



Strategies for building resilient pastoral and agropastoral systems in Africa

Whitbread, A*; Baba B*, Banerjee, R*; Dhulipala, R*; Flintan, F*; Houessionon, P*; Joseph, E*; Olesikilal, B*; Paliwal, A*; Sarr, A**; Shikuku, K*; Sircely, J*; Worou, ON*; Wane, A*

*International Livestock Research Institute (ILRI), Tanzania, Kenya, Senegal.

**Centre de Suivi Ecologique, Dakar, Senegal.

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Abstract

In the drylands of Africa, low and variable rainfall and the increasing incidence of extreme weather events, leave poor communities, dependent on pastoral and agropastoral livelihood systems, highly vulnerable. Building resilience must consider the immediate ‘tactical’ approaches for managing climate risk (e.g. de-risking measures such as the index-based livestock insurance (IBLI) bundled with credit, inputs, climate information services) and ‘strategic’ approaches, where communities work together to reimagine sustainable land-use and resilient livelihoods (e.g. participatory rangeland management (PRM) supported through bylaws). Enhanced mobile network penetration also offers unprecedented opportunities for the dissemination of information to pastoralists and farmers through digital channels. Further, digital technologies enable new methods of acquiring and sharing data, ground truthing, and obtaining user feedback especially in data sparse environments (e.g. KAZNET, a citizen science innovation that crowdsources information on rangelands animals, markets, food security, conflict). Data collected through such innovations can contribute to the monitoring of shocks, improving product design, informing policies and institutional decision making. This paper gives examples of several tactical and strategic approaches to building resilience in pastoral and crop-livestock systems in Africa.

Introduction

Climate variability is a major source of risk in livelihood systems of the drylands, that are home to almost 3 billion people and cover some 46% of the globe’s land area (IPCC 2022). In the drylands, pastoral livelihoods take place on the rangeland areas (some 25% of the total land area), and in crop-based farming systems (some 12% of the total land area) (FAO 2019). Increasingly, these livestock-based livelihood systems are in flux and are threatened. Along with other biophysical, socio-economic and political factors, climate risk contributes enormously to food insecurity, economic losses, and multi-dimensional poverty (Shiferaw et al. 2014). Research has also identified potential options that can contribute to improved management of agricultural systems under variable climatic conditions, and the perceptions and coping strategies being adopted by farmers. Resilience, agricultural productivity and profitability under these high climate risk environments are therefore dependent on: (i) the inherent resilience of the livestock and farming

enterprises which is a function of landscape and farm design within the context of the agricultural innovation system (strategic); and (ii) how well the livestock and farm management are planned and executed in the context of the risk (tactical). How this applies to agropastoral and pastoral systems in Africa is presented in a series of examples of on-going work that ILRI and its partners are undertaking in West, East and Southern Africa.

Tools and methodologies

Examples of strategic approaches to build agricultural system resilience include:

- Working with communities and government to co-design more sustainable land-use, for example the joint village level land use planning coupled with PRM and supported with bylaws (ICPALD 2024).
- Co-design climate information services with community of practice (CoP) for livestock farmers with digital technologies (mobile phones and radio program dissemination) (Houessionon et al. 2023, Diallo et al.2024).
- Influencing the decisions of pastoralists regarding routes and movements of livestock to access fodder and water (IGAD 2024).
- The use of model-based approaches to underpin the farm/landscape co-design process or to influence policymakers and development practitioners understand the farming systems' sensitivities and the potential benefits of climate change adaptation to current and future climate scenarios (AGMIP 2024; Whitbread et al. 2021)

Examples of tactical management of climate risk include:

- Innovative insurance schemes for livestock producers (i.e. IBLI) (Banerjee et al. 2019).
- The intelligent Systems Advisory Tool (iSAT) (Ramaraj et al. 2023)
- KAZNET as a data collection and dissemination approach based on citizen science principles to crowdsource data on rangeland condition, animal numbers, markets, conflict, household food security etc (Chalenga et al. 2022; Alulu et al. 2024).
- Web-based platforms like (WENDOOU 2024) in Ferlo, Senegal for assessing water availability in ponds, thus facilitating stock drinking water management in arid areas.

Discussion

Strategic approaches for building resilient livelihood systems

The longer-term perspective, where an agricultural system is redesigned to be more resilient to the current and future climate patterns, can be termed 'strategic' planning. The design of the agricultural systems should consider what mix of management, enterprises and farming systems are most resilient to current and future climate also considering market and cultural factors. This requires analytics to understand the historical and projected climate scenarios, model-based scenario analysis, and co-design of farming systems that are more resilient to extreme events and reduce the damage of such events on the natural resource base. In some landscapes and environments, transformational changes in landscape design might be urgently needed (Whitbread et al. 2021).

In agropastoral systems, climate induced risk associated with season-to-season variability of rainfall is one of the major challenges to achieving food security across large parts of semi-arid Africa. Since season outcomes are uncertain, even with the best climate information, farmers have limited flexibility in applying management with confidence. In fact, in risky environments, farmers most often respond by adapting a risk averse strategy and are reluctant to invest in even risk reducing measures (Leathers and Quiggin 1991). In most agropastoral systems, there are a limited range of enterprise or crop options to consider. The options

may be further restricted by cultural traditions, food preferences, market opportunities or simply a lack of access to inputs such as seed and fertiliser or knowledge. New thinking on crop-livestock integration is needed to bring the climate risk lens to the design and management of such systems. Examples include: Using diversification such as multi-species crop-tree-livestock (forage) farm systems (e.g. for the West African Sahel, millet-cowpea-ziziphus agroforestry-based systems show great promise according to Bado et al. (2021)); building soil fertility management and restoring soils to overcome nutrient limitations and avoid water stress (Bado et al. 2022); more broadly using crop breeding programs to enhance the use of multi-purpose traits in cereal germplasm (e.g. Blummel et al. 2020).

In pastoral systems, mobility has been the core adaptation mechanism in pastoral systems for generations. Restrictions on the mobility of pastoral communities and their livestock, conflicts and stricter cross-border control and defective tenure policies pose threats to the sustainability of pastoral livelihoods (IGAD 2024). While well managed rangelands may store carbon in soils and vegetation, and provide a range of ecosystem services, the management of rangeland systems in Africa are increasingly contested as populations grow, government policies tend to aim at settling pastoral populations, and the resource base becomes degraded (Nori and Scoones 2024). Recognizing that pastoral communities remain central to finding solutions, empowering communities to design and manage landscapes with good governance, resolving and preventing conflicts between land users, employing early warning systems (i.e. drought, extreme events) and other methods to manage livestock and rangeland resources are key. Methods such as participatory land use planning or participatory rangeland management (PRM) have been successfully piloted across several East African countries (Waweru et al. 2021). In West, Central and East Africa where transhumance is common, seasonal variations drive transhumant migrations over vast distances between wet and dry zones, providing pastoralists with access to stock feed, and farmers with improved soil fertility via manure, leading to co-benefits and efficient land use. According to Wane et al. (2023) climate change has become a direct and aggravating factor of other shocks (i.e. animal health, markets, conflicts) that result in considerable quantitative, qualitative and economic losses. Development bodies such as IGAD play a key role in building an understanding of the role of pastoralism in managing landscapes and livelihoods and engaging communities and government to agree on movement between countries, on cross border animal health, mapping of transhumance routes, and early warning systems for drought and extreme weather events. Additionally, linking the design, management and restoration of rangelands to the issues of climate risk management, mitigation and carbon sequestration, may be a way to drive much needed innovation in these long-neglected systems.

Tactical approaches for building resilient livelihood systems

Adopting a flexible risk management strategy informed by multiple information sources to make decisions allows a pastoralist, livestock keeper or farmer to develop tactical management approaches. Such strategies may include pre-season planning guided by seasonal climate forecasts, a set of criteria or ‘triggers’ for sowing, variety selection, livestock life cycle planning, and a range of in-season responses to the prevailing weather, market signals or other factors. Recent advances in climate science have led to significant improvements in the predictability of climate and weather at scales that are useful in planning and managing agricultural systems. These predictions, when linked to systems information and scenario analyses through simulation models, provide an opportunity to critically evaluate and identify alternative soil, crop and management options that minimize risk and improve productivity and profitability. While pilot studies have established the usefulness of climate information for decision-making, operational delivery ‘at scale’ of actionable information products requires context-specific granularity, timeliness, formatting and feedback loops for continuous learning (Ramaraj et al. 2023).

While agropastoral systems remain important in the developing world and potentially support more equitable, resilient, and sustainable agriculture than other food systems, climate risk has remained a major disincentive to sustainable intensification. Exacerbating the challenge has been the expansion of cereal farming, especially maize, into the semi-arid regions, leading to a risky food security situation (Tesfaye et al. 2015). Further, the role and potential productive capacity of livestock in agropastoral systems are generally undervalued compared with the farmers' desire for the grain staples. At the farm level, area planned deployment of annual crops (cereals and legumes) within rotations and planning arrangements (e.g. intercropping) must consider temporal (historical and forecasted climate) and spatial (soil fertility, soil moisture conditions) to allow more optimal land use considering risk. The role of dual-purpose germplasm can be made more central for its provision of multiple products options and the end-use decisions that can be made tactically within the season. In crop-based systems, a decision support tool called 'iSAT', which built on earlier work in commercial cropping systems in Australia (see Hochman et al. 2009), defines a process to create context specific climate informed agro-advisories for use in tactical agronomic decisions making at the farm level. In these examples, models have been used in a participatory mode to develop scenarios that farmers face in their day-to-day management and are linked to ICT methods of deployment through a range of public and private dissemination efforts.

For livestock keepers in pastoral or mixed crop-livestock systems, advisory services are much less developed than those developed for agronomic decision making and rarely linked to climate drivers. This represents a significant area for research, by considering the life cycle of fodder or animal components linked to climate information to develop actionable management strategies similar to the agronomic examples of iSAT. For example, the timing of reproduction, management of the herd, timing of marketing or stock movements, prediction of rangeland feed resources could all be linked to climate information. In transhumance systems, Wane et al. (2020) show that the probability of transhumance increases under rainfall delay, drought or with changes in cattle prices. In such systems, livestock itineraries involve detailed planning, adjusting for water conditions and fodder constraints and may be influenced by information coming from a range of sources, for example a multi-stakeholder platform or community of practice (COP). Houessionon et al. (2023) documented a COP in Senegal that made use of decision support tools, market price forecast tools, indigenous and expert knowledge of its members to reach >78,000 herders using various communication channels (e.g. interactive voice response IVR, rural radio). The need for bundled socio-technical innovation bundles comprising of risk financing mechanisms and other services (e.g. inputs, climate information services) is increasingly important for building resilience in the pastoral areas. Research is needed to understand the socially differentiated preferences of pastoralists for such bundled innovations and evaluate their effectiveness ex-ante and ex-post.

Conclusions

The pastoral and agropastoral systems in Africa remain central to the livelihoods and farming systems of millions, but are often highly vulnerable to extreme weather events and affected by land degradation, contested government policies and conflicts. Developing solutions must be considered through a climate lens, with farming system or landscape design co-developed considering future climates. Participatory processes embedded in community dialogue and consultation ultimately supported by government policy, bylaws or customary processes, have been shown to be scalable and sustainable. To maintain livelihoods and food security, farmers and livestock keepers must consider climate risk in their management decisions, especially through the use of advisory and extension information that are linked to climate and indigenous knowledge. Enhanced co-operation of the national agriculture research and extension services, the national meteorological agencies, farmer facing organisations and private sector players (e.g. agri-tech), are needed to develop the digital public infrastructure that support the creation and dissemination of innovations.

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