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The nexus between the interaction among Cowpea actors and its market shares in Uganda. A case of Oyam District

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With the increased use of technology in agriculture, new improved farming and varieties of seeds have been adopted. The study explored how the interaction among the actors helped in sharing vital information on market shares of improved cowpea and relative to improved beans. A cross-sectional research design was used, while quantitative and qualitative approaches were adopted. The respondents were purposively selected because of their expert knowledge in the study. The findings showed, that beans and cowpea enterprise had 0.23 (23%), and 0.14 (14%) interaction density, while 23 and 16 actors participated in the promotion of beans and cowpea enterprises respectively. The findings also show that as a cowpea entrepreneur a farmer is the most influential and dominant actor in providing and using information while in the bean's enterprise, extension service providers stood out as the most influential actor and the farmers remain the most dominant actor. Fellow farmers showed higher influence and dominance in providing and sharing information and other services regarding cowpea. Cowpea was a more profitable and viable enterprise. The study recommends that researchers and other actors should engage in the promotion of improved technologies. There should be increased interaction amongst actors and this creates product loyalty and promotes channel distribution. The actors should also provide and share relevant and timely information regarding agronomic, post-harvest practices, potential market opportunities, and other services.

Key words: Actor's interaction, innovation systems, improved technology, market shares, improved cowpea.

INTRODUCTION

Improved agricultural technologies are seen as one way in which agricultural production systems contribute to addressing the challenge of food, nutrition, national economy, and income insecurity in developing countries (Loevinsohn et al., 2013). Notably, the challenge of the increased global human population of the 20th Century, with more than 7.5 billion inhabitants, and is expected to rise to 9.5 billion by 2050 continues to put pressure on

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the land use and challenge the agricultural production systems (FAO, 2012; Kikuru et al., 2013; Robert, 2016; Chenchen et al., 2019; Dwyer et al., 2012; Kikuru et al., 2013). Notwithstanding, agriculture remains a main source of income for about 2.5 billion people in developing countries (Challa, 2013; Mwangi and Karuiki, 2015). Considerably, for technologies to contribute to increased food production, income, and national economy, there is a need for consistent interaction among actors engaged in improved technology development and promotion (Lavison, 2013; UBOS, 2019; MFPED, 2019).

Correspondingly, actors' interaction is viewed by authors differently, with, Bambang et al. (2013); Mukebezi et al. (2016) referring to information sharing among different departments in an organization to enhance management decisions. Relatedly, Matende and Ogao (2013) views actors' interaction as users' participation in the production system. Similarly, Carsten and Jari (2014); Widyarini et al. (2016) relates the interaction among actors to the engagement of elements like material flow, cash flow, information flow, and humans. Given their definitions, the study considered actors' interaction as the intensity to which actors involved in the cowpea enterprise get in touch directly or indirectly to provide or share required information and other services (agronomic and post-harvest practices, and potential market opportunities) to improve on cowpea production and market shares. Notably, information remains key in understanding the improved technology, in terms of agronomic, post-harvest practices, and potential market opportunities (Sally and Mcguire, 2016), to enhance market shares and profitability of the improved cowpea.

Relatedly, Latruff (2010) equates market shares as the ability of the improved technology to compete with existing technologies and successfully attain the market position. Similarly, market shares of a farm are linked to its presence in the market and generating future results of meeting strategic objectives (Molgorzata, 2016). On the other hand, market shares of the agriculture products are referred to as increased market gains (Darren et al., 2019), and lower costs of production. Accordingly, to cowpea enterprise, market shares are considered as the volume in kgs of improved cowpea produced and sold, relative to improved beans (NABE 2), in a growing season (2019-2020), and profit gained from sales of improved cowpea (SECOW 4W and SECOW 3B), relative to improved beans (NABE2 and NABE4), in a growing season.

As such, cowpea as an improved technology was used in the context to understand such interaction and how it supports increased market shares and profit. The study focused on how and why actors engaged in cowpea enterprise interacts, in a bid to enhance marketing and profitability, supported by UBOS, (2019) who alluded, that for the rural farmers to survive in the existing competitive market, access and use of relevant market information (certified input source/price, competitive output price) needs to be consistent and adequate. Relatedly, frequent interaction between farmers and other actors creates product loyalty, since farmers are able to produce for a specific market, and customers (other actors) constitute part of the production and distribution processes (Rugema et al., 2017). Additionally, such interaction enhances collective marketing, wider market access, and collective action (Coulibaly et al., 2009; Adewale et al., 2014; Rugema et al., 2017). Conversely, the lack of synergies between actors the in agricultural value chain in Uganda may remain a major obstacle to the creation of market opportunities, increased market shares, and achievements of market gains by increased profits (Van Rooyen et al., 2017).

Agricultural sector in Uganda

Agricultural sector is recognized as an important sector for national development in Uganda since it accounts for over 68% of the total employment, 28% of the Gross Domestic Product (GDP), and 48% of the export sector respectively (UBOS, 2018). The frame-works such as National Agricultural Policy (NAP) 2013, Seed and Plant Act (2006), National Agricultural Extension Policy (2018), Vision 2040, Uganda National Council of Science and Technology (UNCST), National Development Plan I, II, III, African Agenda, 2030-2063, East African Community, vision 2050, all emphasize the need to enhance the competitiveness of the agricultural sector in terms of increased yields, market shares, and profitability as a key avenue to achieve the aspired middle-income status by 2040 (UBOS, 2019). These frameworks advocate for the strengthening of the National Agricultural Research Systems (NARS), improved technology development, and extension services delivery systems to develop and promote improved agricultural technologies. (MFPED, 2019) reveals that if technologies are adopted, it may support improvement in crop varieties/livestock breeds and farm practices and extension services as a channel of technology dissemination.

Cowpea and interaction among actors in Uganda

The previous studies on the improved cowpea enterprise in Uganda focused majorly on improving breeds with related agronomic and posts-harvest practices (Bisikwa, 2014; Ayaa et al., 2018), in order to improve on the yields. In the late 1960s, Makerere University Agricultural Research Institute Kabanyoro (MUARIK) in collaboration with Rockefeller Foundation, McKnight Foundation and later with research partners from National Semi-Arid Resources Research Institute (NaSARRI), developed and released several improved cowpeas including SECOW series, 1st Tan (1T), 2nd White (2W), 3rd B (3Black), 4th

W (4White), 5th T(5Tan) and EBOWO series like ACCWC28, ACCW35b, ACCWC39, ACCNE 44. These varieties were tested for both scientific and socio-economic fit (Ddungu et al., 2015), and significantly the SECOW series were taken to the selected farmers by a team of researchers from NaSARRI and Ngetta ZADI through on-farm trials in Lango sub-region, Northern Uganda.

The interaction between researchers and selected farmers was meant to popularise improved cowpea among farmers by use of best agronomic and post-harvest management practices, although little is known about the contribution of researcher-farmer nature of interaction in enhancing the market shares and profitability of the improved cowpea relative to improved beans (NABE4). Beans are considered in the study for its being a leading legume food crop in the sub-region (MAAIF, 2019). However, considering the perspective of Agricultural Innovations Systems, cowpea actors including researchers, extension agents, farmers, Agro input/output traders, NGOs and others were meant to frequently provide and share information and other services beyond agronomic and post-harvest practices which would widen market opportunities of the improved cowpea. Bongiwe et al. (2014); Labarthe and Laurent (2013); Katie and Abigal (2014); Fossen and Schweidel (2016) posits that such interactions among actors provides exposure to potential new markets opportunities and create customer loyalty, since farmers are able to produce for a specific market and consumers constitutes part of the production and distribution channel (Katia et al., 2019).

Ayaa et al. (2018) notes that limited interactions with other actors could explain why farm yields, market shares and profitability of improved cowpea has stagnated at 250-450kg/ha, and cowpea being ranked 4th among the legume food crops respectively. Guy et al. (2015) alludes to the notion that limited interaction among potatoe project farmers in Peru, Ethiopia, Uganda, limited farmers' access to information, technologies, markets and services. The low ranking of cowpea among legume food crops by actors is probably due to low market shares and profitability and yet the crop (cowpeas), unlike other legume food crops adapts easily to harsh climatic condition and it's one of the main sources of food eaten both as grain and green vegetable. As a contribution to the food security in the region, cowpea leaves can be dried and preserved for more than a year and additionally provides a cheap source of protein urgently required among the rural population of Northern Uganda.

UBOS (2019) reveal that there is a prevailing level of malnutrition in the region (Northern Uganda), with 37% of the population among under five years old experiencing staunted growth and yet such children would requires cheap and easily accessible source of protein like Cowpes and the interaction among cowpea actors would contribute towards improved yields, market shares and profitability, as a mechanism to provide a cheap source of protein among the vulnerable young population and reduce the income and food gap. The researcher's previous proposition held that, frequency and intensity of interaction among actors in the cowpea enterprise positively influence the market shares of improved cowpea relative to the improved beans in the Lango sub-region. The frequent interaction between farmers and other actors creates product loyalty since actors operate as collaborators than competitors (Guy et al., 2015; Matende et al., 2013; Zaugg, 2016). The study provided more understanding on the actors, how cowpea actors interact as a pre-requisite in enhancing the market shares and profit of the improved technologies (cowpea). The improved market shares may facilitate the attainment of the anticipated NDP III, Vision 2040, NAP, 2013, NAEP, 2018, and other regional frameworks like, East African Community vision 2050, African Agenda, 2030-2063 and SDGs.The framworks advocate for the socio-economic transformation of subsistence farmers through increased income and food.

Theoretical framework

The study applied Agricultural Innovations Systems (AIS) theory (Klerxk and Nettle, 2013) and theory of information flow (Ron, 2014) that provide illustrations and the insights on actors and how actors interact to provide and share technical information and other services. The cowpea in the context of this study is a product of an innovation developed by multiple actors including extension agents, agro input/output traders and researchers. In order for the interaction to be effective, it has to be frequent and intense for it to offer an opportunity for actors to share relevant and timely information/other services needed by the farmers in order to improve on production and market shares. Ron (2014) notes that based on the theory of information flow, information is best shared using information sharing channels like, on-farm demonstration, local radio, mobile phone SMS/phone calls, brochure, face-to-face and for information shared to be useful, it has to be provided at the time that a farmer needs and it should be able to address the existing problem and the farmer should be able to apply it in a bid to improve on production, market shares and profitability.

METHODOLOGY

A cross sectional research design was applied while both quantitative and qualitative approaches were used in data collection. These approaches enabled the researcher to explain the in-depth aspects of actors' interaction, market shares and profitability. The questionnaires constituted closed ended question on actors, information sharing, market shares of improved cowpea and profit gained. The study was conducted in the district of Oyam in the sub-county and parishes of Amukugungu, Okii and Anyomolyec. From a total population of 475 farmers, a sample of 210 chosen using Morgan and krejice (1970) and a simple random

Table 1. Showing intensity of interaction among cowpea and beans actors in Oyam district.

Measure	Amukugungu parish		Anyomolyec parish		Okii parish	
	Beans	Cowpeas	Beans	Cowpeas	Beans	Cowpeas
Network density	0.233	0.157	0.227	0.138	0.220	0.140
Ties /Relationships.	118	33	105	33	132	38
Nodes/Actors	23	15	22	16	25	17
Average degree (Average number of ties a node has to other nodes)	5.130	2.200	4.773	2.063	5.280	2.235

Source: Primary data (2021)

sampling was applied in the selection. The respondents were purposively selected as they constituted areas where improved cowpea research was piloted by MUARIK, NaSARRI and Ngatta ZADI between 2012-2014.

Qualitative data were collected from the 20 Key informants including, 6 researchers from MUARIK, Ngetta ZADI, and NaSARRI, 6 agro input/output traders, 4 government extension agents and 4 NGOs in the sub-county of Otwal. Three (3) FGDs comprising of 10 members were held, per parish, Members of the FGDs included cowpea farmers.

The questionnaire was uploaded in Ordinary Data Kit (ODK) software and administered to the selected respondents in the three parishes. ODK software allowed the researcher to collect data on line review and forward the collected data to the central server for purpose of data security and further data management.

Data analysis

Qualitative data (actors, roles, information shared, channels used) were collected using KIIs and FGDs were entered into Ucinet software version 6 using NetDraw tool and network maps generated to enable the researcher to visualize Social Network among cowpea and beans actors Oyam district. In the SNA, actors are referred to as nodes while relationships are referred to as ties. Network density provides estimates on potential actors participating in a network, network maps indicate relationships, and measures of centrality illustrate actors' level of influence dominance (Borgatti et al., 2014). The relationship among actors can be positive or negative, that is, existence or nonexistence, and this is referred to as binary (Borgatti et al., 2014). Quantitative data were analyzed using Statistical Package for Scientific Analysis (STATA) computer program to generate inferential statistics. Descriptive Statistics was run using Pearson (r) correlation coefficient to demonstrate the level of relationships between the nature of interaction among cowpea farmers and other actors on the market shares of improved cowpea. The structural Equation Model (SEM) was applied to examine the influence of intensity of interaction (actors' ties, interaction density, average interaction) among cowpea farmers and other actors on the market shares of improved cowpea as compared to improved beans. As such, it (SEM) tests for measurement errors, and estimation of latent (unobserved) variables including the socio-economic variable via observed variables like actors' relationships and establishes a structure that tests for model fitness and analyses data generated from a sample size of more than 200 (Byrne, 2016). Therefore, the model coefficient (beta) estimated the linear increase in the market shares of improved cowpea against improved bean varieties (NABE2 and NABE4), for each unit increase in actors' intensity in the Lango sub-region. SEM is a statistical model that integrates different multi-variate techniques into one model framework (Byrne, 2016).

FINDINGS

The study findings in Table 1 revealed only 16 actors/nodes are engaged in supporting production and marketing in the cowpea enterprise relative to beans with 23 actors. Only 0.14 (14%) of potential cowpea actors are providing and sharing information and other services with one another relative to beans 0.23 (23%). The cowpea had total estimates of 34 ties or relationships while beans had estimates of 118 ties or relationships. The average interaction between cowpea farmers with other actors is at least 2 times in a season relative to beans enterprise with average interaction of at least 5 times. The interactions among beans and cowpea actors are further illustrated in the network map in Figures 1 and 2.

This cuts across the three parishes of Amukugungu, Anyomolyec, and Okii, in the Oyam District. The interaction provides an opportunity for sharing of information and other services in a bid to enhance production and marketing.

The actors in Figures 1 and 2 are categorized into the followings; researchers, comprised of cowpea/beans breeders and agronomists from MaRCCI, Ngetta ZADI, and NaSSARI, whose mandates include; developing the foundation seeds of improved cowpea and beans and disseminating the seeds to seed dealers, extension agents, and farmers. Similarly, the agro-input/output traders whose key roles include; dissemination of cowpea/beans seeds/inputs and the purchase of agro output respectively. The core roles of government extension agents include; the dissemination of information and other services on agronomic/ post-harvest practices, a potential market of cowpea/beans, and other input to the farmers. Non-Governmental Organizations and farmer organizations like AFST, OCDP, WFP, Alito Joint farmer co-operative, and Canomonanino, share a common mandate to provide capacity building to traders, and farmers' mobilization and also provide potential input/output market information in a bid to improve on the production and market shares.

The study findings in Table 2 show that the cowpea enterprise farmer is the most influential and dominant actor in providing and using information and other services with the highest in-degrees (39) and lowest out-

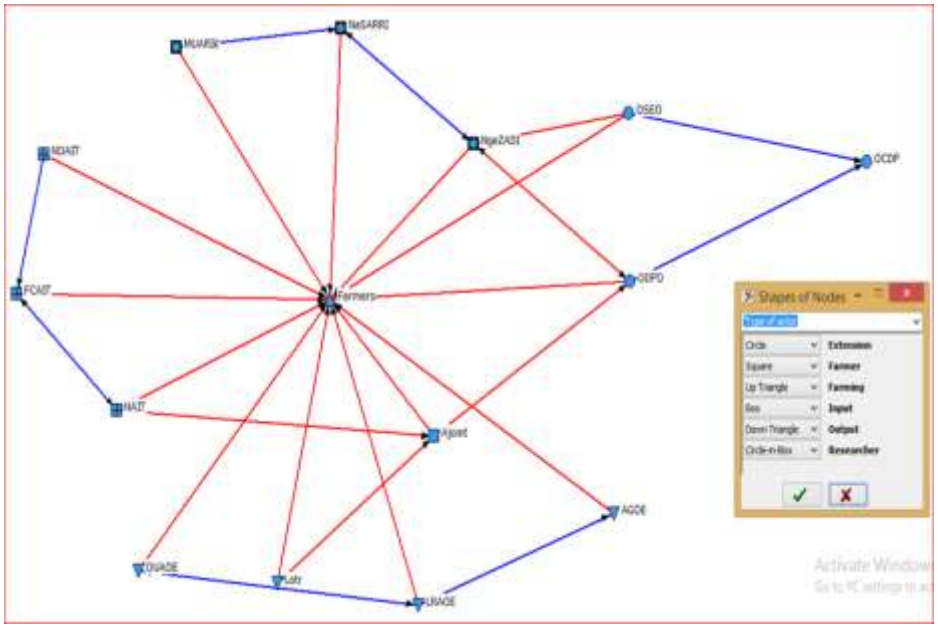

Figure 1. Showing interaction among cowpea actors in Oyam district.
Source: Primary data (2021)

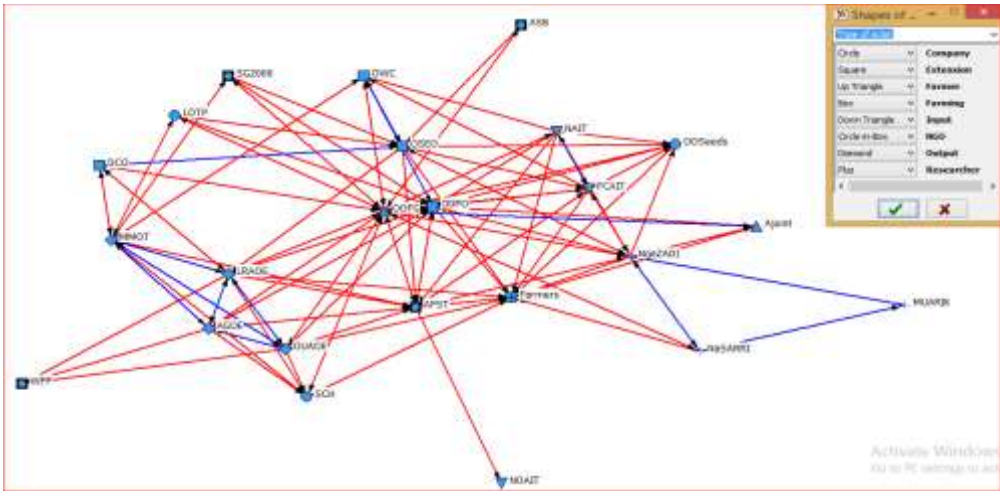

Figure 2. Showing interaction among bean actors in Oyam district.
Source: Primary data (2021)

degrees (0.000) respectively. Meanwhile, Table 3 shows the bean's enterprise, extension service providers stood out as the most influential actor with the highest in-degrees of 33, while farmers remain the most dominant (0.000) actor. The more times an influential actor provide and share information and other services, directly or indirectly, the more they are able to bring in their diversity in the network, close the information and other services gap.

In determining the market shares and level of profitability in cowpea and beans enterprises as a measure of enterprise competitiveness, Table 4 shows that cowpea is a fairly profitable enterprise compared to beans and for any money spent in cowpea enterprise, a farmer earns 1.71% as net profit compared to beans which earns 1.42%. On average, cowpea's overall price is higher in the Oyam district at 2830 Ush, relative to beans with an averagely lower price of 2582 Ush. However, much as a farmer harvests more quantity of beans (360 kgs) and sells 191kgs in a farming season,

Table 2. Showing influential and dominant actor in the cowpea enterprise in Oyam district.

Actor	Out-degree	In-degree	Out-close	In-close	Betweeness
AGOE	6.000	3.000	92.000	99.000	0.000
Ajoint	9.000	6.000	70.000	87.000	23.000
FCAIT	6.000	6.000	69.000	98.000	8.000
Farmers	0.000	39.000	112.000	21.000	0.000
LRAOE	9.000	6.000	91.000	98.000	2.000
Lotr	6.000	3.000	75.000	90.000	0.000
MUARIK	6.000	3.000	83.000	76.000	0.000
NAIT	9.000	3.000	62.000	99.000	14.000
NOAIT	6.000	0.000	70.000	112.000	0.000
NaSARRI	9.000	6.000	80.000	68.000	11.000
NgeZADI	9.000	9.000	79.000	62.000	19.000
OCDP	0.000	6.000	112.000	60.000	0.000
ODPO	9.000	6.000	80.000	60.000	23.000
OSEO	9.000	0.000	74.000	112.000	0.000
OUAOE	6.000	3.000	74.000	112.000	0.000

Source: Primary data (2021)

Table 3. Showing influential and dominant actor in the beans enterprise in Oyam district.

Actor	Out-degree	In-degree	Out-close	In-close	Betweeness
AFST	0.000	15.000	110.000	56.000	0.000
AGOE	0.000	6.000	110.000	65.000	0.000
AUAOE	0.000	3.000	110.000	66.000	0.000
AWFG	21.000	21.000	38.000	57.000	16.369
Ajoint	9.000	6.000	54.000	62.000	0.000
BUG	18.000	12.000	40.000	60.000	5.838
CFG	21.000	18.000	38.000	57.000	17.376
CMSG	21.000	27.000	38.000	53.000	33.246
DCO	6.000	6.000	49.000	65.000	0.250
FCAIT	21.000	18.000	42.000	56.000	8.368
Farmers	0.000	30.000	110.000	49.000	0.000
LRAOE	33.000	27.000	36.000	54.000	59.514
MUARIK	0.000	30.000	110.000	79.000	0.000
NAIT	18.000	9.000	44.000	63.000	1.672
NaSARRI	9.000	3.000	53.000	67.000	16.000
NgeZADI	36.000	30.000	35.000	52.000	69.103
ODPO	30.000	33.000	35.000	51.000	28.533
OSEO	27.000	24.000	36.000	54.000	26.981
OUAOE	33.000	15.000	36.000	59.000	20.546
OWC	18.000	15.000	44.000	59.000	4.066
SCH	9.000	9.000	53.000	62.000	1.286
TFG	24.000	18.000	37.000	57.000	24.853
WFP	0.000	6.000	110.000	65.000	0.000

Source: Primary data (2021)

compared to cowpea, and 196 (kgs) respectively, cowpea still stood out as one of the most desirable enterprises

Table 4. Shows market shares and profit gained from sales of cowpea and beanss in the Lango sub-region.

Parish enterprise	Amukugungu		Anyomolyec		Okii		Overall (district)	
	Beans	Cowpeas	Beans	Cowpeas	Beans	Cowpeas	Beans	Cowpeas
Total costs	711630	502410	654970	533220	583360	487340	654000	494990
Quantity harvested	313	254	483	355	319	265	360	290
Quantity sold	175	176	263	254	187	190	191	196
Price per kilogram	2503	3050	2774	2767	2456	2669	2582	2830
Total revenue/benefit	782500	774700	1337910	983350	784740	707550	926938	840960
Profit (revenue- cost)	70870	272290	682940	450130	201380	220210	272938	345970
Cost benefit ratio	1.11	1.54	2.04	1.84	1.35	1.45	1.42	1.71

Source: Primary data (2021)

among legume crops to the farmer for food and income.

Structural equation modelling

In the cowpea model, Figure 3, actors' ties reported a significant structural (Observed) influence with a p-value of 0.000, and improvement in providing and sharing information and other services by actors in the cowpea enterprise and these therefore increases market shares by a co-efficient of 1.40476 kgs in a season. Whereas, the actors' ties in the bean's enterprise, Figure 4 showed a p-value of 0.008, implying increased networking among bean actors would fairly increase volume in sales of beans output by 1.0002kgs in a season.

Similarly, the cowpea model showed a significant relationship between unobserved factor, land area allocated to cowpea enterprise in the three parishes of Amukugungu, Okii and Anyomolyec, Oyam district and yields with a p-value of 0.000. Thus, an increase in land size (acres) allocated to cowpea enterprise would increase volume in kgs produced and sold and thus increased market shares by a co-efficient of 97.91387 kgs in a season. Relatedly, being a female attached crop showed a significant negative relationship on the market shares of cowpea with a p-value of 0.004, and accordingly, such perception towards cowpea reduces its (cowpea) market shares by a co-efficient of -0.1174906kgs/ha in a season.

The bean model does not show any significant relationship between structural characteristics of the interactions, unobserved variables and market shares. The results in the bean model indicate that maintaining other factors constant, interaction among actors in the bean enterprise coupled with other socio-economic factors were not noticed to significantly influence production and sales of bean in the district. Farmers grow beans for mainly food and partly as a source of income and the contribution of extension agents reported as a main actor in the bean value chain is not significant to amplify production and open market opportunities.

DISCUSSIONS

A strong tie amongst cowpea farmers provides opportunity for sharing of information and other services in a bid to enhance production and marketing. The more times cowpea farmers are influential and a dominant actor would therefore provide and share information and other services directly or indirectly with fellow farmers. The information sharing would bring in the local diversity in the network, use local knowledge regarding agronomic, post- harvest and market opportunities to solve an existing farming and market challenges (Bambang et al., 2013). Cowpea farmers are sure of fellow farmers as the main source of information on agronomic, post-harvest practices, reliable grains and seeds market. Farmers (cowpea) are sure of when to produce and where to sell their farm output. They eliminate sharing of farm profit along the supply chain caused by middle men traders, since they are highly dependent on one another. Non the less, such a relationship has denied both crops (cowpea and beans) break even, with both enterprises operating at a loss.

Accordingly, Lee et al. (2012); Adewale et al., (2014); Zaugg (2016); Kyei-Boahen et al. (2017) alluded to the fact, that strong actors tie brings actors' collaboration other than the competition in the value chain, and they (actors) may constitute part of production and distribution channels. Having such a contribution in the value chain would support the actors to develop product loyalty and avoid middlemen (traders) and consequently contribute towards increased market shares and profitability. This would also explain the profit variations emerging from price differences in the cowpea and beans enterprises emerging from higher prices gained by cowpea farmers. Relatedly, challenges in the public extension service provider as an influential actor in the bean enterprise could explain the low profit gained by bean farmers, as alluded to by MAAIF, (2019).

In Uganda, agricultural extension services have remained uncoordinated with diverse players creating conflicting messages while farmers are not provided with

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Sem (volume sold in kgs Improved <- Ties Cowpeas Network density cowpeas Av degree cowpeas a Land size
planted acres Imp) (Farming system2<- leveleduc1 leveleduc2 leveleduc3 maritalstatus1 maritalstatus2
sexfarmers1 parishfarmer2 Farmers Age Number of years a farmer has How many members are in your How
much land size in acres), nocapslatent
Endogenous variables
Observed:  d volume sold in kgs Improved Farmingsystem2
Exogenous variables
Observed:   Ties cowpeas Network density cowpeas Av degree cowpeas a Land size planted acres Imp
leveleduc1 leveleduc2 leveleduc3 maritalstatus1 maritalstatus2 sexfarmers1 parishfarmer2 Farmers Age
Number of years a farmer has How many members are in your How much land size in acres
Fitting target model:

Iteration 0:   log likelihood = -5565.0761
Iteration 1:   log likelihood = -5565.0761
Structural equation model                       Number of obs     =        210
Estimation method = ml
Log likelihood     = -5565.0761

------------------------------------------------------------------------------
                             |                 OIM
                             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-----------------------------+------------------------------------------------------------------
Structural                   |
  D volume sold in kgs Improved     |
                  Ties cowpeas |    1.40476   .3018154     4.65   0.000     .8132126    1.996307
        Network density cowpeas | -76.55562   88.83202    -0.86   0.389    -250.6632    97.55193
              Av degree cowpeas | -1.580682   11.89724    -0.13   0.894    -24.89884    21.73747
  A Land size planted acres Imp |   97.91387   12.29439     7.96   0.000     73.81731    122.0104
                         _cons |   25.96613   36.28457     0.72   0.474    -45.15032    97.08258
  ---------------------------+------------------------------------------------------------------
  Farmingsystem2             |
                   leveleduc1 |   .2521403   .1002806     2.51   0.012     .0555939    .4486867
                   leveleduc2 | -.0255874   .1010692    -0.25   0.800    -.2236794    .1725046
                   leveleduc3 |   .2911456   .1971705     1.48   0.140    -.0953016    .6775927
               maritalstatus1 | -.0126209   .1051616    -0.12   0.904    -.2187338     .193492
               maritalstatus2 |   .0178281   .1259823     0.14   0.887    -.2290928    .2647489
                  sexfarmers1 | -.1174906   .0405263    -2.90   0.004    -.1969207   -.0380606
                parishfarmer2 |   -.091094   .0401504    -2.27   0.023    -.1697874   -.0124006
                   Farmers Age | -.0016375   .0016132    -1.02   0.310    -.0047992    .0015243
  Number of years a farmer has |   .0107431   .0037697     2.85   0.004     .0033547    .0181315
  How many members are in your |   .0038474   .0085894     0.45   0.654    -.0129875    .0206823?
   How much land size in acres | -.0007728   .0019305    -0.40   0.689    -.0045564    .0030108?
                         _cons |   .1559891   .1386049     1.13   0.260    -.1156714    .4276497
-----------------------------+------------------------------------------------------------------
Var (e. d volume sold in kgs Improved) |    27447.52    2678.604                      22669.11
33233.18
         var (e. Farmingsystem2) |   .0731073   .0071345                      .0603799    .0885176
------------------------------------------------------------------------------
LR test of model vs. saturated: chi2(16) =     35.61, Prob > chi2 = 0.0033
```

Figure 3. Market shares (structural equation modelling).
Source: Primary data (2021)

input on time and inconsistent knowledge and information dissemination (MFPED, 2019). The poor coordination by actors is easily exploited by individuals or self-seekers in the value chain including middlemen traders Bhardwaj et al. (2011), who conceal critical market information and share profit meant for the farmer by up to 75%.

However, considering the perspective of AIS, and providing an account of the improved cowpea, actors in the cowpea value chain were meant to frequently provide and share required information on (agronomic, post-harvest, and potential market opportunities) and other services, in a bid to serve the interest of the farmer as the main user of the innovations.

Conversely, in the case of cowpea, inadequate interaction among researchers certified input traders, agro output traders, extension agents, NGOs, and farmers lowered the opportunity for cowpea farmers to access timely and adequate information on certified input, output market, and other services. Farmers (cowpea) had no option but to resort to fellow farmers as a source of information on farm-saved seeds. Other input and output markets remained sealed off from competitive output markets beyond fellow farmers. Accordingly, such interaction diminishes the aspirations of the National Agricultural Extension Policy (NAEP), 2018, NDP, III (2020), which advocates for the engagement of both

```
Beans sales model
Sem (I volume sold in kgs Improved <- Ties beans Network density beans Av degree beans f Land size
acres Improved b f Distance to the local market) (Farmingsystem2<- leveleduc1 leveleduc2 leveleduc3
maritalstatus1 maritalstatus2 sexfarmers1 parishfarmer2 Farmers Age Number of years a farmer has How
many members are in your How much land size in acres), nocapslatent
Endogenous variables
Observed:  I volume sold in kgs Improved Farmingsystem2
Exogenous variables
Observed:  Ties beans Network density beans Av degree beans f Land size acres Improved b f Distance to
the local market
           leveleduc1 leveleduc2 leveleduc3 maritalstatus1 maritalstatus2 sexfarmers1 parishfarmer2
           Farmers Age Number of years a farmer has How many members are in your How much land size in
acres
Fitting target model:
Iteration 0:   log likelihood = -6758.1965
Iteration 1:   log likelihood = -6758.1965
Structural equation model                       Number of obs     =        210
Estimation method  = ml
Log likelihood     = -6758.1965
------------------------------------------------------------------------------------------------
                               |                 OIM
                               |      Coef.   Std. Err.      z    P>|z|  [95% Conf. Interval]
-------------------------------+----------------------------------------------------------------
Structural                     |
  I volume sold in kgs Improved     |
                      Ties beans |   1.002014   .3767722     2.66   0.008     .2635542    1.740474
            Network density beans |   110.3155   158.3521     0.70   0.486    -200.0489    420.6798
                  Av degree beans | -3.307683   5.332967    -0.62   0.535    -13.76011     7.14474
   F Land size acres Improved b | -.0114724   2.390745    -0.00   0.996    -4.697246    4.674301
   F Distance to the local market | -9.282476   8.285678    -1.12   0.263    -25.52211    6.957154
                           _cons |   153.4136   45.10136     3.40   0.001     65.01659    241.8107
  -----------------------------+----------------------------------------------------------------
  Farmingsystem2               |
                     leveleduc1 |   .2521403   .1002806     2.51   0.012     .0555939    .4486867
                     leveleduc2 | -.0255874   .1010692    -0.25   0.800    -.2236794    .1725046
                     leveleduc3 |   .2911456   .1971705     1.48   0.140    -.0953016    .6775927
                  maritalstatus1 | -.0126209   .1051616    -0.12   0.904    -.2187338     .193492
s                  maritalstatus2 |   .0178281   .1259823     0.14   0.887    -.2290928    .2647489
                     sexfarmers1 | -.1174906   .0405263    -2.90   0.004    -.1969207   -.0380606
                    parishfarmer2 |   -.091094   .0401504    -2.27   0.023    -.1697874   -.0124006
                       Farmers Age | -.0016375   .0016132    -1.02   0.310    -.0047992    .0015243
      Number of years a farmer has |   .0107431   .0037697     2.85   0.004     .0033547    .0181315
      How many members are in your |   .0038474   .0085894     0.45   0.654    -.0129875    .0206823?
      How much land size in acres | -.0007728   .0019305    -0.40   0.689    -.0045564    .0030108?
                           _cons |   .1559891   .1386049     1.13   0.260    -.1156714    .4276497
-------------------------------+----------------------------------------------------------------
Var (e.I volume sold in kgs Improved) |   55762.27   5441.841                      46054.46    67516.39
         Var (e. Farming system2) |   .0731073   .0071345                     .0603799    .0885176
------------------------------------------------------------------------------------------------
LR test of model vs. saturated: chi2(17) =     33.70, Prob > chi2 = 0.0092
```

Figure 4. Market shares (structural equation modelling).
Source: Primary data (2021)

public/private actors, NGOs, and researchers, toward the realization of the desired agricultural socio-economic transformation (MAAIF, 2019). This corroborates with Cerna, (2013); Tatek; et al. (2015) who maintain, that the continuous engagement of local market agents by the farmers, as the main source of input and output, denies them (farmers) market expansion across national boundaries, and enhancement in farm profitability.

Thus, an increase in land size (acres) allocated to cowpea enterprise would increase market shares by a co-efficient of 97.91387 kgs in a season. This tallies with Ndambi et al. (2009) who alluded, that larger farms are better performers for they benefit from economies of scale and competitive output markets. Larger cowpea farmers would benefit from free transport due to bulk sales, credit opportunities, and high negotiation opportunities. Increased output market as such may increase farmers' income base, and probably influence their (farmers') decision to allocate more land towards cowpea farming in a bid to fulfill market demands, and attain higher income gains. Correspondingly, Alene et al. (2015) alluded, that farmers regularly allocate significant acreage of the land for an enterprise depending on farm gains such as food and income.

Notably, being a female attached crop makes cowpea regarded as an orphan legume crop. Thus, male

counterparts render the crop (cowpea) limited attention in terms of agronomic and post-harvest management practices, and in consideration of the limited authority that African women hold towards family land resource allocation and use. This is supported by the World Bank Group, (2018); Ojo (2011); Wikipedia (2010) the majority of smallholder farmers, most especially women farmers in Africa do not have access to adequate land. Ultimately, keeping cowpea as a kitchen gardening legume crop with low yields quality and limited marketing resources. Conversely, low attention to the crop (cowpea) as such disregards its attributes as a cheap source of protein needed to combat malnutrition among the population of children in Northern Uganda. UBOS, (2019) alluded that malnutrition in Northern Uganda has a prevalence of 37%, with stunted growth among children below 5 years, and yet the crop (crop) has a shorter maturity period of 14 days and would render it a necessity to support food security and alternative income source in the dry spelt regime.

CONCLUSION AND POLICY IMPLICATION

The study found out that an increase in land size (acres) allocated to cowpea enterprise would increase volume in kilograms produced and sold and therefore increases market shares in a season. An improvement in the information sharing and other services by actors in the cowpea enterprise increased market share in a season. An increase in networking among bean actors would fairly increase the volume of sale output. The established interaction framework set by actors creates a solid production, product loyalty, distribution, and marketing structure for the farmers to produce and sell to a specific food chain market and gain more profit. The study also established that farmers only grow beans for food and partly as a source of income and the contribution of extension agents was not significant in amplifying production and open market opportunities. The Interaction with actors may become part of the production and distribution channels and this leads to the development of product loyalty, enabling farmers to produce and sell at right time in a competitive market in a bid to reduce the income and food gap.

The study, therefore, recommends a continuous interaction among actors to enhance the development and promotion of improved agricultural technologies through information sharing and other services. The actors should also provide and share relevant and timely information regarding agronomic, post-harvest practices, potential market opportunities, and other services. There should be the promotion of improved technologies and this could be done by consistently engaging with other actors including agro-input/ output traders, local and international markets, private and public extension agents, Non-Governmental Organizations, schools, and other farmers' associations.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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