International Journal of Plant & Soil Science

Volume 37, Issue 12, Page 53-61, 2025; Article no.IJPSS.148418
ISSN: 2320-7035

The Informal Maize Seed Sector in Sub-Saharan Africa: Role of Community Seed Banks and Institutional Support

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.9734/ijpss/2025/v37i125872

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://pr.sdiarticle5.com/review-history/148418

Review Article

Received: 30/09/2025
Published: 06/12/2025

ABSTRACT

The informal seed sector is a non-law regulated system which permits seed production and distribution especially under small scale farmers. Seed security is critical for agricultural sustainability and rural development among smallholder farmers. Like with formal seed sector, activities such as seed production, seed processing and storage are undertaken but in a non-law regulated manner. Estimations advocate that 60-80 percent of the seeds for small scale farmers in sub-Saharan African is saved on farm or obtained through informal system. The informal seed system plays a critical role in maintaining on-farm genetic diversity, local adaptation, and availability to smallholder farmers, while on the other hand, the formal sector drives crop productivity through enhanced high-yielding, certified varieties. This paper reviews the general characteristic of the maize seed sector in sub-Saharan Africa. Further more it seeks to review how community gene banks and institutional support strengthens the informal seed system. The constituted manuscript was generated from the collection and analysis of published data and information.

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Cite as: *Governor Siamasamu, Victoria Ndeke, and Langa Tembo. 2025. "The Informal Maize Seed Sector in Sub-Saharan Africa: Role of Community Seed Banks and Institutional Support". International Journal of Plant & Soil Science 37 (12):53–61. https://doi.org/10.9734/ijpss/2025/v37i125872.*

Keywords: Seed security; smallholder farmers; seed exchange.

1. INTRODUCTION

A key element of agricultural productivity, food security, and smallholder farmers' livelihoods is seed security, or a supply of high-quality seeds of appropriate categories (Abebe and Alemu, 2017; McGuire and Sperling, 2016). With maize being a major staple food in sub-Saharan Africa, its security is critical in fostering agricultural sustainability and rural development (Tembo et al., 2016; AFP in Zimbabwe, 2024). It was estimated that 60-80 percent of the seeds used by small scale farmers in sub-Saharan is saved on farm or obtained through informal system (Vernooy et al., 2023). This could mainly be attributed to an inherited farmer custom and or a cheaper seed source in the informal seed sector compared to the formal one (Nkhoma, & Nangamba, 2020; Sperling & Almekinders, 2023).

Seed security is a prerequisite for sustained crop output, responding to shifting agricultural challenges, and being resilient to climate change (Louwaars et al. 2013). For smallholder farmers to achieve optimum yields, promote nutritional diversity, and minimize production risks, they need to access seeds of excellent quality for a wide range of crop varieties (Bishaw et al., 2007). Furthermore, seeds constitute genetic diversity which is key to breeding projects and the continued existence of agriculture (Swarup et al., 2021).

Seed used by small scale farmers in the informal seed sector generally correspond to their agro-ecological situations via informal seed systems (Fig. 1). These are defined by farmer-to-farmer seed exchange, neighbourhood seed markets, and collective seed-saving initiatives (McGuire & Sperling, 2013). On the other hand the formal system employs legal laid out procedures to ensure seed quality is maintained. These informal strategy strengthen farmers' ability to withstand shocks from the environment and adjust to the market, assist in preserving agricultural gene pool, and make it easier for geographically adapted varieties to be propagated (Engels & Ebert, 2021).

Developing a robust informal seed systems to guarantee seed security is vital for sustainable agricultural development and poverty alleviation in developing countries where smallholder farmers represent a substantial portion of the population and encounter an array of socio-economic and environmental obstacles.

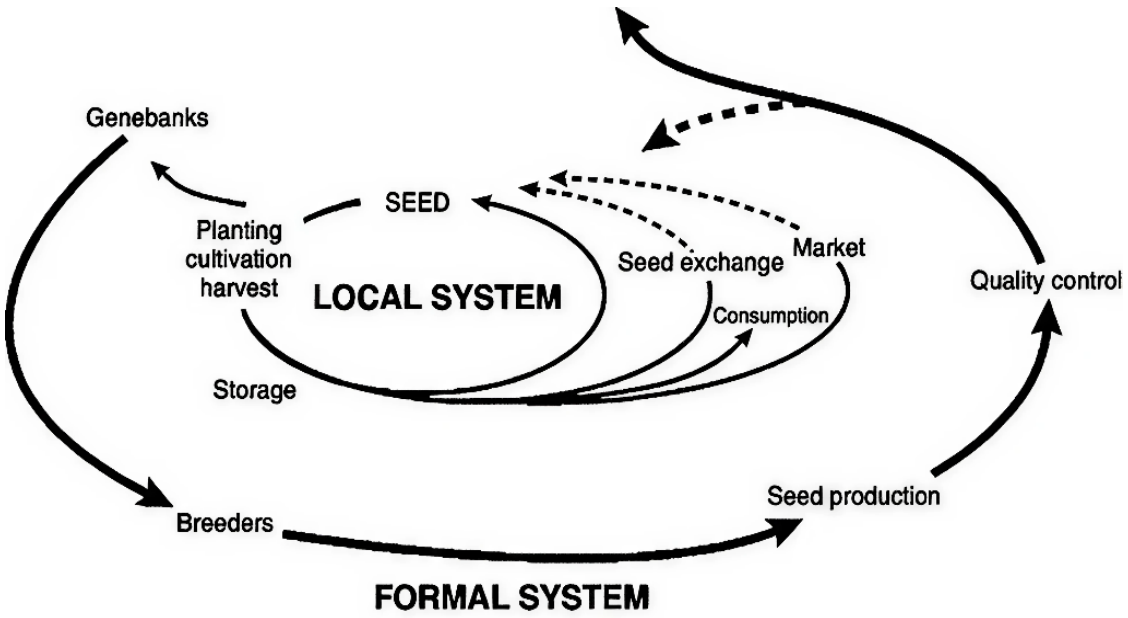

Fig. 1. The informal (local) and formal seed network (Almekinders & de Boef; 2000)

2. CHARACTERISTICS OF THE MAIZE INFORMAL SEED SECTOR

Smallholder farmers obtain a fair share of maize seeds through the informal sector, (Ncube et al., 2023). Under this sector, farmers are able to get maize seeds through several kinds of unofficial channels that operate outside regulated seed markets and legal structures.

The farmers often have difficulties procuring certified seeds through formal channels owing to variables including short supply, prohibitive costs, and underdeveloped distribution systems (Nkhoma, and Nangamba, 2020; Sperling et al., 2020; Vernooy et al., 2023). The key characteristics of informal seed sector include unregulated seed exchange networks and activities.

2.1 Seed Exchange Networks

Robust seed exchange networks among farmers at the local level have evolved in the informal maize seed sector. These networks make it possible to easily share and distribute maize seeds (Ricciardi, 2015). Reliable seed exchange networks being at social events, agricultural exhibitions, and or through unstructured arrangements. This practice aids to preserve crop diversity and adaptation to the local environment.

2.2 Activities of Informal Seed Sector

In the unregulated maize seed sector, farmers, just like in the formal, are involved in similar activities of production, harvesting, selection, storage and distribution of seeds but these are non- law regulated (Plate 1 and 2) (Sperling et al., 2013). Activity procedures have been handled down from generation to generation. Smallholder farmers in the informal seed sector have adopted seed saving strategies over time (Louwaars et al., 2013). Grain storage mechanisms differ from that of seed storage (Plate 3).

Plate 1. Maize harvesting. One of the farmer practices- involves an initial set up of the cut maize stalks (with cobs) in several piles in the field to reduce losses. Good looking cobs are selected as seed (for propagation in the next season) and the rest are selected as grain (for home consumption) (Source: Self help Africa, 2019)

Plate 2. Selected seed cobs hanged on thatched roof of a kitchen for storage. Smoke preserves the cobs from pest attack (Source: https://www.alamy.com/)

Plate 3. Maize granary. Grain stored for consumption. Excess grain may be put in sacks and may be sold as 50 kg bags (Source: https://www.alamy.com)

Lately the farmer-to-farmer seed networks have been strengthened to support crop diversity, community resilience, and environmentally friendly agriculture methodologies. The utilization of community seed banks have provided a key role in strengthening the informal seed sector.

3. DEPLOYMENT OF COMMUNITY SEED BANKS

Community seed banks are centers for seed collection, conservation, and exchange that are controlled by the community and comprise locally adapted agricultural crop varieties of various kinds (Vernooy et al., 2015). These are set in order to protect traditional crop types, enhance agro-biodiversity, and secure seed security at the local level. These banks are usually run by smallholder farmers, community-based groups, or non-governmental organizations (NGOs) (Louwaars et al., 2013).

Community seed banks are vital for preserving and improving crop genetic diversity geographically (Peres, 2016). Thus landraces and wild variants of many crop species are also collected and kept in these seed banks. These seeds are valued for their resistance to diseases, pests, and external stresses (Kranner et al., 2010; Vernooy et al., 2015). Community seed banks avert genetic erosion and strengthen agricultural systems' adaptability to changing climatic situations, emerging pest and disease challenges, and other factors by preserving a wide genetic base (Sthapit, 2013; CABI 2014). The endurance and long-term viability of unregulated maize seed industry could be greatly enhanced by the setting up of community seed banks (CSBs) (Louwaars et al., 2013; CABI 2014). Community seed banks (CSBs) augment the ability to recover farmer seed systems by collecting, conserving, and propagating locally adapted seed types. This allows farmers withstand pressures from the environment and volatile markets primarily as a result of the consequences of climate change.

3.1 Enhancing Crop Genetic Diversity

Encouraging farmers to share and distribute seeds, community seed banks not only help safeguard the gene pool but also enrich the available germplasm (Plucknett & Smith, 2014; Louwaars et al., 2013). In order to experiment with different crops and various types suited to their particular agro-ecological environments, farmers can access a wide range of cultivars from the seed bank's collection, including regionally adapted landraces and improved varieties (Louwaars et al., 2013). Active seed swaps assist useful seed characteristics proliferate, hardy and high-yielding cultivars become increasingly adopted, and agricultural communities are encouraged to be creative and willing to change (Setimela et al. 2004).

In an effort to protect ancestral cultivars while promoting local adaptation in agricultural systems, community seed banks perform an essential part as archives of crop genetic variation. These banks aid the resilience, sustainability, and food security of farming communities by maintaining and encouraging genetic variety domestically.

The expansion of seed diversity and accessibility for smallholder farmers is a prominent outcome of community seed banks. As matter of example, community seed banks in Malawi backed the interchange and retention of an extensive range

of seed kinds, including ancient and geographically adapted crops (Tione et al., 2025). These neighborhood-based schemes provide farmers access to an array of genetic materials by functioning as a reservoir for native seeds, thereby limiting their demand on seeds acquired elsewhere.

3.2 Facilitates Farmers to Take Charge of Their Seed Resources

Community seed banks also help local communities take charge of their seed resources, and this in essence fosters and promotes farmer independence. Farmers regularly manage, decide on, and maintain seeds through collaborative methods that perpetuates historical practices and builds a sense of communal responsibility (Vásquez & Andersen, 2023). Farmers that engage in that manner have a better capacity to cope with external stresses as a result of volatile markets and climate change (Tione et al., 2025).

Community seed banks also prove critical to establishing social capital and information transfer among smallholder farmers. These schemes permit the dissemination of the most effective crop management methods, and ancestral wisdom pertinent to seed preservation and safeguarding through providing discussion boards for cooperation and development (Vásquez & Andersen, 2023). This interaction not only reinforces regional seed systems but also encourages societal unity and integration, amplifying farmers' ability to handle challenges jointly. (Tione, et al 2025).

3.3 Conservation of Agrobiodiversity

Smallholder farmers frequently depend on these banks to obtain traditional and locally adapted varieties of maize that are better suited to their unique agro-ecological conditions (Almekinders and Louwaars, 2002) Community seed banks secure genetic resources that might otherwise get lost.

It becomes more essential as never before to keep a broad pool of types of maize in consideration of climate change. Community seed banks tend to put the greatest emphasis on gathering and preserving heritage cultivars and landraces that have proven resistant to pests, diseases, and other kinds of adverse conditions (Padulosi et al., 2013). Seed banks aid boost, the adaptability of agricultural systems via offering accessibility to these genotypes.

3.4 Enhanced Seed Exchange Networks

Local seed banks enable farmers to exchange seeds and establish networks. These networks promote access to a wider range of maize cultivars for smallholder farmers, letting them to evaluate various alternative seed kinds and adjust their planting patterns in adaptation to shifting environmental conditions (Coomes et al., 2015).

Smallholder farmers rely on informal seed systems; however, they may be deficient in variability if they are controlled by just a couple of economically viable varieties. By distributing a wider range of seeds, including unique and specifically suited genotypes that might not be obtained through unofficial means, community seed banks complement these systems (David and Sperling, 1999).

Conservation gene bank creates an avenue for encouraging networks that facilitate the conveyance of genetic material and information, enabling farmers to swap seeds amongst one another (ESAFF et al., 2022). These collaborations stimulate exploration and responsiveness to regional conditions by offering smallholder farmers a chance to purchase an increased number of maize cultivars (Tione, et al., 2025).

Local organizations or farmer associations in certain cases oversee community seed banks, permitting farmers to take up the duty of supply and preservation initiatives (Sibanda et al., 2010; Tione et al., 2025). Guaranteeing an adequate supply of domestically appropriate seeds, assists farmers produce food and gain revenues in a sustainable manner (Bakum, 2024).

3.5 Empowerment and Ownership

A sense of empowerment and ownership is nurtured by community-based organizations and local farmers overseeing community seed banks (Kaihura and Stocking, 2003). Farmers improve their ability to administer agricultural resources sustainably by being involved in the processes of seed selection, conservation, and distribution.

Community seed banks may operate as reservoirs for regional maize cultivars that correspond to specific agro ecological environments in sub-Saharan Africa (Tione et al., 2025). These storage facilities remain vital to the maintenance of indigenous species and ancient cultivars since they sustain genetic variety, which

is important for adaptation to external stresses such as disease and drought (Minot, 2008).

3.6 Seed Collection and Storage

Seed collection in community seed banks involves the methodical gathering of seeds from an assortment of crop categories, including ordinary cultivars and landraces that have adjusted locally, with the intent to create an extensive seed bank (Lippitt et al. 1994). Farmers willingly donate seeds from their own cultivars to seed gathering initiatives, guaranteeing that appropriate types for the agro-ecological conditions in the region are taken into account (Vernooy et al., 2015). Farmer involvement in seed collection and documentation can be strengthened by deploying collaborative tactics including farmer field schools and community seed fairs (Louwaars et al., 2013).

The fundamental objective of seed storage in CSB operations is to safeguard seed quality and survivability for a longer duration (Joshi et al., 2012; Oliver et al., 2015). In order to control temperature, humidity, and pest infestations, seeds are usually kept in purposefully constructed facilities (Oliver et al., 2015). Novel storage technologies like seed bunkers or airtight bags may be utilized in conjunction with conventional storage methods such as clay pots or wooden containers to improve the longevity and protection of seeds (Louwaars et al. 2013).

3.7 Seed Management and Distribution

One of the primary roles of CSBs is to spread seeds across communities, granting farmers access to all kinds of seeds for planting (Louwaars et al., 2013). Distribution techniques are specific to the setting and differ yet they frequently incorporate interactive methods that provide fair access and community involvement prominence (Sperling & Almekinders, 2023). The CSB management committee may advocate direct exchanges, seed swaps, or seed financing opportunities for farmers to receive seeds. As a way to boost the use of seeds and agricultural innovation, seed distribution operations may be coupled with training sessions, field demonstrations, and farmer-to-farmer extension tasks (Oliver et al., 2015).

Within respective local communities, community seed banks exist as broad and dynamic platforms for the exchange, management, and conservation of seeds. CSBs enhance farming systems' resilience, sustainability, and food security through incorporating farmers at every level of the seed banking process.

4. INSTITUTIONAL SUPPORT FOR COMMUNITY SEED BANKS

The associated policies, laws and regulations in support of farmer-managed seed systems vary across countries (Table 1). Restricted access to seeds of superior quality still remains a major concern, in sub-Saharan Africa.

Table 1. Assessment of support for farmer-managed seed systems in selected sub Saharan Africa countries

Country	Acknowledgement of existence of diverse farming/ seed systems	Recognition of farmer-managed seed systems' roles	Support for farmer-managed seed systems	Recognition of and support for community seed banks
Benin	No	No	No	No
Burkina Faso	Yes	No	No	No
Burundi	Yes	No	No	No
Ghana	Yes	Yes	No	No
Kenya	No	No	No	No
Malawi	Yes	Yes	No	No
Mali	Yes	Yes	Yes	No
Namibia	Yes	Yes	No	No
Nigeria	Yes	Yes	Yes	No
South Africa	Yes	No	No	Yes
Tanzania	No	No	No	No
Uganda	Yes	Yes	Yes	Yes
Zambia	Yes	Yes	Yes	Yes
Zimbabwe	Yes	Yes	Yes	Yes

(Source: Vernooy et al., 2023)

Integrating government and NGO's effort in seed accessibility with community seed banks requires commendation and support. First and fore most government or community based organization can help set up these banks. Experts can help check the accessions to avoid duplications. Furthermore financial training assistance in crop diversification, sustainable farming methods, seed maintenance and multiplication should be prioritized (ESAFF, 2022; Katongo and Qutieshat, 2025). Technically sustaining seed bank operations calls for building robust partnerships with local authorities, non-governmental organizations and government entities including international organizations such as JICA and FAO (Vernooy et al., 2015).

5. CONCLUSION

The significant role Community Seed Bank (CSB) play in safeguarding biodiversity, and seed security should be appreciated. Maize being an integral part of seed stored in CBS entails a significant contribution to food security as it is the leading staple food in sub-Saharan Africa. Enhancing the capacity of CSB members through educational initiatives in quality assurance, managerial abilities, and production of seeds should be accorded the greatest attention in legislative actions. Community seed banks could enhance their organizational capacity and technical knowledge by means of corroborating with government entities, academic centers, and charitable organizations. With the exception of few countries such as Zambia, Zimbabwe and Uganda, there is still need for more countries in the region to recognize and support community seed banks to appreciable levels

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
https://pr.sdiarticle5.com/review-history/148418