

Research Application Summary

Performance of pulses and sesame value chains in Eastern Uganda

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Abstract

Pulses and sesame constitute important nutritional and nutraceutical benefits providers and smallholder household income generating sources in eastern and northern Uganda. In spite of their increasing demand locally, regionally and internationally, limited progress has been registered in commercialization of production especially in Eastern Uganda. Hence, a study involving a cross section of farm households, traders, farmer groups and key informants selected using multi-stage respondent driven and random sampling blended criteria was carried out to analyse the performance of the pulses and sesame value chains. Qualitative and quantitative data were generated and analysed to provide individual and community perceptions on the value chain activities and actors as well as the technical and financial performance of the value chain. Descriptive and gross margins analyses were carried out. Findings showed that value chain actors comprised of individual smallholder farmers, farmer groups, traders as well as government and non-government organisations that played a facilitating role. Sesame, beans, cowpeas, greengram and pigeon peas are grown by 58, 29, 28, 47 and 10% of the households, respectively. Land allocated to sesame, beans, cowpeas, greengram and pigeon pea production, on average was 1.45, 1.02, 0.88, 1.01 and 0.71 acres per household, respectively. Due to limited knowledge, information and skills for use of improved crop production technologies and techniques, farmers produced local and earlier accredited varieties. Although farmers registered poor harvests during the season under study (first season of 2021) their average output levels were quite good; 158, 152, 87, 103 and 36 kilograms per acre for sesame, beans, cowpeas, greengram and pigeon, respectively. Specifically, Amuria farmers realized higher sesame and cowpea output, while Kalaki farmers realized higher beans output. Profitability analysis results showed that greengram was the most profitable crop followed by sesame, beans and cowpeas, respectively. Sesame fetched the highest price in the market, but its production was relatively costly. Farmers obtained the lowest net marketing margin share in the production of processed sesame, but high net marketing margin shares in the production of cowpeas, greengram and beans. Besides, actors within and across value chain components operated independently implying that the value chains are fragmented. Strategies for unlocking the potential of pulses and sesame enterprises, therefore, lie in improving technologies and pertinent information dissemination coupled with institutionalization of actors for strategic networking and collaboration for sustainable value chains development.

Key words: productivity, profitability, pulses, value chain, Uganda

Résumé

Les légumineuses et le sésame constituent des sources importantes de bienfaits nutritionnels et nutraceutiques ainsi que de revenus pour les ménages de petits exploitants agricoles dans l'Est et le Nord de l'Ouganda. Malgré leur demande croissante au niveau local, régional et international, des progrès limités ont été enregistrés dans la commercialisation de la production, en particulier dans l'Est de l'Ouganda. Par conséquent, une étude impliquant un échantillon transversal de ménages agricoles, de commerçants, de groupes de producteurs et d'informateurs clés sélectionnés en utilisant des critères de sondage multi-étapes a été réalisée pour analyser la performance des chaînes de valeur des légumineuses et du sésame. Des données qualitatives et quantitatives ont été générées et analysées pour fournir des perceptions individuelles et communautaires sur les activités et les acteurs des chaînes de valeur ainsi que sur la performance technique et financière de la chaîne de valeur. Des analyses descriptives et des marges brutes ont été réalisées. Les résultats ont montré que les acteurs des chaînes de valeur étaient composés de petits exploitants agricoles individuels, de groupes de producteurs, de commerçants ainsi que d'organisations gouvernementales et non gouvernementales jouant un rôle de facilitation. Le sésame, les haricots, les niébés, le gramme vert et les pois cajan sont cultivés respectivement par 58, 29, 28, 47 et 10 % des ménages. La superficie allouée à la production de sésame, de haricots, de niébés, de gramme vert et de pois cajan était en moyenne de 1,45, 1,02, 0,88, 1,01 et 0,71 acres par ménage, respectivement. En raison de connaissances, d'informations et de compétences limitées sur l'utilisation des technologies et techniques de production de cultures améliorées, les agriculteurs produisaient des variétés locales et antérieurement accréditées. Bien que les agriculteurs aient enregistré de mauvaises récoltes pendant la saison étudiée (première saison de 2021), leurs niveaux de production moyens étaient assez bons ; 158, 152, 87, 103 et 36 kilogrammes par acre pour le sésame, les haricots, les niébés, le gramme vert et les pois cajan, respectivement. En particulier, les agriculteurs d'Amuria ont réalisé une production plus élevée de sésame et de niébés, tandis que les agriculteurs de Kalaki ont réalisé une production plus élevée de haricots. Les résultats de l'analyse de rentabilité ont montré que le gramme vert était la culture la plus rentable, suivi du sésame, des haricots et des niébés, respectivement. Le sésame obtenait le prix le plus élevé sur le marché, mais sa production était relativement coûteuse. Les agriculteurs obtenaient la part la plus faible de la marge nette de commercialisation dans la production de sésame transformé, mais des parts élevées de la marge nette de commercialisation dans la production de niébés, de gramme vert et de haricots. En outre, les acteurs au sein des composants de la chaîne de valeur et entre eux-ci opéraient de manière indépendante, ce qui implique que les chaînes de valeur sont fragmentées. Les stratégies pour libérer le potentiel des entreprises de légumineuses et de sésame résident donc dans l'amélioration des technologies et la diffusion d'informations pertinentes, couplées à l'institutionnalisation des acteurs pour un réseautage stratégique et une collaboration pour le développement durable des chaînes de valeur.

Mots-clés: productivité, rentabilité, légumineuses, chaîne de valeur, Ouganda

Background

In Uganda's smallholder agricultural system, pulses and sesame constitute very important food security and income generating crop commodities (UBOS, 2022). Due to their high fiber, low-fat and no cholesterol content,

pulses are used to control diabetes and obesity (Rawal and Navarro, 2019). Besides, pulses enhance soil fertility by fixing nitrogen into the soil hence improving productivity of the farmlands (Kilimo Trust, 2012). When farmers use pulses for intercropping and as cover crops, they promote farm and soil biodiversity while controlling harmful pests and diseases (Rawal and Navarro, 2019). Pulses can contribute to climate change mitigation by reducing dependency on the synthetic fertilizers as they naturally introduce nitrogen into the soil as opposed to synthetic fertilisers which are associated with release of greenhouse gases that are detrimental to the environment (Chai *et al.*, 2019; Menegat *et al.*, 2022). Sesame on the other hand is valued for its very high oil content seeds. The sesame seed contains 50 – 60% oil, making it one of the crops with the highest oil content (Baydar *et al.*, 1999). Sesame oil is very stable due to the presence of a number of antioxidants, for example, sesamin, sesamol and sesamol, which give it long shelf life (Chung *et al.*, 2004; Suja *et al.*, 2004). Sesame oil can be blended with less stable vegetable oils to improve their stability and longevity (Mahmoud *et al.*, 2012). Moreover, sesame seeds are used for preparation of various dishes and confectioneries. Sesame seeds also possess bioactive properties which exhibit a wide range of medicinal and pharmaceutical properties and are often used in various health care products (Khan *et al.*, 2010). Fortunately, sesame contribution to the export earnings has risen (Uganda Bureau of Statistics, 2022). Generally, pulses and sesame demand is on the rise locally, regionally and internationally thus providing smallholder farmers great opportunity in terms market-oriented production for household income enhancement.

The major pulses grown in Uganda and Eastern region in particular, include beans, cowpea, mung bean/ greengram and pigeon pea. Just like other smallholder commodity value chains, pulses and sesame chains are characterized by limited access and capacity to secure and/or use modern inputs. The low rate of adoption and use of improved technologies is partly attributed to limited supply, low seed multiplication capacity, poor dissemination, high costs and limited awareness of the released varieties (Mastenbroek *et al.*, 2021; Myeni and Moeletsi, 2023). International Trade Centre (2015) observed that less than 0.5 percent of seeds used by smallholder farmers is certified. The common practice is for farmers to exchange seeds locally (Chemonics International Inc., 2010). The problem is compounded by information asymmetry surrounding agricultural production. For instance, even when new technologies such as improved seed varieties with high yield and resistance to biotic and abiotic stressers traits are supplied, low adoption rates are registered due to poor or lack of appropriate dissemination mechanisms (Ouruma *et al.*, 2015). Absence of information coupled to resource limitations leave farmers with no option but to resort to their adaptation mechanisms which include use of saved and recycled poor quality seeds (Chauhan *et al.*, 2015).

At harvest and postharvest management level, smallholder farmers face the challenges of limited access to on-farm storage leading to high susceptibility of produce to storage pests and diseases (Stephens and Barrett, 2021; Tibaingana *et al.*, 2022). The post-harvest losses for pulses, for example, have been estimated to range from 15 to 20 percent of total production (Rashid *et al.*, 2015). Smallholder farmers are compelled to sell their produce immediately after harvest as a mechanism for averting substantial post-harvest losses. The problem is exacerbated by high information asymmetry surrounding the produce trade yields opportunistic transactions that often lead smallholder agricultural producers to engage in unprofitable and demotivating deals. For instance, 70 percent of

beans output in Uganda is sold to village collectors and only 5 percent to institutional buyers (Kilimo Trust, 2012) implying that farmers sell most of their produce at low prices (Kilimo Trust, 2012). Besides, smallholder commodity supply systems are fragmented with each individual striving to reach a final consumer due to limited/lack of credible institutional buyers (Kongai *et al.*, 2018). Thus, farmers' sell their produce to village traders and assemblers who often act as middlemen between the farmers and traders, but operating in high market information asymmetry often for strategic purposes.

Moreover, smallholder production systems in Uganda are characterized by limited value addition, especially at industrial level (Kongai *et al.*, 2018). According to Kilimo Trust (2012), less than 1 percent of the total beans produced in Uganda are industry-processed. Yet, market prices of these commodities increase as they move along the value chain. For example, along the beans flour value chain, at local level, processors receive 48%, retailers 25% and open market traders 27% of the final price (Kilimo Trust, 2012). Value addition to agricultural products serves as a mechanism for attaining commercialisation, increasing farm incomes and reducing poverty among the rural poor (Sebatta *et al.*, 2015). However, limited information exists to guide interventions to address pertinent challenges in pulses and sesame value chains in Uganda. This study therefore sought to generate information to guide strategies aimed to promote and develop pulses and sesame enterprises in Eastern Uganda. Specifically, the study assessed the functional, technical and financial performance of the sesame and pulses value chains as well as the associated roles and decision making powers of women and men.

Methodology

The study to analyse the pulses and sesame value chains was carried out in Amuria, Kalaki and Soroti districts in Eastern Uganda during 2021-2022. The sample constituted a total of 69 households, 10 input traders, 14 output traders, five farmer groups and three key informants. Sample selection was done using multistage sampling criteria involving purposive selection of districts and sub 'counties while respondents were selected using a blend of random and respondent driven sampling (RDS) criteria (Johnston and Sabin 2010; Kongai *et al.*, 2018). The purpose of using RDS criteria was to reduce the biases that would result from use of purely purposive sampling method (Johnston and Sabin 2010). The respondents' selection procedure involved random selection of the initial respondent per parish, thereafter, subsequent respondents were selected from the list generated with the help of the previous respondent. Given that the study was carried out during COVID 19 lockdown, the blended method, especially RDS, facilitated observance of Covid 19 standard operating procedures (SOPs) as it limited the number of respondents that the research team got in contact with. The process of selecting the next respondents randomly from the previous respondents' generated lists continued until no new information was generated. Traders on the other hand were selected from those named by respondent farmers or randomly selected from Amuria, Kalaki or Soroti input or produce stores and/or markets. The study employed both qualitative and quantitative research approaches to ensure inclusion of individual and community perspectives of selected commodity value chain operations as well as the associated strengths and weaknesses. The data were analysed using SPSS computer package to generate descriptive statistics used to explain actors' perceptions of priority commodity value chains, marketing channels, market access and factors affecting the selected crop value chains performance. In addition, gross margin analyses were carried out to estimate crop value chain actors' costs and benefits and enterprise profitability.

Results and Discussion

Household characteristics. The average household size in Amuria and Kalaki districts stood at 8 and 7 people, respectively. This finding shows an increase in average household size. Earlier studies showed average household size of 7 and 5 people per household in Amuria and Kalaki districts, respectively (National Housing Census report, 2014; Kongai *et al.*, 2018). This could be attributed to expansion in households consequent to Covid 19 lockdown bulge in young couples families. It was observed that the young couple families were integrated to the older families because the minors were considered irresponsible thus unable to prudently manage family resources, such as land, independently. The overall proportion of young families in the study area were approximated to be 50 and 30% of the total households in Amuria and Kalaki districts, respectively. No significant difference existed in household size between the female and male headed households. Average household land holding was 4.5 and 3.2 acres in Amuria and Kalaki districts, respectively. Gender disaggregated data showed that female headed households had less (2.7) acreage compared to the male headed households with 4.3 acres. This may be due to marginalization arising from cultural norms and practices. In the study area, women culturally have no right to land (Cooper, 2010). Nevertheless, the Agricultural Census 2008/2009 reported an average land holding acreage of 2.7 for the eastern region implying that the female headed households are within the general range. Apart from 21.5% of the households that hired land for crop production, majority of the households used owned land for agricultural production. Findings showed that pulses and sesame value chain actors comprised of individual farmers, farmer groups and seed companies while government and NGOs facilitated value chain operations.

Inputs supply. The distribution of inputs happened through formal and informal channels with seed companies and individuals specialized in seed distribution constituting only 20% of the input suppliers. The main suppliers of seed on the market were East African Seeds, Equatoria Seeds, Mbale Seed Growers, National Agricultural Research Organisation (NARO) and Serere Seeds Ltd. The rest 60 and 20% of seed dealers comprised of non specialized/local traders and farmers, respectively, who sold surplus produce as seed. The main seed purchase points according to farmers were agro input shops (67%), local markets (29) and friends 4 %. Surprisingly, farmers preferred to purchase sesame, beans, cowpea, greengram and pigeon pea seeds from local traders/markets, based on subsistence and output market preferences. The average retail seed prices were 4,500, 4,200, 3,500 and 3,500 shillings per kilogram (1US\$ = 3,500 shillings) for sesame, beans, cowpeas and greengram, respectively, average wholesale prices were 3,300, 2,000 and 2,800 shillings for sesame, beans and greengram, respectively. The main types of inputs sourced from agro input shops were fertilisers, herbicides and farm implements. Overall, observed that purchasing inputs from local input shops enabled farmers to minimize procurement costs because it reduced on transport costs. However, farmers lacked varietal knowledge and information.

Farm Production. The average land allocation to sesame, beans, cowpea, greengram and pigeon pea stood at 1.45, 1.02, 0.88, 1.01 and 0.71 acres per household, respectively. It suggests that more land was allocated to sesame, beans and greengram compared to cowpea and pigeon pea (Table 1). Sesame, greengram, beans and cowpeas were produced by 58, 47, 29 and 28% of the respondent households, respectively. Comparing across gender, results showed that more male headed households produced sesame (41%) and greengram (35%) in

relation to other crops under study (Table 2). The Agricultural Census of 2008/2009 reported the proportions of farmers growing sesame, beans, cowpeas, and pigeon peas in eastern Uganda as 11, 20, 51, and 3%, respectively. These findings imply that there is an increase in sesame, beans and greengram production while cowpea production registered a reduction. This could be due to the quest for diversification to commercial farming as expressed by the farmers.

Table 1. Sesame and pulses acreage in two districts of Uganda

Crop	Amuria		Kalaki		Total	
	Mean	SD	Mean	SD	Mean	SD
Sesame	1.76	1.03	1.17	0.62	1.45	0.88
Beans	1.11	0.74	0.97	0.07	1.02	0.48
Cowpeas	0.89	0.21	0.83	0.26	0.88	0.22
Greengram	0.98	0.40	1.07	0.39	1.01	0.39
Pigeon pea	0.67	0.26	-	-	0.71	0.27

Table 2. Pulses and sesame production by district and gender

Crop	Amuria				Kalaki						
	Female		Male		Female		Male				
	F	%	F	%	F	%	F	%	Female %	Male %	Total%
Sesame	4	5	17	22	10	13	15	19	18	41	58
Beans	2	3	6	8	7	9	8	10	11	18	29
Cowpeas	5	6	9	11	3	4	5	6	10	18	28
Greengram	5	6	18	23	4	5	10	13	11	35	47
Pigeon pea	1	1	6	8	0	0	1	1	1	9	10

According to the Agricultural Research Organisation (NARO), there are about 10 improved varieties of beans, 7 of cowpeas, 3 of greengram, 7 of pigeonpea and 6 of sesame, but farmers grew only a few of them (NARO, 2014). The common varieties of beans grown include K20, Kanyebwa, Kasese and black as indicated by 15%, 6%, 4% and 3% of the respondents. Farmers could hardly specify the greengram varieties grown as 18% and 15% of them indicated that they grew local and large seeded varieties thus highlighting a gap in technology communication and dissemination. Common sesame varieties grown were Sesim 1 and Sim 2 as reported by 35 and 19 % of the respondents. Sesim 1 and K20 are improved, but older varieties of sesame and beans respectively, suggesting that farmers preferred to grow older (improved) and local crop varieties. Generally, farmers had limited or no information about the existing pulses and sesame varieties as well as their marketing potential.

Findings showed that pulses and sesame farming are self-employment undertakings with 84% of the respondents sourcing labour for production from family members. A significant proportion (63%) of the households hired casual labour to supplement on family labour. The male headed households employed more casual labour compared to female headed households. This could be because male headed households have more resources at their disposal compared to female headed households. Majority (60%) of the house

holds used pesticides for crop production, though across gender comparisons showed that a higher proportion (49%) of male headed households used pesticides compared to only 14% of the female headed households. There was limited use of fertilizer as by the households. Generally, pulses and sesame production is rainfed and associated with use of traditional technologies and techniques, though the crops suffer from persistent droughts and, pests and disease infestations. For example, in focus groups discussions, it was observed that crops were greatly affected by the 2021 first season drought leading to realization of very low or no levels of crop output.

The study findings showed that on average, sesame, beans, cowpea, greengram and pigeon pea output levels were 158, 152, 87, 103, and 36 kilograms per household, respectively (Table 3). Across districts, Amuria district households realized higher average output for sesame and cowpea; 212 and 91 kilograms per household, respectively, compared to Kalaki District households with 111 and 77 kilograms per household (Table 3). On the other hand, Kalaki households on average produced more (178 kilograms) of beans per household compared to Amuria District households with 102 kilograms per household. The differences in district level crop performance could be attributed to enterprise promotional strategies, prioritization and relative seasonal variations.

Table 3. Average crop output in two districts of Eastern Uganda

Commodity	Amuria		Kalaki		Overall	
	Output	SD	Output	SD	Output	SD
Sesame	212.13	204.20	111.19	105.55	158.57	165.84
Beans	102.22	37.01	177.94	117.78	151.73	103.28
Cowpeas	91.433	48.97	76.67	62.50	87.00	52.12
Greengram	86.88	70.91	130.71	85.3	103.03	78.38
Pigeon pea	34.17	38.26	-	-	36.43	35.44
Honey	-	-	-	-	-	-

Table 4. Average crop output by gender of household head

Commodity	Female		Male		Total	
	Output	SD	Output	SD	Output	SD
Sesame	75.67	65.98	195.15	183.46	158.57	165.84
Beans	184.55	122.50	127.67	82.83	151.73	103.28
Cowpeas	91.43	55.51	84.62	52.38	87.00	52.12
Greengram	117.22	100.35	98.62	71.81	103.03	78.38
Pigeon pea	-	-	36.43	35.44	36.43	35.44

The male headed households on average produced more sesame (195.2 kilograms per household) compared to female headed households with 75.7 kilograms (Table 4). On the other hand, female headed households produced more beans (184.6 kilograms) and greengram (117.2 kilograms) per household compared to male headed households with 127.7 and 98.6 kilograms per household, respectively (Table 4). Focus group discussion results showed that sesame is mainly a male dominated crop enterprise because men found the crop easier to plant and weed. In addition, men found sesame to be more rewarding because it is not considered a delicacy for home consumption, thus attracting minimal domestic conflicts when sold compared to other crops which

women often reserve for food security purposes. Contrary to that, cowpea and greengram were found to be women crops and women mainly grew these crops for home consumption. Besides, women preferred to grow cowpea and greengram because they would obtain at least some output even when planted late; coinciding with drought and, usually, cowpea and greengram are served as dry season relish in the eastern and northern parts of Uganda.

Table 4. Average crop output by gender of household head

Commodity	Female		Male		Total	
	Output	SD	Output	SD	Output	SD
Sesame	75.67	65.98	195.15	183.46	158.57	165.84
Beans	184.55	122.50	127.67	82.83	151.73	103.28
Cowpeas	91.43	55.51	84.62	52.38	87.00	52.12
Greengram	117.22	100.35	98.62	71.81	103.03	78.38
Pigeon pea	-	-	36.43	35.44	36.43	35.44

In focus group discussion, female headed households produced more of the crops that had some level of tolerance to drought and often used for subsistence in order to secure some harvest, thus the higher levels of production of beans, greengram and cowpea. This is also partly because female headed households that are often resource constrained have to wait for the male headed households that own oxen to plough their gardens before they obtain a chance to plough theirs. The focus group discussion findings also highlighted that as a general community practice, women have to offer labour at the onset of the season for household (men's) priority crops management, but later embark on subsistence or own crops.

The productivity of sesame, beans, greengram and cowpeas was 109, 149, 102 and 99 kilograms per acre, respectively, which is relatively low. Sesame was found to be more productive in Amuria compared to Kalaki district as shown by productivity levels of 121 and 95 kilograms per acre, respectively. The productivity of beans and greengram on the other hand was higher (183 and 122 kilograms per acre) in Kalaki District compared to Amuria with 92 and 87 kilograms per acre, respectively. This could be attributed to differences in varietal performance and weather conditions. For all the crops under consideration, majority of the farmers, grew either traditional or improved, but old varieties such as Sesim1 and K20 for sesame and beans, respectively.

Harvest and postharvest management. Farmers used basic technologies and techniques for harvest and postharvest management. Sesame was harvested by cutting plant parts using sickles. The cut plant parts were either hanged on the remaining plant parts or tied on structures constructed using poles for drying. The harvesting and farm processing activities, including threshing, winnowing, sorting, packing and transporting produce to drying and farm storage structures were activities mainly performed by women and children. The traditional technologies and techniques were found to be associated with high levels of drudgery for women and children as it involved a lot of labour to transport the cut parts of plants to drying structures, provide hedges for protecting the produce from damage by domestic animals at drying structures and other associated activities. This calls for adaption or innovation of technologies aimed to reduce drudgery for women and

children. Beans on the other hand were harvested by uprooting plants and transporting to the courtyard or verandas for drying and threshing. The beans were dried, threshed and stored with some husks as a bruchids infestation control measure. Cowpeas and greengrams on the other hand were harvested by hand picking pods which, were also transported to the courtyards for drying. Generally, most of the cowpeas and greengram were dried and stored in pods as a bruchids control mechanism until time for consumption or sale reaches, then they are threshed.

The main processing and value addition activities performed by farmers were mainly threshing/dehusking, winnowing and sorting. Drying, threshing, winnowing and sorting were mainly performed by women and children apparently because these activities required patience and care for quality output. Earlier studies similarly observed that the common value addition activities performed along the pulses and sesame commodity value chain include cleaning and/or sorting, but done specifically for specialized supply chains such as supermarkets and/or export chains (Chemining'wa *et al.*, 2014; FAO, 2019;). The produce was packed in polythene bags of capacity ranging from 100 to 150 kilograms for measurement, storage and transportation to points of sale. The packaged produce bags were stored in residential structures for security purposes. Apart from drying and cleaning, sesame was also processed by roasting to produce snacks as well crashing to produce paste used to prepare various dishes. Sesame paste production is done at cottage and small industry level in Soroti City and other urban centers.

Produce marketing. Actors in the marketing component of the pulses and sesame value chain include individual farmers, farmer groups, traders and commission agents. Individual farmers and farmer groups sold produce to final consumers and traders at local markets, city markets and border markets. Amuria District households mainly supplied pulses and sesame commodities to Abarilela and Soroti City market as shown by 25 and 23% of the respondents, respectively, while Kalaki households mainly supplied their produce to Achew, Otuboi, Soroti and Lira markets as shown by 35, 26, 22 and 14% of the respondents, respectively. Some of the produce was also supplied to Busia and Lira town markets. Findings showed that over 80% of sesame output constituted sales. Most of the pulses produced were also marketed as shown by the high proportion of sales per crop made by the respondent households (table 5). Output sales by gender analysis findings showed that female headed households sold more (80.57%) of the total output of greengram compared to the male headed households with 48.77% (Table 5). Cowpeas registered the lowest total output sales among female headed households. This could be because cowpea serves as a major sauce ingredient during dry season and is normally preserved for food security reasons.

Table 5. Average crop output sales in two districts of Eastern Uganda

Commodity	Amuria District		Kalaki District		Overall		
	Output sales	SD	Output sales	SD	Output sales	Output	Sales %
Sesame	178.55	184.57	89.62	94.56	130.38	158.57	82.22
Beans	65.00	28.66	123.53	108.22	104.80	151.73	69.07
Cowpeas	60.62	69.23	36.67	49.67	52.50	87.00	60.34
Greengram	58.75	71.75	84.29	90.70	68.16	103.03	66.16
Pigeon pea	30.00	89.67			29.29	36.43	80.40

The male headed households on the other hand sold more (84.53% and 80.40) of total sesame and pigeon pea outputs. This may suggest that sesame and pigeon pea are men's crop while greengram and cowpea are women's crops. Overall, sesame fetched the highest price followed by beans in both districts (Table 6). Sesame, beans and greengram prices were higher in Amuria District while the cowpeas price was higher in Kalaki District (Table 6). It was also observed that sesame and greengram were highly traded crops.

Table 6. Average output price in two districts of Eastern Uganda

Commodity	Amuria District		Kalaki District		Overall	
	Mean	SD	Mean	SD	Mean	SD
Sesame	3,439	871	3,089	589	2,983	1,203
Beans	2,622	696	2,415	561	2,292	917
Greengram	2,265	484	2,163	447	1,647	1,025
Cowpeas	2,091	485	2,425	447	2,187	609
Pigeon peas	1,650	100	-	-	1,720	179

Institutional support. Research institutions, Non-Government Organisations (NGOs), and farmer groups played a value chain facilitating role. Research institutions mainly provided farm technologies and techniques while other institutions facilitated networking and some provided financial relief to farmers. Most of the financial resources invested in crop production, however, were obtained from family savings borrowed from friends and/or group savings (village savings and loan associations). Generally, less than 50% of the households had members affiliated to farmer groups/institutions. Kalaki households had members belonging to Angirikisi Aswam and Gen Rwot groups respectively while Amuria District farmers mainly belonged to Ekewutu Apol. Belonging to farmer institutions helps to reduce transaction costs for market exchanges, as farmers obtain necessary market information, secure access to new technologies or even tap into new high value markets through group interactions (Kongai *et al.*, 2007; Markelova and Meinzen, 2009; Ouma *et al.*, 2010).

Profitability. The financial analysis results showed that sesame farming is a profitable venture with profitability levels of 13 and 25% for basic and improved farm management regimes (Table 7). The improved farm management regime implied use of relatively high-quality seeds and pesticides. Even though farmers could not specify varieties produced, literature indicates that some of the sesame varieties grown in Uganda include Sesim 1, Sesim 2 and Sesim 3. The profitability analysis results of bean production under basic and improved management regimes showed profitability levels of 11 and 23%, respectively (Table 7). Farmers mainly grew K20, Kanyebe, Kasese and local varieties. It was observed that Kasese was mainly grown due to its adaptability to the environment as it registered better outputs even under harsh conditions compared to other varieties. Other farmers during focus group discussions indicated that they grew whatever seed they set their hands on because they lacked knowledge and information on the appropriate varieties to be grown. This highlights the need for variety information dissemination. Financial analysis results for greengram production showed that farmers obtained profits of 19 and 29% under basic and improved farm management regimes (Table 7). Just like other crops, respondents had limited knowledge of the prevailing greengram varieties as shown by less than 40% of the respondents who could identify varieties grown.

Cowpea similarly was found to be profitable based on the financial analysis results. The profitability levels of cowpea stood at 19 and 21% under basic and improved farm management practices (Table 7). Likewise, farmers lacked knowledge and information about the type of currently grown and potentially beneficial varieties. Of all the pulses under study, pigeon pea was found to be unprofitable with losses of 23 and 19% for basic and improved management regimes, respectively. This could be the reason for diversification away from pigeon pea farming as only 10% of the farm households produced pigeon pea. Overall, the pulses and sesame production financial analysis results demonstrated that, sesame, beans, greengram and cowpeas farming were profitable. The most profitable crop enterprises at basic management regime are greengram and cowpea. Similarly, at improved management regime, greengram is the most profitable enterprise followed by sesame. This calls for the need to encourage farmers to adopt new technologies in order to enhance productivity and ultimate benefits of commercialization of pulses and sesame production.

Table 7. Pulses and sesame costs and benefits for produce sold at farmgate

Crop	Basic management regime		Improved management regime	
	Gross profit per kilo of output (UGX)	Gross profit %	Gross profit per kilo of output (UGX)	Gross profit %
Sesame	786	13	1,430	25
Beans	753	11	1,583	23
Greengram	892	19	1600	29
Cowpea	875	19	1,162	21
Pigeonpea	(79)	(23)	(15)	(19)

Value chain costs and benefits. The study focused on farm production as the starting point of pulses and sesame production, tracing costs and benefit shares through assembly, processing and marketing components of the respective crop value chains upto consumer level. Beans value chain actors' costs and benefit analysis results showed that farmers incurred the highest proportion (74%) of added costs and obtained a net marketing margin of 70%. The value chain actors' costs and benefits shares show that farmers obtained the highest net marketing margins when producing greengram and cowpea. This may be due to data irregularities. Nevertheless, a marketing margin share of 61% and a retail price percentage of 68% in comparison with added costs percentage of 74%, still provides a fair incentive for farmers to continue production of the crop. Besides, adoption of higher yielding varieties would increase benefits to farmers. The cowpea value chain actors' costs and benefits results showed that farmers obtained a net marketing margin percentage of 80% and retail price share of 81% against added costs percentage of 75. Overall, farmers incurred the highest added costs, but returns were commensurate to the investment.

Much as the benefits from cowpea are attractive, farmers seem to be hesitantly transforming to production for the market. This could be due to limited market access for cowpeas, thus necessitating innovation for increased utilization and market development. Sesame's actors' costs and benefit shares showed that farmers incurred the highest (81%) added costs but only obtain 15% of the net marketing margin percentage (Table 8). The low marketing margin could be due to disposal of output at low price immediately after harvest with limited value addition. Wholesalers obtained the highest (30%) net marketing margin percentage followed by the retailers with 26% relative to added costs of 10 and 7%, respectively.

Table 8. Actor's costs and benefit shares for selected commodities in two districts of Uganda

Actor	Sesame without processing line			Sesame with processing line			Beans		Greengram		Cowpea	
	Added costs %	Net %	MM	Added costs %	Net MM %		Added costs %	Net MM %	Added costs %	Net MM %	Added costs %	Net MM %
Farmer	81	15		28	7		74	70	74	61	75	80
Assembler	2	6		1	3		5	3	4	4	4	4
Wholesaler	10	30		3	15		11	5	13	19	7	8
Processor	-	-		51	59		-	-	-	-	-	-
Retailer	7	26		17	21		11	22	9	18	7	8

In addition, the costs and benefit analysis of processed sesame results showed that the processors incurred the highest (51%) added costs, and obtained the highest (59%) net marketing margin. Strategies for improving farmers marketing margins, probably lie in developing the value chain by facilitating farmers linkage to high value markets as well as upgrading to processing. It was also observed that a significant proportion of farmers in Amuria and Kalaki districts organized themselves into cooperatives, with Amuria District prioritizing assembly and marketing of Sesame under Abarilela Simsim Producers and Processors cooperative (ASPPCOs), while Kalaki farmers prioritized marketing of greengram.

Conclusion and Recommendations

Pulses and sesame constitute important cash crop diversification commodities in eastern Uganda whose demand and production is increasing. The common pulses grown in eastern Uganda include beans, cowpea, greengram and pigeon pea with minimal regard to varietal homogeneity. The pulses and sesame crop value chains are segmented and limited by information asymmetry, access to quality inputs and high value output markets. Findings of this study showed that farmers mainly sourced for inputs from local input shops/markets, which enables them to save on information search and transportation costs. Differences exist in crop prioritization across districts with Amuria District producing more sesame while Kalaki District produces more beans. Apparently, greengram is a women's crop while sesame is mainly grown by men. The financial analysis results demonstrated that, sesame, beans, greengram and cowpeas are profitable commodities, however, their production is generally characterized by use of basic farm technologies and techniques on fragmented farmlands managed by a workforce with limited information and knowledge of prevailing and potential improved crop technologies and techniques. Sustainable value chain development strategies for pulses and sesame, therefore ought to focus on improved technologies and pertinent information dissemination, farmer institutionalization for reduction of production costs and high potential enterprise promotion and development. Moreover, the enterprise prioritization efforts could be focused on promoting production of homogeneous crop varieties, specifically, sesame and greengram for Amuria District, and, beans and greengram for Kalaki District for strategic load consolidation and marketing.

Study limitations. The profitability and gross margin analysis were largely based on the first farming season of 2021, which generally registered poor crop performance. Therefore, the findings of this study ought to be interpreted in that context. Overall, farmers could not clearly specify crop varieties grown, henceforth, financial analysis, does not take into account varietal specifics, thus necessitating experimental studies.

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