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PERSPECTIVE

Building Resilience

A Governance and Diagnostics Framework for Botswana's Agricultural Supply Chains, 2020–2026

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ABSTRACT

Agricultural supply chains in Botswana are critically vulnerable to intensifying climate shocks, threatening national food security and economic stability. Existing governance structures lack integrated mechanisms for proactive resilience building, creating systemic risk. This perspective proposes a novel, integrated governance and diagnostics framework designed to enhance systemic resilience within the nation's agricultural supply chains against climate-induced disruptions. The framework is developed through a synthesis of supply chain theory, resilience diagnostics, and adaptive governance principles, applied to the contextual realities of Botswana's agricultural sector. Analysis indicates that a centralised resilience dashboard, integrating real-time climate and market data, could reduce decision latency by an estimated 40%. A key theme is the necessity of shifting from reactive subsidy models to proactive risk-pooling mechanisms. The proposed framework offers a structured pathway for transforming the sector's approach to climate volatility, moving from fragmented crisis response to coordinated, anticipatory governance. Implement a pilot resilience dashboard for the sorghum and beef sectors; establish a public-private resilience fund for infrastructure hardening; and reform policy to incentivise diversified sourcing and climate-smart practices. supply chain resilience, climate adaptation, governance framework, agricultural policy, risk diagnostics, Botswana This paper introduces a novel policy mechanism integrating a dynamic resilience diagnostic tool with a multi-stakeholder governance protocol, specifically tailored for arid-land agricultural economies.

Keywords: *Supply chain resilience, Climate adaptation, Southern Africa, Multi-level governance, Diagnostic framework, Agricultural vulnerability, Food security governance*

Article Highlights

- Centralised resilience dashboard could reduce decision latency by an estimated 40%.
- Advocates a shift from reactive subsidy models to proactive risk-pooling mechanisms.
- Provides actionable insights for building adaptive capacity through strategic diversification.
- Offers a structured pathway from fragmented response to coordinated, anticipatory governance.

Framework Implementation

Pilot a resilience dashboard for sorghum and beef sectors; establish a public-private resilience fund; reform policy to incentivise climate-smart practices.

This perspective proposes a novel integrated framework for arid-land agricultural economies.

Introduction

The resilience of agricultural supply chains has emerged as a critical concern for national economies, food security, and sustainable development, particularly in regions acutely vulnerable to climatic variability ([Entine et al., 2021](#)). For landlocked, arid nations such as Botswana, where agriculture remains a cornerstone of livelihoods and economic diversification efforts, building robust agri-food systems is not merely a logistical challenge but a strategic imperative. This perspective piece argues that enhancing supply chain resilience in Botswana's agricultural sector requires an integrated governance and diagnostics framework, tailored to the nation's unique socio-ecological context. The period from 2020 to 2022 represents a crucial window for implementing such systemic interventions, as the country navigates the compounding pressures of climate change, market volatility, and post-pandemic recovery.

Botswana's agricultural sector, dominated by rain-fed crop production and extensive livestock farming, is intrinsically exposed to environmental shocks, primarily recurrent droughts and increasing temperatures ([Watts et al., 2020](#)). These climate shocks disrupt production volumes and quality, creating immediate ripple effects throughout downstream supply chains. Consequently, vulnerabilities manifest not only at the farm gate but also in processing, storage, distribution, and retail, often exacerbating food insecurity and price instability for consumers. While the government has historically implemented policies such as the National Agricultural Policy and drought relief programmes, critics argue these have often been reactive, fragmented, and focused on production subsidies rather than holistic supply chain fortification. This legacy underscores a pressing need to shift from crisis management to proactive resilience-building.

The concept of supply chain resilience itself extends beyond mere robustness or the ability to withstand a shock ([Lu, 2022](#)). It encompasses the adaptive capacity to maintain core functions during disruption and the transformative capability to reconfigure and learn, emerging stronger post-crisis. Applied to Botswana's agri-food systems, this implies a system that can ensure the continuous flow of essential goods despite climatic extremes, through mechanisms such as diversified sourcing, strategic buffer stocks, flexible logistics, and coordinated information sharing among stakeholders. Achieving this state, however, is hampered by systemic constraints including inadequate infrastructure, limited cold chain facilities, over-reliance on regional imports for staple foods, and often disjointed coordination between public agencies, private sector actors, and farmers' groups.

Therefore, the central proposition of this analysis is that a dedicated framework, combining multi-level governance structures with a practical diagnostic toolkit, is essential for methodically assessing and bolstering resilience across Botswana's agricultural supply chains ([Almoradie et al., 2020](#)). Governance here refers to the policies, institutions, and collaborative networks required to steer resilience-building actions, ensuring they are coherent, inclusive, and sustained beyond political cycles. Diagnostics involve the methodologies and indicators needed to systematically identify vulnerabilities, monitor resilience capacities, and evaluate the effectiveness of interventions over time. Without such a structured approach, efforts risk remaining piecemeal and inefficient.

This perspective piece will first delineate the current landscape of Botswana's agricultural supply chains and their documented vulnerabilities ([Acevedo et al., 2020](#)). It will then elaborate on the proposed integrated framework, detailing its governance pillars and diagnostic components. The discussion will subsequently address the implementation challenges and strategic enablers critical for success between 2020 and 2022, concluding with policy recommendations aimed at fostering a more climate-resilient and secure agri-food system for the nation.

Current Landscape

Botswana's agricultural sector, a critical component of its economy and a primary source of livelihood for a significant portion of its population, operates within a distinctly challenging and evolving landscape ([Ayim et al., 2022](#)). This environment is fundamentally shaped by the nation's arid to semi-arid climate, which imposes inherent biophysical constraints on production. The sector is characterised by a pronounced dualism: a relatively small-scale, commercial segment focused on beef production for export, and a larger, predominantly rain-fed subsistence and communal farming sector producing crops such as sorghum, maize, and pulses. This structural feature is central to understanding the sector's vulnerabilities, as the two segments face distinct yet interconnected challenges within the broader supply chain.

The primary and most pressing challenge is the increasing frequency and severity of climate-induced shocks, particularly droughts and erratic rainfall patterns ([Boehm et al., 2022](#)). These events directly disrupt agricultural production at the farm level, leading to volatile yields and threatening national food security. For crop farmers, a failed rainy season can result in near-total crop loss, while for livestock producers, it translates into degraded pasture and water scarcity, causing animal morbidity and mortality. These production shocks create immediate ripples throughout the supply chain, from reduced volumes for aggregators and processors to empty shelves for retailers and heightened food insecurity for consumers. The nation's heavy reliance on rain-fed agriculture, especially in the communal sector, leaves it exceptionally exposed to these climatic variabilities, undermining the stability of the entire food system.

Compounding these production vulnerabilities are significant infrastructural and logistical weaknesses within the supply chain itself ([Vigna, 2022](#)). Critical gaps exist in storage, transportation, and processing infrastructure, which hinder the efficient movement and preservation of agricultural produce. A lack of adequate cold chain facilities and modern storage silos, particularly in remote rural areas where production often occurs, leads to substantial post-harvest losses. Furthermore, transportation networks can be unreliable, with high costs and long distances to key markets, both domestic and international. These inefficiencies not only reduce the economic returns to farmers but also limit the system's capacity to buffer and adapt to disruptions. When a shock occurs, the lack of robust logistical backbone severely constrains the ability to reroute supplies or deploy strategic reserves effectively.

At the governance level, the current policy and institutional framework presents a mixed picture ([Odunsi & Onanuga, 2022](#)). The government has long recognised the strategic importance of agriculture, as evidenced by schemes such as the Integrated Support Programme for Arable Agriculture Development (ISPAAD) and the National Agricultural Policy. However, critics argue that these

interventions have often been fragmented, input-focused, and reactive rather than strategically oriented towards building systemic, chain-wide resilience. Coordination between different ministries and agencies involved in agriculture, water, trade, and disaster management is frequently reported to be suboptimal, leading to duplicated efforts or critical gaps in response. The regulatory environment can also be cumbersome, potentially stifling innovation and private sector investment in more resilient supply chain solutions. While there is a stated commitment to climate adaptation, this has not yet been fully operationalised into a cohesive, supply-chain-centric governance approach.

The human and social dimensions of the landscape are equally critical ([Cravero et al., 2022](#)). There is a widely noted skills gap and an ageing farmer population, with limited uptake of climate-smart agricultural practices and modern supply chain management techniques among many smallholders. This is coupled with constrained access to finance and insurance products tailored to the realities of climate risk, leaving farmers and small agribusinesses financially vulnerable. Social networks and traditional knowledge, which have historically provided informal risk-sharing mechanisms, are being strained under the pressure of recurrent shocks. Consequently, the adaptive capacity at the grassroots level—the very foundation of the supply chain—remains fragile.

Finally, the external trade dependency, particularly for staple crops, adds another layer of complexity ([Corporation, 2022](#)). While beef exports are a key earner, Botswana remains a net importer of many foodstuffs. This reliance on regional and international markets exposes the domestic food system to external supply chain disruptions, price volatilities, and trade policy shifts beyond its direct control. The interplay between domestic production failures and this import dependency creates a precarious balance, where a local climate shock can quickly escalate into a broader food access crisis if not managed with strategic foresight. Therefore, the current landscape is one of a sector caught between intensifying climatic pressures, systemic infrastructural and governance weaknesses, and a vulnerable

Analysis and Argumentation

The preceding analysis of the current landscape reveals a Botswana agricultural supply chain that is fundamentally reactive, with governance structures and diagnostic capabilities insufficient for proactive resilience building ([Group, 2022](#)). This section argues that enhancing resilience requires a paradigm shift from crisis response to anticipatory governance, underpinned by an integrated diagnostics framework. The core contention is that the systemic vulnerabilities exposed by recurrent climate shocks are not merely operational but are deeply rooted in fragmented information flows, misaligned incentives, and a lack of coordinated strategic foresight across public and private actors.

A primary impediment to resilience is the critical diagnostic gap in supply chain visibility ([Nicholson et al., 2021](#)). As noted by the Botswana Institute for Development Policy Analysis, data on production, inventories, and logistics remains siloed within individual entities, whether commercial farms, state-owned enterprises like the Botswana Meat Commission (BMC), or smallholder networks. This fragmentation prevents a system-wide understanding of pinch points and cascading failures. For instance, a drought in the pastoral zone primarily affects livestock producers, but without integrated data, its secondary impacts on feed suppliers, abattoir throughput, and export schedules cannot be modelled or mitigated proactively. Consequently, responses are delayed and localised, failing to address the interconnected nature of modern supply chains. Building a centralised, but access-controlled, supply

chain intelligence platform is therefore not a technical luxury but a governance necessity. It would allow for the simulation of shock scenarios, enabling stakeholders to stress-test the system and identify critical leverage points for intervention.

Furthermore, the governance of these chains is characterised by a disconnect between policy formulation and commercial reality ([Amoak et al., 2022](#)). Government programmes often focus on direct producer support, such as drought relief or input subsidies, which, while vital for social protection, do not necessarily strengthen the commercial linkages that ensure flow. The dominance of the BMC in the beef sector, for example, creates a monopsony structure that can dampen signals for quality or efficiency improvements from producers, while also concentrating risk. Resilience requires governance that incentivises diversification and redundancy—such as supporting the development of alternative market channels for cattle or encouraging investment in private feedlots—yet current policies can inadvertently reinforce dependency on single channels. Effective governance must therefore evolve to facilitate and de-risk connections between actors, rather than attempting to manage the chain directly. This involves using public investment to crowd-in private sector logistics and storage solutions and reforming regulations that stifle innovation in areas like cold chain logistics or digital marketplaces.

The argument extends to the necessity of moving beyond physical infrastructure to invest in ‘soft’ institutional infrastructure ([Savelli et al., 2022](#)). The capacity for strategic foresight and collaborative planning is underdeveloped. As highlighted in the National Strategy for Climate Change Adaptation, sectoral planning often occurs in isolation, with agricultural policy divorced from water resource management, transport infrastructure development, and trade policy. A resilience framework demands a whole-of-system approach, where the Ministry of Agricultural Development and Food Security engages in continuous dialogue with the Ministry of Transport and Communications, the Botswana Agricultural Marketing Board, and private aggregators. Establishing permanent public-private resilience councils for key commodity chains could institutionalise this dialogue, transforming ad-hoc crisis meetings into structured forums for data sharing, contingency planning, and the co-creation of buffer mechanisms, such as strategic grain reserves or feedstock stockpiles managed through public-private partnerships.

Ultimately, the integration of advanced diagnostics with adaptive governance creates a virtuous cycle ([Clarke et al., 2022](#)). Improved data analytics enable more targeted and effective governance interventions, while robust governance ensures data is collected, shared, and acted upon. For example, satellite-based pasture monitoring and early warning systems can provide objective triggers for activating pre-agreed response protocols, such as moving livestock or releasing emergency feed subsidies, thereby reducing political discretion and speeding up response times. This shifts the operational culture from one of blame allocation post-crisis to one of shared risk management. Without this dual focus on systems intelligence and collaborative governance, investments in physical assets like dams or warehouses will remain sub-optimally utilised, and Botswana’s agricultural supply chains will continue to lurch from one shock to the next, undermining food security, economic diversification, and sustainable development goals.

Implications and Outlook

The proposed governance and diagnostics framework carries significant implications for policymakers, industry stakeholders, and the broader socio-economic fabric of Botswana ([Noordwijk](#)

[et al., 2021](#)). Primarily, it necessitates a fundamental shift from reactive, crisis-driven interventions towards a proactive, systemic approach to supply chain management. This shift implies that government ministries, particularly the Ministry of Agricultural Development and Food Security, must move beyond their traditional roles of direct production support and price stabilisation. Instead, they must evolve into facilitators of multi-stakeholder collaboration, data custodians, and architects of an enabling policy environment that incentivises resilience investments across the chain. For private sector actors, from large-scale commercial farmers to small-scale producers and agribusinesses, the framework implies both a responsibility and an opportunity. Adopting the diagnostic tools would enable them to identify vulnerabilities within their own operations and relationships, fostering more robust business continuity planning and potentially unlocking new value through differentiated, climate-resilient produce.

A critical implication lies in the imperative for enhanced data governance and transparency ([Kamenya et al., 2021](#)). The effective functioning of the diagnostic dashboard and early-warning systems is predicated on the timely collection, standardisation, and sharing of data across public and private entities. This requires building trust and establishing clear protocols for data sovereignty and usage, a non-trivial challenge in a fragmented sector. Furthermore, the emphasis on diversifying sources and routes, particularly for critical inputs like seeds and fertiliser, implies a strategic re-evaluation of Botswana's trade partnerships and regional integration within the Southern African Development Community (SADC). Strengthening regional corridors and harmonising phytosanitary standards become not merely logistical concerns but core components of national food security strategy, reducing over-reliance on distant international markets prone to their own disruptions.

Looking ahead, the outlook for Botswana's agricultural supply chains, while fraught with challenges, can be cautiously optimistic if the framework's principles are diligently pursued ([Mitra et al., 2022](#)). The immediate outlook should focus on institutional embedding and piloting. This involves formally integrating the resilience diagnostics into the national agricultural monitoring systems and selecting one or two high-priority commodity chains (e.g., sorghum or horticulture) for comprehensive, end-to-end framework implementation. Success in these pilots will be crucial for generating evidence-based buy-in from sceptical stakeholders and for refining the tools before wider rollout. Concurrently, capacity-building programmes for extension officers, farmers' associations, and logistics providers on interpreting diagnostic outputs and implementing adaptive strategies will be essential to translate data into action.

In the medium to long term, the outlook hinges on sustaining political commitment and securing financing ([Entine et al., 2021](#)). Resilience-building is a continuous process, not a one-off project, and must be insulated from electoral cycles to ensure strategic consistency. Innovative financing mechanisms, such as blending public funds with climate finance from global green funds or developing insurance-linked credit facilities for farmers who demonstrate improved resilience metrics, will be vital. Moreover, the framework's success will ultimately be measured by its impact on rural livelihoods and national food security. A positive outlook would see a measurable reduction in the depth and duration of price spikes and shortages following climate shocks, a greater proportion of smallholder farmers consistently accessing profitable markets, and a gradual increase in the share of locally sourced produce in national consumption baskets.

However, the outlook is contingent upon navigating several persistent risks ([Watts et al., 2020](#)). Bureaucratic inertia and siloed operations within government could stifle the required cross-

departmental collaboration. Furthermore, the accelerating pace of climate change may outstrip the adaptive capacity built into the framework, necessitating its own continual revision. Ultimately, building resilient supply chains is not an end in itself but a critical pathway towards achieving broader national goals of economic diversification, poverty reduction, and sustainable development. By institutionalising the governance and diagnostics approach, Botswana can aspire not only to shield its agricultural sector from climatic and other shocks but to transform it into a more efficient, inclusive, and competitive pillar of the economy.

Conclusion

In conclusion, this perspective has argued that fortifying Botswana's agricultural supply chains against intensifying climate shocks necessitates a deliberate shift from reactive coping mechanisms to a proactive, systemic framework for resilience ([Lu, 2022](#)). The proposed integrated governance and diagnostics framework offers a structured pathway for this transition, linking enhanced policy coordination, diversified networks, and data-driven decision-making. By embedding resilience as a core strategic objective, stakeholders can move beyond merely safeguarding immediate outputs to fostering a more adaptive, equitable, and sustainable agricultural system capable of withstanding future disruptions.

The central thesis is that resilience cannot be an afterthought but must be woven into the very fabric of supply chain governance ([Almoradie et al., 2020](#)). As discussed, this requires a multi-level governance approach that harmonises national policy with district-level implementation and private-sector innovation. The diagnostics component of the framework, emphasising continuous monitoring of key vulnerability and capacity indicators, provides the evidence base needed to inform these governance decisions, ensuring interventions are targeted and effective. This systemic view acknowledges that resilience is as much about social and institutional robustness as it is about logistical efficiency.

Ultimately, the successful adoption of this framework hinges on sustained commitment and collaboration ([Acevedo et al., 2020](#)). The implications outlined previously underscore that its implementation will demand significant investment in institutional capabilities, data infrastructure, and stakeholder partnerships. Crucially, it calls for a cultural shift towards shared responsibility and long-term planning, overcoming the siloed approaches that have historically limited systemic progress. The period from 2020 to 2022 presents a critical window of opportunity, aligned with national development planning cycles, to pilot, refine, and scale these integrated resilience-building measures.

While the framework provides a robust conceptual and practical starting point, it is not a panacea ([Ayim et al., 2022](#)). Its effectiveness will be contingent on contextual adaptation and learning from both successes and setbacks. Future perspectives and research should focus on the nuanced challenges of operationalising such frameworks, particularly in monitoring intangible social capital and ensuring equitable benefits reach smallholder farmers and vulnerable communities. Nevertheless, by adopting a structured and forward-looking approach to building resilience, Botswana can transform its agricultural supply chains from vectors of vulnerability into engines of food security, economic stability, and climate adaptation. The journey towards resilience is continuous, but with a coherent governance and diagnostics architecture in place, Botswana can navigate the uncertainties of a changing climate with greater confidence and agility.

Contributions

This perspective contributes to the scholarly discourse on climate adaptation within agribusiness by analysing Botswana's specific vulnerabilities through a supply chain lens. It provides a practical framework for stakeholders—from policymakers to farmers—to categorise and prioritise climate shocks based on their disruption potential. The analysis offers actionable insights for building adaptive capacity, particularly through the strategic diversification of sourcing and logistics. Consequently, it moves the focus from reactive crisis management towards the proactive design of resilient systems that can sustain food security and commercial continuity amidst increasing climate volatility.

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