

**ANALYSIS OF THE MARKET PERFORMANCE OF IMPROVED BEAN VARIETIES
FOR ENHANCING HOUSEHOLDS INCOME IN RUKIGA DISTRICT**

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<https://doi.org/10.35410/IJAEB.2025.5993>

ABSTRACT

Improved agricultural technologies such as enhanced crop varieties are increasingly recognized as essential for boosting household incomes and ensuring food security in rural communities. In Uganda, the adoption of improved bean varieties has shown potential to uplift smallholder farmers by providing better yields and access to premium markets. However, to realize these benefits, a clear understanding of market performance and dynamics is crucial. The study made an analysis of the market performance of improved bean varieties for enhancing household's income in Rukiga District. It was conducted to specifically; determine the market players in improved bean variety sector, determine the market, share and channels for improved bean varieties, compare the costs and returns for marketing improved bean varieties compared to local varieties and examine the challenges associated with value chain of improved bean varieties. Information was gathered from 366 respondents using questionnaire and interviews. The study came up with different market players in improved bean variety sector including input suppliers, farmers, traders and consumers. The market share for improved bean varieties was average with most of the beans being marketed through a farmer to consumer channel. However other channels like farmers to retailers and consumers channel, farmer-wholesaler-retailer-consumer channel and farmer-agent-middlemen-retailer-consumer were also being utilized. The average number of bean sacks marketed is slightly higher for local varieties (25.30 sacks) compared to improved varieties (24.77 sacks). Average marketing cost for improved varieties (159,627.13 shillings) was slightly higher than for local varieties (157,885.49 shillings). However, average total income generated from marketing beans was 5,750,000.23 shillings for local beans and 6192500.01 shillings for improved varieties indicating a substantial revenue difference of 442500 shillings for improved varieties compared to local varieties. Marketing of improved bean varieties was constrained by several factors including price fluctuation, poor road networks, high marketing costs, low supply by producers, competition from local varieties, access to extension service, lack of storage facilities, and poor pre- and post-harvest handling.

Keywords: Market Performance, Improved Bean Varieties, Household income, Rukiga

1. INTRODUCTION

Pulses are among the earliest crops cultivated by humans (Murekezi et al., 2013). Common dry beans (*Phaseolus vulgaris* L.) are especially significant for food and nutrition due to their high protein content, complex carbohydrates, fiber, and other essential nutrients (Asfaw et al., 2011). Their affordability, excellent preservation qualities, and long shelf life make them a staple food in developing countries like Uganda. Beans are considered an almost perfect food by nutritionists and play a vital role in addressing malnutrition.

Despite their importance, bean production in Africa suffers from low productivity and limited use of improved technologies. According to FAO (2015), global bean production is increasing slowly, particularly in developing countries where beans serve as a low-cost protein alternative to meat. Africa's low yields are attributed to poor soils, ineffective application of technologies, and widespread crop diseases (ZerihunAbebe, 2017). As a result, improved crop varieties and better management practices have been introduced to enhance yields.

Demand for beans in Sub-Saharan Africa (SSA) has grown significantly. Katungi et al. (2011) note that current demand is around 20,000 metric tons per year and is expected to rise to 40,000 metric tons within a decade. From 2004 to 2015, regional consumption increased from 1.5 million to 10 million tons annually. High demand from institutions like schools, hospitals, and prisons offers SSA farmers a unique opportunity to increase production and participate in value chains (Asare-Marfo et al., 2011).

Uganda reflects these trends with widespread bean consumption, particularly among low-income households (Larochelle et al., 2015). Beans are grown by 86% of Ugandan farmers and cover 40% of the cultivable land (Amongi et al., 2014; Larochelle et al., 2013). They are the second most cultivated crop after bananas and provide up to 65% of the nation's dietary protein (Sibiko et al., 2013). However, challenges like pests, diseases, and drought have caused bean yields to decline from 60% to 30%, with current yields at only 2–3 t/ha/year compared to the potential 10 t/ha/year (Athanasie et al., 2013; Larochelle et al., 2014).

To address these challenges, the National Agricultural Research Organization (NARO) developed improved bean varieties such as Narobean 4C, 5C, 17, 19, NABE 12C, NABE 17, and NABE 19 (Abate, 2012). These varieties are bred for resilience to pests, diseases, and climate change. However, despite the growing market, there is limited information about the market performance of these improved varieties, especially in rural areas like Rukiga District. As such, this study was undertaken to assess their market response, consumer preferences, profitability, and marketing challenges (Rukiga District, 2012).

Statement of the problem

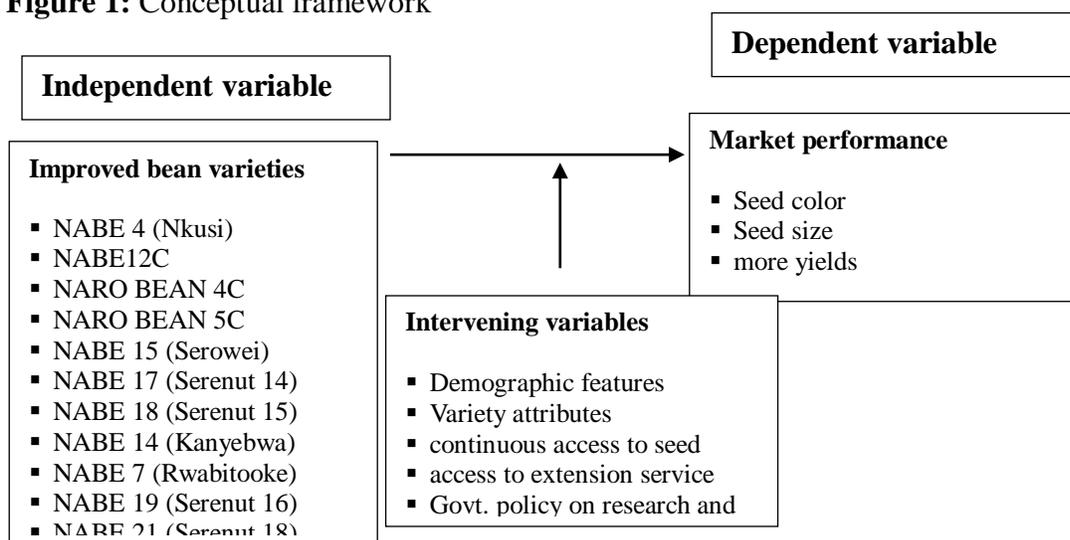
Smallholder farmers in bean-growing regions, especially in the Kigezi area and Rukiga district, heavily rely on common beans for both income and food. The rising demand for beans is largely due to their high protein content, particularly as animal protein becomes increasingly scarce. Additionally, beans serve as a food security crop because they mature quickly and provide reliable yields even during challenging times (Ronner & Giller, 2012). Despite the importance of beans to local livelihoods, production levels remain inadequate to meet local consumption and export needs. This shortfall is mainly due to limited use of improved technologies, drought stress, poor input use, and the inherently low yields of traditional bean varieties (Larochelle et al., 2014). These production constraints continue to affect the region's ability to meet rising bean demand. To address these challenges, the National Agricultural Research Organization (NARO) and local authorities introduced improved bean varieties in Rukiga district. These varieties are designed to be high-yielding, disease-resistant, and adaptable to poor soil conditions (Kilimo Trust, 2012). However, despite their potential, there was limited understanding of how these varieties performed in the market specifically regarding consumer preferences, market dynamics, pricing, and marketing challenges. The overall purpose of the study was to determine the market performance of improved bean varieties in Rukiga district. The study specifically identified the market players in improved bean variety sector, determined the market, share and channels for

improved bean varieties, compared the costs and returns for marketing improved bean varieties compared to local varieties and further examined the challenges associated with value chain of improved bean varieties.

Conceptual framework

The independent variable in the study was improved bean seed varieties, and the dependent variable was market performance. The outcome of the independent variables (IVs) was measured by the dependent variable (DV). Variations in the dependent variable (DV) were caused by the effects of the independent variables (IVs) on the dependent. However, the two sets of variables interact via intervening variables, as shown below.

Figure 1: Conceptual framework



(Source: Researcher 2024)

2. MATERIALS AND METHODS

The research was carried out in the Rukiga district of southwestern Uganda. The district is primarily rural, with agriculture being the primary occupation of the majority of residents. Rukiga District had a population of 100,726 people according to the August 2014 national census and household survey. The district receives about 1000 mm of rain per year on average. There are two seasons of rainfall, the first from March to May and the second from August to November. These are broken up by two dry spells in June and July, as well as between December and February. Average annual maximum temperature stands at 200 degrees Celsius, and minimum temperature at 14.50 degrees Celsius. High temperatures are recorded from January to March and July to September, which correspond to dry spells. Through marketing and income, improved bean varieties have been developed and promoted to alleviate poverty and food insecurity. The area was chosen for research because of the widespread use of improved bean varieties, despite the fact that their market performance is unknown.

A descriptive-cross-sectional research survey incorporating both quantitative and qualitative approaches was used to collect and analyze data from targeted bean market players (including

input suppliers, farmers, traders, consumers) and key informants like extension service providers and political leaders. This was ideal for it allowed the collection of detailed data through description. The qualitative approach involved use of interviews to capture respondents' views, feelings, knowledge, and opinions on the subject matter, whereas the quantitative approach involved the use of questionnaires to capture quantifiable responses on the market performance of improved bean varieties. Data was collected from 366 respondents.

A mixture of procedures was employed in the selection of respondents. Stratified random sampling criteria was used in the selection of study participants in the entire bean value chain. Different groups were divided into strata' and respondents selected from the groups using random selection. Groups were formed based on shared characteristics. It was from each group that a target sample was drawn using random selection. This was achieved through obtained registers of input suppliers, bean farmers and traders. Purposeful sampling method was used to select key informants such as agricultural service providers and local leaders.

A structured questionnaire with both closed-ended and open-ended questions was designed and used to elicit quantitative data from different respondent groups. The questions were written in English and then translated into local languages to make them easier for farmers/respondents to understand. The tool was checked for completeness, coded and entered into SPSS version 21 software for cleaning and analysis.

Data was analyzed using both qualitative and quantitative methods. Descriptive statistics such as Mean, Percentage, Tabulations, and Frequency Distribution were computed at univariate analysis. Multivariate analysis using correlations and regression statistics was performed to assess the possible associations between the dependent and independent variables and significant relations with the dependent variables. Data outputs were presented in tables.

Results

Table 1: Socio-economic characteristics of farmers

Socio-economic characteristics of farmers	Total (n=366)
<i>Gender (%)</i>	
Male	134 (36.6%)
Female	232 (63.4%)
<i>Age bracket (%)</i>	
Under 20 years	20 (5.5%)
20 - 29 years	48 (13.1%)
30 – 39 years	140 (38.3%)
40 – 49 years	133 (36.3%)
50 and above	25 (6.8%)
<i>Marital status (%)</i>	
Single	125 (34.2%)
Married	142 (38.8%)
Divorced	62 (16.9%)
Cohabiting	37 (10.1%)
<i>Level of education (%)</i>	
No education	41 (11.2%)
Primary	108 (29.5%)
Secondary	145 (39.6%)

Tertiary	44 (12.0%)
Others	28 (7.7%)

According to the findings in table 1 above, majority (63.4%) of the respondents were female suggesting that women play a more active role in the production and marketing of improved bean varieties. This implies that interventions targeting market performance should be gender-sensitive and inclusive of women's needs. 38.3% of the respondents were aged of 30 - 39, 36.3% were aged 40-49 years, 13.1% were aged 20-29, 5.5% were under 20 years while 6.8% were above 50 years. Most farmers (74.6%) fall between 30 and 49 years, indicating that the most economically active age group is engaged in improved bean farming. This age range may be more open to innovation and market participation, potentially boosting household income.

Married individuals (38.8%) formed the largest group, followed by singles (34.2%), a submission that improved bean farming was important for both independent and family-based livelihoods, highlighting its role in household income support across different family structures. Majority of respondents had secondary education (39.6%), suggesting a moderate literacy level among farmers that probably influenced adoption of improved bean varieties and understanding of market dynamics, supporting better market performance.

Table 1: Production characteristics

Production characteristics	Total (n=366)
Total farm size in acres (<i>mean ± Std. D</i>)	3.03 ± 1.233
<i>Mode of land acquisition (%)</i>	
Inheritance	74 (20.2%)
Purchase	273 (74.6%)
Communal	19 (5.2%)
<i>Do you grow beans (%)</i>	
Yes	366 (100%)
No	00 (00%)
Size of bean field in acres (<i>mean ± Std. D</i>)	1.05 ± 2.235
<i>Bean production system used (%)</i>	
Local type only	65 (17.8%)
Improved varieties only	212 (57.9%)
Grow both	89 (24.3%)
<i>Specific type of improved varieties grown (%)</i>	
NABE12C	168 (45.9%)
NARO BEAN 4C	78 (21.3%)
NABE 17	53 (14.5%)
NARO BEAN 5C	39 (10.7%)
NABE 19	28 (7.7%)
<i>Motive behind bean growing (%)</i>	
Cash	178 (48.6%)
Food	117 (31.9%)
Both	71 (19.4%)
Bean harvest a in sacks per season (<i>mean ± Std. D</i>)	5.02 ± 2.168

As shown in table 2, average farm size for most respondents was relatively small at 3.03 acres with a standard deviation of 1.233 indicating some variation around this mean, though most farms were clustered around the size. Majority (74.6%) of the respondents acquired land through purchase, indicating a significant investment in farming as a business, one-fifth (20.2%) acquired land through inheritance, reflecting traditional land transfer practices whereas small portion (5.2%) used communal land, that is subject to collective decision-making and usage restrictions. All the surveyed (100%) respondents grew beans, an indication that bean cultivation is universal among these market players. Average size of the bean fields was 1.05 acres. However, the large standard deviation (2.235) suggested substantial variability, with some farmers cultivating significantly larger areas than the average.

In terms of bean varieties used, majority (57.9%) of the respondents grew only improved bean varieties, which is indication of a preference or perceived benefit from these varieties, nearly a quarter (24.3%) grew both local and improved varieties, suggesting a strategy to balance risk and productivity whereas a smaller segment (17.8%) grew only local bean varieties, possibly due to tradition or lack of access to improved varieties.

NABE12C was the most popular improved variety, grown by 45.9% of the farmers. Its high adoption rate is mainly due to its superior yield, disease resistance, or market demand. The second most popular variety was NARO BEAN 4C grown by 21.3%, followed by NABE 17 grown by 14.5%, NARO BEAN 5C grown by 10.7%, while the least common was NABE 19 grown by 7.7%.

Close to a half (48.6%) of the respondents grew beans primarily for cash, indicating its importance as a cash crop, 31.9% grew beans primarily for food, reflecting its role in food security and nutrition whereas 19.4% grew beans for both cash and food, demonstrating a dual-purpose strategy to meet economic and subsistence needs. On average, most respondents (farmers) harvested 5.02 sacks of beans per season. The standard deviation of 2.168 suggested variability in production, possibly due to differences in farm size, bean variety, and farming practices.

Table 2: Market players and role of value chain services in improved bean variety sector

Variables	Total (n=366)
Market players (%)	
Input suppliers	16 (4.3%)
Farmers	150 (40.9%)
Traders	68 (18.6%)
Consumers	132 (36%)
Value chain services (%)	
Credit provision	92 (25.1%)
Value addition	66 (18%)
Advisory services	84 (22.9%)
Education and training	47 (12.8%)
Research and development	44 (12%)
Technology and innovation	33 (9%)

Farmers (40.9%) and consumers (36%) made up the largest proportion of market participants, indicating strong engagement at both production and consumption ends. Traders (18.6%) played

a moderate role, suggesting a need to strengthen market linkages. Input suppliers (4.3%) were the least represented, possibly pointing to limited access to improved inputs, which partially affect production efficiency and variety adoption. Credit provision (25.1%), advisory services (22.9%), and value addition (18%) were the most prominent services, indicating a focus on financial access and production support. Lower figures for education/training (12.8%), research (12%), and technology (9%) suggested underinvestment in long-term capacity building and innovation. Strengthening these areas could enhance sustainability and competitiveness in the improved bean value chain.

Table 3: Market share and channels for improved bean varieties

Variables	Total (n=366)
<i>Market channel (%)</i>	
Farmer to consumer	142 (38.8%)
Farmer-agent-middlemen-retailer-consumer	46 (12.5%)
Farmer-wholesaler-retailer-consumer	64 (17.5%)
Farmers to retailers and consumers	114 (31.1%)
<i>Market share for improved bean varieties (%)</i>	
High	138 (37.7%)
Average	169 (46.2%)
Low	59 (16.1%)

As shown in table 5, the most common channel was direct farmer-to-consumer (38.8%), indicating a preference for short value chains that offered better prices to farmers. Channels involving intermediaries were less utilized, possibly due to limited market access or trust issues. The combination of farmers selling to both retailers and consumers (31.1%) also reflected efforts to diversify selling points. A majority of farmers reported average (46.2%) or high (37.7%) market share for improved bean varieties, suggesting a growing preference and market presence. Only 16.1% experienced low market share, which pointed to challenges in production scale, marketing, or consumer awareness in some areas. Overall, the results showed positive adoption and market integration.

Table 4: Descriptive Statistics for costs and returns of improved bean varieties compared to local varieties

	N	Mean	Std. Deviation
Local bean variety	Statistic	Statistic	Std. Error
Number of bean sacks marketed in a season	366	25.30	1.121
Total cost of marketing (in shillings)	366	157885.49	23109.460
Total income generated (in shillings)	366	5750000.23	81307.898
Improved bean variety	Statistic	Statistic	Std. Error
Number of bean sacks marketed in a season	366	24.77	1.098
Total cost of marketing (in shillings)	366	159627.13	24106.216
Total income generated (in shillings)	366	6192500.01	27088.988

Results in table 6 above show that farmers marketing local bean varieties sold an average of 25.30 sacks per season whereas farmers marketing improved bean varieties sold an average of 24.77 sacks per season, which was slightly less than the local variety. Average cost of marketing was 157,885.49 shillings per sack for local bean varieties and 159,627.13 shillings for improved varieties which was slightly higher than the cost for local varieties and indication that marketing improved beans involved additional expenses. Average total income generated from marketing beans was 5,750,000.23 shillings for local beans and 6192500.01 shillings for improved varieties indicating a substantial revenue difference of 442500 shillings for improved varieties compared to local varieties.

Table 5: Parameter estimates for the challenges associated with value chain of improved bean varieties

Variables	AOR (95% CI)	p-value
Price fluctuation	0.898 (0.806 - 1.001)	0.026**
Lack of market information	1.025 (0.885 - 1.187)	0.742
Negative perceptions	0.156 (0.068 - 1.608)	0.864
Poor road networks	0.808 (0.319 - 1.978)	0.002**
High marketing costs	0.789 (0.113 - 2.116)	0.039**
Poor reception and demand	0.871 (0.229 - 3.309)	0.839
Low supply by producers	0.121 (0.226 - 2.566)	0.004**
Competition from local varieties	0.384 (0.169 - .871)	0.047*
Poor quality supply	0.717 (0.447 - 1.151)	0.168
Access to extension service	1.603 (0.390 - 3.933)	0.023**
Change in customer preferences	1.364 (0.863 - 2.153)	0.183
Lack of storage facilities	0.936 (0.468 - 1.158)	0.115
Poor pre- and post-harvest handling	0.493 (0.275 - 0.887)	0.018*

a. Dependent variable: Participation in improved bean varieties value chain

*, **, *** statistically significant at 10%, 5% and 1% significance level

- AOR → Adjusted Odds Ratio
- CI → Confidence Interval

Price fluctuations significantly affected value chain by reducing market stability for improved beans. The adjusted odds ratio (AOR) for price fluctuation was 0.898 with a 95% confidence interval (CI) of 0.806 to 1.001, and a p-value of 0.026, indicating a statistically significant negative association with participation in the improved bean varieties value chain at the 5% significance level. The odds ratio suggested that as price instability increases, engagement in the improved bean value chain decreased which probably discouraged consistent production and marketing.

Inadequate road infrastructure negatively impacts the bean value chain by hindering timely transportation. The AOR was 0.808 with a 95% CI of 0.319 to 1.978, and a p-value of 0.002, indicating a statistically significant negative impact on participation in the value chain at the 5%

significance level. Poor road networks hindered transportation and market access hence increasing post-harvest losses as well as discouraging producer participation.

High costs related to marketing activities such as transport, packaging, and market fees significantly reduced farmer participation in the value chain. With an AOR of 0.789 at 95% CI of 0.113 to 2.116, and a p-value of 0.039, high marketing costs showed a statistically significant negative association with participation at the 5% significance level. High marketing costs reduced the profitability and attractiveness of participating in the improved bean varieties value chain.

Inadequate supply from producers significantly constrained the value chain. A very low odds ratio (0.121 at 95% CI of 0.226 to 2.566, and a p-value of 0.004) indicated that insufficient production volume severely limited market flow and profitability. A low supply from producers hampers the overall functioning and sustainability of the value chain.

The presence of well-established local bean varieties posed a significant challenge. The AOR for competition from local varieties was 0.384 and a p-value of 0.047, suggesting a statistically significant negative impact on participation at the 10% significance level. Competition from local varieties reduced the market share and appeal of improved bean varieties, affecting participation in the value chain. Farmers and consumers preferred familiar types over improved ones, reducing demand and adoption rates of improved varieties.

Interestingly, better access to extension services increased the likelihood of involvement in the improved bean value chain. The AOR for access to extension services was 1.603 with a 95% CI of 0.390 to 3.933, and a p-value of 0.023, indicating a statistically significant positive association with participation in the value chain at the 5% significance level. This suggests that advisory services play a crucial role in supporting adoption and overcoming value chain challenges.

Improper handling before and after harvest significantly weakened the bean value chain. Poor pre- and post-harvest handling decreased the chances of participation in improved bean value chain. The AOR for poor pre- and post-harvest handling was 0.493 with a 95% CI of 0.275 to 0.887, and a p-value of 0.018, indicating a statistically significant negative association with participation at the 5% significance level. Poor handling practices reduce the quality and marketability of beans, thereby discouraging participation in the value chain.

Discussion

The results provided a distribution of respondents in the improved bean variety sector, segmented into four main categories including input suppliers, farmers, traders, and consumers. The findings revealed a clear dominance of farmers (40.9%) and consumers (36%) as the primary market players in the improved bean variety value chain in Rukiga District. This distribution underscored the grassroots-driven nature of bean production and consumption in this largely agrarian community. Farmers are the backbone of bean production in the district, often cultivating improved varieties such as NABE 15 and NABE 17, which are preferred for their high yield and resistance to drought and pests. The active engagement of consumers also reflects the staple role of beans in the local diet. According to NARO, (2013), similar patterns were observed in Central Uganda, where consumer preferences significantly shaped the demand for improved varieties, incentivizing farmers to adopt such types to meet market expectations.

Traders made up 18.6% of the total respondents. They are crucial intermediaries in the value chain, responsible for buying beans from farmers and selling them to consumers or other market actors. The role of traders in the improved bean sector is crucial for facilitating the efficient movement of beans from producers to consumers. Their activities in market analysis, sourcing,

aggregation, quality control, storage, transportation, price negotiation, and market linkages contribute to the overall success and profitability of the local bean sector. Traders mainly operate individually and buy bean, stock and later transport it to markets. They play a leading role in collecting and distributing beans from producers to alternative markets. They act as intermediaries, connecting various actors in the value chain and contributing to the efficient distribution and marketing of beans. This is in line with Timu et al., (2012) who also reported that traders serve as bean buyers as well as input raw input suppliers. They are strong financially as well as management know how in all aspects of the business activity in relative with actors of this chain. They purchase beans from producers directly by physically and by commission men.

Consumers represented 36% of the total respondents, indicating their end position in the value chain. They are the final recipients of the improved bean varieties for consumption purposes their demand, preferences, purchasing decisions, feedback, and consumption patterns shape the activities of farmers, traders, and retailers. By understanding and responding to consumer needs, the value chain can adapt, innovate, and deliver bean varieties that meet the expectations of consumers while driving economic growth and sustainability. Consumers create the initial demand for bean varieties. Their preferences for beans as a staple food item drive the production and supply by farmers and traders. Consumer demand sets the stage for bean cultivation and influences the scale and variety of beans produced in the area. The main bean consumers in the area include households, restaurants and institutions. This study finding is in line with Timu et al., (2012) who reported that consumers are end users of bean in the value chain. Private consumers purchase beans directly from producers, retailers and wholesalers though most of the consumers purchase from retailers. Farmers also make important segment of the rural consumers since they consume part of their produces.

Input suppliers accounted for only 4.3% of the market players, a significantly low representation that had critical implications. This points to limited access to certified seeds, fertilizers, and inoculants necessary for optimal production of improved varieties. In Rukiga, agro-dealers are few and concentrated in trading centres like Muhanga and Bukinda, forcing many farmers to rely on recycled seeds or distant suppliers. A study conducted by Nchanji et al., (2020) in East Africa similarly identified poor input distribution networks as a key constraint to the adoption of improved legume varieties. Without adequate input supply systems, the adoption and sustained use of improved bean varieties in Rukiga are likely to remain suboptimal.

The study identified the different marketing channels used for improved bean varieties including; farmer to consumer channel, farmer to retailers and consumers channel, and farmer-agent-middlemen-retailer-consumer channel. The direct farmer-to-consumer channel, accounting for 38.8%, was the most prevalent route for selling improved bean varieties in Rukiga District. This underscored a strong farmer preference for short value chains that provide better price margins and direct customer interaction. In rural areas such as Kashambya and Mparo, where farmers often operate with limited infrastructure and market access, selling directly to consumers particularly through weekly markets like the Mparo Friday market remains practical and economically beneficial. This pattern is also evident in other contexts, such as in western Kenya, where Lunze et al., (2012) found that smallholder bean farmers preferred direct selling due to greater income retention and flexibility in pricing.

The second most utilized channel was a mixed model of farmers selling to both retailers and consumers (31.1%), reflecting a strategic approach by farmers to diversify their marketing outlets. In Rukiga, this could mean a farmer sells part of the harvest in Kabale Municipality to

urban retailers and the remainder directly to households in their local village. This diversification enhanced income stability and allowed farmers to tap into both rural and peri-urban markets. A similar model was reported in Kenya, where Ojiem et al. (2014) documented that mixed marketing channels increased profitability and reduced dependence on a single market source.

Conversely, channels involving intermediaries were less utilized, mainly attributed to low levels of trust, poor infrastructure, or unfavorable terms of trade. In Rukiga's highland terrain, transporting produce to aggregation centers can be difficult and expensive. Moreover, farmers were hesitant to engage middlemen due to concerns about underpricing or delayed payments. This aligns with findings from Uganda, where Ronner & Giller, (2012) observed that smallholder farmers were reluctant to work with brokers due to a lack of transparency and reduced bargaining power.

Market share for improved bean varieties was relatively high for varieties like NABE12C, NARO BEAN 4C, NABE 17, NARO BEAN 5C and NABE 19. Market share was highly correlated the level of demand which was determined by characteristics like big pods, size and non-perishability. Varieties like NABE12C and NARO BEAN 4C have attributes that are attracted by consumers which perhaps explained their demand in the area. This study finding is comparable to findings by Chitete et al., (2023) who argued that bean marketing is a multi-stage process which includes accumulation, transportation, grading, distribution etc. For the improvement and development of the marketing structure, a coordinated approach aimed at removing all the weak links in the marketing chain is essential.

The study revealed nuanced differences between the marketing performance of improved and local bean varieties, where agriculture remains the bedrock of rural livelihoods. Although farmers marketed slightly more sacks of local bean varieties per season (25.30 sacks) compared to improved varieties (24.77 sacks), the improved varieties generated substantially higher average income UGX 6,192,500.01 versus UGX 5,750,000.23 for local beans yielding an additional UGX 442,500 in revenue. This income gap suggests that improved beans fetched a higher market price, likely due to their better yield, resistance to pests, uniformity in appearance, and consumer preference for traits like faster cooking times and better taste. However, the marginally higher marketing cost for improved beans (UGX 159,627.13 per sack vs. UGX 157,885.49 for local beans) indicates that these varieties involve slightly more logistical or quality-related expenditures possibly including packaging, transport to distant markets with higher demand, or sorting and grading for premium markets like Kabale town or Mbarara. Comparative studies affirm these trends. A study by Sibiko et al. (2013) in eastern Uganda found that farmers using improved beans earned significantly more, even with slightly higher input and marketing costs, due to increased yields and better market demand. Similarly, in Western Kenya, studies by Tumu et al. (2012) found that improved beans fetched higher prices due to superior quality, though they incurred higher costs in post-harvest handling. These parallels indicate that the Rukiga results are part of a broader regional trend where improved agricultural technologies, despite incurring slightly more costs, provide higher returns due to market preferences and productivity.

The study identified different significant challenges associated with marketing of improved bean varieties. The AOR for price fluctuation was 0.898, with a 95% CI of 0.806 to 1.001, and a p-value of 0.026. This result was statistically significant at the 5% level, indicating that price fluctuation negatively affected participation in the value chain of improved bean varieties. The nearly significant confidence interval close to one suggested that while price fluctuation reduces

the likelihood of participation, the impact is marginal but notable. Price volatility deters farmers and other stakeholders due to the associated financial risks and unpredictability in income. Therefore, stability in prices is crucial for encouraging more consistent participation in the value chain. This finding is comparable to findings by Muimui et al., (2010) who in their study also identified price fluctuation or instability as a major constraint for traders in the common bean market. This was primarily due to the seasonality of common bean supply and market fluctuations

Poor road networks were a significant constraint to improved bean marketing with a p-value of 0.002. The variable showed a statistically significant negative impact on participation at the 5% level. Poor road infrastructure hinders the efficient transport of beans from farms to markets, leading to increased transportation costs, delays, and potential spoilage. This infrastructural challenge significantly reduced the attractiveness and feasibility of engaging in the value chain, as stakeholders face logistical hurdles that could diminish profitability and efficiency. Muimui et al. (2010) also reported that transportation losses were a major impediment to bean marketing in their study. The coefficient of transport losses was significant (P0.1), and due to high transport losses, most farmers were unable to transport the desired quantity to the market. The mode of transportation, primarily bicycle (32%), and human head (33%), resulted in increased transportation losses such as spillage and theft.

High marketing costs had an AOR of 0.789, with a 95% CI of 0.113 to 2.116, and a p-value of 0.039. High marketing costs had a statistically significant negative association with participation in the value chain at the 5% level. Elevated marketing expenses erode profit margins and make it financially unviable for small-scale producers and traders in Rukiga to compete. These costs included advertising, transportation, and market fees, which cumulatively increased the burden on stakeholders, deterring their active involvement in the improved bean varieties value chain. This study finding is in line with findings by Katungi et al., (2011) who in their study stated high marketing costs arise from inadequate and inappropriate market infrastructure, lack of competition in domestic supply chains. Following the liberalization of agricultural markets in Malawi, farmers in rural areas where ADMARC withdrew its services faced difficulties in purchasing inputs, food and selling produce

The AOR for low supply by producers was 0.121, with a 95% CI of 0.226 to 2.566, and a p-value of 0.004. This variable had a statistically significant negative effect on participation at the 5% level. A low supply from producers disrupted the equilibrium of the value chain, leading to insufficient volumes of beans to meet market demand. This scarcity undermined the reliability and stability of the value chain, causing potential buyers and processors to seek alternative sources, thereby discouraging ongoing participation from current stakeholders. In their study, Laroche et al., (2013) noted that another issue that traders face is low supply and poor quality of common bean supplied. These include the mixing of different varieties, product impurity due to the inclusion of foreign matters and dirt, stone, and straw. Because of the high standard and grade, traders are forced to undergo rigorous cleaning, resulting in a loss of net weight.

Poor pre- and post-harvest handling presented as a significant challenge to marketing of improved bean varieties with a p-value of 0.018. This variable had a statistically significant negative association with participation at the 5% level. Inefficient handling practices significantly diminished the quality and marketability of beans, resulting in lower prices and reduced income for farmers. Improving pre- and post-harvest handling techniques is essential for maintaining bean quality and ensuring that stakeholders remain engaged in the value chain. In

their study, Spring & Kimberley, (2015) revealed that bean pre- and post-harvest losses are extremely high throughout the value chain, owing primarily to poor harvest and post-harvest practices, as well as inadequate on-farm storage facilities. Because of poor pre- and post-harvest handling, the majority of beans on the market are mixed varieties and of poor quality, with high levels of foreign matter, rotten or shriveled beans, and infestation hence leading to significant losses for farmers.

The AOR for competition from local varieties is 0.384, with a 95% CI of 0.169 to 0.871, and a p-value of 0.047. This factor had a statistically significant negative impact on participation at the 10% level. Local bean varieties, which are more familiar to consumers and better adapted to local conditions, pose a significant competitive threat to improved varieties. This competition limits the market share and reduce the incentives for farmers and traders to adopt and invest in improved bean varieties, thus hampering the overall participation in the value chain. This finding is comparable to findings by Sibiko et al. (2013) who report that bean grain trading in Uganda is highly informal and unstructured, with little product differentiation or value addition. Smallholder farmers are not integrated into markets because they typically operate independently (highly fragmented) or are organized into weak farmer organizations with weak leadership (lack of trust among members) and poor management capacity.

Conclusions

The study confirmed that market for improved bean varieties in Rukiga District is primarily driven by farmers and consumers, indicating strong production and consumption interest. However, the moderate involvement of traders and minimal representation of input suppliers points to structural weaknesses in market integration and input access. The dominance of direct farmer-to-consumer channels and significant market share for improved bean varieties in Rukiga District reflect growing adoption and trust in these varieties. However, disparities in market access and scale of production remain barriers for some farmers. Diversified marketing approaches are helping bridge these gaps. Local context, infrastructure, and institutional support continue to shape farmers' marketing behavior. The study also confirms that while local bean varieties are marketed in slightly higher quantities, improved bean varieties provide significantly higher income despite marginally higher marketing costs. Improved varieties, though demanding more investment, prove more profitable due to better pricing and quality perception. This trend mirrors regional patterns where improved agricultural technologies enhance farmer income. Nonetheless, traditional varieties continue to play a vital role in local food systems. The study confirmed that price fluctuation, poor road networks, high marketing costs, low supply by producers, and competition from local varieties negatively affect participation, while access to extension services positively influences it. Addressing these challenges through policy interventions, infrastructure development, and support services is crucial for enhancing the value chain's efficiency and sustainability.

Recommendations

The following are the recommendations from the study;

- Strengthen trader-farmer networks through cooperatives and market hubs to improve price negotiation and market access. This should be followed by strengthening and subsidizing input supply chains through public-private partnerships to improve access to certified improved bean seed and related agro-inputs
- Increase investment in agro-input distribution channels in remote areas to ensure farmers have timely access to quality inputs.

- Enhance farmer access to structured markets and cooperatives by supporting local aggregation centers, which can reduce reliance on intermediaries and improve price negotiation.
- Expand extension services and seed access programs targeting remote sub-counties to promote uniform adoption and raise awareness about the benefits of improved bean varieties.
- Extension services should enhance farmer training on cost-effective marketing of improved varieties, including sorting, packaging, and accessing premium markets to offset higher marketing costs.
- Government and NGOs should support local farmer cooperatives with infrastructure like storage and transport, reducing unit costs and increasing profitability for both improved and local beans.
- The findings, demonstrate that among all the improved bean varieties considered, NABE12C, NARO BEAN 4C, NABE 17, NARO BEAN 5C and NABE 19 were the most prevalent relatively because of their good performance and consumption traits. The study recommends that these specific varieties be disseminated widely across the community. This can be done through development of a farmer selection criteria targeting these specific varieties.

Acknowledgements

Special thanks go to my supervisors Prof. Fina Opio and Mr. Wycliffe Tumwesigye for the tireless and invaluable guidance, positive criticisms and suggestions through which learning was accomplished towards the completion of this dissertation. My sincere thanks further go to Bishop Stuart University for providing e-library resources that have enabled me to gather and review relevant information successfully.

Competing interests

The authors declare that they have no competing interests.

Conflict of interests

None.

Funding

None.

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