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Actor social networks as knowledge sharing mechanisms in multi-stakeholder processes: a case of coffee innovation platforms of Uganda

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ABSTRACT

Purpose: This study examined knowledge sharing mechanisms in coffee IPs and their effect on actor linkages in four districts of Uganda.

Design/methodology/approach: Thirty one respondents from the public and private sector were interviewed using a qualitative approach. Data were analyzed using the Atlas ti qualitative software version 7.5.18 to generate themes for information sources, types and channels. Social network analysis was used to measure the actor centrality positions and influence in the IP network.

Findings: Results revealed seven main categories of actors in the Coffee IPs who shared information on coffee inputs, agronomic practices, processing and markets through three main channels. Level of cohesion was less than 10% which had negative implications on the knowledge flow, trust and collaboration among the actors. Influential positions were occupied by the processors and farmer leaders in IPs in the southern districts of Luwero and Rakai, while nursery operators were most influential in IPs of the western districts of Ntungamo and Bushenyi. Weak linkages within the social networks indicated that initiatives of the actors were fragmented, as each actor acted as an individual detached from the platform activities limiting inter-actor knowledge sharing.

Practical implications: Innovation intermediaries should focus on integrated systemic and innovative approaches to strengthen actor social linkages for knowledge sharing and better platform performance.

Theoretical implications: Actor positions and relationships in innovation networks are critical tenets for fostering knowledge exchange and performance. In an innovation platform, diverse actors are multiple sources for accessing information within a given social and institutional context.

Originality/value: The study contributes to existing debate and knowledge on institutional change in agricultural innovation systems.

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Knowledge; communication; social networks; multi-stakeholders; coffee; Uganda

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Introduction

Collaboration, interaction and knowledge sharing are essential elements of innovation and problem solving in multi-stakeholder processes (Ebrahimi Mehrabani and Azmi Mohamad 2015). Virtual communities for diverse stakeholders are significant in facilitating learning, joint problem solving, actor connectivity and knowledge generation to improve response to emergent issues (Wright et al. 2016). As research and development agencies utilize multi-stakeholder and value chain approaches to innovation, the need for effective collaboration, interaction and knowledge sharing becomes central (Anderson, Feeder, and Ganguly 2006; Klerkx, van Mierlo, and Leeuwis 2012). Different actors largely depend on their direct and indirect network relationships to seek information to address their challenges. However, contemporary public extension agents still face challenges to effectively synthesize explicit knowledge with farmers' tacit knowledge for appropriate technologies in farm management (Karpouzoglou et al. 2016).

About half a century ago, extension approaches of technology and knowledge transfer have experienced a shift from linear to participatory approaches, and then to the current innovation system approaches (Anderson, Feeder, and Ganguly 2006). The evolution from linear to innovation systems approach resulted from the demand for spread of impact at local context, recognizing that agricultural change is a function of adopting new technologies, complex actor interactions, organizational and institutional factors (Mur and Wongtschowski 2013; Vereijssen et al. 2017). Cullen et al. (2014), observed that agricultural technology diffusion required localized adaptation and socio-technical innovation in specific contexts which led to the development of the innovation systems concept in the agricultural sector as a pathway for delivery of agricultural extension services (Hall et al. 2006; Klerkx, van Mierlo, and Leeuwis 2012). Value chain actors therefore assumed new information and communication roles in rural development (Sseguya et al. 2012). In order to pursue the new roles, actors need to adapt and use tacit and explicit knowledge which requires pluralistic involvement of actors and 'new forms' of interaction in the agricultural innovation system (Sseguya et al. 2012).

Innovation follows a non-linear process that depends on the density and quality of relationships among actors (Altenburg, Schmitz, and Stamm 2008) and diverse stakeholder participation in action research experimentation (Botha et al. 2017). Actor interactions are assumed to strengthen linkages for better information exchange, opportunities and innovation (Nederlof, Wongtschowski, and Lee 2012). Research and development agencies therefore emphasize multi-stakeholder processes including innovation platforms as participatory and demand driven approaches for exploiting new opportunities and overcoming constraints (Cullen et al. 2014).

Innovation platforms (IPs) exemplify innovation systems as more inclusive and interactive virtual spaces where different stakeholders interact, develop shared priorities, define roles and agree on joint actions (Mulema and Mazur 2016). The IPs define the roles and the expected forms of engagement for actors to interact and exchange information in the innovation processes (Consoli and Patrucco 2008). Interactions and structures of different contexts thus significantly influence knowledge sharing among diverse actors and IP performance. Wood et al. (2014) observed in New Zealand, agricultural knowledge is communicated to network members as they engage in development interventions. In Uganda, the IP approach was recognized to stimulate development of agricultural enterprises including

coffee due to its emphasis on value chain approach, networking and partnerships (Pyburn and Woodhill 2014; UCDA 2014).

Coffee is one of Uganda's key priority commodities that contributes 49% of the total agricultural exports (UBOS 2017). Over 69% of Robusta coffee is produced in central, 13% in eastern and 10% in south-western regions of the country (UBOS 2010). The sub-sector supports about 3.5 million families across the value chain of whom 39% are small holder farmers (UCDA 2014). Despite its importance, coffee's production has stagnated at 180,000MT per year for over four decades due to technological and non-technological constraints (MAAIF 2013). This scenario prompted actors to seek for solutions through initiation of twenty District Coffee Innovation Platforms across Northern, Eastern, Southern and Western regions of the country (UCDA 2012; MAAIF 2013). The aim of the coffee IPs was to improve the quality and quantity of coffee exports by fostering information sharing and learning among diverse actors (Café Africa 2009). However, globally IPs still have challenges with knowledge sharing and managing interactions among the actors (Kilelu, Klerkx, and Leeuwis 2013). Such challenges are related to the choice of the right partners and accountability mechanisms which make it difficult to demonstrate the benefits and to justify future funding of IPs (Kibwika, Wals, and Nassuna-Musoke 2009; Agrawala et al. 2011).

Studies on innovation platforms have been done on multi-stakeholder learning, power dynamics and ICTs' potential to support innovation-intermediation (Buchanan et al. 2013; Munthali et al. 2018) with little known on how knowledge is disseminated through the multi stakeholder processes. While social networks have always been important in agriculture, they have remained implicit and under researched as part of the agricultural extension system (Crona and Parker 2011; Lubell, Niles, and Hoffman 2014). Sanya et al. (2017) found that the existence of strong information linkages between international and national level research organizational actors is a pre-requisite for successful development of hybrid banana technologies in Uganda. Coffee innovation platforms in Uganda faced performance challenges associated with strengthening linkages, effective information sharing among actors, meeting quality standards which may be due to weak institutional arrangements and knowledge sharing mechanisms (Café Africa, 2009). A better understanding of the structures and functioning of the knowledge networks would provide the basis for modifying the existing knowledge sharing mechanisms in agricultural innovation systems for improved outcomes.

Conceptual and theoretical framework

Innovation platforms are perceived as interactive networks that revolve around social interactions and strengths of diverse actors resulting into potential structures and mechanisms for knowledge exchange (Morrar 2015). An actor operates independently but has connections with other actors and it is these nodes and connections that link to form networks (Sanya et al. 2017). The IPs are recognized as systemic extension delivery approaches to innovation for development since they enable diverse actors to jointly learn, negotiate, coordinate and innovate to overcome challenges and capitalize on opportunities through a facilitated innovation process (Ekboir 2012; Schut et al. 2018). Téno and Cadilhon (2017), suggest that the structure of an IP is best understood by its composition, diversity of members, decision making processes, sources of funding and innovation

intermediaries. IPs are embedded in existing social networks beyond their original scope and play an important role in facilitating innovation to overcome complex agricultural problems (Hermans et al. 2017; Schut et al. 2018). The study therefore integrates elements of the Social Network Theory (Borgatti et al. 2009) to examine the social ties, actor positions and relationships among diverse coffee actors across four districts. Park (2011) defines social networks as a set of linkages among a defined group of persons and relationships in form of similarities, social relations, interactions and flows. Two measures of SNA were used in this study, the degree and centrality. Centrality is useful for identifying individuals that control flow or relationships between groups (Borgatti et al. 2009). Using the SNA, this study examined the social networks and how the information sharing relationships among the coffee actors influenced the performance of coffee IPs. Performance in this study refers to the strengths of the information and knowledge sharing linkages among the Coffee IP actors.

Methodology

The study was done in Bushenyi, Luwero, Rakai and Ntungamo districts renowned Robusta coffee growing areas. The districts were selected because Uganda Coffee Development Authority (UCDA) and Café Africa intensively promoted coffee campaigns and established coffee IPs. A qualitative multiple case study research design (Yin 2009) was used to enable an in-depth inquiry into how the coffee IP actors networked and shared knowledge basing on their individual perspectives and experiences. District coffee innovation platforms were taken as cases because they represented different contexts as districts and this therefore enhanced the external validity of the study findings. The study sample was purposively selected from the current lists of the district steering committees members and aggregated to form the sampling frame of 67 leaders. From this sampling frame, 31 key informants were selected based on the following criteria; (i) active leadership role, ii) high actor engagement in the last 12 months and iii) good knowledge of the IP operations, iv) representation of each actor category (Table 1). Eight one percent (n = 26) of the respondents were men and nineteen percent ($n = 5$) were women. The gender disparity in the IP may be attributed to the fact that coffee is commercial commodity in Uganda and mainly characterized as a male dominant crop (Table 2).

By December 2014, the Luwero coffee IP knowledge network size had six actor categories including farmers, extension agents, nursery operators, processors, agro-input dealers and district leaders (Figure 1). Out of 272 (17*17-1) possible ties only 17 were observed. Each individual actor had sixteen maximum numbers of possible connections. The Rakai coffee IP social network consisted of seven categories of actors with only 15 of

Table 1. Respondents by district and actor category.

Region	District	Farmer	extension agent	Nursery operator	SACCO	Processor	Input dealer	trader	Total
Central	Luwero	3	4	1	0	1	1	0	10
	Rakai	3	2	1	1	1	0	1	9
Western	Bushenyi	2	1	1	0	1	0	0	5
	Ntungamo	1	2	2	1	0	1	0	7
Total		**9**	**9**	**5**	**2**	**3**	**2**	**1**	**31**

Source: Primary data, 2015.

Table 2. Elements of the Social Network Analysis used in this study.

Element	Definition
Nodes	Represent the individual actors within the networks and are presented in different colors and shapes
Edges	Represent the relationships between the actors.
Centrality	This measure gives a rough indication of the social power of an actor based on how well they 'connect' the network.
Degree of centrality	Measures the number of direct ties an actor has to other actors in the network. It is an indicator of expertise and power of network member.
In degree	In-degree analyses the actors who are the most receivers of information within a network.
Out degree	Out-degree, is the measure of how influential an actor is in the network
Social network	Is a social structure made up of individuals (or organizations) called 'nodes', which are tied (connected) by one or more specific types of interdependency (e.g. friendship, common interest, financial exchange or relationships)

Source: Scott (1991).

210 (15*15-1) active information sharing relationships. Ntungamo coffee IP social network consisted of six categories of actors with eleven of 110 (11*11-1) possible information sharing relationships while the Bushenyi coffee IP network had the least categories with 13 out of 156 (13*13-1) possible ties (Table 3).

From the analysis, there were weak relationships across all the coffee IPs. Institutionalized knowledge sharing structures within the IPs were not well defined and knowledge seeking was based on individual initiatives. Holders of knowledge were actors who had more than one role to play in the IPs and held influential positions as demonstrated by the centrality measures. On average, the networks under study exhibit less than 10% degree of cohesion which had implications on the information flow and collaborative innovation. Munthali et al. (2018) agree that when networks exhibit low degrees of cohesion, this has implications on the information flow and collaborations on the innovation platform. Wood et al. (2014) had similar findings, and suggest that farmers who have

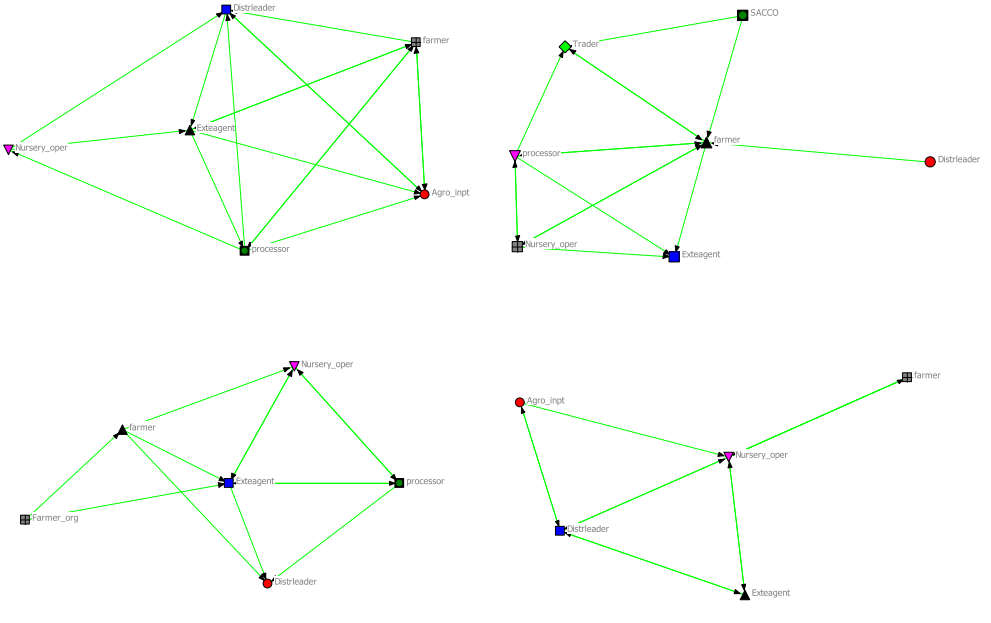

Figure 1. Coffee IP Knowledge networks of the four sites. Source: Primary data, 2015.

Table 3. Level of actor connectivity by district.

District	No. of knowledge actors	Expected ties	Observed ties	Degree of cohesion * *no. of observed ties divide by no. of possible ties*
Bushenyi	5	156	13	0.0962
Luwero	10	272	17	0.0625
Ntungamo	7	110	11	0.1
Rakai	9	210	15	0.0174

Source: Primary data, 2015.

homogenous ties grow their networks faster than those with loose ties. They further emphasize that dense networks are formed by social peers who generate shared understanding.

Influential actors in the coffee knowledge IP networks

In the Luwero coffee IP, farmer leaders and coffee processors were the highest receivers of information with an in-degree measure of 35 per cent (Table 4). The coffee processor interacted with the majority of the actors on the platform particularly with farmers by providing farm inputs on credit as narrated; ' … I was contacted by farmers about coffee prices, processing and farm inputs. They normally bring their coffee here to process. Some of these are among the village agents so we interacted on monthly basis … ' (Processor, Luwero district, 9th May 2015). As a contact person for USAID project and representative on the coffee IP, other actors interacted with this processor for market information which positioned him to receive critical market information compared to other processors in the district.

Coffee actors shared information on crop agronomy and planting materials, better post-harvesting and drying techniques and prices. A key informant interviewed said, ' … I mainly share information with farmers on rains and soil fertility to improve yield, proper drying of coffee for better prices. … ' (Processor, Luwero district, 9th May 2015). Farmer leaders and coffee processors were followed by the district leaders, agro-input dealers and extension agents as highest receivers' of information at 24 per cent respectively (Table 4).

In Luwero Coffee IP, the most influential actor was a male farmer leader with an out degree measure of 29 per cent and therefore had direct links with the coffee farmers as a knowledge source and mobilizer. In Ntungamo coffee IP, the nursery operator had

Table 4. Centrality measures of different actors in the coffee IP social networks.

	Coffee IPs							
Actors	Luwero	Ntungamo	Rakai	Bushenyi	Luwero	Ntungamo	Rakai	Bushenyi
	Out-degree centrality (%)				In-degree Centrality (%)			
Input dealer	12	27	0	0	24	9	0	0
District leader	12	18	7	8	24	27	0	23
Extension agent	24	39	0	31	24	18	20	39
Nursery operator	12	9	20	23	6	46	13	31
Farmers	29	0	33	31	35	9	40	15
Processors	24	0	27	23	35	0	13	15
SACCO	0	0	13	0	0	0	0	0
Trader	0	0	7	0	0	0	20	0

Source: Primary data, 2015.

the highest degree of a centrality of 46% since he was a district leader, chairperson of the district coffee platform and leader of Abateganda Cooperative Society which offered processing and marketing services to coffee farmers as narrated by a respondent; ' … The nursery operator is our chairperson, and so he gives us information on current coffee prices … ' (Nursery operator, Ntungamo district, 11th April, 2015). Results show that the nursery operator was better positioned to receive critical information compared to other actors in the network. Although agro-input dealers were represented, only the district agricultural officer (9%) reported interaction with him.

The extension agent was perceived to hold a strategic position with access to resources (funds, time and technical expertise) as narrated by one of the respondents; ' … His strategic position in the agricultural sector as an extension agent and NAADS coordinator grants him access to agricultural funds. He gave us funds to transport farmers to the coffee show … ' (Nursery operator, 10th April 2015).

The District Agricultural Officer (DAO) performed the role of knowledge broker, but focused more on the technical aspects of verification and distribution of coffee seedlings as the treasurer of the platform (DSC reports 2014). In the Rakai Coffee IP, farmer leader was the central actor (40%), followed by extension agent and trader (20%). Almost all the actors in this platform sought varied information on crop agronomy, processing and marketing from the farmer representative. As the chairperson of the platform, the farmer leader performed a brokering role as one of the tasks involved frequently consulting individuals within and outside the IP as narrated by one of the respondents;

> … I normally talk to the farmer because he is the chairperson and he provides information from UCDA, NUCAFE, Café Africa and exhibitions about distribution of seedlings to the farmers, information about what quantities of seedlings are required at district level. … (Nursery operator, Rakai district, 5th April 2015)

The most influential actor in Rakai was a male farmer with an out degree measure of 33%. He held community leadership positions and had direct links with most of the coffee farmer organizations, coffee actors and organizations. In Bushenyi Coffee IP, the extension agent was the highest receiver of information (36%) for distribution of planting materials but less for market information. Bushenyi had two influential actors, the extension agent and farmer (31%) (Table 4). The male extension agent was a UCDA regional coordinator, other actors mainly interacted with him during rainy season for distribution of coffee seedlings. Although farmer leaders were influential in the coffee knowledge exchange and IP performance, they had a weaker bargaining power due to their limited organization and capacities to determine premium coffee prices. Farmers were beneficiaries rather than active stakeholders in the coffee IPs. This called for the need to collectively share new knowledge, build stable relationships and access vital market information from the IP actors to enable improvement of the IPs performance. Mashavave et al. (2013) observed that improved vertical ties and information flows mechanisms to farmers can significantly influence their decision-making capacities. Phelps, Heidl, and Wadhwa (2012) concur that influential actors have greater access and control over valuable information flows, they provide positive signals and have the ability to influence the performance of the network.

From the study, the extension agents ($n = 28$) farmers ($n = 22$) and nursery operators ($n = 15$) were the main knowledge sources due to their leadership positions and expertise. Coffee exporters and traders played minor roles and appeared to be periphery actors in the

coffee IP networks. The study concurs with other studies in Texas-Colorado which explored that actors with a higher degree of centrality are likely to be major channels of information and knowledge (Ramirez 2013). However, such actors tended to advance their individual interests with limited consideration to other actor interests in the network. These kind of relationships tended to affect integration of knowledge from the various actors, especially the market actors, regulatory institutions and end-users. And yet, as Šūmane et al. (2018) suggest, these are critical knowledge sources for farmers and players in the value chain as well as in technology development and use. These findings suggest the need to explore the policies and programs that create more space for critical market chain actors like exporters and traders to actively participate in smallholder innovation networks in order to improve welfare (Spielman et al. 2010).

Actors with the highest in-degree measures were perceived as a cluster of experts since they had dense connections amongst themselves in the coffee knowledge sharing networks. The peripheral position of processors, Savings and Credit Cooperative Societies (SACCOs), agro-input dealers in the coffee networks implied that they had a very low information sharing relationship yet such actors have a structural role to bridge network clusters of supply chain actors in agricultural IPs. These findings corroborate with studies by Navimipour and Charband (2016) who suggest that direct ties with knowledge sources and trust are essential factors for strengthening collaboration and knowledge sharing between members. Study findings reflect that the coffee sub-sector is unlikely to adequately meet its goal of commercializing smallholder production as critical market actors remain peripheral to networks.

Knowledge sharing channels and types

The main knowledge sources were extension agents, farmer leaders and nursery operators ranging between 1 and 6 options per respondent (Figure 2). The main type of information

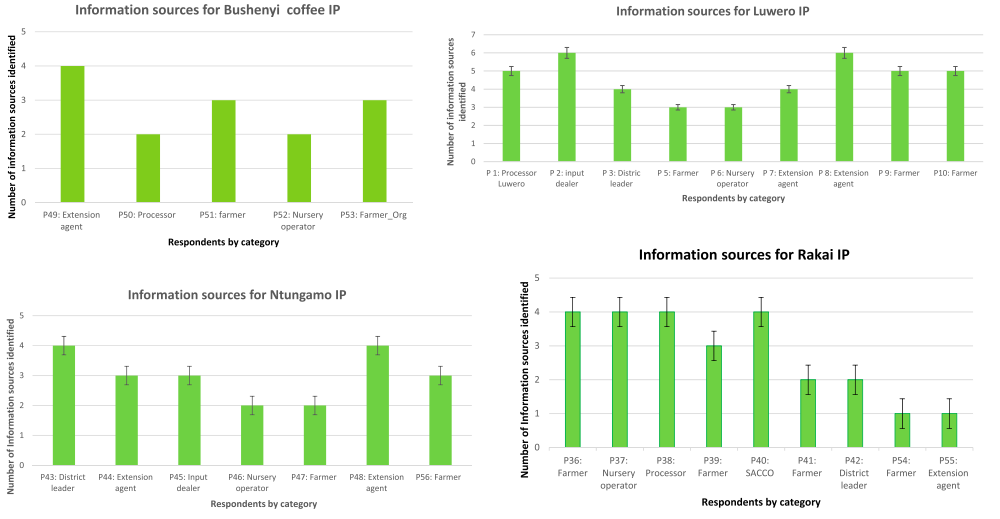

Figure 2. Identified information sources by respondent and district. Source: Primary data, 2015.

shared were on crop agronomy ($n = 14$) and planting materials ($n = 27$), better post-harvesting and drying techniques and crop prices (Figure 3).

Generally, coffee actors shared information on production, seed multiplication and distribution, market prices and agro-inputs. Across categories, actors shared production information on climate change, pest and disease management for coffee twig borer, spacing, pruning and weed management. Actors sought information on source and type of quality of seedlings while promotion of KR disease resistant varieties was more popular in the Rakai coffee IP. Coffee IP actors shared information on sources, types and quality of farm inputs. Although some coffee IPs had representative for processors and traders, farmers had challenges of accessing marketing and business development services information which were critical for market integration and IP outcomes (Fielke et al. 2018). With exception of Ntungamo and a few farmers in Rakai who sold their coffee through cooperatives; joint procurement of agro-inputs and bulk marketing were not mentioned as tangible outcomes of knowledge sharing.

In all the four coffee IPs, actors reported to have sought information mainly using mobile phones which was suspected to be more of inquiry than learning. Further, there were inadequate opportunities to exploit tacit knowledge in collectivity. This scenario was due to limited face to face roundtable sharing opportunities (Figure 4). Face to face one on one interactions (FFI's) or interpersonal communication between actors took place once a year in form of meetings for organizing coffee shows. The annual coffee shows were funded by Café Africa. Actors also met informally while on other duties and would exchange information on the source of inputs, prices, quality and distribution of coffee seedlings. Shepherd (2016) confirms that face to face engagement meetings are the most preferred channel among members of a network as they enhance interactions and learning among diverse actors. This reveals that there

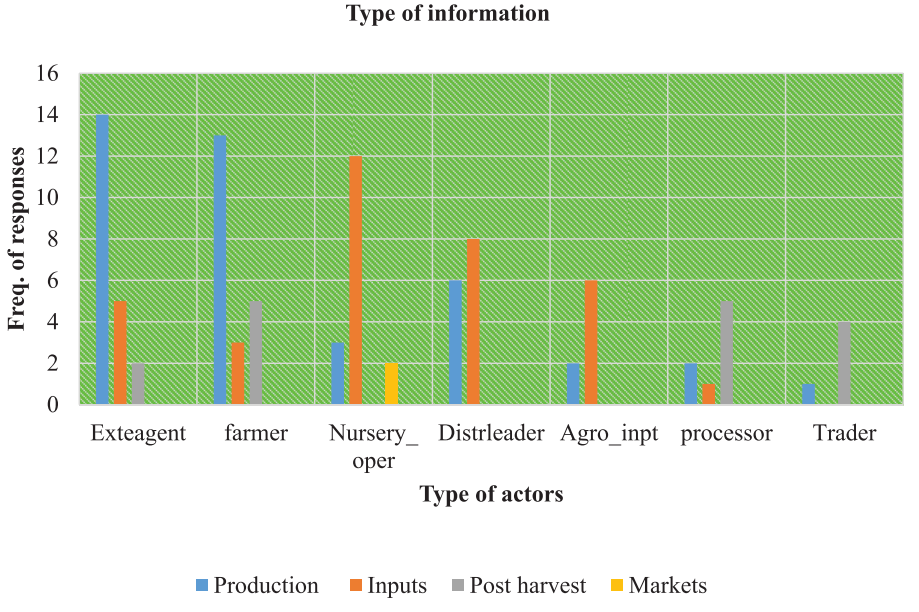

Figure 3. Types of information shared by coffee IP actors. Source: Primary data, 2015.

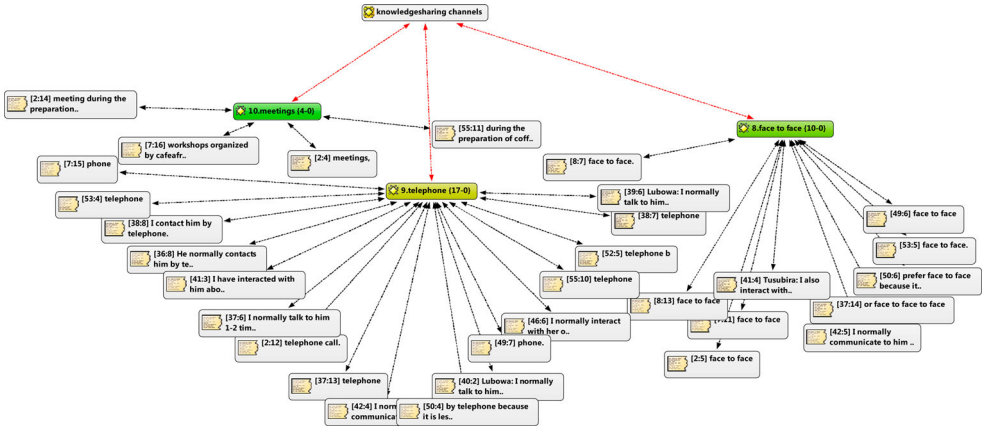

Figure 4. Knowledge sharing channels for Coffee IP actors. Source: Primary data, 2015.

was insufficiency of mobile phones in generating depth of knowledge sharing in this context.

Conclusions and implications

The study intended to understand how coffee IP knowledge systems were structured using SNA. The level of knowledge sharing between the actors in the four innovation platforms of Luwero, Rakai, Bushenyi and Ntungamo districts was found to be very low and therefore affected the IP performance. This implied that there was lack of coordination for knowledge sharing as one of the goals; IPs focused more on coffee show meetings than addressing the real challenges facing the actors.

The most influential actors in the innovation platforms were farmer leaders, coffee processors and nursery operators. Other actors like the exporters and financial providers were periphery actors. This meant that actors who could have played critical roles in the performance of the coffee IPs had no influence.

The options of knowledge sharing channels that were limited to the mobile phone, face to face meetings and individual interactions did not permit deeper knowledge sharing opportunities among diverse actors. Since the concept of innovation platforms is appreciated as a useful approach for knowledge exchange, designers and promoters of agricultural innovation platforms should work out an integrated knowledge mechanism for engagement all commodity value chain actors.

Recommendations

There is need for awareness creation and popularization of the platform activities to stimulate interests of different key market actors through existing local structures. Planning mechanisms that can foster actor interactions to achieve the IP goal are needed to share knowledge that creates solutions for specific problems. Strategies for attracting all actors to coffee IPs are necessary; when actors converge they can propose suitable options for knowledge sharing in their local context. Innovation intermediaries should focus on integrated systemic and innovative approaches to strengthen actor social linkages

for knowledge sharing and better platform performance. Although contemporary agricultural extension policies advocate for knowledge base management and information systems, less emphasis is placed on proper mechanisms for documenting outcome processes and experiences resulting from social learning which the study advocates.

Given the timeframe of this research, the study only explored direct ties among coffee actors. Indirect social networks of the actors and their influence on IP performance should be another area to explore for further research. The perception on the quality of information shared requires more investigation in terms of relevancy and whether it was really 'new'. Since only 19% of the respondents were women, more gender lens research is recommended to explore how knowledge is shared in the coffee sub-sector; recognizing that women are known to maintain integrity and good networking.

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