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Original Article

Entrepreneurial Capacity of Local Seed Business Farmers Supplying Seed of Common Beans in Western Uganda

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Abstract

The Government of Uganda, in partnership with non-governmental organizations such as Integrated Seed Sector Development, has been supporting Local Seed Business (LSB) farmer groups to enhance profitability, scale up seed production, and strengthen marketing in order to address the problem of seed deficits. Despite these efforts, poor-quality seed continues to constrain common bean yields, and evidence of sustainable commercial seed production remains limited. This study assessed the entrepreneurial capacity of LSB farmers and the factors influencing the sustained supply of common bean seed in Western Uganda.

A cross-sectional mixed-methods design was employed. Data were collected from 386 common bean seed farmers (200 males and 186 females) across four districts using stratified, random, and purposive sampling techniques. Quantitative data were gathered through structured questionnaires, while qualitative insights were obtained from focus group discussions and in-depth interviews. T-tests and chi-square tests were used to assess differences in means and proportions across districts and gender. A binary logistic regression model identified factors influencing entrepreneurial capacity in bean seed marketing, with results triangulated using qualitative findings.

Results showed that 88% of male and 85.48% of female LSB farmers demonstrated high entrepreneurial capacity, while 12% of males and 14.52% of females exhibited low capacity. Female farmers accessed significantly more foundation seed through LSB groups than males ($T = -4.343$, $p < .001$). Farmer group meetings were the main capacity-building platform, with 84.6% participation. Farmers who joined the LSB project between 2020 and 2022 were less likely to perform well. Increased distance to district and sub-county centers significantly reduced the entrepreneurial capacity of LSBs.

In conclusion, this study indicates that both male and female LSB farmers have high entrepreneurial capacity, which is attributed to better access to public-private partnerships, extension services, and good quality inputs. To address the low seed deficit challenge, there is a need to strengthen seed quality assurance systems, decentralize equitable access to foundation seed, promote community-based seed procurement, and train newer LSB members in seed production and

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marketing, and establish robust market linkages and institutional incentives that integrate LSBs into the national seed system.

Categories: Innovation Economics, Marketing and Market Issues in Business, Entrepreneurship in developing nations

Keywords: local seed business, entrepreneurial capacity, common bean seed, seed deficit, western uganda

Introduction

Entrepreneurship has been widely conceptualized as a dynamic process through which individuals identify opportunities, mobilize resources, and generate value (Sharam et al., 2016). Scholars emphasize that this value creation often emerges from addressing unmet community needs, thereby linking entrepreneurial activity to broader social and economic development (Watson et al., 2023). Central to this discourse is the notion of entrepreneurial capacity, defined by Díaz-Casero et al. (Díaz-Casero et al., 2013) as the willingness and ability to establish new ventures. Entrepreneurial capacity is not a static attribute; rather, it is shaped by a range of factors, including personal traits such as risk tolerance and innovation, as well as community-level influences such as institutional support and market access. Recent studies highlight the growing importance of understanding entrepreneurial capacity, particularly in contexts where entrepreneurship is viewed as a pathway to poverty reduction and sustainable development. As Watson et al. (Watson et al., 2023) argue, this concept has become increasingly relevant for researchers, policymakers, and development practitioners seeking to strengthen local economies and build resilient livelihoods.

Sharam (Sharam, 2016) describes entrepreneurial capacity as the ability and willingness to identify, evaluate, and exploit opportunities by transforming new knowledge and innovations into goods and services of economic value. This perspective highlights both individual and collective abilities to assess economic potential and convert it into tangible outcomes for specific markets (Acs et al., 2009). Entrepreneurial capacity therefore goes beyond personal initiative; it also requires access to human, physical, and institutional resources, as well as the ability to operate effectively within social, political, and economic environments (Kritikos, 2024).

Existing literature shows that entrepreneurial capacity is shaped by personal, social, and educational factors. Personal traits and life skills strongly influence entrepreneurial ability, with family support acting as a moderator and entrepreneurship training serving as a mediator (Campo-Ternera, 2022). Social and cultural norms, along with investment in research and development, also play a significant role. However, formal education and training alone are often insufficient to build strong entrepreneurial capacity (Almodóvar-González et al., 2020).

Although entrepreneurship research increasingly acknowledges the importance of collaboration and collective action, limited attention has been devoted to understanding how group cohesion enhances synergy and strengthens entrepreneurial capacity among individuals working together. This gap is particularly significant in collective enterprises such as Local Seed Businesses (LSBs), where success depends not only on individual capabilities but also on effective group functioning and shared entrepreneurial effort (Sharam et al., 2016).

Problem statement

Globally seed is a critical reproducible resource for agricultural production (Njingulula, 2014). Quality seed accounts for about 60% of the yield potential; and the rest (about 40%) is attributed to agronomic practices like the use of fertilizer, pest, and disease control (Mastenbroek et al., 2021). Due to limited use of improved seed, current farm-level crop yields are far below potential. For example, yields of beans, a significant legume food crop, range between 300 and 500kg per acre per season, despite a potential of up to 900kg per acre per season (MAAIF, 2018).

According to Uganda's 2017 seed sector analysis report, the country's seed systems remain underdeveloped. The formal seed system contributes only 10-15% of the estimated national seed requirements, largely due to the limited capacity of seed companies to supply adequate quantities and weaknesses within the regulatory framework (Mastenbroek et al., 2017) (Semba, 2021).

In addition, 30-40% of traded seed is counterfeit, forcing many farmers to rely on home-saved seed (MAAIF, 2018) (Mastenbroek et al., 2017). Although seed companies often cite poor markets among smallholder farmers, few have developed strategies to stimulate demand for quality-declared seed (MAAIF, 2018) (Mastenbroek et al., 2021). Government and NGO initiatives have supported LSBs, yet substandard seed continues to reduce bean yields and farmer profitability (Akpo, 2020). Evidence of sustainable commercial seed production remains limited, as the growth of LSBs has not matched demand (ISSD, 2022).

Consequently, about 85% of farmers still face seed deficits during planting seasons, even in areas with active LSBs. These deficits reflect challenges in seed availability, accessibility, and affordability (Coles and Mitchell, 2010). The entrepreneurial capacity of LSB farmers and the factors influencing their ability to supply quality seed in sufficient quantities remain less understood. This study therefore examines entrepreneurial capacity of LSB farmers marketing common bean seed in Rwenzori and Kigezi sub-regions of Western Uganda to identify drivers of sustainable seed supply that can unlock bean yield potential and contribute to improved incomes, food security, and nutrition in line with Sustainable Development Goals 1, 2, and 3.

Objective of the study

The objective of this study was to assess the entrepreneurial capacity of LSB farmers and to specifically measure quantity of bean seed sold as a fraction of quantity harvested and factors that shape sustained supply of common bean seed.

The dependent variable in this study was the entrepreneurial performance of LSB farmers. This was measured quantitatively as the proportion of common bean seed, in kilograms, sold by a farmer relative to the total quantity harvested. Entrepreneurial performance was classified as low when a farmer sold less than or equal to half of the harvested seed, and this category was coded as zero (0).

In this study, entrepreneurial performance is defined by the quantity of quality-declared bean seed sold in relation to the quantity harvested and the existing seed demand. This indicator reflects the farmer's ability to identify and exploit market opportunities by transforming foundation breeder seed into quality-declared seed as a business venture with economic value (Schechner, 2003), (Acs et al., 2009), and (Akpo, 2020).

To achieve the study objective, the following research questions were addressed:

(a) What is the level of entrepreneurial capacity of local seed business farmers?

(b) How do LSB farmers build their capacity in marketing common bean seed?

(c) What are the determinants of entrepreneurial capacity of common bean seed farmers?

Research Method

The study was conducted in the Kigezi and Rwenzori sub-regions of Western Uganda. Two districts were selected from each sub-region: Kabale and Kisoro in Kigezi, and Kabarole and Kamwenge in Rwenzori. These districts were chosen because they have active LSB members, significant bean production volumes, diverse bean varieties, and cultural diversity.

Within each district, LSB farmers were drawn from both rural sub-counties and urban town councils where farmer groups had been established through the efforts of NARO, MAAIF, ISSD, and local governments. A mixed-methods cross-sectional design was adopted. Qualitative data were collected through focus group discussions (FGDs) and key informant interviews (KIIs), while quantitative data were obtained through a survey of all accessible LSB members. This design was chosen because it is efficient, cost-effective, and suitable for identifying potential relationships between variables.

Sampling was conducted in two phases. In phase one, purposive sampling was used to select 8-12 LSB members for each FGD. A total of 13 FGDs were conducted across the four districts: Kabale (3), Kisoro (3), Kabarole (3), and Kamwenge (4). In addition, 15 KIIs were conducted with production staff, community development officers, NARO agronomists, LSB leaders, and a loans officer to capture insights into social, cultural, policy, and institutional factors influencing seed

marketing. In phase two, all LSB members from 14 groups were surveyed. Given the small population size (25-30 members per group), a census approach was used to avoid sampling error and ensure comprehensive data (Greenwood and Robinson, 2006), (Groves et al., 2009), and (Creswell, 2014)

Quantitative data were collected from 386 bean seed farmers (200 males and 186 females), representing a 92% response rate. Semi-structured questionnaires, FGDs, and in-depth interviews were used. Data analysis employed descriptive statistics (means, percentages, frequencies), chi-square tests, t-tests, and ordered probit regression to assess entrepreneurial capacity. Entrepreneurial capacity was measured as the proportion of bean seed sold relative to total harvest. Farmers selling less than or equal to half of their harvest were coded as low capacity (0), while those selling more than half were coded as high capacity (1). Binary logistic regression was used to identify factors influencing entrepreneurial capacity, as the dependent variable was binary. Quantitative findings were triangulated with qualitative data.

The dependent variable in this study was the entrepreneurial capacity of LSB farmers. Entrepreneurial capacity was measured quantitatively as the proportion of common bean seed sold, in kilograms, relative to the total quantity harvested. Farmers who sold less than or equal to half of their harvested seed were classified as having low entrepreneurial capacity and coded as zero (0). Farmers who sold more than half of their harvested seed were classified as having high entrepreneurial capacity and coded as one (1). This measure reflects the farmer's ability to identify and exploit market opportunities by transforming foundation breeder seed into quality-declared seed as a business venture with economic value (Schechner, 2003), (Acs et al., 2009), and (Akpo, 2020).

To analyze differences across districts, t-test statistics were used to compare means, while chi-square tests were applied to assess differences in proportions. A binary logistic regression model was employed to determine factors influencing entrepreneurial capacity. Binary regression was chosen because the dependent variable was categorical with two possible outcomes: high capacity (1) and low capacity (0). Ordinary linear regression was not appropriate since the outcome was binary rather than continuous. Binary regression is specifically designed to estimate the probability of an event occurring when the dependent variable takes only two values. Quantitative findings were triangulated with qualitative data obtained from FGDs to strengthen validity and provide deeper insights.

Entrepreneurial capacity in selling of bean seed index (EC) was constructed for consideration as a categorical dependent variable that is; High and Low.

Entrepreneurial capacity level was measured as a discrete choice variable based on quantity of common beans sold as seed out of total bean harvested which was expressed as follows:

$$Y = C/1 - C = \beta 0 + \beta 1 Age + \beta 2 Mari + \beta 3 Edu + \beta 4 Head + 5\beta Vols + \beta 6 Land + \beta 7 Off + +$$

$$\beta 8 Mkt + \beta Lo + \beta 10 Ext + \beta 11(Bean) + \beta 12 lead + \beta 13 Head + \beta 14 Deci + \beta Use + \mu i$$

Dependent Variable (Y) = Entrepreneurial capacity by selling bean seed, C = high 1-C = low capacity; the chance of one having high or low capacity = half. βo = Value of the regression coefficient. β1- βn = vectors of coefficients associated with vectors of variables (X) that explain the change in probability of entrepreneurial capacity dependent on quantity of common bean sold as quality declared seed. X1 to X14 = Independent variables were as follows: age, marital status, gender, educational level, household head, volume sold, land size, off-farm employment, access to market stalls, location, access to extension, LSB membership, involvement in leadership of LSB, use of technology, and involvement in decision-making.

These variables were selected because they reflect both the economic and organizational capacity of individual farmers within LSBs. Age was included as it influences experience, risk-taking, and openness to innovation. Marital status was considered since family responsibilities and support systems can affect entrepreneurial decisions. Gender was included because roles and access to resources often differ between men and women, shaping their participation in markets. Educational level was important as it enhances knowledge of seed standards, record-keeping, and marketing. Household headship was considered because household leaders usually control resources and decision-making authority.

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The volume of seed sold directly reflects market participation and entrepreneurial success, while land size determines production potential and the ability to expand seed enterprises. Off-farm employment was included because it provides additional income and reduces risk, although it may limit the time available for farming. Access to market stalls was considered essential since physical selling points increase opportunities to reach customers. Location was included because proximity to markets and infrastructure influences both opportunities and constraints.

Access to extension services was selected because extension agents provide training and technical advice that strengthen entrepreneurial capacity. Membership in LSBs was considered important since collective action enhances bargaining power, resource sharing, and credibility. Leadership roles within LSBs were included because they increase influence, networking, and decision-making power. Use of technology was selected as it improves efficiency and competitiveness in seed production and marketing. Finally, involvement in decision-making was included because it reflects empowerment and the ability to act entrepreneurially within households or groups. Together, these variables capture personal characteristics, household and social dynamics, economic resources, institutional support, and innovation factors, providing a comprehensive picture of the drivers and constraints of entrepreneurial capacity in bean seed enterprises (Almodóvar-González et al., 2020).

Theoretical framework of the study

This study on the entrepreneurial performance of LSB members is informed by three frameworks: the theory of performance (Schechner, 2003), the knowledge spillover theory of entrepreneurship (Acs et al., 2009), and the sustainable development framework (Baser and Morgan, 2008).

The theory of performance suggests that farmers participate in groups to gain both social and economic benefits through collective action. Performance is assessed in terms of cohesion, social outcomes, and economic benefits that contribute to improved livelihoods (Schechner, 2003).

The knowledge spillover theory of entrepreneurship emphasizes that new knowledge or innovations developed by researchers serve as sources of entrepreneurial opportunities. Entrepreneurs commercialize this knowledge by transforming it into products of economic value. The successful translation of knowledge into profitable enterprises depends on the absorptive capacity of entrepreneurs-their ability to understand new knowledge, recognize its economic value, and convert it into goods and services that meet diverse customer needs (Acs et al., 2009).

The sustainable development framework by Baser and Morgan (Baser and Morgan, 2008) highlights five interactive capabilities that underpin organizational and social systems: (1) the capability to relate and partner in scaling innovation, (2) the capability to commit resources and act, (3) the capability to adapt and navigate challenges, (4) the capability to balance diversity and coherence among partners, and (5) the capability to make innovation work for development outcomes. These capabilities are interconnected and provide a basis for assessing performance. According to Keijzer et al. (Keijzer et al., 2011), achieving coherence within groups is essential for unlocking other capabilities and building collective capacity.

This framework will be applied to assess LSB innovations, the interactions among actors, and the relationships that sustain knowledge acquisition and interactive learning. It will also examine the relative importance of actors in innovation processes and the practices that determine the propensity to innovate. Sustainable engagement in LSBs requires coordinated partnerships among diverse actors in both public and private sectors, offering a wide range of services for the benefit of LSB groups and their target communities.

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Results And Discussion

Marketing variables	T-test	P-value	Cohen's d	Male, n = 200		Female, n = 186	
				Mean	SD	Mean	SD
Foundation seed sourced through LSB	-4.343	.000	-0.0247	70.91	108.155	75.88	91.620
Foundation seed privately sourced	-0.067	0.947	-0.004	23.32	59.760	23.81	37.880
Total bean seed harvested dry	1.615	0.108	0.120	450.26	488.125	351.04	307.545
Bean seed saved	-4.343	.000	-0.323	32.12	26.899	60.91	53.109
Bean seed can supply in a season	0.502	0.616	0.0288	479.37	692.385	435.76	815.994
Bean sold as QDS	0.358	0.721	0.031	171.65	278.097	159.31	28.837
Bean seed price	-2.754	0.007	-0.207	2924.19	1968.221	3730.51	1830.278
Bean seed sold as grain	1.573	0.118	0.135	182.9	230.209	122.5	212.788
Bean seed sold collective	-1.806	0.073	-0.135	96.06	129.378	136.49	163.23
Quantity sold individually	2.563	0.011	0.188	154.42	272.809	70.49	145.607
Price per kg of grain	1.377	0.17	0.105	2782.28	1698.846	2437.82	1542.308

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TABLE 1: T-test for amount of bean seed marketed by male and female LSB farmers (N = 386)

QDS, quality-declared seed; LSB, local seed business

Table *1* presents the results of an independent t-test comparing male and female LSB farmers across eleven aspects of seed marketing. These aspects include: the quantity of foundation bean seed sourced, yield volumes, bean seed saved, seed available for the next season, bean seed sold as quality-declared seed (QDS), bean seed price, bean seed sold as grain, seed sold collectively, seed sold individually, and price per kilogram of grain.

Female bean seed farmers obtained significantly more foundation seed through Local Seed Business groups compared to male farmers. (T = -4.343, p < .001, Cohen's d = -0.247, Male mean = 70.91, SD = 108.16; Female mean = 75.88). The negative t-value and small-to-moderate effect size indicate a meaningful difference in sourcing based on gender, favoring women.

Female bean seed farmers also saved significantly more bean seed than male farmers. The average bean seed saved was significant: Male mean = 32.12; Female mean = 60.91; t = -4.343, p = 0.000, d = -0.323. This shows that female farmers save more bean seed for future use. It highlights women's skills in post-harvest management and seed conservation practices compared with men. The moderate effect size points to real importance in that LSB female farmers save more bean seed for future use than their male counterparts.

Bean seed prices showed a statistically significant difference (Male mean = 2924.19, Female mean = 3730.51, t = -2.754, p = 0.007, d = -0.207) with a small effect size. This indicates a modest difference where female LSB farmers sell their beans at an average of 3,730 Uganda shillings per kilogram. In contrast, male LSB farmers sell at an average of 2,924 Uganda shillings per kilogram.

The sale of quality beans individually was also statistically significant (Male mean = 154.42, Female mean = 70.49, t = 2.563, p = 0.011, d = 0.188). This means more male LSB farmers sell their beans individually than female LSB farmers, who tend to sell their beans more collectively through LSB.

From FGDs, it was reported that, the cost of foundation seed is UGX 8,500 per kilogram, with recommended planting rates of 50-60 kg per hectare for small seeds and 80-90 kg per hectare for larger seeds. This yields 600-800 kg per hectare for NARO bean 1. If farmers harvest and sell 600 kg as QDS at a price of UGX 5,000, they can expect to earn UGX 3,000,000. However, LSB farmers sold QDS both as seed and grain due to a lack of a stable seed market. Female farmers earned UGX 1,507,144 while male farmers earned UGX 1,443,086 per season which significantly lower than the expected gross income of UGX 3,000,000. According to FGDs, factors for this included selling beans as fresh pods at harvest time to solve agent problems, selling dry quality declared seed as grain due to the lack of a market, the price of bean seed being below expectations, and access to less than a hectare of land for seed multiplication in Kabale and Kisoro Districts.

From FGDs farmers observed that the prices for foundation seed is very high ranging from UGX 8,500-9,000, yet farmers sell their QDS at much lower price ranging from UGX 3,000-4,500 and sometimes farmers sell their bean seed as grain at low price (UGX 2437) and LSB farmer said:

"We buy foundation Breeder seed of NARO BEAN1, NAROBEAN2, NAROBEAN3, NABE4, NABE16 and NABE17 at the cosh of UGX 8,500-9,000 per kilogram but struggle to sell our QDS at Shs3500" - respondent in the FGD at Kaburisoke in Kamwenge District.

Some FGD members observed that some farmers who were no longer sourcing foundation bean seed for multiplication into QDS were demoralized by lack of market for their QDS bean seed. Some of these farmers resorted to old ways of planting saved seed, others diversified to growing other crops like potatoes whose market was readily available. Other farmers blamed the outbreak of COVID-19 pandemic which disrupted the seed business. In FGDs it was observed that:

"During COVID-19 pandemic the prices for beans went down since the demand for QDS was at its lowest. We lost all the money that we had invested in acquiring the foundation seed, but also because there was restricted movement, the traders would not easily access us".

This, coupled with the end of the ISSD project - which trained farmers in seed production, linked them to markets, involved MAAIF for quality assurance inspections, and NARO for sourcing foundation seed - also demoralized new LSB members, especially in Kabarole District, which had enrolled new LSB groups toward 2022, the year in which the project ended.

However, in FGDs at Kaburisoke in Kamwenge district and Mariba in Kisoro District, it was observed that farmers who no longer produce and market QDS are still in the group working jointly with other members because of group saving and credit lending component of the group, financial support during social functions, and value addition in other agricultural enterprises. For example, in Masaka Ward, Bataka Cooperative in Kamwenge District, the LSB group currently processes maize into maize flour and livestock feed with support from the Agriculture Cluster Development Project (ACD Project) to generate additional income as a means to sustain their entrepreneurial capacity.

The findings of this study reveal that farmers used different avenues to learn about seed production and Marketing. The most used avenue was the farmer groups and this was significantly different ($\chi^2 = 13.8972$; $p = 0.003$) across the districts (Table *2*).

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Source of capacity	Kabale (n = 110)	Kamwenge (n = 144)	Kabarole (n = 64)	Kisoro (n = 68)	Total (N = 386)	Chi-value	P-value
Farmer group meeting	76.92	92.93	95.45	75.93	84.6	13.8972	0.003
Public extension training	15.38	14.14	13.64	18.52	15.4	0.5755	0.902
Private extension training	16.67	13.13	18.18	33.33	19	9.7203	0.021
Agricultural show	8.97	24.24	4.55	24.07	17.8	11.0615	0.011
University-engagement	0	0	4.55	0	0.4	10.5417	0.014
NARO outreach	42.31	13.13	4.55	3.7	19.4	40.3291	0
Phone call	8.97	12.12	13.64	31.48	15.4	14.0491	0.003
Radio	10.26	46.46	9.09	31.48	28.9	32.4657	0
Television	1.28	2.02	0	0	1.19	1.5065	0.681
Print media	1.28	1.01	0	0	0.79	0.9067	0.824
Internet	1.28	1.01	0	0	0.79	0.9067	0.824

TABLE 2: Source of knowledge and skills about bean seed production and marketing (n = 386)

Table *2* results shows that farmer group meetings were the most prominent source of capacity building with an overall participation rate of 84.6% - 75.93% in Kisoro, 76.92% in Kabale, 95.45% in Kabarole, and 92.93% in Kamwenge. The chi-square test shows a significant difference across Districts (χ^2 = 13.8972; p = 0.003), suggesting that farmer group meetings are not uniformly utilized maximally across the four Districts.

Public agricultural extension training showed minimal variation across districts, with participation rates between 13.64% and 18.52%, and no statistically significant difference (χ^2 = 0.5755; p = 0.902), indicating a relatively uniform but low engagement. In contrast, private extension training exhibited significant variation (χ^2 = 9.7203; p = 0.021), with Kisoro reporting the highest engagement (33.33%) and Kamwenge the lowest (13.13%).

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Agricultural shows were another notable source, with significant district-level differences (χ^2 = 11.0615; p = 0.011). Kamwenge (24.24%) and Kisoro (24.07%) had higher participation rates while Kabarole reported only 4.55%. University engagement was minimal overall (0.4%) but statistically significant (χ^2 = 10.5417; p = 0.014), driven by a small contribution from Kabarole District (4.55%).

NARO outreach revealed the most distinct disparity (χ^2 = 40.3291; p < 0.001), with Kabale showing the highest engagement with LSBs (42.31%) and Kisoro the lowest (3.7%), suggesting high uneven distribution of institutional outreach efforts. Also, phone calls and radio as sources of information showed significant differences across districts (χ^2 = 14.0491; p = 0.003 and χ^2 = 32.4657; p < 0.001, respectively), with Kisoro reporting the highest reliance on phone calls (31.48%) and Kamwenge on radio (46.46%).

Television, print media, and internet were marginal sources of knowledge, with no significant differences across districts (p-values of 0.681, 0.824, and 0.824, respectively). These findings suggest that traditional and interpersonal communication channels - especially farmer group meetings, radio, and institutional outreach - play a more substantial role in disseminating agricultural knowledge than digital or mass media platforms.

Overall, results highlight the importance of tailoring agricultural extension strategies to district-specific situations and optimally utilize LSB group meetings as the most effective and accessible channels to enhance knowledge dissemination and skill development among bean seed producers.

Results shows clear differences in the sources of knowledge and skills related to common bean seed production and marketing across Districts in Western Uganda. Farmer group meetings were the most common source, used by 84.6% of respondents, with a statistically significant variation (χ^2 = 13.8972; p = 0.003). This supports Uganda's client-oriented extension model, which focuses on participatory learning through farmer groups as a key strategy for improving agriculture (MAAIF, 2023). This gender difference in effective participation reflects findings from studies on gendered access to agricultural resources (Meinzen-Dick et al., 2011) (Doss et al., 2015). Women often deal with limitations related to time, mobility, and social norms. These factors restrict their involvement. Gender-inclusive programs, such as flexible scheduling and initiatives led by women, have shown potential in improving women's participation (Liangzhi, 2020).

Public extension services are a key part of Uganda's agricultural policy, but they had low and uniform engagement at 15.4% (p = 0.902). This is due to under staffing, funding, and logistical support within the Directorate of Agricultural Extension Services (ISSD, 2022). In contrast, private extension services showed significant differences between districts (p = 0.021). This suggests that NGOs, agribusinesses, and cooperatives are increasingly stepping in to fill gaps left by public systems, especially in underserved areas (MAAIF, 2023).

Agricultural shows and university engagement, although less common, were significant sources of knowledge (p = 0.011 and p = 0.014, respectively). These events provide specialized learning opportunities but are often limited by geographic and institutional barriers. The uneven distribution of NARO outreach (χ^2 = 40.3291; p < 0.001), with Kabale receiving the most support, shows the need for fairer implementation of research-extension connections. This aligns with past NAADS evaluations reports of the NAADS program (MAAIF, 2023).

The significant use of radio and phone calls (p < 0.01) points to the increasing importance of ICT-based extension methods. These methods are recognized for their ability to effectively reach remote farmers at a lower cost (UBOS, 2021) (Aseete et al., 2023). However, traditional media channels like television, print, and the internet had minimal effect and showed no significant variation, likely due to infrastructure and literacy challenges in rural areas (MAAIF, 2023).

Table *3* results reveal that Kisoro ranked highest in seed production trainings at 27.9%, followed by Kamwenge at 13.2%, while Kabale and Kabarole lag behind. Kamwenge leads in seed preservation practices at 30.6%, followed by Kabarole at 26.6%, and Kabale is the lowest at 7.3%. Storage facilities and ownership of seed banks were highest in Kisoro at 26.5%, followed by Kamwenge District at 16.7%, showing stronger infrastructure, while Kabale and Kabarole are below 10%. Kabale dominates in ownership of packing equipment at 25.5%, whereas Kisoro is at 1.5%. According to KII informants,

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limited trainings in seed production disadvantaged new Local Seed Business members, who rely on experienced farmers through peer learning, with no access to supportive equipment or seed banks, which older farmers benefited from through ISSD, Biodiversity International, and NAADS programs.

Kamwenge District leads in operating at a profit level with 13.2%, followed by Kisoro at 19.1%. Kabarole leads in sourcing foundation seed at 18.8%, followed by Kabale at 11.8%, for being the host centers of NARO's Zonal Agriculture Research and Development Institutes (Rwebitaba ZARDI in Kabarole for the Rwenzori region & Kachwekano ZARDI in Kabale for the Kigezi sub-region), thus reducing travel distance and cost. Kisoro District revealed low capacity to source foundation bean seed at 2.9%, unless provided on a contractual basis for multiplication, which has always been the case in partnership with NARO and Biodiversity International.

Market linkage in Kamwenge was at 9.7%, followed by Kabarole at 9.4%, which shows moderate linkage. Kabale at 8.2% indicated the most running contracts to supply bean seed, while Kisoro has none. Regarding regulatory inspection to ensure quality assurance by agricultural officers, only Kabale reported inspection at 7.3%, and Kamwenge (1.4%) had any inspection activity. MAAIF inspection scored Kabale at 6.4%, while other districts were negligible or lacking seed inspection. FGDs attributed underperformance in accessing support from government and NGOs to the end of the ISSD project, which trained farmers, and NAADS projects, which offered contracts to LSBs to supply bean and potato seed under community-based procurement.

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Knowledge skills and facilities	Kabale	%	Kamwenge	%	Kabarole	%	Kisoro	%	Over all	%
Trained in seed production	4	3.6	19	13.2	4	6.2	19	27.9	46	11.9
Trained in seed preservation	8	7.3	44	30.6	17	26.6	14	20.6	83	21.5
Has enough storage facility	11	10.	24	16.7	6	9.4	18	26.5	59	15.3
Operating at a profit	6	5.5	19	13.2	6	9.4	13	19.1	44	11.4
Actively sourcing seed	13	11.8	6	4.2	12	18.8	2	2.9	33	8.5
Has enough market linkage	8	7.3	14	9.7	6	9.4	0	0	28	7.3
Has packing equipment	28	25.5	6	4.2	4	6.2	0	1.5	39	10.1
A.O. inspection	8	7.3	2	1.4	0	0	0	0	10	2.6
MAAIF inspection	7	6.4	2	1.4	2	3.1	0	0	11	2.8
Got financial	3	2.7	0	0	2	3.1	1	1.5	6	1.6

credit from bank										
Received government. grant	0	0	0	0	2	3.1	0	0	2	0.5
Got NGO support	0	0	1	0.7	0	0	0	0	1	0.3
New bean varieties multiplication	1	0.9	2	1.4	1	1.6	0	0	4	1
Has bulked seed in store	1	0	1	0.7	0	0	0	0	2	0.5
Paying acquired loan in time	3	2.7	1	0.7	0	0	0	0	4	1.0
Total	110	100	144	100	64	100	68	100	386	100

TABLE 3: Entrepreneurial skills and facilities possessed by LSB farmers (n = 386)

LSB, local seed business

Financial credit support from commercial banks was scored relatively higher in Kabale at 2.7% and Kabarole at 3.1%, while Kamwenge had none. Government grants and NGO support were extremely low across all districts, with only Kabarole ever receiving a grant (3.1%) and Kamwenge having the least NGO support at 0.7%. Multiplication of new bean seed varieties was slightly active in Kamwenge at 1.4% and Kabarole at 1.6%, while Kisoro was inactive. Kabale led in loan repayment at 2.7%, and Kamwenge at 0.7%.

Most LSB groups lacked collateral to access credit from commercial banks. In cases where LSBs succeeded in acquiring loans, they used the collateral of their leaders. In Kisoro District, the members of Mariba Bahinzi Boronzi got a loan of UGX 40,000,000 (forty million) because the executive member staked personal property as collateral for the group. Fortunately, members worked hard as a group and managed to pay back the loan because of the wise leadership of this group's executive and used the loan to buy a plot of land in Kisoro town, which they later used as collateral to acquire another loan of UGX 3,000,000 (three million) from Centenary Bank to invest in the seed business.

In Kamwenge District, when members of Kaburisoke LSB farmers failed to pay a loan, the burden to pay back was left on the leader who staked private land. This has affected the group's morale and cohesion. LSBs that fail to secure loans from commercial banks resort to using the meagre savings of members to buy foundation seed, which also affects production volumes. "We have used only loans from group savings," stated an FGD with Byabasamu Twimukye LSB in Kamwenge District.

Uneven development in training, infrastructure, market access, and financial support among common bean seed farmers in Kabale, Kisoro, Kamwenge, and Kabarole Districts shows the broader challenges facing Uganda's seed sector. This sector still struggles with low certification rates and counterfeit seeds (ISSD Uganda, 2022).

Training in seed preservation was the most common skill, with 21.5% of respondents trained in Kamwenge, 30.6% in Kabarole. However, overall seed production training was lower at 11.9%, despite its important role in ensuring seed quality. Kisoro had the highest percentage of trained LSB farmers at 27.9%. At the end of the ISSD project, LSB groups in Kisoro sought ongoing support from the Common Ground initiative, which promotes farmer-to-farmer knowledge sharing, integrated farm planning, and therefore has not felt an NGO support vacuum.

In the Rwenzori region, when the ISSD project ended, all LSBs formed a regional LSB platform. District production officers joined to advocate for LSB inclusion in district agriculture extension work plans and projects. This advocacy informs the relative performance of Kabarole and Kamwenge, though Kamwenge LSBs currently receiving support from the ACDP project are more inclined toward maize processing than seed marketing (MAAIF, 2023) (WUR, 2022).

Regarding infrastructure, only 15.3% of LSB farmers had adequate storage facilities, with Kisoro leading at 26.5%. Kabale showed strength in packing equipment at 25.5%, indicating localized investment in post-harvest technologies supported by ISSD and Biodiversity International, which co-founded the construction of seed banks. Many farmers also bought airtight storage bags. However, most still used calabash containers with lids smeared with cow dung to deter pests, along with locally woven buckets made from papyrus and banana fiber, which are vulnerable to pests like bean weevils. These disparities highlight the need for more localized infrastructure development and technical services at the parish level, which is closer to farmers than sub-counties. This need is emphasized by IFDC and ISSD Uganda in their joint efforts to strengthen the seed sector (IFDC, 2023).

Market access remains a significant challenge. Only 11.4% of LSB farmers reported making a profit, and just 7.3% had sufficient market connections, with Kisoro reporting none. This gap between production and commercialization reveals broader issues in Uganda's seed value chain. MAAIF (MAAIF, 2023) notes that providing quality seed sustainably requires strong market integration and institutional support, including field inspection, educational guidance, professional organization, market focus, technical tools, road infrastructure, and storage facilities, all of which are currently lacking or inadequate in these districts.

The role of MAAIF and District extension agents in providing regulatory and technical support was low. Agricultural officers reported low inspection rates at 2.6%, and MAAIF was even lower at 2.8%. Inspections were rare, yet local seed producers sought inspection certificates. This indicates weak regulatory enforcement that could compromise seed quality supplied to other farmers. This aligns with findings from ISSD Uganda, which state that the absence of a functional seed tracking system contributes to the circulation of counterfeit seeds (ISSD Uganda, 2022) (Aseete et al., 2023).

Innovation was minimal, with only 1% involved in multiplying new bean varieties and 0.5% reporting bulked seed in storage. This suggests limited interaction with research institutions or seed companies. Access to finance from commercial banks and community-based savings and credit cooperatives (SACCOs) was the weakest area. Only 1.6% of respondents had received bank credit, 0.5% had accessed government grants, and 0.3% had received support from NGOs. This financial exclusion is a significant barrier to growing seed enterprises. As noted by Sperling et al. (McGuire and Sperling, 2013), finance is vital for seed entrepreneurs to invest in quality inputs like fertilizers, pesticides, breeder seeds, clean bean herbicide, seed storage bags, seed banks, packaging, and branding.

Overall, the data highlight the need for integrated, district-specific actions that combine training, infrastructure, market development, and regulatory reform through extension agents. There is a clear need for collaboration among stakeholders to address infrastructural gaps, such as road construction, that affect agricultural marketing, even though these plans are often budgeted outside the agriculture sector (WUR, 2022).

Performance level	Male	Female	Total	Chi-value	P-value
LOW (F)	24	27	51	0.5321	0.466
%	12	14.52	13.21		
HIGH (F)	176	159	335		
%	88	85.48	86.79		
Total	200	186	386		
%	100	100	100		

TABLE 4: Entrepreneurial performance of women and men in bean seed marketing (n = 386)

Table *4* results show that 12% male LSB bean farmers were categorized under low entrepreneurial performance, while 88% were categorized as of high entrepreneurial performance level. 14.52% female LSB farmers exhibited low performance and 85.48% demonstrated high performance in bean seed marketing.

Overall, 13.21% common bean seed farmers recorded low performance levels, while the majority, farmers 86.79% fell within the high-performance category. These figures suggest that high performance is predominant among both male and female local seed business farmers in western Uganda with no significant gender difference with a chi-square value of 0.5321 with an associated p-value of 0.466 which exceeds the conventional alpha level of 0.05.

There was no significant difference in entrepreneurial performance between women and men. The lack of significance suggests that gender is not a determining factor in marketing entrepreneurial performance of LSB farmers in Western Uganda. This aligns with findings of Musimenta et al. (Musimenta et al., 2020) who found no evidence that gender predicted performance differences in mathematics among students in South Western Uganda. That study concluded that performance disparity could not be attributed to gender alone.

Though this study does not show significant gender-based entrepreneurial performance difference among LSB members, literature reveals that in agricultural marketing and production, women are more involved in tasks but less involved in decision-making with less access to resources (Tumuramye et al., 2025). If such limitations exist in non-agricultural marketing contexts, they might not yet manifest strongly in performance measure or they are being mitigated in some settings.

Though performance may be similar between male and female common bean seed farmers, gendered differences often underlie access to inputs, entrepreneurial orientation, market access, and family roles. For instance, a recent study in Fort Portal city markets found that gender and family roles negatively affect monthly income and business growth (Tumuramye et al., 2025). These findings suggest that while performance metrics may appear similar, the underlying burdens and constraints could differ, affecting sustainability and well-being over time. For example, Orobia (Orobia, 2013)

studied working capital management among small business owners in Kampala and established that gender differences were not in overall performance but in how gender moderates the influence of individual attributes on management practices. This suggests that even when performance is similar, behaviors, perceptions, and processes may still diverge by gender, with implications for long-term efficiency and growth.

Capacity level	Kabale	Kamwenge	Kabarole	Kisoro	Total	Chi-value	P value
Low	15	4	11	21	51	33.0882	.000
%	13.64	2.78	17.19	30.88	13.21		
High	95	140	53	47	335		
%	86.36	97.22	82.81	69.12	86.79		
Total	110	144	64	68	386		
%	100	100	100	100	100		

TABLE 5: Entrepreneurial capacity level of districts in marketing bean seed (n = 386)

Table *5* presents the entrepreneurial performance of districts marketing bean seed in Western Uganda. Out of a total of 386 bean seed farmers, 86.79% were classified as high performers, while 13.2 % were low performers. Notable variation was observed across Districts. Kamwenge exhibited the highest proportion of high-performing entrepreneurs at 97.22%, followed by Kabale at 86.36%, Kabarole at 82.81%, and Kisoro at 69.12%. Kisoro had the highest proportion of low performers at 30.88%.

A chi-square test of independence yielded a value of $\chi^2 = 33.0882$ ($p < .001$), indicating a statistically significant association between district location and entrepreneurial performance. These results suggest that the level of entrepreneurial success in bean seed marketing is not uniformly distributed across districts and is significantly influenced by district-specific factors.

The statistically significant differences in entrepreneurial performance across Districts align with recent findings that emphasize the role of structural, institutional, and infrastructural factors in agricultural entrepreneurship (Aseete et al., 2023) (Bagamba et al., 2023).

Kamwenge's exceptionally high performance may reflect greater access to bundled agricultural services, such as improved seeds, extension, market linkages, and business training factors shown to enhance entrepreneurial outcomes in seed systems (Aseete et al., 2023). Public private partnerships (PPPs) operating in this District may also be playing a role by facilitating access to high-quality inputs and output markets, consistent with previous findings that bundled interventions significantly increase market participation and farmer income.

Equally, Kisoro's relatively high rate of low-performing entrepreneurs may reflect geographic, institutional, or infrastructural challenges. The district's terrain and relatively limited road networks could restrict market access and reduce exposure to innovations such as Quality Declared Seed (QDS) systems or demonstration plots, which are known to drive improved seed adoption and entrepreneurial learning (Aseete et al., 2023).

The adoption of seed policy reforms, such as decentralized QDS production and mobile-based seed verification systems, has not been uniform across Uganda (Bagamba et al., 2023). Districts lagging in policy implementation and extension services may underperform despite national-level improvements. Furthermore, as noted by Sendawula et al. (Sendawula et al., 2023), entrepreneurial success also depends heavily on networking, innovation capacity, and institutional support all of which vary by district and could explain the performance disparities observed.

Additionally, farmer-based seed enterprises and local seed businesses, when properly trained and supported, have been linked to improved entrepreneurial outcomes (WUR and ISSD Uganda, 2023). Districts with weak or underdeveloped seed producer associations may therefore lag in performance.

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Local seed business group	Frequency	Performance			
		Low %	High %	Chi-value	P-value
Mariba bahinzi barozi	21	5	95.2	86	0.00
Bugara Women bean producers	19	15.8	84.2		
Busanza bean farmers	28	28.6	71.4		
Kamwange Tukolerehamwe co.	12	8.3	91.7		
Kanyamura twekambe co.	20	10	90		
Kaburoba LSB	36	11.1	88.9		
Katibani mpora bakaka	32	6.3	93.8		
Kibeede LSB farmer group	29	51.7	48.3		
Kidunduma farmers' Coops. Ltd.	49	49	51		
Kigarama Tukorrehamu	15	60	40		
Kitohwa Tuhinge Emond	31	71	29		
Masaka ward Bataka Kw	27	14.8	85.2		

TABLE 6: Entrepreneurial capacity of LSB groups marketing bean seed (n = 386)

LSB, local seed businesses

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Table *6* shows that most local seed business farmer groups showed strong entrepreneurial capacity. Mariba Bahinzi Barozi had the highest percentage of high performers at 95.2%, based on a sample of 21. The chi-square test produced a significant result (Chi-value = 86, p = 0.00), indicating a clear link between group membership and high performance. Kamwange tukolerehamwe Co., Katibani Mpora Bakaka, and Kaburoba LSB also reported high performance rates of 91.7%, 93.8%, and 88.9%, respectively. This suggests they have effective business strategies and operate efficiently.

On the other hand, some groups performed relatively poorly in bean seed marketing. Kitohwa tuhinge Emondi and Kigarama tukorrehamu had 71% and 60% of their members in the low-performance category, respectively. This points to possible challenges in seed marketing or business management. Kibeede LSB and Kidunduma farmers' Cooperative Ltd. had almost equal numbers of low and high performers, with 51.7% and 49% in the low-performance group, respectively. These results show differences in business capacity, market access, or organizational support among the groups.

In general, results show a notable difference in entrepreneurial capacity among the LSB groups. This variation is influenced by access to resources, training, and local market conditions. The existence of high-performing groups alongside lower-performing ones emphasizes the need for focused support efforts. These efforts include building capacity through training about seed marketing, creating market connections, and providing financial services to help underperforming LSBs maintain their entrepreneurial potential. The chi-square result for Mariba Bahinzi Barozi confirms that, in at least one case, the differences in performance levels are not random. This finding highlights the role of group characteristics in determining entrepreneurial success.

Results revealed that groups like; Mariba bahinzi barozi LSB, Katibani mpora bakaka LSB, Kamwange tukolerehamwe, Kaburoba LSB, display very high proportions of high capacity (> 85-90%), whereas others like Kitohwa tuhinge emondi LSB, Kigarama tukorere-hamu have low capacity rates. This is consistent with studies that have found that entrepreneurial seed performance is highly uneven. For example, Policy and Performance in Uganda's seed sector (Bagamba et al., 2023) shows that while Uganda has numerous seed actors, performance in terms of reach, quality, market share, innovation varies greatly depending on organizational capacity, regulatory environment, access to finance, and market linkages. This according to Riungu et al. (Riungu et al., 2021) could be due to high yielding varieties in unyielding environments which is the case of NABE 4 in Kabale and NARO BEAN 3 in Kamwenge Districts. Therefore, farmer awareness, demonstration plots, and proximity of agro-inputs affects whether farmers adopt new technologies.

Most striking number of groups with very high capacity (over 90%) suggests that in Western Uganda, some LSBs may be achieving near best practice levels of entrepreneurial performance. This according to Nateebwa et al. (Nateebwa et al., 2017) can be attributed to group membership, training, and access to improved seed which significantly influence access and utilization. While recent studies show improvement and potential for high performance, many note constraints that limit performance in regard to quality, adoption, market reach (WUR, 2023). From the FGDs in Kabale, Kisoro and Kamwenge good performance of LSBs was attributed to good leadership, access to credit, favorable local policies and strong social capital as emphasized by a group member of Busanza LSB in Kisoro district.

Groups with nearly equal or slightly above 50% low capacity Kibeede LSB and Kidunduma Farmers' Co. LSB were found to have joined ISSD LSB project late toward closure in 2022. And senior agriculture officer Kabarole district observed that groups stuck in low capacity always reports internal contradictions on accountability, leadership and enterprise to focus on due to heterogeneity within groups. Also 50/50 capacity results suggest internal variance: some individuals in those groups are doing well while others not.

Table *7* results shows that many variables are important predictors of entrepreneurial capacity. The number of years a farmer has been active in the local seed business (LSB) has a positive and significant effect (Coef. = 0.794, p = 0.02). This indicates that longer involvement in LSB activities leads to better entrepreneurial outcomes. The coefficient means that each additional year of active participation helps improve results. This is due to the trust built over time through contractual seed multiplication with NARO-NACRRI, strong relationships with local seed buyers, and cooperation with local government agriculture extension staff. These staff members inspect field seed crop gardens at a subsidized cost and connect farmers to MAAIF inspectors, NARO breeders, and potential markets.

Bean performance factors	Coef.	St. Err.	t-value	p-value	[95% Conf Interval]	Sig
Education	1.156	0.125	1.34	0.181	0.935 – 1.429	
District : base Kabale	1	.	.	.	.	
Kamwenge	0.035	0.067	-1.73	0.084	0.001 – 1.578	*
Kabarole	0.691	0.876	-0.29	0.771	0.058 – 8.284	
Kisoro	0.673	0.882	-0.3	0.762	0.052 – 8.786	
: base 0	1	.	.	.	.	
Joined 2017–2019	0.23	0.236	-1.43	0.153	0.03 – 1.728	
Joined 2020–2022	0.083	0.114	-1.8	0.072	0.005 – 1.248	*
LSB-active years	0.794	0.079	-2.33	0.02	0.653 – 0.964	**
Farm-experience	1.062	0.034	1.84	0.066	0.996 – 1.131	*
Employed-Male	1.33	0.299	1.27	0.204	0.856 – 2.067	
Employed-Female	0.804	0.203	-0.86	0.388	0.491 – 1.318	
HH-head-Educ.	1.157	0.125	1.35	0.177	0.936 – 1.43	
Home-seasonal-road distance	0.875	0.09	-1.3	0.192	0.716 – 1.07	
Home-district road	0.867	0.056	-2.22	0.026	0.764 – 0.983	**
Home-sub county road	0.636	0.099	-2.92	0.004	0.469 – 0.862	***
Home town	1.03	0.068	0.45	0.652	0.905 – 1.172	
Home-produce_ACE society road	1.281	0.227	1.4	0.161	0.906 – 1.813	

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Home_LSB distance	1.113	0.206	0.58	0.563	0.775 – 1.599	
Training_001	1.098	0.991	0.1	0.918	0.187 – 6.435	
Times_foundation_seed	0.934	0.104	-0.61	0.542	0.751 – 1.162	
Constant	199.56	615.892	1.72	0.086	0.471 – 84546.76	*
Model statistics						
Statistic	Value					
Mean dependent var	0.699					
SD dependent var	0.461					
Pseudo r-squared	0.311					
Number of obs	103					
Chi-square	39.143					
Prob > chi2	0.004					
Akaike crit. (AIC)	126.864					
Bayesian crit. (BIC)	179.558					
Significance levels:						
p < 0.1						
** p < 0.05						
*** p < 0.01						

TABLE 7: Determinants of the entrepreneurial capacity of common bean seed farmers

Farm experience has a positive and significant effect (Coef. = 1.062, p = 0.066). This suggests that the knowledge and skills gained in seed production and marketing lead to better business results. Bean seed farmers who joined the LSB Project between 2020 and 2022, near the end of the ISSD-LSB Project in 2022, were less likely to do well. This is shown by

the low coefficient and marginal significance ($p < 0.1$). The results indicate a lack of time for skill development, networking, and insufficient storage facilities. This was evident in Kabarole District, where Kanyamura twekambe and Kibeede LSB farmers joined the ISSD project close to its official in 2022. They missed out on construction of a seed bank with support from ISSD because they could not cofound it and needed more training in seed production and marketing.

The District variable for Kamwenge shows a weak significant negative association (Coef. = 0.035, $p = 0.084$). This reflects the transition phases of local seed business groups in Kamwenge district as they build their entrepreneurial skills. From FGDs in Kamwenge, it was observed that local seed business groups improved their entrepreneurial skills with help from the Private Sector Development Cooperative (PRICON). PRICON mobilized farmers to form Rural Producer Organizations (RPO) for bulk buying and marketing. This effort coincided with the second phase of the NAADS program in 2011, where RPOs could supply bean and potato seeds to fellow farmers under a community-based procurement strategy. This allowed RPOs to earn profits while paying a 6% withholding tax to Uganda Revenue Authority (URA).

In 2017, ISSD introduced the concept of local seed business groups to RPO farmers, connecting them with NARO for sourcing foundation breeder seeds and with the Micro Finance Centre for soft loans. They also helped build seed banks and offered ongoing training in seed marketing. This support enabled them to keep supplying bean and potato seeds to local farmers under the community procurement strategy of the NAADS program. However, in 2014, NAADS transformed into Operation Wealth Creation, ending the direct community procurement of quality seeds from local seed businesses. Despite this change, these seed producers continued supplying seeds to individual local farmers with support from ISSD, NARO, and MAAIF.

When the ISSD project ended in 2022, local seed businesses in Kamwenge sought support from the Agriculture Cluster Development Project (ACDP). ACDP guided these farmers in processing agricultural products by providing milling machines, drying tarpaulins, fertilizers, storage bags, and grants of 77% from the government along with 33% from the Area Agriculture Enterprise (ACE), which included more local seed businesses farmers. Under the ACDP project, Kamwenge bean seed farmers shifted to maize production, processing, packaging, and branding maize grain into flour and animal feeds for income generation. Currently most LSBs in Kamwenge District only produce on contract with a major emphasis on value addition in maize. This change has contributed to their underperformance in bean seed marketing compared to Kabale and Kisoro.

The number of active years in LSB programs is positively and significantly associated with high entrepreneurial capacity (Coef. = 0.794, $p = 0.02$). This finding supports the argument that sustained participation in structured agricultural initiatives enhances farmers' capacity to innovate, access markets, and manage resources effectively. Kirungi et al. (Kirungi et al., 2023) emphasize that entrepreneurial orientation and long-term engagement in climate-smart agriculture programs significantly influence adoption and performance outcomes. Also, farm experience shows a marginally significant positive effect (Coef. = 1.062, $p = 0.066$), suggesting that experiential knowledge contributes to better decision-making and risk management. This is consistent with the Ministry of Trade's Entrepreneurship Index, which highlights human capital and practical experience as key drivers of MSME success in Uganda.

Road distance to district and sub-county centers negatively affects entrepreneurial capacity (District: Coef. = 0.867, $p = 0.026$; Sub-county: Coef. = 0.636, $p = 0.004$). These results emphasize the importance of physical infrastructure in facilitating access to inputs, markets, and extension services. The UNCTAD Entrepreneurship Policy Review for Uganda identifies poor infrastructure as a major barrier to entrepreneurial growth, particularly in rural areas.

Farmers who joined entrepreneurial programs between 2020 and 2022 show low capacity (Coef. = 0.083, $p = 0.072$), possibly due to limited integration or early-stage challenges. This finding suggests the need for targeted support for new entrants. Additionally, Kamwenge District shows a marginally significant negative effect (Coef. = 0.035, $p = 0.084$), indicating regional disparities in entrepreneurial outcomes. Contrary to expectations, formal education and training variables do not show significant effects on entrepreneurial performance. This may reflect a disconnect between curriculum content and the practical needs of agricultural entrepreneurs. Kirungi et al. (Kirungi et al., 2023) argue that business and entrepreneurial skills training must be context-specific and aligned with farmers' operational realities to be effective

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Conclusions

High entrepreneurial capacity levels in Kamwenge and Kabale are attributed to better access to seed innovation systems, public-private partnerships, extension services, and good quality inputs like fertilizer from Rwanda, as well as functional farmer-based seed organizations. In contrast, Kisoro's relatively high proportion of low-performing LSB entrepreneurs points to persistent barriers such as poor infrastructure, weak institutional support, and limited access to innovation.

The findings from this study highlight the importance of long-term institutional engagement, infrastructural development, and experiential learning in enhancing farmer entrepreneurial capacity. Policymakers should prioritize these areas while re-evaluating the design and delivery of education and training programs to ensure they meet the evolving needs of rural local seed business farmers.

Recommendations

There is a need for district-specific actions that combine training, infrastructure, market development, regulatory reform through extension agents, and collaboration among stakeholders to address infrastructural gaps, such as road construction, that affect agricultural marketing, even though these plans are often budgeted outside the production sector.

There is a need for government policy to prioritize community-based procurement of quality-declared common bean seeds from LSB farmers. This will help them secure government and NGO contracts to supply seeds for legumes and tubers. It would improve their entrepreneurial capacity and protect them from commercial seed companies, which often outsource seeds from LSBs at low prices whenever they win contracts to supply bean seeds.

Due to comparable entrepreneurial capacity levels, gender-targeted interventions in performance improvement may not be necessary in this setting. However, it remains important to explore whether females are experiencing additional barriers, like access to credit, time constraints, or training, that may not immediately show up in performance but could impact long-term outcomes.

To promote fairness and efficiency in Uganda's seed sector, targeted and specific actions are necessary. These should include strengthening local seed businesses, expanding bundled services, improving extension networks, and ensuring fair policy implementation across districts. Further research is recommended to examine gender dynamics, financing methods, and long-term trends to inform sustainable business development in agricultural input markets.

Appendices

APPENDICES

CROSS-SECTIONAL HOUSEHOLD SURVEY QUESTIONNAIRE FOR LOCAL SEED BUSINESS (LSB) FARMERS IN WESTERN UGANDA

INTRODUCTION

My name is Kule Birengesyo Eriya, a student researcher at Makerere University. You have been selected to participate in this study because you may have information that can help examine the determinants of the performance of Local Seed Business (LSB) groups in Western Uganda.

Your participation in this study is voluntary. I will ask you a number of questions. All your answers will be kept strictly confidential and will not be used for any purpose other than informing this study.

I therefore request your permission to participate in this study.

Date of interview (DD/MM/YYYY): _____ / _____ / _____

Enumerator's name: _____

Contact: _____

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Farmer Profile

District: _____

Sub-county: _____

Parish/Ward: _____

Village/Cell: _____

Gender: Male ____ Female ____

Age (in complete years): _____

Marital status:
1 = Single
2 = Married
3 = Divorced
4 = Separated
5 = Widowed

Years of education: _____

Occupation: _____

Do you have any disability?
1 = Yes
0 = No

Section A: Participation in LSB Enterprise

Name of LSB: _____

Year you joined the LSB: _____

Number of years active in the LSB: _____

Do you currently hold a leadership position?
1 = Yes
0 = No

If yes, which position?
1 = Executive
2 = Production Committee
3 = Marketing Committee
4 = Quality Control Committee
5 = LSB Trainer

Have you attended any LSB activities in the last 12 months?
1 = Yes
0 = No

If no, why not? _____

If yes, list activities participated in (last 12 months):
1 = Decision-making meetings
2 = Agronomy training
3 = Financial literacy training
4 = Business planning

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5 = Marketing training
6 = Certification
7 = Seed marketing
8 = Planting
9 = Weeding
10 = Roguing (removing off-type plants)
11 = Harvesting
12 = Sorting
13 = Grading
14 = Packaging
15 = Threshing
16 = Winnowing
17 = End-of-year/quarter meetings
18 = Transportation

Main crop seed enterprise in your LSB:
1 = Beans
2 = Potato
3 = Groundnuts
4 = Soybeans
5 = Field peas
6 = Cassava/Millet
7 = Rice

Which of these crops do you grow? (Use same codes as above)

Section B: Land Ownership and Allocation

Total land owned (acres): _____

Land allocated to crop production (acres): _____

Land allocated to LSB priority crops (acres): _____

Land allocated to beans (acres): _____

Section C: Foundation Seed Sourcing, Harvest, and Marketing

Foundation Seed Sourcing (last 12 months)

Crop	Variety	Quantity (kg)	Date Last Accessed	Source
Beans				
Potato				
Groundnuts				
Soybeans				
Field peas				
Cassava				
Millet				

TABLE 8: Foundation Seed Sourcing (last 12 months)

Source codes:
1 = NARO
2 = LSB
3 = Seed company
4 = University
5 = OWC
6 = Other NGOs

Marketing of Seed

Crop	Variety	Qty Harvested	Sold as Seed	Sold as Grain	Sold Collectively	Sold Individually	Saved for Planting
Beans							
Potato							
Groundnuts							
Soybeans							
Field peas							

TABLE 9: Marketing of Seed

Number of times you have sourced foundation seed: _____

Crops for which you sourced foundation seed:
1 = Beans
2 = Potato
3 = Groundnuts
4 = Soybeans
5 = Field peas
6 = Cassava/Millet
7 = Rice

Indigenous varieties you have multiplied and marketed: _____

Section D: Influence of Member Cohesion

Membership Role

Tick all that apply:

Group executive member (Yes/No)

Committee member

Seed farmer only

Retail store owner

Casual labour

Trainer/model seed farmer

Active money saver

Others (specify) _____

Reasons for Continued Membership

(Select all that apply)

Includes:

Financial support

Sourcing foundation seed

Leadership elections

Respect for rules

Good leadership relations

Market information

Collective marketing

Profitability

Acceptance of diversity

Equal reward distribution

Partnerships

Task allocation

Social support

Trainings

External support

Market availability

Timely delivery

Customer affordability

Group Sustainability Factors

Weekly meetings

Monthly meetings

Rewarding good performers

Punishing poor performers

Leadership accountability

Saving and lending

Fines for defaulters

Conflict and Resolution

Experience of conflict: Yes/No

Frequency: _____

Causes include:

Leadership issues

Poor relations with NARO/inspectors

Cultural differences

Lack of respect for roles

Discrimination

Poor resource pooling

Lack of collective marketing

Resolution methods:
1 = Not resolved
2 = Meetings
3 = Mediation
4 = Sanctions
5 = Fines
6 = Suspension
7 = Other

Marketing Practices

% of produce marketed through LSB: _____

Marketing channels:

Collective

Contractual

Mobile traders

Markets

Retail stores

Entrepreneurial Capacity

Benefits Achieved

Includes:

Resource pooling

Skills development

Business start-up

Quality seed production

Record keeping

Market bargaining

Packaging

Financial/seed loans

Infrastructure support

Skill Development Support

Includes:

Training (production, preservation)

Storage facilities

Market linkages

Contracts

Financial access

Government/NGO support

New varieties

Performance Indicators

Seed supply per season: _____

Profit level: High / Moderate / Low

LSB performance: Excellent / Very good / Good / Fair / Poor

Household Decision-Making

Access to market info: Wife / Husband / Children

Sales decisions: Wife / Husband / Both

Income control: Wife / Husband / Both

Income and Resources

Marketing resources owned:
(Motorbike, bicycle, storage, phone, etc.)

Share of income from beans: _____

Objective 3: Farmer Innovativeness

Practices for High Yield

Group gardens

Fertilizers

Irrigation

Pest control

Multiple plots

Mechanization

Post-Harvest Practices

Drying racks

Tarpaulins

Proper moisture control

Storage methods

Marketing Innovations

Contract farming

Branding

Packaging

Bulking

Tender bidding

Buyers

Farmers

NGOs

Government

NARO

Bean Varieties

Examples:

NABE2

NAROBEAN2

NABE16

NABE15

NARO BEAN 5C

Sugar 31

Others

Objective 4: External Support

Support Sources

Government (NARO, NAADS/OWC)

NGOs

Banks

SACCOs

Support Types

Credit/loans

Grants

Training

Advisory services

Infrastructure

Seed multiplication

FOCUS GROUP DISCUSSION (FGD) GUIDE

Main Objective

Examine the performance of LSB groups.

Key Questions

What keeps members committed?

How were LSBs formed?

Expected benefits?

Performance relative to expectations?

Sources of support?

KEY INFORMANT INTERVIEW (KII) GUIDE

Questions

How do LSB groups maintain cohesion?

How functional are they?

What benefits have been realized?

What opportunities exist?

What challenges exist and solutions?

What support is needed?

Government support?

NGO support?

Selection of Key Informants

12 LSB members selected based on experience

Agronomists

Agricultural officers

Development officers

Research technicians

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Eriya Kule Birengesyo, Monica Karuhanga, Losira Nasirumbi, Gabriel Karubanga, Lucy Mulugo, David Agole, Obaa Ben, Bwambale Lazrus, Tony Obua

Acquisition, analysis, or interpretation of data: Eriya Kule Birengesyo, Losira Nasirumbi, Bwambale Lazrus

Drafting of the manuscript: Eriya Kule Birengesyo, Losira Nasirumbi, Gabriel Karubanga, Lucy Mulugo, David Agole, Obaa Ben, Bwambale Lazrus, Tony Obua

Critical review of the manuscript for important intellectual content: Eriya Kule Birengesyo, Monica Karuhanga

Supervision: Eriya Kule Birengesyo, Losira Nasirumbi, Gabriel Karubanga, Lucy Mulugo, David Agole, Tony Obua

Disclosures

Human subjects: Consent was obtained or waived by all participants in this study. Ethics committee at Makerere University and the National Council for Science and Technology before conducting research issued approval (2019/HD02/25441U). The researcher got clearance from the ethics committee at Makerere and the National Council for Science before conducting the research. Participation in this study was voluntary, and all information was kept confidential, only for use for its intended purpose. The Key Informant Interview (KII) guides included a provision for seeking the consent of respondents before proceeding with the interview. Data were protected to ensure that respondents' details were not revealed to an unintended audience. Participation in this study was voluntary, and all information collected was kept confidential, only for use for its intended purpose. Although respondents were encouraged to participate, they were requested to feel free when responding to questions. The KII guides included a provision for seeking the consent of respondents before proceeding with the interview. **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** Eriya Kule Birengesyo declare(s) a grant from Makerere University Research and Innovations Fund (MAK.RIF). **Intellectual property info:** In the future, with successful performance of common beans through participatory plant breeding, we shall have patents for new common bean varieties. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

Data Availability Statements

The datasets (and/or code) supporting this study are available from the corresponding author upon reasonable request.

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