsible for pasture management needs to be established, and a monitoring and regulation program needs to be created. The IFAD project does monitoring, but only beginning in late 2014, when it began to measure plots.

Based on a workshop on thematic mapping in Baljuvon, GeoIDee prepared land use and pasture management maps for more than 30 watersheds for the Natural Resource Management Project of Deutsche Welthungerhilfe e.V. in southern Tajikistan. The pasture management maps support the use and rotational grazing of pasture during spring, summer, and autumn.

Farm Management

The IFC has two tools for assessing agricultural risk. The tools are Internet based. CLARA (Cashflow Linked Agricultural Risk Assessment) was developed through an IFC project in Ukraine and has been adapted to Tajikistan, Uzbekistan, and the Kyrgyz Republic. It uses information based on agronomy, livestock, engineering, and finance to develop scenarios for farm production and risk and to cross-check certain operational elements, such as the match between tractor horsepower and implementation sizes. Any individual farm can be compared to benchmarks. The system requires that the local database for the benchmarks be populated. The system is for sale to banks to support their agricultural credit programs.

Animal Health Programs and Veterinary Service

Tajikistan has been a member of the OIE since 2001. Accordingly, the professional veterinary association was established in 2003, with the assistance of the FAO. There are 901 members and 42 local veterinarian associations across the country. Capacity-building activities under an EU-FAO program began in 2008 (www.tvg.tj). One of the roles of the association is to provide continuing education and training to its members. Three training centers have been established as well as 50 centers for veterinary service and consulting, which provide services directly to farmers. To date, the centers have provided training to 3,591 veterinarians, farmers, and others. Training responds to the needs of projects and communities, covering topics such as feeding and fodder production. Land has been allocated for 777 veterinary stations, of which 535 are under construction and 160 are operational. A mobile veterinary service has 33 vehicles, and 380 refrigerators have been provided to create a cold chain for vaccines and other animal health products. In addition to the clinics, there are 148 veterinary drug stores, 138 animal feed stations, and 107 artificial insemination stations.

Artificial insemination services are important, but services are limited in Tajikistan (see box 6). There is limited space for bulls in small household farms, and small farms may have room for just one or two cows and no bull. However, artificial insemination services suffer from a series of problems. Small household farms cannot afford the services, and veterinarians are not trained to conduct pregnancy checks or heat detection. Dystocia is frequent due to lack of proper equipment. There is a shortage of nitrogen and functioning generators. The Institute of Physics has an unreliable unit. The aluminum plant has a generator, but access to it is restricted.

Box 6 Private Veterinary Clinic and Artificial Insemination Service in Tajikistan

A veterinarian based near Dushanbe operates a clinic providing both clinical and artificial insemination services. He extends credit to farmers, allowing them to pay for the service after the calf is born and milk production begins. He charges TJS 80–100 with an 80–100-day warranty. If the cow does not become pregnant, he redoes the insemination for free. A pregnancy check 60 days after the second insemination is also free. If the cow is still not pregnant, he provides treatment for the cow. In all cases, the farmer pays for the veterinarian's transportation.

Veterinarians need training in the use of straw artificial insemination, heat detection, and pregnancy testing. The Breeding and Artificial Insemination Center in Redicke district has a pilot program that might have an artificial insemination plant in a couple years.

Government is constrained in its ability to carry out animal health programs. There is insufficient budget to carry out a complete vaccination program. What is done is incomplete and poorly targeted. The FAO project would like to draw up a business model for vaccination programs.

There is considerable animal movement between Afghanistan and Tajikistan and between Tajikistan and the Kyrgyz Republic. Regional animal health cooperation exists between the three countries, which inform each other of disease outbreaks. A formal agreement drafted with Afghanistan and the

Kyrgyz Republic is ready to be signed at the presidential level. The agreement formalizes vaccination work that Tajik veterinarians are doing in Afghanistan, establishes communication protocols for reporting disease, and addresses customs procedures and trans-boundary diseases. Each country will use its own budget to implement the program.

Laboratory Testing: Inspection, Animal Health, and Feed Stuffs

Laboratory capacity is inadequate. The central laboratory was assisted under an FAO–EU program and is functioning. All other laboratories are in poor condition, having been built in the 1940s and equipped in the 1960s. There are 22 labs in total, including 3 regional labs. In a recent OIE assessment, they received a score of 0 out of 4.

Innovation Systems

There is a lack of both knowledge and a comprehensive system to bring knowledge to farmers. The gap is particularly large in relation to high-value products and poses a large risk to diversification and value added. This gap has not been addressed.

The EU Enhancing Agribusiness Project is creating business linkages between processors and farmers via agronomists in the region. The project works with farmers to achieve better crop management, paying agronomists a small fee for working with established farms and a small commission for recruiting new farmers. Generally, few agronomists are available in the country, and knowledge about the new technologies being introduced is limited. Given the small pool of human resources, it is difficult to find advisers both to train farmers and to provide technical support to processing plants.

SAROB is a cooperative of 160 agricultural advisers who provide fee-based services to the crop sector. Established in 2011 with GIZ support, SAROB works with many international and domestic NGOs to provide extension services to farmers either via projects or directly. The objective is to increase the profitability of both farmers and advisers. The advisers provide ongoing services, follow up with producers, and provide links to input and output markets. They also facilitate access to equipment. At this point, advisers have 4,000 farmer clients.

The government extension system places agents down to the district (jamod) level. There are 500 extension officers, but little budget to support programs or professional development. The extension staff is under the authority of the local government, not the MOA, and there is a disconnect in the flow of technical information between the MOA and local government.

Insurance

Tajikistan has a small but growing insurance industry. Penetration was 0.34 percent in 2012. The market includes 2 government and 14 private insurance companies. Mandatory insurance products represent 75 percent of the market. However, the government diverts 70 percent of state insurance company profits into the general budget, which means that these organizations have limited success in building their reserves.

Agricultural insurance is provided by TAJIKSUGURTA, a state-owned company. Although the insurance is mandatory, there is little uptake by producers. Private insurance companies are not interested because of the high degree of regulation and the weak statistical foundation for risk analysis.

The government is attempting to develop a public-private partnership for weather-index crop insurance.

Livestock insurance is not available at this time. There are several prerequisites to the expansion of crop or livestock insurance: a larger risk pool, including access to reinsurance, regulatory freedom for private insurers to set premiums and other conditions, a more robust statistical base, stronger institutional capacity for risk assessment, and a demonstrated commitment from government to meet its financial obligations in a public-private partnership.

Irrigation

The majority of arable land was irrigated under the Soviet system. Since the transition, these systems have been costly to operate and maintain, and many have fallen out of use. Most irrigation is flood irrigation, with very limited mechanical irrigation. In hilly areas, where irrigation used to rely on inefficient pumps, the systems have fallen out of use. Canals are not cleaned or maintained as required due to a shortage of funding at the district level. Anecdotal information indicates that up to 40 percent of irrigation water might be lost through leakages. Water user groups have been piloted, but they have not been sustained after projects ended. An assessment of economic viability should underpin reform of the system.

Emergency Response and Disaster Relief

An emergency committee, with representatives from a cross-section of agencies, is consistent with the United Nations approach to emergency management. Representatives include the central government and the ministries of agriculture, finance, economic development, and transport as well as regional and district governments and local departments of all ministries as well as the Material Resources Agency.

The committee responds to natural disasters, including floods. However, financing for emergency response is limited, and the MOA has no funds allocated for emergency response. In an emergency, the committee first issues a statement of the losses and then seeks funds within the national government for infrastructure or housing assistance. Finally, the international community is asked for humanitarian aid. The response and timing are prioritized by level of damage associated with the disaster.

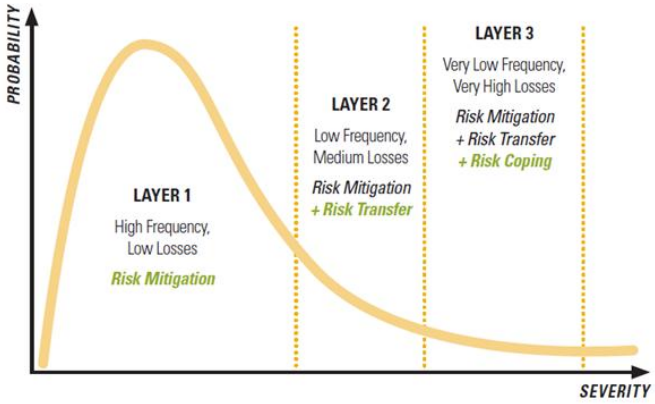
Potential Interventions

The recommendations offered here are based on a holistic, layered approach to addressing agricultural risk in Tajikistan. They take an in-depth look at the nuanced sources of risk within the broad areas of feed production, animal health, and finance. Successful programs and pilot projects that could be scaled up and the relevant institutions for action are identified. Where possible, good regional and global examples are provided.

Figure 43 illustrates the concept of risk layering. The first layer includes high-frequency, low-loss risks. These events are addressed through mitigation, usually by the producer. The second layer includes low-frequency, medium-loss events. These are dealt with through risk mitigation and risk transfer. Risk transfer can include, among other things, insurance programs, risk sharing through contracting,

and risk pooling through collaborative producer actions. These second-layer responses are generally managed through markets, but they also may entail government involvement either directly or through public-private partnerships. The third layer deals with very low-frequency, very high-loss disasters. Here risk mitigation and risk transfer are accompanied by risk-coping (disaster recovery) responses.

Figure 43 Risk Layering



Source: ARMT

Table 9 summarizes the key livestock risks and the proposed interventions in the areas of markets, feed, animal health, human resources, and policy. These have been broken into their component parts and addressed to produce a targeted, holistic approach to risk management.

Table 9 Risks and Proposed Responses for the Livestock Sector in Tajikistan

	Risk level and response strategy		
General risk area and specific targets for risk management	*Micro (idiosyncratic): affects individuals and households; reduce or mitigate risk*	*Meso (covariant): affects groups or communities; share and transfer risk*	*Macro (systemic): affects regions or nations; cope with and recover from disaster*
Market and price risks	—	Changes in price of land; new requirements from food industry	Changes in input and output prices due to shocks, trade policy, new markets
Market access constrained due to animal health and product quality	Quality assurance, quality control programs; supply chain management; on-farm food safety and herd health programs; advisory services to ensure farm quality and food safety; information and training for exporters to understand international trade requirements	Certification and labeling; laboratory and inspection; infrastructure (cold chain); animal health and trace back; border-crossing capacity, efficiency, and transparency; stability of the power supply; export insurance	Trace back and recall system; corporate taxation-averaging program for processors; income-averaging program for primary producers; tax incentives for saving to smooth income flows from year to year
Input and output price risk due to exchange rate fluctuations	—	Export insurance	Exchange rate management
Feed price shocks due to drought, exchange rate shocks	On-farm feed production and storage (improved haying, storing, and silaging)	Forward contracting; legal framework for forward contracting; contract resolution mechanisms for forward contracting; information and training for farmers on benefits, use, right, obligations of forward contracts	Finance program for feed production, purchases, and storage; public-private partnership income stabilization schemes
Access to feed due to market failure (information gaps, storage, transport, market structure)	Online platform for feed markets; feed standards and testing; market infrastructure and pricing	Public-private partnership on feed storage	Emergency feed finance program to allow producers to purchase supplementary feed

Production risks	Hail, frost, noncontagious diseases, personal, assets risks	Rainfall, landslides, pollution	Floods, droughts, pests, contagious diseases, technology
Animal health			
Epidemic and trans-boundary disease	On-farm biosecurity programs; complete vaccination programs; conditional access to subsidized credit based on insurance and vaccination/on-farm food safety (OFFS) participation	Index-based livestock insurance; regional infectious disease control program (FMD, PPR, brucellosis, tuberculosis); improved border inspection; conditional access to subsidized credit based on insurance and vaccination/OFFS participation	Farmer compensation program for livestock slaughtered in disease eradication programs; contingency plans with predefined procedures, responsibilities, and limits
Production disease	On-farm herd health programs; training for farmers and veterinarians	Animal health circles for veterinary services; diagnostic labs	—
Natural disasters			
Drought and storms affecting feed supplies or causing death of animals	Drought-resistant crops; crop diversification; on-farm feed storage and silaging; irrigation and water-saving technology; soil and water conservation practices; pest control programs (spraying); payments for environmental services (PES) grant fund for environmental improvements	Index-based livestock insurance; community feed storage; income stabilization programs; reserve pastures; reciprocal agreements; regional locust control program; crop insurance; PES grant fund for environmental improvements	Regional livestock early warning system (LEWS); emergency programs for physical response, feed purchases; emergency credit and investment programs for rebuilding; disaster insurance top-ups; exit strategies; regional fund for emergency response; contingency plans with predefined procedures, responsibilities, and limits
Natural disasters destroying agricultural infrastructure (landslides, earthquakes)	On-farm investment for slope strengthening, reforestation, and other preventative measures; PES grant fund for environmental improvements	Insurance; emergency funding for community infrastructure rehabilitation; PES grant fund for environmental improvements	Same as previous

Feed			
Annual variability in annual pasture forage production	Improve pasture management by individual producers; encourage quality over quantity in livestock production; improve feed efficiency; supplementary forage production; conditional access to subsidized credit based on insurance and vaccination/OFFS participation	Pasture management plans; community-level organization; community-based monitoring; infrastructure (wells, roads); reseeding; reserve pastures; conditional access to subsidized credit based on insurance and vaccination/OFFS participation	Legal framework for sustainable rangeland management; differentiated grazing fees on a per animal basis; monitoring and LEWS
Pasture degradation and permanent loss of productivity	Extended rest periods; reseeding	Extended rest periods; reseeding; rehabilitation of idle land; PES grant fund for environmental improvements (matching PUA funds)	Revisions to the Land Code to increase the responsibility of farmers; revisions to the costs of leasing
Annual variability in supply of feedstuffs	Crop diversification, drought-resistant varieties, rotations, intercropping; irrigation infrastructure and water management (user groups); water-saving technologies; soil and water conservation practices	Crop insurance; Cooperatives Law; Insurance Law; irrigation infrastructure and water management (user groups)	Seasonal finance and collateral; access to program credit
Variability in forage and feed quality	Improved processing, handling, and storage, including silage	Processing capacity and quality assurance and control; feed testing facilities	Feed laws and regulations
Loss in storage and handling	On-farm storage and handling	Community storage (cooperatives)	—
Human resources			
Quantity and quality of labor management and specialists	Training programs; information systems	—	—
Policy risk	Liability risk	Changes in local policy or regulations	Changes in regional or national policy and regulations, environmental law, agricultural payments
Transparency, corruption	—	E-governance systems	—

Cross-cutting responses	
Market development	Infrastructure investment and provision of reliable utility service; expanded market information and transaction platforms
Research and extension	Feeds, breeds, seeds, soil and water conservation; farm productivity and profitability
Finance	Income stabilization programs, tax programs; stable and transparent financing; conditional access to subsidized credit based on insurance and vaccination and OFFS participation; PES matching grant program for environmental services
Organizational development	Cooperatives and associations; monitoring systems; government facilitation of good "start-up" conditions for market-based risk management tools such as futures, insurance, and marketing contracts by providing information, regulation, and training

Livestock Feed and Drought Cycle Management

The appropriate response to a localized, recurring drought should be community preparedness and response carried out within the parameters of an effective national framework of fully funded policies, agencies, and programs for protection, preparedness, early warning, response, and recovery. Specifically, these approaches are defined as follows:

- *Drought cycle management.* Drought is an expected, normal event. Specific indicators can be used to trigger preparation or response interventions either alone or in combination, depending on the nature of the drought conditions. Early, timely response is important and preferable in terms of cost-benefit analysis. For example, destocking allows households to decrease the grazing or feeding pressure, while freeing up cash to procure additional feed and medicines or to fund household food purchases.
- *Community preparedness.* Communities should be capable of planning and preparing for both slow- and rapid-onset emergencies. This planning can include the provision of shelter, feedstock, water points, livestock vaccination, market development, pasture distribution, and organization of livestock movement to emergency pastures within the local area or in other jurisdictions through reciprocity arrangements.

Community-Based Pasture Management and Monitoring

The community-based pasture management envisioned in the Pasture Law should be implemented. The work that GIZ and IFAD have been doing on pasture management capacity building should be scaled up and any remaining gaps filled. Based on the first conference of pasture practitioners sponsored by GIZ, the program would have three components.

The first component is policy, which entails technical support for completing a legal and regulatory framework, including amending the Pasture Law to enshrine the legal rights and responsibilities of pasture user associations and authorize the issuance and collection of fees. Harmonization of the Pasture Law and the Land Code, among others, is needed to provide a unified approach to the allocation of pasture and imposition of fees by head of livestock. Subsequently, the supporting by-laws need to be developed. Given the privatization of pastures already under way, solutions to make pasture accessible to user groups need to be found. This could require annulling long-term use agreements, as was done in the Kyrgyz Republic. Alternatively, mechanisms to sublease private pasture by user groups could be explored. International agreements to create a mechanism for the use of trans-boundary pastures will be needed.

The second component is institutional strengthening. A governing body for pastures, the Department of Pastures, should be established (box 7). Standard mechanisms for the establishment and transfer of rights to pasture user groups should be developed. Provisions are needed to accommodate the use of pastures by multiple user groups and the overlapping of pasture and forestry areas. A standard definition and approach to developing and approving pasture management plans are needed. National-level actions are needed to identify and allocate pasture areas and to update maps to show remote pastures allocated to communities and districts for migration.

Box 7 ARIS in the Kyrgyz Republic

Financed in part by the World Bank, the Community Development and Investment Agency in the Kyrgyz Republic (ARIS) focuses on community-based initiatives and has a mandate to alleviate poverty. ARIS supported pastoral reform with village mobilization, capacity building, and implementation of micro projects. ARIS has facilitated formation of Pasture Committees, provided training for Pasture Committees, and administered community pasture-management investment grants.

Source: World Bank

Pasture user associations need to be established at the community level. These groups may need funding to assist their start-up as well as a funding mechanism with uniform procedures for establishment and registration. Initial support will also be needed to help PUAs to develop their first pasture management plans. Local institutions to oversee the PUAs and endorse pasture management plans need to be created. These could follow the model of the Kyrgyz pasture committees.

Leadership is critical to the success of PUAs and local community-based management approaches. Capacity building for PUAs and others in the system should be provided, including training in governance and transparency, financial management, fund raising, and communications, among other topics.

The third component is environmental management. Training in sustainable pasture management is needed for pasture users and local government representatives at the district level. Key pasture specialists should receive training abroad, while local programs in pasture management should be developed to support in-country capacity to train specialists. Legislative, administrative, and economic barriers to migration need to be identified and resolved. Mechanisms, including reciprocal agreements, to access pastures across district and other borders may need to be established and should be done in a way that keeps administrative expenses and other transaction costs low. For PUA members, economic barriers to pasture access should be lowered.

Management of total pasture resources should be improved by making use of remote pastures. To support infrastructure development and pasture rehabilitation, a fund for pasture development using funds generated by pasture user fees should be established with each PUA. These local funds could be linked to a national pasture fund for matching grants. The national pasture fund could be financed through the national budget, international contributions, or taxes and fees imposed on other users of pasture areas, including tourism and mining.

Supplementary feed production should also be encouraged. The funds held by the PUA should be usable for investments in supplementary forage production. Investment could include machinery, fencing, seed and fertilizer, and postharvest storage facilities. Payment for environmental services (PES) approaches, which compensate producers and landowners for adoption of land management

practices that provide ecosystem services, could be used to incentivize investments in pasture reseeding, the conversion of marginal cropland to pasture, and the establishment of perennial hay fields (box 8).

Box 8 Payment for Environmental Services

Payment for environmental services (PES) is a conditional payment system (ADB 2014). It could include payments for specified practices, payments for specific ecosystem services, input subsidies, off-take subsidies, one-off grant payments, and recurring payments for ecosystem services. "Co-investment in land stewardship" is a type of PES that pays communities for adopting best practices (for example, pasture rest and rotation) that will contribute to the desired environmental outcome (for example, improved biodiversity and biomass). In a situation like Tajikistan's, where many subsistence producers are motivated by risk management and avoidance more than short-term profit maximization and where land tenure is based on collective action, this approach can be effective in promoting resource management.

Pasture rehabilitation is one method of improving feed supplies and should be part of a national program to preserve pasture area and potential. Marginal lands where pasture has been plowed for crop production should be returned to forage production. The World Bank Drylands Management Project in Kazakhstan successfully reestablished pastures using wheat grass on 35,000 hectares. A program could be developed to allow pasture committees and individual farmers to apply for government matching grants or loans for the purpose of pasture rehabilitation or reestablishment. PES approaches could be considered for financing the program. To support this program, technical assistance and training would be needed for farmers and herders. Equipment and seed would need to be made available. Equipment could be on a lease or rental basis. Research into varieties and establishment methods should be carried out. Box 9 summarizes the potential PES approaches for Tajikistan.

Box 9 Potential PES Approaches for Tajikistan

With regard to sources of financing,

- Government of Tajikistan. As possible, increased program spending in relation to what other countries spend, from the general budget and other sources
- International donors and programs. Grant money for program design, capacity development, training, and implementation and evaluation of pilot projects; World Bank BioCarbon Fund and methodologies for sustainable agricultural land management
- Tourism and other sectors. User fees, taxes, or environmental fees designated for PES and used directly for PES purchases and for research support and capacity building in land rehabilitation and the development of regional seed banks; voluntary contributions identified as part of environmental management and rehabilitation plans (which might be encouraged through potential tax offsets)

- International carbon market. Quantification of carbon sequestered using the Verified Carbon Standard, which would allow groups to sell certified emission reductions.
- The aims of the PES approach would be to achieve sustainable pasture management, conserve soil and water in crop production, and rehabilitate abandoned cropland.
- Beneficiaries would be herder groups, dairy groups, cooperatives, communities, individual farmers (grains, large-scale farmers), groups (vegetable cooperatives and others), local governments, and partnerships.
- Payments would be made through direct payments, market transactions, and co-investment.

The project would undertake the following:

- Identify successful approaches from previous work in Tajikistan. Review the pasture and resource management programs to identify what approaches are successful.
- Identify and assess options for PES modalities. Identify under what conditions direct payments, market-based payments, or co-investment approaches are most appropriate
- Improve the base of scientific knowledge. Conduct targeted research to identify the links between management and environment, possibly incorporating the Ecological Site Description approach.
- Link public investment in livestock and grassland management with environmental outcomes. Revise policy to support positive environmental outcomes by adding conditionality to funding and removing or revising program elements with perverse environmental impacts.
- Learn from pilot activities. Review PES pilots.
- Ensure community involvement and benefits. Mainstream community consultation and engagement into program design and implementation.

Table 10 summarizes the costs of the proposed interventions regarding community-based pasture management and monitoring.

Table 10 Estimated Costs of the Proposed Community Pasture Management Interventions

Components	*Annual (US$)*	*Five-year total (US$)*	*Reference*
Policy and regulatory development	200,000	1,000,000	Technical assistance and exchanges
Institutional strengthening	2,000,000	10,000,000	Pasture Department, local government, PUAs, pasture committees
Environmental management: demonstrations and training	1,000,000	5,000,000	Investments in pasture infrastructure and productivity
PES fund for environmental management	2,000,000	10,000,000	200 PUAs a year * 1,000 hectares * 10 per hectare
Total		**26,000,000**	

Pasture Monitoring and Regional Livestock Early Warning System

Most livestock emergencies involve drought. Animals weakened by malnutrition during the drought lack the body condition to survive the harsh conditions without sufficient supplementary feed and adequate winter shelter. These are considered "slow-onset" emergencies, and good disaster management systems integrate the information from drought and humanitarian early warning systems into early decision making. Emergency warning systems for drought, weather (including severe weather watches), and significant loss in agricultural income and/or food production, can be useful for determining the extent of an emergency and supporting sound decision making around the response to an emergency (box 10). Drought forecasting systems that integrate information about the quantity and quality of forage can provide livestock producers with information necessary to adapt their grazing patterns and decisions regarding the production and purchase of fodder. Livestock early warning systems (LEWS) also give policy makers and agencies time to anticipate the location and extent of emergencies, the population affected, and potential needs, which supports the preparation of adequate, coordinated responses.

Box 10 Innovative Weather Forecasting in the Kyrgyz Republic

Innovative weather forecasting supported by a World Bank- financed project supported piloting of a weather information system for farmers via cellphones. The project built the capacity of Kyrgyz Hydromet to use a sophisticated local area model in providing localized (the distance between grid points is 5km) 3-day weather forecasts on rolling basis which then are transmitted via cellphones to farmers. The project also trained farmers in crop and livestock protection measures against adverse weather events.

Texas AgriLife Research developed the first LEWS in East Africa (Kenya, Tanzania, Uganda, and Ethiopia). Through the Global Livestock Collaborative Research Program, Texas AgriLife Research collaborated with Mercy Corps in 2004 to develop a LEWS for the Gobi Region of Mongolia (box 11). Given the success of the projects in East Africa and Mongolia, the U.S. Agency for International Development has supported the development of a LEWS for Afghanistan.

Box 11 LEWS in Mongolia

Mongolia has established a LEWS with the assistance of the World Bank, Mercy Corp, and Texas A&M University. The LEWS integrates satellite monitoring and physical sampling to provide forage and carrying-capacity reports and forecasts. This system will provide nationwide data and is institutionalized in the National Agency of Meteorology, Hydrology, and Environmental Monitoring, which conducts regular forage sampling that the LEWS has used to verify its forecasting system to a high degree of reliability. The cost of developing the system and training regional users was approximately US$900,000.

A pasture monitoring program should be formalized domestically and linked into a regional LEWS system. The program would include components on policy and regulatory development, institutional strengthening, and development of a regional LEWS.

The first component of a LEWS is to develop policy and regulations. A government body responsible for pasture management—the Pasture Department—needs to be established. Regulations and guidelines for pasture monitoring need to be developed that clarify the responsibilities for pasture monitoring at the national, district, and local levels. Any supporting legislation for participation in a regional LEWS program needs to be developed, and operational agreements with international and national bodies involved in pasture monitoring and the LEWS need to be completed.

The second component is to strengthen the institutions for pasture monitoring. Local monitoring systems for the purpose of developing pasture management plans need to be established to support sustainable rangeland management. This work is currently being piloted in Tajikistan by various projects. This information needs to be shared with the national level to establish a database of forage information. Methodologies and sampling protocols need to be developed, and personnel at the national, district, and local levels need to be trained. A national database and reporting system needs to be developed to maintain the data and provide analytical reports to various users of the system from the national to the community level.

Participatory monitoring systems can help to build local knowledge of pasture conditions, but the processes need to simple and cost-effective. The GreenGold Project in Mongolia and others have used combinations of clipping programs and photographic sampling. Participatory monitoring programs would have to be integrated into the national monitoring system. Herders would need to be trained in the objectives and methods of the system.

The third component is to establish a regional LEWS. A regional LEWS could be established to monitor pasture condition in Kazakhstan, the Kyrgyz Republic, and Tajikistan. The system would combine near real-time weather, computer modeling, and satellite imagery to monitor and forecast livestock forage conditions, providing the information needed for timely decision making in advance of drought. Developing the system would include forage monitoring technology to assess the regional quantity of forage, nutritional profiling technology to assess forage quality, and information delivery and outreach.

Table 11 presents the estimated costs of the proposed interventions for pasture monitoring and creation of a regional LEWS.

Table 11 Estimated Costs of Proposed Pasture Monitoring and LEWS in Tajikistan

Component	*Annual (US$)*	*Five-year total (US$)*	*Reference*
Policy and regulatory development	200,000	1,000,000	Technical assistance and exchanges
Institutional strengthening	400,000	2,000,000	Technical assistance, database, systems, and training
LEWS		1,000,000	System development and data input
Total		**4,000,000**	

A joint Kazakh-U.S. International Science and Technology Center project (2006–11) tested and demonstrated pasture-monitoring technologies using remote sensing and ground information based on the rangeland growth model "PASTURE." This system could possibly be scaled up to the national and regional levels. As climate change creates the potential for more frequent and severe droughts, a regional system for drought warning and early response could provide policy makers and producers with the time required to take mitigating measures.

Supplementary Feed Production, Conservation, and Storage

Supplementary feed in the form of forage crops and feed grains is important to sustaining livestock through winter and providing the reserve feeds necessary to keep livestock off early spring pastures, when grass needs to attain a minimum level of growth prior to grazing. The three main approaches to providing supplemental feed are to (1) grow perennial hay crops (either native or seeded grasses and legumes) and use either cut and baled or left as standing hay crops, (2) grow annual fodder crops (oats, barley) and harvest and bale them before maturity to use as "greenfeed" or preserve as silage, and (3) grow feed grains (oats, barley) to maturity and use as high-energy feeds. Additional sources of feeds include crop by-products (distillers mash, canola, and soybean meal).

In Tajikistan, the livestock production system can be divided very broadly into (1) dryland regions that rely entirely on pasture resources for livestock feed and have limited scope for producing supplementary feed and (2) locations where livestock is raised adjacent to irrigated crop farming. Near settlements where dairy production has a market and requires daily delivery of milk to market, households are less likely to send lactating cows to distant pastures, regardless of accessibility, increasing the need to provide year-round, high-quality feed.

In pastoral areas, promoting forage production by livestock producers requires a number of supporting activities. Hay-making areas need to be allocated and, in most cases, fenced to ensure that livestock do not consume the crop before it is harvested. Fencing is a major long-term investment that requires materials and finance. Improving the stand of forage requires top seeding or reseeding and fertilization. Seeds must be purchased, and suitable equipment for seeding must be purchased or

rented. In many semi-arid locations, forage establishment is not possible without supplementary irrigation.

In cropping regions, the introduction of more sustainable crop rotations into the grain sector can significantly increase the supply of supplementary feedstuffs, provided there is suitable market incentive for crop producers to do so. In Tajikistan, this could be the dairy market. Crop rotations can include feed grains (oats, barley) and legumes (alfalfa, field peas), which provide the added benefit of nitrogen fixing. Introducing alfalfa or other nitrogen-fixing legumes in a four-year rotation can improve soil fertility and disrupt weed and disease cycles, lowering input costs. Additional benefits include control of soil erosion and improved wildlife habitat.

Switching from a primary cash crop to livestock fodder production may not provide sufficient economic return to the farm business. Intercropping spring and winter cereals (spring wheat with winter wheat or fall rye) can successfully extend the grazing season into the late fall without removing the main economic crop. Another form of intercropping involves seeding annual crops such as barley into living mulch, an established legume cover crop.

In Tajikistan, orchard grazing could provide considerable areas of pasture that could be grazed directly by small livestock. Water must be provided for the livestock, protection is needed to prevent livestock from browsing or rubbing trees, and movable fencing is needed to establish rotational pasture areas in the orchard. Alternatively, the forage crop could be harvested mechanically and then used in dairy feeding. This would require small-scale power and haying equipment and ongoing operating inputs (diesel, oil) to cut and bale hay.

In irrigated areas, introducing an alfalfa crop in rotation could provide a large proportion of the feed required by a typical household farm. For example, a five-hectare farm with two dairy cows could put 1 hectare of land into alfalfa in a four- or five-year rotation. Estimating the consumption of a 550-kilogram cow at 2 percent of body weight per day, a 365-day feeding period would require 4 metric tons per cow. Irrigated alfalfa production yielding 8 metric tons per hectare could support two dairy cows for an entire year. In addition, the average acre of alfalfa will fix about 500 kilograms of nitrogen per year, thus reducing the need to apply expensive nitrogen fertilizers.

The conservation and storage of feed need to be improved. Hay cut late and stored loose or in loose bales is prone to high losses from breakage, sun, and water. As a result, little can be stored into subsequent years. Proper conservation and storage can allow hay to be stored with good nutritional quality for multiple years. This is important for the ability to hold reserve supplies for use during droughts and their aftermath. Methods of conservation range from the simple to the complex and can include dense baling (large or small), round bales, bagging, and silaging. Improved storage ranges from simple tarping to roofs or buildings. Silaging can be done in pits or silos, but pits are economical and easy to construct. All of these approaches require some level of investment supported by information and training for producers. Research into feed efficiency and economic returns should underpin the introduction of any improved conservation and storage system.

Technical and funding approaches to support supplementary forage production could include the following:

- Ensuring better access to smallholders, possibly through loans and grants to pasture committees or their legal cooperatives
- Integrating PES to incentivize producers to establish perennial forage stands and improve pasture productivity and, in the crop sector, introducing long rotations involving perennial forages
- Supporting the program with applied research and development that would involve variety trials, demonstrations, and research into intercropping and rotations that are technically feasible and economically viable.
- Providing practical, hands-on training to livestock and crop producers on how to manage forage production and livestock feeds.
- Retaining the funds obtained from pasture use fees and supplementing them with matching grants and loans
- Establishing feed financing programs to assist herders and PUAs to purchase feed supplies as part of winter preparedness.

A livestock feed sector development project should be implemented to address feed policy; feed production emphasizing drought-resistant varieties (trials and demonstrations on pasture, forage, and feed grain production); feed manufacturing (feed mills and ration formulation); feed testing (feed laboratory); and feed use (research and on-farm livestock nutrition and feeding programs). Table 12 summarizes the costs of the proposed feed sector development project.

Table 12 Estimated Costs of Proposed Feed Sector Development Initiative in Tajikistan

Component	*Annual (US$)*	*Five-year total (US$)*	*Reference*
Feed policy	200,000	1,000,000	Technical assistance and exchanges
Feed production trials and demonstration	250,000	1,250,000	Variety testing and commercial demonstrations in five regions
Feed manufacturing	200,000	1,000,000	Technical assistance on feed mill design and least-cost ration formulation
Feed testing	850,000	4,250,000	Central feed-testing lab (US$3 million) and capacity building
Feed utilization	250,000	1,250,000	Feeding trials and on-farm demonstrations
Revolving fund for industry adoption	500,000	2,500,000	50 PUAs per year * 50 hectares * US$200 per hectare; repayment in five years
Total		**11,250,000**	

Irrigation and Water Management

Irrigation is a priority under the Agrarian Reform Program. Supporting economically viable and environmentally sustainable irrigation systems should be a central part of improving productivity and adapting to climate change. The program should address the following:

- Assess water resources and management based on hydrological boundaries
- Review and reform institutional arrangements for water management, including ministerial responsibility, institutional arrangements, and mechanisms for operations management
- Develop effective and sustainable water user groups
- Review and reform water tariffs and cost recovery
- Review and rationalize irrigation infrastructure to determine what elements of the system can be operated in an economically viable and sustainable manner
- Identify new water- and energy-efficient technologies for pumping and distributing water
- Implement agricultural adaptation programs in areas that will no longer be served by irrigation.

Animal Health

A national animal health and food safety program should be implemented in Tajikistan to address various issues contributing to higher risks to human and animal health, food safety, product quality, and market access. The core components of the program would be to strengthen the following:

- *Infectious disease control.* This would include strengthening the vaccination program, including vaccine procurement systems, vaccines quality control, cold chain and handling of vaccines, creation of incentives for farmers to carry out vaccine programs (access to credit and other support services), and training for farmers.
- *Surveillance systems.* This would include strengthening laboratories for food safety and disease detection (infections and production) by providing upgraded facilities and equipment, upgraded processes and protocols, and training for management and staff.
- *Animal identification and trace back systems.* National rollout of the animal identification program based on a scale-up of the FAO pilot project would include building capacity for handling information and responding to disease (identification, trace back, containment, treatment, destruction).
- *On-farm herd health and food safety programs.* Animal health and food safety starts at the frontline of disease and health management, the farm. This component would address, among other things, farm bio-security, hygiene, product handling (new milking and handling equipment), storage (milk tanks, coolers), proper drug withdrawal protocols, diagnosis and treatment of production diseases (especially of parasites and mastitis), guidelines for designing new farms, and standards. Animal health circles could be established, where a group of farmers, possibly PUAs, would together hire the services of a veterinarian to help them to set up herd health programs to improve productivity and profitability.
- *Food safety in processing.* This would include plant design and equipment selection, quality control and assurance systems (HACCP, ISO, good manufacturing practices), and food testing capacity (somatic cell counts, antibiotics, hormones).
- *Capacity development.* This would include improving practical animal health and food safety knowledge and skills by veterinarians, para-veterinarians, extension personnel, and farmers and building the capacity of the national veterinary service for implementing, monitoring, and

evaluating programs (see box 12 for an example from China). Assistance would be given to the MOA to develop implementation manuals on (1) HACCP standards, (2) good agricultural practices, and (3) good manufacturing practices.

Box 12 China-Canada Livestock Health Extension Services Project

The China-Canada Livestock Health Extension Services Project (LHESP) supported capacity building in animal health policy, epidemiology, laboratory training, veterinary associations, on-farm bio-security, and herd health and the development of livestock health extension services. Work was carried out in seven provinces and at the national level. More than 13,000 people received training. The total budget was US$19 million over five years, with matching contributions from the government of China.

The approximate costs of the program could be US$47 million over five years (table 13).

Table 13 Estimated Costs of Proposed Animal Health Program in Tajikistan

Component	*Annual (US$)*	*Five-year total (US$)*	*Reference*
Infectious disease control	2,544,000	12,720,000	Shortfall in funding placed into credit revolving fund
Laboratory upgrading		20,000,000	Veterinary service proposal
Animal identification		2,000,000	Veterinary service estimate
OFFS and herd health	1,000,000	5,000,000	Based on LHESP, China
Food safety in processing	1,000,000	5,000,000	Based on LHESP, China
Capacity development	500,000	2,500,000	Estimate
Total	**5,044,000**	**47,220,000**	

Regional Control of Trans-boundary Disease

A regional animal health program could be implemented to control zoonotic and trans-boundary diseases with the potential to affect trade and threaten public health and the livelihood of livestock farmers. FMD should be the first disease targeted. Additional target diseases would include PPR, brucellosis, tuberculosis, and other diseases identified by the national veterinary services and the OIE. The project would include Tajikistan, Afghanistan, and the Kyrgyz Republic, where tradition trans-border grazing patterns contribute directly to the risk of trans-boundary disease outbreaks and for which a tripartite agreement has already been prepared. The components of the project would include (1) policy and regulatory development of protocols and guidelines governing livestock movement,

disease prevention and control, and communication; (2) strengthening of border-crossing facilities (inspection, testing) and procedures; (3) strengthening of disease response programs, including zoning, quarantine, livestock eradication, and compensation. Table 14 summarizes the estimated costs of the proposed intervention.

Table 14 Estimated Costs of the Proposed Animal Health Regional Trans-boundary Control Intervention in Tajikistan

Component	*Annual (US$)*	*Five-year total (US$)*	*Reference*
Policy, regulations, and protocols	100,000	500,000	
Strengthening border crossings and protocol	300,000	1,500,000	Facilities, inspection, and testing, training in 10 sites
Strengthening disease response	100,000	500,000	Capacity building
Total	**500,000**	**2,500,000**	

Livestock Insurance

Tajikistan could consider introducing index-based livestock insurance, which has been introduced in Mongolia with the assistance of the World Bank, or pasture insurance. Index-based insurance operates using aggregate livestock mortality rates by species and geographic area (county) rather than by individual household. The approach combines the three layers of risk response: self-insurance, market-based insurance, and social safety net. If losses are low and do not threaten the viability of their business, herders cover the cost through themselves. If losses are larger, the private insurance industry pays. In the case of catastrophic loss, the government bears the cost. Insurance is provided through partnerships with private insurance companies.

Any consideration of agricultural insurance should be done on the basis of a solid feasibility analysis, livestock and/or pasture, insurance. Following the feasibility study, if the results are promising, a pilot project involving the Ministry of Finance, the Ministry of Agriculture, and private insurance companies could be implemented. Table 15 summarizes the estimated costs of the proposed project.

Table 15 Estimated Costs of the Proposed Livestock Insurance Initiative in Tajikistan

Component	*Five-year total (US$)*	*Reference*
Index-based livestock insurance	18,000,000	Based on Mongolian experience
Conditional credit program	5,000,000	Revolving fund: interest subsidy of 5% provided on 6-month operating credit for a 5-hectare farm assuming US$200 in operating costs per hectare
	—	
Total	**23,000,000**	

Credit, Grants, and Tax Reform

Access to credit is necessary for producers to invest in risk mitigation. This includes longer term investment into assets for feed production, conservation, and storage as well as on-farm infrastructure for water and other environmental assets (retaining walls, berms).

Seasonal credit is required to plant forage and fodder crops and to purchase feed prior to winter. Given the relatively thin margins typical in agriculture, the long growing and storage periods, and the large amount of funds required for inputs or feed, it may be necessary to stretch repayment periods for borrowers. The reverse argument is that the productivity of crops and livestock must be high enough to generate a positive return over interest carrying charges.

A broader range of agricultural credit products should be made available on the market to accomplish the following:

- Allow producers to obtain finance using future crops, or the expected sale of crops or livestock as collateral
- Use warehouse receipts to collateralize products in storage
- Allow processors, input providers, and commercial advisory services to act as loan guarantors for small holders
- Support good risk analysis and planning by including productivity and profitability assessments and collecting those assessments into a database of agricultural performance data to support farm management, investment, and lending decision making, such as the IFC's CLARA program.

A package that would provide long-term loans to individual producers and prosducer groups (PUAs, cooperatives, shareholder organizations) based on proof of participation in animal health (vaccination, herd health) and insurance (crop, livestock) to safeguard the loan in case of crop failure or livestock death could be considered.

A PES conditional grant fund could be created that would provide grants to individual producers and producer groups (PUAs, cooperatives, shareholder organizations) based on proof of participation in environmental management programs (implementation of pasture management plans, pasture

rehabilitation, forage establishment, infrastructure investments, participation in monitoring programs). The fund could be created through donor contributions, the World Bank Bio-Carbon Fund, government contributions, and user fees charged on other users of pasture areas (tourism, mining). Additional market-based funding could be obtained by quantifying the carbon sequestered using the Verified Carbon Standard and selling certified emissions reductions.

Table 16 Estimated Costs of Proposed Financing Initiative in Tajikistan

Component	*Annual (US$)*	*Five-year total (US$)*	*Reference*
Feed sector revolving fund	—	2,500,000	
Vaccination-conditional credit program	—	12,720,000	
Livestock insurance conditional credit	—	5,000,000	
PES grant program	1,000,000	5,000,000	100 PUAs per year * 1,000 hectares * US$10 per hectare
Total	**—**	**25,220,000**	

Innovation and Adaptation

Tajikistan's research and extension system needs to be revitalized to serve the needs of the agriculture sector as it modernizes to compete in global markets and survive in the shifting environment caused by climate change. Researchers need to upgrade their research skills and be given the laboratory, research facilities, and mandate needed to conduct research that is relevant to the needs of industry. Research into drought-resistant varieties of cereals, feed grains, and forage crops needs to be undertaken. Research into livestock genetic improvement should be undertaken to develop cross-breeding programs that improve feed use, growth rates, and carcass yields.

Research into livestock feeds, feeding, and feed efficiency should be given high priority. The feed sector needs to be supported with research, testing, and extension. A feed testing laboratory fully capable of testing feed and feed ingredients and screening for contamination and adulteration is needed (box 13). Building local capacity to develop least-cost feed rations is required. Producer understanding of livestock nutrition, feed, and feeding is fundamental to providing the motivation to invest in improved pasture management and production of supplementary feed.

Box 13 Canada-China Feed Industry Project

The Canada-China Feed Industry Project established a national feed testing laboratory in Beijing. The program worked with feed millers across the country to improve feed milling facilities and quality control processes. Least-cost formulation of rations was introduced. The project helped to modernize the Chinese livestock feed industry and contributed to the improved use of feed in China.

Knowledge platforms should be established to build the capacity of processors and their supply-chain partners around quality control, food safety, and good agricultural manufacturing practices. Market information systems should provide price forecasts to assist processors and primary producers to conduct better planning and risk management (box 14).

Funding and technical support for innovation and climate change adaptation could come from the following sources:

- Increase public expenditure on agriculture and funds allocated specifically to innovation and climate change adaptation at a level at least equivalent to that of other countries in the region. For example, the Kyrgyz Republic spends 2.2 percent of its agricultural GDP on research and extension.
- Establish an innovation council with representation from research, industry, and science to provide leadership and oversight to the research program.
- Agricultural projects should include applied, farmer-focused research and extension in project design to facilitate the establishment these programs.

Box 14 Market Information System to Facilitate Export Growth

Market information systems (MIS) provide market monitoring indicators and decision-making support to agricultural stakeholders. The goal of MIS is to correct for information asymmetry between market actors and to improve market efficiency by increasing transparency. Price data alone is not sufficient for MIS to be effective; the data must be comprehensive, timely, and commercially useful. Agricultural stakeholders, particularly smallholders, should also be empowered to use the information to facilitate decision-making and to negotiate with trade partners. Thus, successful MIS are typically linked to support services, such as: business opportunities, market analyses, climate forecasts, and training. Ideally, MIS are integrated into value chain and enterprise development activities.

The case of the Agricultural Market Information Service (SIMA) in Bolivia is a successful example of a MIS designed to support export growth with regional trading partners. Donors provided long-term funding for the creation of a private, non-profit organization to operate and maintain SIMA. Today, SIMA collects daily price data on over 180 agricultural products in key markets in Bolivia, Peru, and Argentina, providing access to annual historical data dating back to 2002. Fundación

Valles, the non-profit created to operate SIMA, disseminates price data via radio and provides value-added services to farmers, including improving marketing channels and training on new technologies and practices.

Source: World Bank 2009b.

Disaster Relief

Instead of responding in an ad hoc manner to disasters, disaster relief programs should clearly define eligibility for participation. Mechanisms for assessment, compensation, and distribution of funds should be established. Payments could be designed in two streams, one to compensate for lost income and one to compensate for the repair or replacement of damaged infrastructure and productive assets.

The reform of support and disaster response programs should be assessed for their efficiency and impact on beneficiaries. Programs should be developed within the concept of drought cycle management and community preparedness. The devolution of budget and program management to the community level should be considered, where possible.

Summary and Recommendations of the Solutions Areas

Table 17 Summary of Actions in Response to Market Risks

Main program and subprogram	*Estimated time for implementation*	*Estimated cost (total and per beneficiary per hectare, etc.)*	*Expected outcome*	*Proposed monitoring indicators*
Market Knowledge and Training	2015–20			
Timely regular reporting of public sector market information			Improved market information; increased market efficiency	Reports complete and timely
Training and market development for private market intelligence products			Increased end market diversity for production	Survey access and utilization of market intelligence products by producers
Investment Environment and Business Enabling Environment	2015–20			
Regular public/private consultative dialogue to promote ag sector investment and improve BEE			Increased private sector downstream investment; improved competitiveness of Tajik products domestically and abroad	Value of downstream investment in Ag Sector
Matching Grant Fund for Investment in Innovation and Technology Upgrades in Ag Sector			Increased efficiency and competitiveness of Tajik ag sector; Increased value addition of products (packing, grading and sorting, and/or processing)	Value of downstream investment in Ag Sector;

Trade Facilitation	2015–20			
Food Safety Regulatory Reform			Increased diversity of exports	Value and diversity of export products
Community-based pasture management	2017–	26,000,000	Improved pasture management and increased pasture productivity	Number of pasture installations; biomass and biodiversity measures
Pasture monitoring and LEWS	2016–20	4,000,000	Climate resilience; improved emergency preparedness	Ongoing monitoring; functional LEWS; biomass and biodiversity measures
Feed sector development	2017–21	11,250,000	Increased supply of high-quality nutritionally balanced livestock feeds; improved feed use on-farm	Area of feeds (hectares); amount of manufactured feeds (metric tons); average livestock growth rates (average daily grain); average milk yields (liters per lactation)
Irrigation management	2016–20		Rationalization of irrigation infrastructure and technologies; improved water management by water user groups	Area under improved irrigation; irrigation costs per hectare; number of water user groups
Domestic animal health	2016–20	47,220,000	Improved animal health status that supports exports; improved rural livelihoods	% coverage of vaccine programs; laboratory evaluations by

				OIE; % coverage of animal identification tags
Animal health: regional trans-boundary control	2015–19	2,500,000	Reduced incidence of trans-boundary disease	Reported incidence
Indexed-based livestock insurance	2016–20	23,000,000	Increased use of insurance products by livestock producers	% of producers participating
Conditional loans and grants	2016–25	25,220,000	Increased investment in productivity and risk management approaches	Number of loans and % of producers participating; number of grants and % of producers participating

a. Included in individual programs and summarized here.

Appendixes

Appendix A: Risk Assessment Methodology

A. 1. Data Needs Collected and Reviewed

Task	Data Source
Description of the main agro-ecological zones in each country, including the characteristics and areas of these zones and the main farming systems and crops and livestock produced in each zone.	Country level data
Data series on average annual rainfall for the period 1980-2012for the main agro-ecological zones.	Country level data, for the period 1980-2012/3
Respective contributions to crop and livestock production made by household plots, small-scale private (dekhan) farms, large-scale private corporate farms, and state-owned agricultural enterprises.	Country level data, for period 2000-2012.
Major crop and livestock production shocks observed from 1980-2012 and describe the causes of these shocks and the level of loss incurred (area of crop damaged, yield losses, number of livestock lost etc, reduction in livestock productivity etc)	Country level data, for period 1980-2012/3.
Description of the incidence of livestock disease outbreaks and the associated livestock losses.	Country level data, for period 1995-2012/3.
Description of government policy for intervention in agricultural markets from 1995-2012 for wheat, cotton, potatoes and the most important high-value vegetable crop, including the form of intervention and the dates of any significant changes to these policies.	Country level data, for period 1995-2012/3.
Government exchange rate policy from 1995-2012 and the dates of any significant changes to these policies.	Country level data, for period 1995-2012/3.
Government interest rate policy from 1995-2012 and the dates of any significant changes to these policies.	Country level data, for period 1995-2012/3.
Government trade policy for the three major crops for the period 1995-2012, including the level of import tariffs or export duties and taxes imposed, and the dates of any significant changes to these policies – including the imposition of trade embargoes. Information on country membership of any trade agreements or customs unions.	Country level data, for period 1995-2012/3.

Data series on Gross Value of Production (crops, livestock, total) from FAOSTAT for the period from 1995-2011.	FAOSTAT data, for the period 1995-2011.
Data series on production, area and yield of the three major crops (wheat, cotton, potatoes) grown in the region, plus the most important high-value, vegetable crop in each country (see above).	Country level data, for the period 1980-2012/3.
Data series on livestock numbers for the period 1980-2012 for: total cattle, milking cows, sheep, goats, pigs and horses.	Country level data, for the period 1980-2012/3.
Data series on average annual producer prices for the three major crops (wheat, potatoes, cotton) plus the most important vegetable crop, for the period 1995-2012/3.	Country level data, for the period 1995-2012/3. If producer price data are not available then market level price data can be used. If monthly price data are available for all or part of this time period, they should also be collected and compiled.
Data series of international prices for wheat and cotton for the period 1980-2012.	Data for the period 1980-2012/3.
Data series on the exports and imports of cotton, wheat, and wheat flour – volume and value - for the period 1995-2012. For wheat and wheat flour these data should also include a break-down of the trade flows among Central Asian countries. This will be important for analysis of the regional implications of wheat price and/or production shocks in Kazakhstan.	Data for the period 1995-2012/3. For wheat and wheat flour these data should also include a break-down of the trade flows among Central Asian countries.
Data series on total public expenditure and expenditure on agriculture and irrigation (in nominal national currency) for the period 1995-2012.	Data for the period 1995-2012/3.
Data series on government and donor expenditure in response to any agricultural shocks or emergencies for the period 2000-2012.	Data for the period 2000-2012/3.

A. 2. Production: Price Derivation for Indicative Loss Analysis

Base Case: Derivation without Loss Threshold

Let total output be $Y_1 = P_1Q_1$, change in output be $Y_2 - Y_1 = P_2Q_2 - P_1Q_1$, and decompose this change into a production impact and a price impact. Consider production impact alone by holding prices constant at P_1. Let production impact be $P_1(Q_2 – Q_1)$. Then price impact is total impact – production impact:

$= (P_2Q_2 - P_1Q_1) – [P_1(Q_2 – Q_1)]$

$= P_2Q_2 - P_1Q_1 – P_1Q_2 + P_1Q_1$

$= Q_2(P_2 – P_1)$.

Hence

$Y_2 - Y_1 = P_1(Q_2 – Q_1) + Q_2(P_2 – P_1)$. (1)

Total impact is production impact + price impact.

This construct allows full decomposition of the production and price impact on the total value of output for each of the following scenarios:

- Both production and price increase
- Production increases and price decreases
- Production decreases and price increases
- Both production and price decrease.

The methodology is only useful for individual commodities. It is technically possible to use it at the aggregate level if all of the relevant price and production data for the aggregate are available. But this would be very difficult and time-consuming to do.

The methodology cannot be used to disaggregate production and price impacts at the aggregate level by using the results of constant price and real price analysis. At the aggregate level, the following are the relevant parameters for analysis:

- P_1Q_1
- P_2Q_2
- P_1Q_2.

The first two parameters are available from real price analysis. In principle, the third parameter is available from the constant price analysis. In fact, the P_1 variable available from the constant price analysis is not the same as the P_1 variable from the real price analysis.

Derivation with Loss Threshold

Derivation varies according to whether the threshold applies to production (Q), price (P), or total output (Y).

Where the loss threshold applies to production alone (Q), threshold = $w Q_1$, where w = loss threshold in percentage (for example, 0.1). Substitute Q_1^* for Q_1, where $Q_1^* = Q_1 - wQ_1$.

Then indicative loss = $Y_2 - Y_1 = P_1(Q_2 - Q^*_1) + Q_2(P_2 - P_1)$. Price impact is unchanged in this scenario. Production impact falls by the amount equivalent to the threshold.

Where the loss threshold applies to price alone (P), threshold = wP_1, where w = loss threshold in percentage (for example, 0.1). Substitute P_1^* for P_1 where $P_1^* = P_1 - wP_1$. Then indicative loss = $Y_2 - Y_1 = P^*_1(Q_2 - Q_1) + Q_2(P_2 - P^*_1)$. Price threshold affects both production and price impacts.

Where the loss threshold applies to total output (Y), threshold = wP_1Q_1, where w = loss threshold in percentage (for example, 0.1). Let $Y_1^* = Y_1 - wP_1Q_1$. Then indicative loss = $Y_2 - Y_1^* = Y_2 - (Y_1 - wP_1Q_1) = (Y_2 - Y_1) + wP_1Q_1 = P_1(Q_2 - Q_1) + Q_2(P_2 - P_1) + wP_1Q_1$.

Rearranging

$= P_1Q_2 - P_1Q_1 + wP_1Q_1 + Q_2(P_2 - P_1)$

$= P_1(Q_2 - Q_1 + wQ_1) + Q_2(P_2 - P_1)$

$= P_1[Q_2 + Q_1(w - 1)] + Q_2(P_2 - P_1)$.

Appendix B Chronology of Major Economic and Adverse Events

Table B.1 Major Events in Tajikistan

Year	*Event*
1992	
1993	Civil war begins; cattle and sheep numbers fall 10%; low rainfall parts of Khatlon
1994	Civil war continues; shortages of fertilizer and fuel. Poultry numbers (hens) fall 33%. Wheat production falls 13% (12% fall in area harvested).
1995	Civil war continues; shortages of fertilizer and fuel. Egg production falls 58%; milk production falls 18% (cow productivity). Drought; cotton production falls 22% (19% fall in yield). Potato production falls 17% (yield falls 22%).
1996	Civil war continues; cotton production falls 24% (16% fall in area, 10% fall in yield); Cow milk production falls 54% due to sharp fall in production/cow. Egg production falls 88% (hen numbers fall 79%). Tomato and onion production fall 19% (area & yields fall); watermelon production falls 55% (area and yield falls). Locust outbreak.
1997	Civil war ends; low rainfall parts of Khatlon. Tomato and onion yields fall. Sharp fall in number of sheep and beef slaughtered.
1998	Post-civil war impact; wheat production falls 14% (yield falls 10%); Beef production falls further (continued decline in animals slaughtered). Russian ruble crisis.
1999	Lower rainfall; cotton production falls 18% (yield falls 18%)
2000	Low rainfall Khatlon. Tomato production falls 12% (area fall).
2001	World cotton price falls 19%; real tomato prices fall 25% as production rises
2002	Price volatility. Real wheat price falls 30% due to good harvest; real onion prices fall 53% and water melon prices fall 24% due to continuing increases in production
2003	
2004	Low rainfall parts of Khatlon; some insect (butterfly) damage to cotton. Cotton debts begin to escalate Vegetable price volatility; real potato and onion prices fall 40% in response to continued increases in production
2005	Drought; cotton production falls 20% (18% fall in yield).
2006	Beef production falls due to decline in the number of animals slaughtered following the 2005 drought. Real cotton prices fall 13% (impact of debt crisis)

2007	Generalized fall in nominal and real producer prices due to market saturation. Real wheat price falls 36%, vegetable prices by 47%-87%. Milk prices fall by 30%, beef by 62%, mutton by 39%. Locust outbreak (35,000 ha), but no major fall in aggregate crop production. Real cotton price falls 22% (impact of cotton debt crisis)
2008	Global food price crisis (GFPC), Kazakh ban on wheat exports Major drought; wheat yield falls 16%; Cotton production falls 16%. Real cotton price falls 21%; Vegetable prices fall by 17% to 28%
2009	Cotton debts written off, but cotton production still falls 16% (29% fall in area); offset by increased prices. Real wheat price falls 39% in the aftermath of the price hikes caused by the global food price crisis (GFPC); offset by 65% increase in production.
2010	Low rainfall, minor rust damage to wheat; real wheat prices continue to fall slightly in aftermath of GFPC Real potato and water melon prices fall by 22% and 27%, respectively Real beef prices fall by 25%
2011	Real cotton price falls 11%; offset by 26% increase in production. Wheat production falls 30% due to a switch to cotton production and lower fertilizer use (23% fall in yield); offset by sharp increase in real wheat prices. Watermelon production falls by 18%; offset by sharp increase in real watermelon prices.
2012	Low rainfall

Note: GAO = gross agricultural output; FMD = foot and mouth disease.

Appendix C Coefficients of Variation and Adjusted Coefficients of Variation

Table C.1 Coefficients of Variation or Adjusted Coefficients of Variation

Coefficients of Variation/Adjusted Coefficients of Variation*			
Aggregate Output			
	Constant Prices[a]		Real Prices[b]
Total GAO	0.18*		0.14*
Crop GAO	0.15		0.14*
Livestock GAO	0.27*		0.17*
Individual Commodities			
	Production[a]	Yield[a]	Real Prices[b]
Wheat	0.20*	0.18*	0.23
International wheat price	--	--	0.17*
Cotton	0.20*	0.20*	0.26*
International cotton price	--	--	0.30*
Potatoes	0.17*	0.16*	0.35
Onions	0.26	0.19*	0.24*
Tomatoes	0.21	0.21*	0.23
Water Melons	0.40*	0.31*	0.36*
Fresh Cow Milk	0.24*	--	0.15*
Beef	0.26*	--	0.33
Sheep Meat	0.24*	--	0.18
Eggs	0.85*	--	0.09*

Source: FAOSTAT, Author's calculations

* Adjusted for trend using the Cuddy Delle-Valle Index

[a]1992-2012; [b]2000-2011

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