



Senegal Agricultural Sector Risk Assessment

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Despite uneven performance, Senegal's agricultural sector remains vital to the national economy. It accounts for roughly one-sixth of gross domestic product (GDP) and continues to be a major source of employment. Nearly three in five Senegalese (58 percent) live in rural areas and depend primarily on agriculture for their livelihood. Expanding the sector and achieving food self-sufficiency is one of the core pillars of the country's economic development strategy, Plan Senegal Emergent. Successive government policies have promoted intensification of crop and livestock production. Yet, sector growth has lagged behind population growth and growth in other sectors. During the most recent decade (2004–13), the sector expanded by 3.5 percent on average, well below Government targets. The sector's poor performance is partly due to limited take up of productivity-enhancing inputs among smallholder farmers who dominate the country's agricultural production. It is also due to increasing climate unpredictability and adverse impacts from unmanaged risks.

This Note summarizes key findings, conclusions, and recommendations of an agricultural risk assessment that was undertaken jointly by the World Bank and the Government of Senegal during 2014–15. The study's principal objective was to assess production, market, and enabling environment risks facing farmers and other stakeholders across Senegal's agricultural sector and to identify pathways to improved risk management.

The analysis was based on extensive analysis of crop and livestock production, price, and meteorological data records over the period 1980–2012. It included a review of key documentary evidence of yield and risk events together with input from interviews held with

farmers, traders, processors, and others in rural Senegal as well as with government and agricultural research staff. The results of the analysis are considered in the light of the vulnerability of the different stakeholders to the effects of ex post shock events and the resulting ex ante impact upon investments.

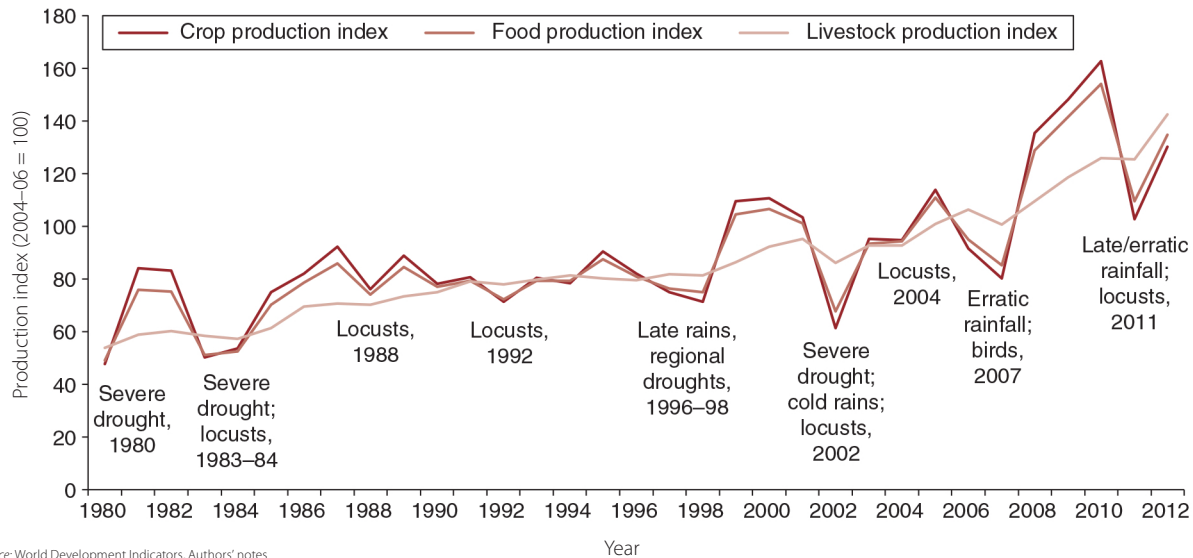
MAJOR RISKS

The study's principal findings highlighted agricultural production and livelihood systems in Senegal that are highly vulnerable to downside risks.

Production risks

The most significant risk facing Senegalese agriculture is increasingly erratic rainfall and drought as a more

FIGURE 1: Timeline of major shocks to agricultural production in Senegal (2004–06 = 100), 1980–2012



Source: World Development Indicators, Authors' notes.

extreme but less frequent expression of the same phenomenon. Severe drought, especially in northern regions, emerges as the biggest risk in terms of estimated aggregate losses to crop and livestock—a one in every four years event on average over the review period. The analysis also suggests a corresponding increase in the frequency of floods over the same period, but with limited aggregate impact on agricultural supply chains. After drought, locust infestations were the second most common and costly risk to agricultural production. Other crop pests—such as birds and grasshoppers—brushfires, and livestock diseases also count among the most significant production risks.

Market risks

The impact of price risk varies substantially according to the crop and its importance to the rural economy. There is considerable variability in domestic food crop prices and more limited variability in domestic cash crop prices. International prices of rice, maize, groundnut oil, and cotton were more variable, with coefficients of variation exceeding 40 percent in some cases. Companies that process locally purchased commodities for export (cotton and groundnuts) face a significant price risk because the domestic purchasing price may vary independently of the export price. Although exchange rate fluctuations can also contribute to price risk for exporters of locally purchased products, the exchange

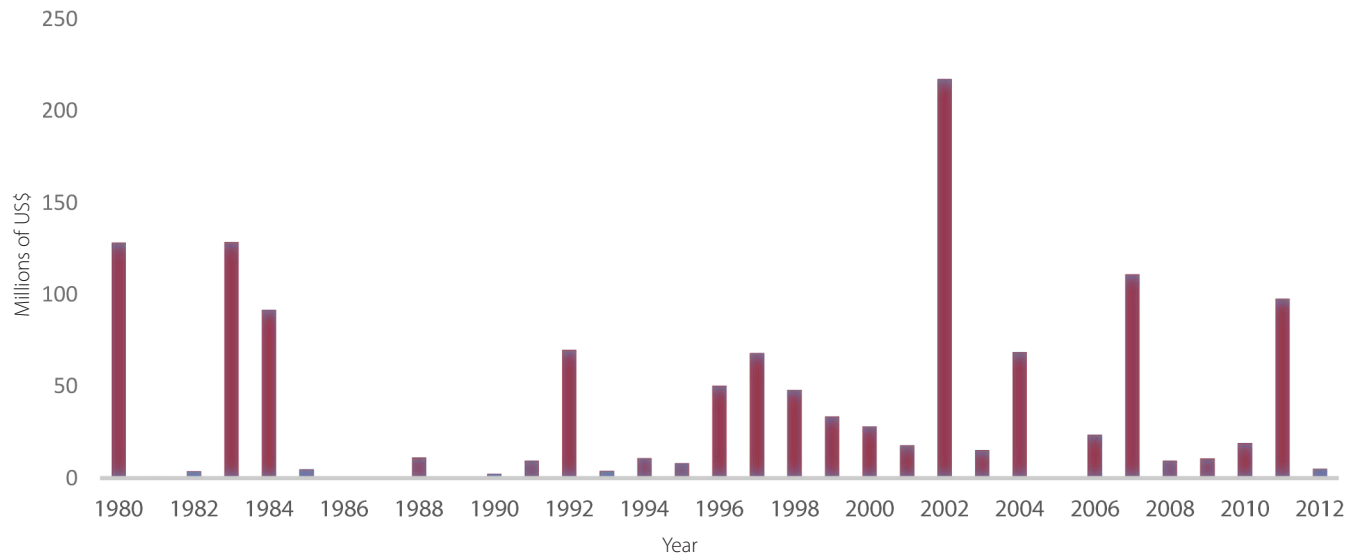
rate of the CFA franc (XAF) to the U.S. dollar has shown only modest variability over the past 12 years.

Traditionally, the limited reliance of pastoralists upon markets implied a limited impact of price risk upon pastoral livestock production, but this situation is changing. Livestock prices often plummet while food prices increase; this is now a common shock-induced pattern in dry lands and a major risk for livestock owners. Within the poultry sector, price volatility of imported feed components—notably corn and soya, which contribute 80 percent of poultry feed—is considered a major source of risk.

Enabling environment risks

When ranked in terms of impact and frequency, a key risk noted within the livestock sector is derived from uncertainty over land tenure and access. Since access and mobility are critical to pastoral livelihoods, inconsistent land tenure policy and uneven implementation of regulations may weaken traditional coping mechanisms and increase vulnerability levels among pastoralist communities, particularly in the north where land-use pressures are increasing. Similar uncertainty is derived from the inconsistent delivery of animal health services, including the enforcement of policies on vaccination, quarantine, and movement.

FIGURE 2: Estimated losses from agricultural production shocks 1980–2012



ADVERSE IMPACTS OF RISKS

Figure 1 depicts a historical timeline of risk events that adversely affected sector performance from 1980–2012. Since 1980, the agricultural sector has been subject to at least 11 major production shocks, with a frequency of every three to four years on average across the 33-year review period. The results of trend analyses indicate that for the 12 crops analyzed, annual production losses amounted to approximately 4.82 million metric tons, with an estimated value of US\$1.4 billion, or 3.9 percent of annual agricultural GDP, on average (see figure 2). It is worth noting that this reflects only the ex post impact. The ex ante impact may be of equal or even greater magnitude.

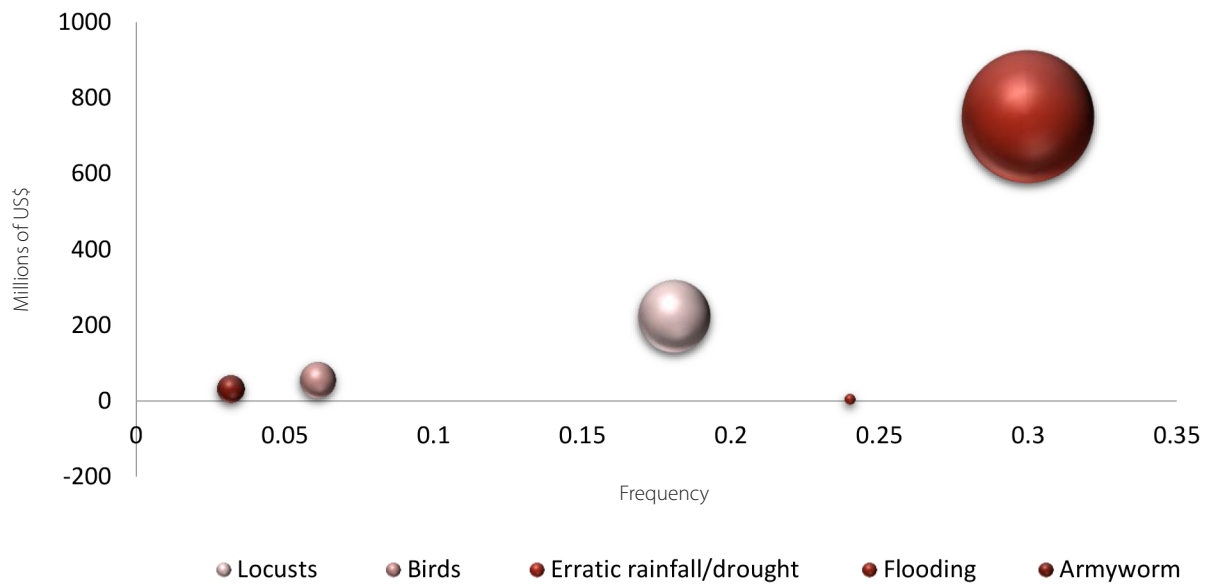
Although the average annual impact of shocks on GDP is relatively modest (less than 4 percent), actual impacts when they occur can result in losses of 10 to 20 percent of sector GDP. Senegalese agriculture is subject to losses exceeding 10 percent of gross production value in one out of every five to six years due to unmanaged risks. In 2002, a particularly severe drought followed by widespread locust infestation contributed to losses exceeding US\$217 million, or 32.7 percent of gross production value (see figure 3). Erratic rainfall and/or drought account for an estimated 50 percent of crop yield reductions. Pests and diseases, especially locusts, account for roughly 25 percent. Losses from agricultural risks have adverse impacts that are acute and far-reaching. Risks negatively affect rural employment, savings, and assets, and both

rural and urban households are affected through food price spikes, which increase food insecurity and correlate to spikes in malnutrition rates. The government's fiscal position is affected due to the cost of ex post response, crowding out spending on health, education, and other poverty-reducing investments.

RISK MANAGEMENT

The government of Senegal (GoS) understands the importance of putting in place effective agricultural risk mitigation systems. In recent years, it has adopted a range of capacity-building measures geared toward reducing Senegal's exposure to natural disasters and impacts from a changing climate. These measures include the creation of the Directorate of Civil Protection, the development of a National Platform for Disaster Risk Reduction (DRR) and elaboration of a National Action Plan on DRR (2010–15), and adoption of the National Adaptation Programme of Action for climate change adaptation. Such GoS initiatives are already helping to safeguard livelihoods, promote climate adaptation, and strengthen household resilience. And yet, agricultural supply chains in Senegal remain highly vulnerable to a wide range of risks that jeopardize rural livelihoods. Building more productive, more resilient, and more sustainable food and marketing systems is crucial to safeguarding livelihoods and increasing economic growth.

FIGURE 3: Impact and frequency of major agricultural risks in Senegal, 1980–2012



A multidisciplinary team of technical specialists from the World Bank, the Ministry of Agriculture and Rural Equipment, the Ministry of Livestock and Animal Production (MEPA), and the Senegalese Institute of Agricultural Research conducted a follow-up assessment in early 2015. The team evaluated Senegal’s existing risk management landscape in three target areas to identify pathways to increased climate resilience via assessing the effectiveness of current and past interventions, principal barriers and challenges, and potential leverage points for scaling up the most effective risk mitigation interventions. Based on outcomes of the earlier risk assessment, the three target areas included: 1) enhancing climate resilience of smallholder systems via improved soil and water management and diversification, 2) strengthening Early Warning and Early Response (EW/ER) systems, and 3) improving management of pastoral resources.

The objective of the Phase II assessment was to generate insights, inform, and kick-start the development of a framework for improved risk management and stronger resilience for the agricultural sector. More specific objectives included identifying existing practices and systems that helped smallholders manage risks and increase productivity; identifying the enabling conditions necessary for scaling up; and proposing an evidence-based program of investments, technical assistance, and policy changes that would establish those conditions.

The following sections summarize the key findings and recommendations from the Phase II report across the three focus areas.

1. Strengthening early warning and early response

To increase effectiveness of its national EWS, the GoS should prioritize upgrading the timeliness, accuracy, and area-specificity of seasonal and short-term weather forecasts. This information should be made more broadly available in targeted, user-friendly formats to a growing number of trained rural communities. Communities should be increasingly integrated into the national EW/ER system through decentralized mechanisms. Senegal’s ongoing participation in African Risk Capacity (ARC) should be based on improved customization of the Africa RiskView model. This could also benefit from an analysis of various risk-management and risk-sharing options under different drought/disaster ARC insurance options. Finally, to make the overall system more effective, improved access to climate and short-term forecast information should be matched with improved access to risk-lowering farming practices and to key agricultural inputs.

Increase awareness and training in weather forecasts (media, institutions, rural communities).

Training rural communities in weather forecasts provides



Photo credit: World Bank

substantial benefits in terms of higher yields, lower input use, and greater resilience to erratic rainfall events. It can also 1) provide a basis for expansion and higher density ground-level data collection points needed for a down-scaling of current weather forecasts, and 2) contribute to better integration of rural communities into local early warning/early response mechanisms.

Broaden the current dissemination of seasonal and short-term weather forecast, and warnings.

Weather-forecast information is in high demand, but does not always flow smoothly; many rural radio stations, for instance, have intermittent or no access to internet or even to the mobile network. A modest amount of support is needed to improve internet and/or telephone connections and to increase the number of individuals who receive weather forecast information through their mobile devices.

Refine and downscale seasonal and short-term weather forecasts, and seasonal monitoring. This would address one of producers' chief complaints: due to high spatial variability, current forecasts for any given area do not necessarily pertain to all communities within that area and can be misleading. Another advantage is that it would improve the spatial accuracy of vegetation index and rainfall estimates modeling.

Improve ground data-based validation for seasonal monitoring. A combination of higher density

of rainfall data points and of ground observations for ground-truthing of analyzed satellite data would improve seasonal monitoring, yield forecasts, and prospective food security analysis.

Customize Africa RiskView and refine the analysis of the drought insurance instrument. National institutions and ARC worked together for over a year to derive the set of parameters which triggered the 2015 indemnity payment. However, all parties recognize that further improvements could be made. In light of the country's evolving risk profile, the respective risks being assumed by Senegal and the insurer and the premium-payout ratio under the ARC scheme should be re-assessed.

Broaden and formalize the involvement of rural communities in early warning/early response. An increasing number of rural communities are capable of playing more active roles in natural resources management, weather information use, rainfall data collection, and even food security monitoring.

Improve desert locust contingency planning.

Locust early warning should be integrated with other EW/ER interventions, and the national desert locust control plan should be updated accordingly, with a view to its use as the basis for potential applications through the UN for emergency response funds. Financial requirements for desert locust control need to be revised based on past experiences and the new configurations of EW/ER consistent with improved seasonal monitoring. Finally, explore options for quick disbursement of all or part of the desert locust control budget under the current ARC Memorandum of Understanding or the upcoming ARC Outbreak and Epidemic Insurance Programme for African Sovereigns.

2. Strengthening the climate resilience of smallholder systems

While challenges from climatic shocks are significant and growing, this report highlights experiences in Senegal and elsewhere in the sub-region that show how certain risk management practices can help most dryland farmers reduce climate-induced risks to their livelihoods. They do this by reducing runoff, improving the soil's capacity to retain soil nutrients and hold moisture, improving rainfall- and fertilizer-use efficiency,



Photo credit: M. Tall/CCAFS

and via livelihood diversification. Experiences in Senegal and within the region also show that promoting a business approach to scaling up these practices is not only possible, but is the most effective pathway to successful adoption.

Promote broader adoption of Conservation Agriculture (CA). Through demonstration plots and farmer-to-farmer visits, wider farmer use of furrows and minimum tillage technology combined with composting, mulching, and other soil conservation practices would help to increase rainfall and fertilizer-use efficiencies and reduce fertilizer costs. In 2013, yields on CA fields were 57 percent higher than non-CA fields (USAID 2014) and as much as double the yields in some areas.

Promote adoption of Farmer-Managed Natural Regeneration (FMNR). FMNR benefits include the annual deposits of organic matter from annual tree pruning on the fields, nutrient recycling, hydrologic lifting of soil moisture, and income diversification via the provision of high-quality browse and fuel wood.

Promote farmer adoption of effective water harvesting practices. *Aménagement en Courbe de Niveau*, a form of ridge tillage, has been shown to increase rainfall infiltration rates by 66 percent and yields by 30–50 percent in Mali field tests, with even greater increases recorded during poor rainfall years.

Promote farmer adoption of Zai holes and Demi-Lunes. Zais have a long track record of improving yields, particularly in areas subject to poor and erratic rainfall. Applying micro-doses of manure/compost and urea to the zai increases yields substantially.

Scale up Community-based Charcoal Management (CBCM). Introduced recently to Senegal by the World Bank's Sustainable and Participatory Energy Management Project and USAID's Wula Nafa program, CBCM is a sustainable-yield, revenue-generating forest management intervention that generates revenues for local governments and supplemental income for rural farming communities that is less dependent on rainfall.



Photo credit: Milo Mitchell/IFPRI

Promote integration of small animal husbandry into cropping systems. Integration of livestock into rain-fed cropping systems can be transformational as a strategy for improving household resilience as it provides a supplemental source of nutrition and income that is not directly dependent on adequate rainfall. Animals such as chicken and goats can also become a cash reserve in times of food shortages.

Promote household gardening. By offering a year-round revenue stream that is less dependent on rainfall than annual staple crops, micro-gardening is another activity that can help strengthen the climate resilience of vulnerable populations, particularly for women. Given that such gardens are in production year round, they provide a viable means to manage risks during the time of the year when food or cash may be scarce.

3. Strengthening management of rangeland and livestock resources

The main objectives of the proposed set of priority interventions are to broaden the feed-base for livestock, reduce dependence on rainfall, decrease grazing

pressure, and optimize trade-offs between cash income needs, family labor, productive smaller herds, and local sales of fodder and milk. The aim is to enable a more sustainable, dynamic combination of both mobile and sedentary livestock production. In the short-term, a less rainfall dependent, broader feed-base for pastoral livestock can provide the extra resilience the system requires to remain sustainable in order to benefit from longer-term positive changes in land tenure, supportive policy, more efficient value chains, improved natural resource management, and better access to services and education.

Promote development of local fodder production. Following analysis of site-specific rainfall, hydrological, agro-ecological, and economical parameters, including local market studies for milk, fodder, and fodder seeds, promote market-driven models to establish fodder production via: 1) purely rain-fed fodder production; 2) rain-fed fodder with supplemental irrigation from harvested rainwater (e.g., sub-surface dams); and 3) fodder production based on the groundwater irrigation for sites with groundwater table close to the surface.

Build-out of underground rainwater storage & water harvesting infrastructure. Sub-surface dams (or “sand dams”) for trapping and storing run-off in riverbeds provide water for human needs, livestock, pastures, and crop and fodder production. In comparison to conventional surface dams, this technology loses far less water to evapo-transpiration and has very low maintenance requirements (i.e., no silting up). It is well established in parts of east Africa and also in semi-arid northwest India. Costs for a large sand-dam (including well, infiltration pipe, pump, and generator) supplying 80,000m³ water/year are in the range of US\$16,250, excluding community labor and pump-house (Nissen-Petersen 2006). Considering the low number of conventional surface dams for water harvesting in the Ferlo, systematic placement of such dams in underutilized pasture areas should be prioritized. Potential for establishment of water spreading weirs, or spate irrigation, in the Ferlo (widely used in Burkina Faso, Chad, and Niger) to improve pastures and grow crops and fodder next to seasonal rivers should also be explored.

Fast-track reform of Operation Sauvegarde du Bétail (OSB). OSB has long been a central component of GoS emergency response strategy in times of drought. The potential transformation of OSB into a mechanism that secures access of pastoral livestock owners to affordable animal feed during the most critical part of the dry season by regulating animal feed markets and curbing excessive prices should be explored. OSB can also be designed to directly complement local fodder production. Tying access to OSB-subsidized feed to maximum herd size limits would specifically target low- and middle-income livestock owners. Compliance of herd owners with the national livestock vaccination campaign should be a precondition to access.

Securing livestock mobility by reducing conflict along transhumance routes. During normal years Ferlo livestock mobility is critical only 20 percent of the time. During drought years transhumance regains critical importance for the larger part of the herd (75–80 percent of the animals). Proposed investments would support MEPA in building capacity of the communautés rurales (multiple villages administered by directly elected local government) to defuse existing tensions in transhumance corridors and dry-season grazing areas. It is crucial to strike a suitable balance between interests of resident communities (e.g., protection of crops, timing of livestock arrival in relation to harvest, prevention of bushfires) and interests of mobile communities that only graze livestock in these areas for a short time per year (e.g., access to water, sufficient grazing areas along the corridors). Interventions could draw on positive experiences from Niger and elsewhere.

CONCLUSIONS

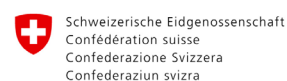
This policy note highlights potential pathways to increase the climate resilience of agricultural systems in Senegal via improved ex ante risk mitigation. The list of options it presents within the proposed priority areas of intervention is not meant to be exhaustive but only illustrative of the types of strategies and approaches that have shown promise in Senegal and elsewhere in the region in strengthening the resilience of agricultural production and marketing systems. More research is needed to generate crucial empirical evidence as to which investments offer the best returns when considered from a cost/benefit standpoint. Nonetheless, it is hoped that the main findings will serve to inform policy discussions and future investment planning for the sector.

This Note was based on the World Bank publication: Stephen D'Alessandro, Amadou Abdoulaye Fall, George Grey, Simon Simpkin, and Abdrahmane Wane. 2015. *Senegal agricultural sector risk assessment*. Agriculture global practice technical assistance paper. Washington, D.C.: World Bank Group.

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