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Assessment of multi-stakeholder interactions and networks in the grape innovation system in Dodoma city, Tanzania

[1]SOSPETER J C., [1]MASELLE A E*

[1]Department of Geography and Economics, Mkwawa University College of Education, University of Dar es Salaam, P.O. Box 2513, Iringa, Tanzania.
[2]Institute of Development Studies, P. O. Box 395, The University of Dodoma, Dodoma, Tanzania

***Corresponding Author**: jibunges@gmail.com

Abstract

Scientists all over the world agree that the multi-stakeholder interaction embraced by the agricultural innovation systems (AIS) approach is critical for boosting agricultural development. Despite this important role of enhancing agricultural production, the concept of multi-stakeholder interactions is under studied in the grape innovation systems (GIS) in Tanzania. This study examined multi-stakeholder interactions and the perceived challenges influencing interactions in the GIS at the wards of Mpunguzi, Mbabala, and Hombolo in Dodoma City. Structured interview via interview schedule was used to collect the social network data from 277 and 116 sampled grape farmers and other respondents from the other eight stakeholder groups, respectively. Also, key informant interview and Focus Group Discussion were employed to collect the qualitative data. The findings showed that the multi-stakeholder interactions and networks in the GIS were limited. Also, farmers, consumers, processors, traders, and input suppliers, in particular, had not yet been empowered to articulate their demands regarding grape innovations. Moreover, the findings revealed that a lack of innovation platforms ($\bar{x}$= 2.9), communication barriers ($\bar{x}$= 2.4), insufficient financial resources ($\bar{x}$= 2.4), and a lack of time ($\bar{x}$= 2) were among the challenges scored high average mean to imply that they were seriously impeding interaction between stakeholders in the GIS. This study recommends that strong links be strengthened among all key stakeholders in the GIS, as they rely on one another to function and achieve the goals of improving grape production. Finally, the study encourages the Tanzanian government to adopt various financial resource mobilization strategies in order to collect money for establishing the innovation platforms and solve other obstacles were identified to have been inhibiting interactions among stakeholders.

Keywords: *Agricultural innovation system; Challenges of interaction; Grape innovation system; Innovation platform; Multistakeholder interactions; Tanzania*

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Introduction

The role of multi-stakeholder interactions and networking in agricultural innovation system (AIS) has gained increasing recognition in agricultural innovations. Research and policy discourses have emphasised that the shape and impact of agricultural innovation activities stem not only from the intentions, resources, or capabilities of the actors involved but also from

multiple interactions between stakeholders (Markow *et al.,* 2023). This is because agricultural innovation often does not merely involve the 'handing down' of ready-to-adopt newly-developed technology from researchers to farmers, but rather results from similar interactions between various stakeholders (Bentley *et al.,* 2021). In the context of agriculture, strong interactions among stakeholders are crucial for addressing challenges like food security, climate change, and sustainable development. In Africa and Tanzania in particular, the need for effective networking among diverse stakeholders is particularly pressing, as many countries strive to increase agricultural productivity and competitiveness (FAO, 2019).

It is argued that strong interaction among stakeholders within an agriculture system centres on knowledge generation and exchange as well as the development, scale-up, and use of innovations (Aerni *et al.,* 2015). Rajalahti (2012) posts that a "wide array of formal and informal stakeholders - agricultural research and extension institutions, private sector and agro-industrial players, and regulatory institutions as well as civil society and farmer-based organizations, and financial institutions influence and play key roles in the development and application of innovations". Notably, actors' interactions also involve taking advantage of chances and using their individual and group strengths (Candel, 2014), which is essential for the creation of innovations and the advancement of agricultural systems (Clarke *et al.,* 2018). As stated in Yongabo (2022), the interactions among stakeholders in the AIS can be used to harness both scientific and indigenous knowledge for increased inventive performance.

Following this, Charles *et al* (2022a) argue out that when actors communicate during technology development, farmers can share their requirements and implicit knowledge of farming characteristics with the researchers and other players. They continue arguing that the interaction among actors during the development and diffusion of technologies serves as a feedback mechanism for farmers to report difficulties with innovations. In doing so, researchers and policymakers can modify and reintroduce innovation based on feedback, ensuring that innovation is beneficial to farmers or end users such as consumers found along a particular commodity value chain.

In this connection, Tanzania has made significant strides in developing and establishing multi-stakeholder platforms aimed at improving agricultural production. For instance, the Agricultural Sector Development Programme (ASDP) I (2006/2007 - 2013/2014) and ASDP II (2016/2017 - 2024/2025) prompted the creation of district commodity value chain platforms. One of the important crops covered in this proposed district commodity value chain platforms is grape, which is primarily growing in Dodoma city. These platforms put into action a key premise of AIS, which aims to facilitate the interactions among key stakeholders (the farmers who are always typically marginalized in the innovation process, traders, processors, etc.), public and private service providers (including extension and research).

Horton *et al.* (2023) argue that the "best-known practical applications of AIS thinking are in multi-stakeholder innovation platforms - formal or informal network structures designed to foster technical, socio-economic, and institutional innovation". Innovation platforms are characterized as multi-stakeholder structures that provide a space for diverse stakeholders to interact, learn from one another, and work together to identify challenges and capture opportunities (Horton *et al.,* 2023; Onumah *et al.,* 2023). Thus, platforms improve information flow, thereby reducing information asymmetry among stakeholders within the network; facilitate the diffusion of innovation; provide access to resources for resource-constrained actors; and build capacity and social capital of members (Horton *et al.,* 2023; Onumah *et al.,* 2023).

The proposed multi-stakeholder innovation platforms in Dodoma City exemplify how effective stakeholder interactions can lead to the successful adoption of new technologies for increased production, quality and value addition, and efficient market access, ultimately increasing income for local farmers. Whilst, there are initiatives in place, there is limited empirical research that systematically has assessed the

dynamics of these networks and their impact on grape innovation outcomes. This study aims to fill this research gap by providing a comprehensive assessment of the interactions and networks among stakeholders in the GIS in Dodoma City. Therefore, this research was conducted to answer the questions: 1) to what extent do the main stakeholders in the GIS interact? 2) What are the perceived challenges to their interactions? In so doing, we offer policy opportunities for the establishment of an effective GIS, thereby strengthening the GIS for sustained productivity growth. Some studies (Wambura *et al.,* 2015, Charles *et al.,* 2022a) have been conducted to examine the level of interaction among stakeholders and their power relationships under the AIS approach lens in the country, but none has assessed the multi-stakeholder interactions between actors in GIS using the social network analysis, which makes this study original.

Theoretical Perspective

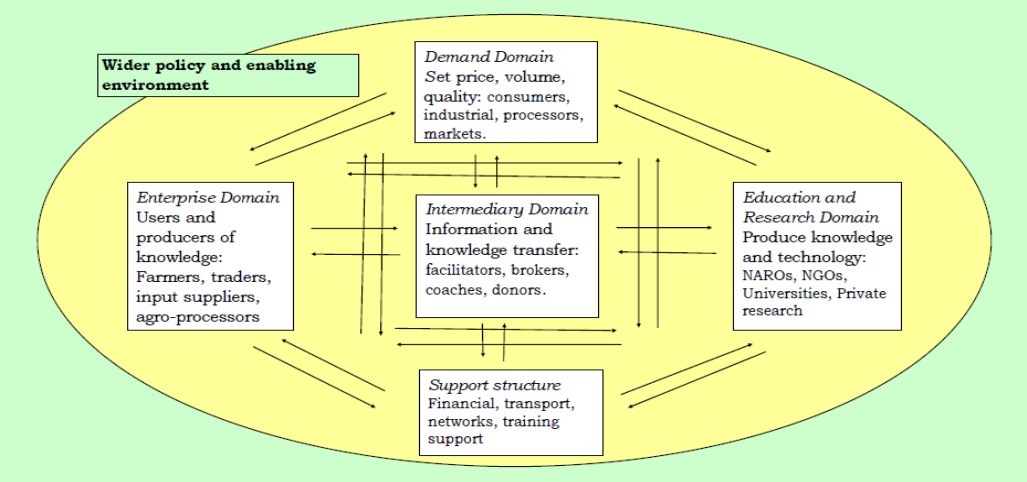
This study used an AIS perspective. According to Singh and Gill (2019), the origin of the AIS goes back to Friedrich List in 1842, who devised the concept of a national system of production. For the first time, Christopher Freeman (1982) "developed the concept of a national innovation system based on the premises of Friedrich List to examine how countries build knowledge and knowledge-related institutional arrangements at the national level to promote economic development and international competitiveness." The early literature on the national innovation system that emerged in the late 1980s and early 1990s (Freeman, 1987; Nelson, 1988; Lundvall, 1992; Edquist, 1997) developed the concept of a network of institutions involved in the development and dissemination of technological knowledge that increases the capacity of economic actors of production to supply new goods and services. Since the emergence of the national innovation system, there are other system-level analyses have emerged. These include regional innovation systems, sectoral innovation systems, technological innovation systems, and AIS.

Since the early 2000s, the AIS concept emerged, that shifts focus from research to innovation, which is considered a dynamic, interactive process between stakeholders involved in agricultural production, processing, packaging, distribution, and use (Toillier *et al.,* 2022; Horton *et al.,* 2023). Rajalahti (2012, 2) defines AIS as "a network of organizations, enterprises, and individuals focused on bringing new products, new processes, and new forms of organization into economic use, together with the institutions and policies that affect their behaviour and performance." AIS emphasises the need for a greater understanding of innovation processes, considering them as complex and multidimensional interactions among various actors engaging in new and interdependent practices (Toillier *et al.,* 2022). It highlights the significance of complex systems, the integration of diverse knowledge sources, and the acknowledgment of regulations and standards (hard institutions), and informal rules and habits (soft institutions) (Clarke *et al.,* 2018). Additionally, it considers the role of infrastructure, as these elements collectively shape and influence learning and innovation processes through their interactions (Murray-Prior, 2020).

The multitude of actors and institutions that make up the AIS have been categorized under various domains in the literature (Anandajayasekeram, 2022; Onumah *et al.,* 2023) depending on the role they play in the system as shown in Figure 1. It illustrates that innovation occurs through the interaction between the different stakeholders from different domains such as enterprises domain; demand domain; research and education service, support structure, and in the centre the domain of intermediaries who help to broker innovation. Wide policy and enabling environment also include the institutions that are defined as the 'rules of the game' that shape the way humans behave and the way markets operate (Woodhill *et al.,* 2011). They include government policies, laws and regulations, taxation arrangements, coordination mechanisms between different actors in markets, informal rules between market players, and agreements for the provision of financial, marketing, and communication services for transportation (Woodhill, 2008). In particular institutional innovation is even more dependent on effective coordination and multi-stakeholder engagement (Woodhill *et al.,* 2011).

Figure 1

Simplified representation of AIS with key stakeholder domains



Source: Adopted from Woodhill (2011)

The AIS was used in this study because it offers a way to analyse and identify options for addressing complex challenges in agricultural systems. Central to this approach is the idea that agricultural innovations emerge from networks of various stakeholders, rather than individual entities operating alone (World Bank 2012). It is also in contrast to the idea of knowledge transfer, which implies linear flows of knowledge, as well as a "top-down" approach (Toillier *et al.*, 2022). The AIS approach recognises that change comes from both non-human (e.g. machines, environmental and social conditions) and human actions (individual, institution, organisation) at different levels and is influenced by interactions between different stakeholders (Schut *et al.*, 2015). In this regard, the grape innovation comes from various actors from the five domains presented in Figure 1. In this regard, GIS in Dodoma city focuses on drawing together multiple actors who operate at a range of levels, and integrating knowledge and understandings, to solve complex problems.

Materials and Methods

Description of the study area

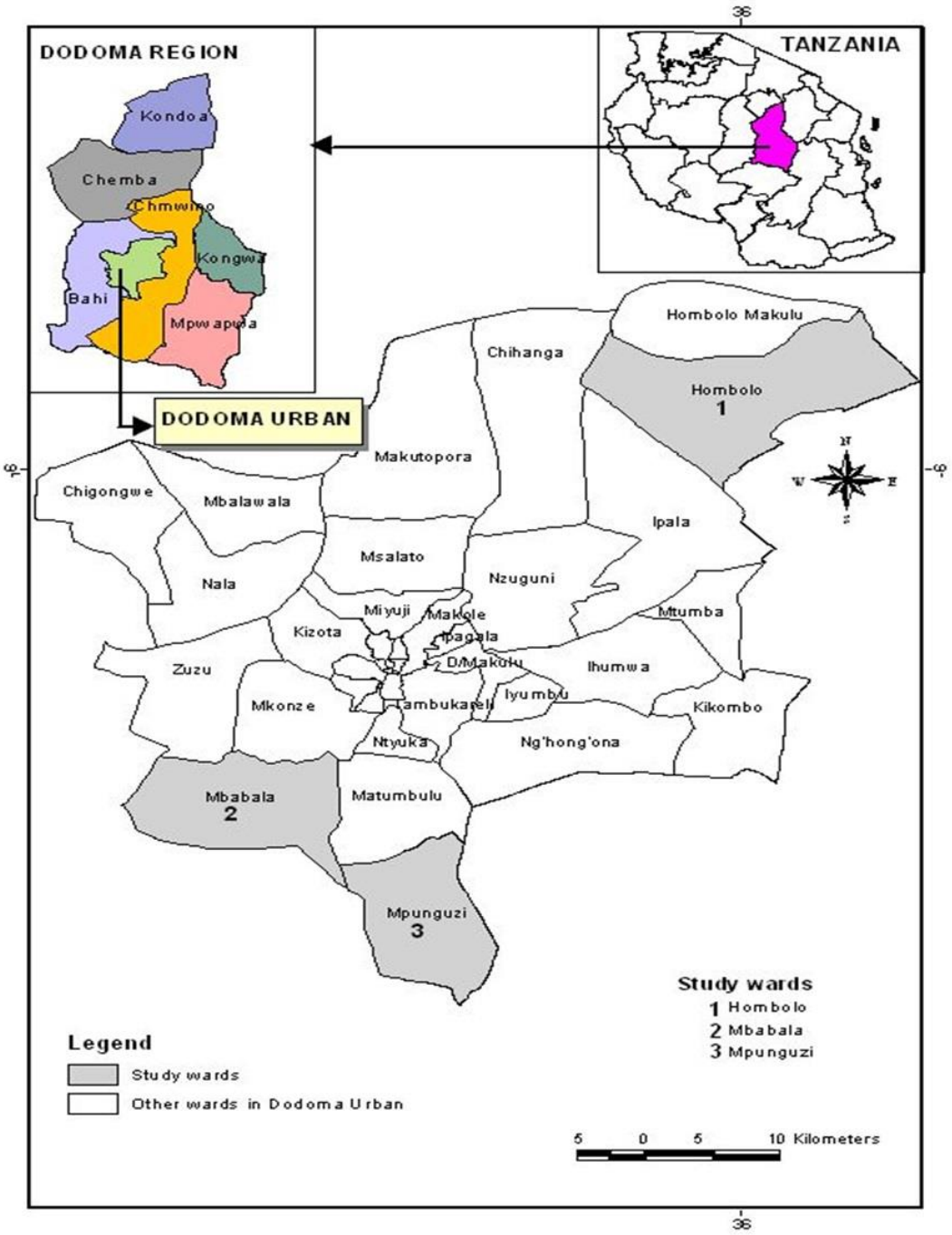
This study was conducted in Dodoma City, specifically in the wards of Mpunguzi, Mbabala, and Hombolo (Figure 2). Dodoma City is part of the Dodoma Urban District of Dodoma Region. The Dodoma city is located at Latitude 6°09'35"South and Longitude 35°47'53"East (URT, 2019). Dodoma city is located 453 kilometers west of Dar es Salaam, the former capital, and 441 kilometers south of Arusha, the East African Community headquarters (URT, 2019). It is 259 kilometers north of Iringa via Mtera. It is also about 260 kilometers west of Morogoro.

The wards of Mpunguzi, Mbabala, and Hombolo were purposively selected due to their potentialities in grape farming in Dodoma Region. These wards are one of the areas that contribute to the Dodoma region being the main producer of grapes in Tanzania. Tanzania is Sub-Saharan Africa's second-largest producer of wines made from grapes grown in the Dodoma region, trailing only South Africa. According to records, the city's grape production increased from 3930 tonnes in 2008 to 6831 tonnes in 2014 (Sundy, 2018). Similarly, the number of grape growers increased from 768 to 1012 (a 31.8% increase) during this period (Sundy, 2018). This implies that the massive expansion of grape farming has a significant impact on the

livelihoods of grape growers in Dodoma.

Figure 2

Map showing the Study Area

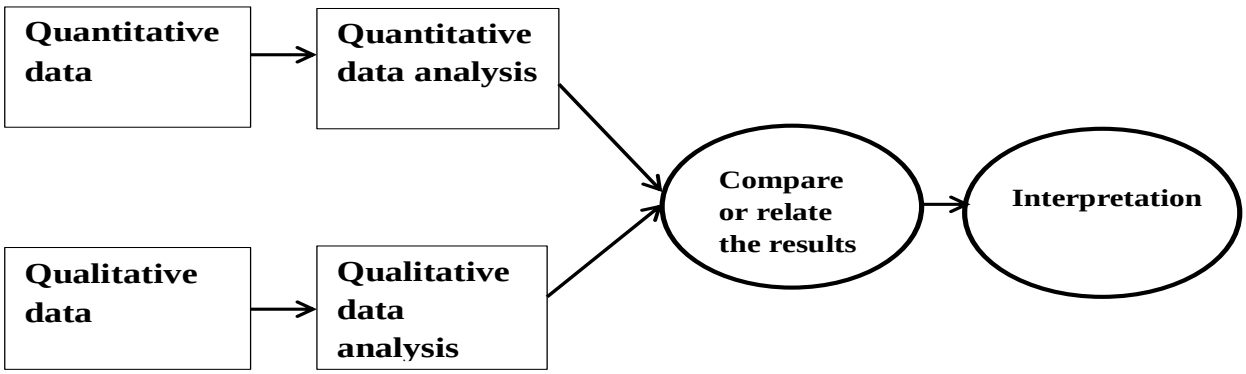


Research design

A convergent parallel design was adopted for this study. The design enabled the researchers to simultaneously collect quantitative and qualitative data which typically both were given equal weight (Bryman, 2016). The resulting analyses were then compared and/or merged to form an integrated whole and interpreted. As affirmed by Creswell (2017), convergent parallel design provides more comprehensive evidence for studying research problems than either quantitative or qualitative research alone. The design enables researchers to obtain simultaneously numeric and non-numeric data from different categories of respondents. Kipapy *et al.* (2018) pointed out that "each approach had its shortcomings that helped to compensate and supplement each other and yield more satisfactory results than using one research design method". Figure 3 summarizes the process of convergent parallel mixed methods.

Figure 2

Convergent parallel mixed methods research procedure



Sample size and sampling procedure

The study population consisted of all key stakeholders in the GIS located in Dodoma City. Each category of actors was sampled separately. Farmers' sample size was determined because their population was substantial enough to form a sampling framework. The list of farmers (i.e. sampling frame) was obtained from the City Agricultural Irrigation and Cooperative Officers of Dodoma City. The sample size of 277 grape farmers was obtained by using the formula by Yamane (1973) as follows:

$$n = \frac{N}{1 + N\,(e)^2} = \frac{903}{1 + 903\,(0.05)^2} = 277.206 \approx 277$$

Where n = sample size, N = population size of smallholder grape farmers, and e = the desired level of precision or sampling error, estimated in percentages (0.05).

To ensure equal distributions of the sample of the respondents from each ward, a proportional sample size was calculated (see Table 1). Thereafter, a simple random sampling and particularly container draw (or lottery) was employed to select the fractional sample size from each ward.

The other 116 respondents from other eight stakeholder categories whose sampling frames were difficult to establish were purposively selected (see Table 2). The classification of these stakeholder groups was designed based on their related common objectives and innovation activities along the gape value chain. In addition,

12 key informants were purposively selected based on their positions and experience in the grape innovation activities (Table 2).

Table 1

Sample fraction from each ward

Ward	Total number of farmers	Sampled farmers $a = \frac{n}{N}\ x\ b$
Mpunguzi	509	$= \frac{277}{903}\ x\ 509 = 156$
Mbabala	304	$= \frac{277}{903}\ x\ 304 = 93$
Hombolo	90	$= \frac{277}{903}\ x\ 90 = 28$
Total	**903**	**277**

Table 2

Sample of Stakeholders

Category of stakeholders	Number of respondents
Policymakers from the ministry of agriculture	5
Researchers from Makutupora Agricultural Research Institute	6
Village and ward extension workers	4
Loan officers and managers from financial institutions	10
Grape, and wine consumers	50
Traders (retailers and wholesalers)	25
Processors	9
Input suppliers	7
Total	**116**
Category of Key informants	
City Agriculture Development Officer,	1
Ward Community Development Officers	2
Ward Executive Officers	3
Village Executive Officers	3
Director of Makutupora Agricultural Research Institute	1
Head of Extension Department of the Ministry of Agriculture	1
Deputy Permanent Secretary of Ministry of Agriculture	1
Total	**12**

Methods of data collection

Quantitative data was collected using a standardized structured interview with 393 respondents from the nine stakeholder groups (i.e. smallholder farmers, policymakers, researchers, village and ward extension workers, loan officers and managers, grape and wine consumers, traders, processors, and input suppliers). The interview questions were designed to elicit information about the interactions between stakeholders, with binary codes of 0 indicating the presence of interaction and 1 indicating the absence of interaction. Similarly, the strength of interactions between

stakeholders was assessed by asking respondents to rate on a four-point Likert scale adopted from Charles *et al*. (2022a) as follows: "0 = no interaction or collaboration in the exchange of knowledge and other resources, 1 = low interaction implying the existence of a one-way directional flow of information and knowledge between two stakeholders; 2 = medium interaction, implying the existence of a rare reciprocity of knowledge, information and experience sharing; and 3 = strong interaction, indicating the availability of mutual knowledge and information flow between stakeholders." Finally, respondents from each stakeholder group were asked to rate the seriousness of the challenges impeding their interactions on a four-point Likert scale, with 0 representing no challenge, 1 representing a less serious challenge, 2 representing a challenge, and 3 representing a serious challenge.

As previously stated, we conducted in-depth interviews with 12 key informants (see the list of key informants in Table 2) and 6 Focus Group Discussions (FGDs) with smallholder grape producers to supplement, triangulate, and validate quantitative data. In each ward, two FGDs were held. Each focus group had 9 to 12 participants. The FGDs and in-depth interviews were both guided by a checklist that summarized the research's main themes. The key informant interviews lasted 30 to 50 minutes, while the discussions lasted 30 to 45 minutes. From an ethical standpoint, during the interview, each interviewee was asked to sign a consent form indicating his/her willingness to participate in the study. Similarly, with the consent of group discussion participants and key informants, the discussions were documented in a notebook and audio recorded, and researchers ensured the confidentiality of all interview data.

Data analysis

The identified binary codes of interactions between stakeholders in the GIS were translated into a matrix and node edge list. Likewise, the identified strength of interactions between nodes was reduced to an average for each group of stakeholders. Then, sociogram, out-degree, and in-degree measures of centrality were performed by using social network analysis through the UCINET programme. Moreover, descriptive statistics primarily mean scores from each stakeholder group was calculated to determine the perceived seriousness of challenges of interaction between stakeholders. The responses which was in Likert scale, with 0 representing no challenge, 1 representing a less serious challenge, 2 representing a challenge, and 3 representing a serious challenge from each stakeholder group were used to determine the average values of each stakeholder group. On the other hand, the thematic analysis technique was used to analyze the qualitative data from FGDs and in-depth interviews. The transcription was first conducted and followed by a coding process. Upon completion of the coding process, the codes were then bunched into themes based on the conceptual description of ideas. Thereafter, both quantitative and qualitative data were merged and interpreted.

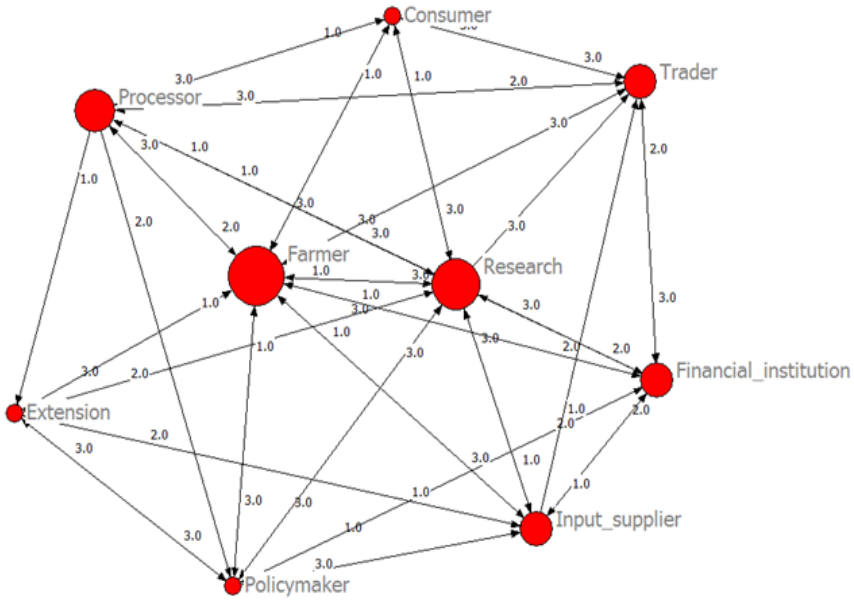
Results

Interactions between stakeholders and their power relationships

Figure 4 depicts stakeholder interactions regarding the flow of knowledge, experience, market links, and credits in the GIS. According to the graph, each stakeholder category interacted with more than one stakeholder. However, the number of interactions between stakeholders varied from one stakeholders to another. In this regrad, farmers and research institutions had the most interactions compared to other nodes. Traders, processors, financial institutions, and input suppliers interacted with a moderate number of stakeholders, whereas consumers, extension, and policymakers interacted with a small number of stakeholders in the GIS.

Figure 3:

Interactions between stakeholders in the GIS in Dodoma City



The size of the node corresponds to the number of interactions the stakeholder had with in the system. The greater the node's size, the greater the number of linkages it had, and vice versa. The numbers along the ties represent the calculated mean score ($\bar{x}$) concerning the strength of interactions (minimum $\bar{x}$ = 1, maximum $\bar{x}$ = 3).

Similarly, the analysis of the outdegree and indegree of centrality measures of the nodes in the GIS revealed that the farmers were the most central node. Farmers' normalized outdegree and indegree values were both 1.00 (Table 3). This implies that all of the farmers indicated that they had interacted with all stakeholders in the GIS. Similarly, all the other stakeholders (100%) responded that they had been interacting with farmers.

Also, the social network analysis shows that, with the exception of consumer and financial institution nodes, other stakeholders had a mean score ($\bar{x}$) of 3, indicating that they have had strong interaction with farmers (Figure 4). Farmers, on the other hand, rated their interactions with consumers and traders as strong ($\bar{x}$ = 3), moderate ($\bar{x}$ = 2) with processors and weak ($\bar{x}$ = 1) with policymakers, researchers, extension workers, financial institutions, and input suppliers (Figure 4). The reported strong relationship of farmers with consumers and traders was reported resulting from selling and buying grapes.

Also, results in Table 3 show that research institutions had the second-highest outdegree (87.5%) and indegree (87.5%) centrality of measures. Interviewees in the research institutions reported having been collaborating with seven nodes namely policymakers, extension workers, consumers, traders, processors, farmers, and input suppliers. Similarly, with exception of traders, all other stakeholders showed that they were interacting with researchers.

Table 3

Stakeholder-network centrality measures (Degrees) in GIS

Stakeholder	Outdegree	Indegree
Policymaker	62.500	50.000
Research	87.500	87.500
Extension	50.000	62.500
Financial institution	75.000	50.000
Consumer	50.000	62.500
Trader	50.000	75.000
Processor	75.000	62.500
Farmers	100.000	100.000
Input supplier	62.500	62.500

Similarly, Figure 4 shows that ties of the outgoing research node had a mean score of 3 for all actors in the GIS. This means that researchers rated themselves as having strong interaction with all key selected stakeholders along the grape value chain. This implies that researchers reported to have had reciprocal grape knowledge and information sharing with all stakeholders along the grape value chain. However, the social network analysis results of incoming ties to the research node show that traders reported having no interaction with researchers at all. Similarly, the nodes of farmers, processors, consumers, and input suppliers received a mean score of 1, indicating that these stakeholders rated their interaction with researchers as weak. Only policymakers and financial institutions indicated strong ($\bar{x}$ = 3) and moderate ($\bar{x}$ = 2) interaction with research institutions, respectively. This was later confirmed by one key informant, who stated:

Researchers are aware that there should be reciprocal or mutual knowledge and skill sharing with all stakeholders across all nodes of the grape value chain. When asked if they have shared mutually the knowledge and skills with other stakeholders, they will automatically say yes. However, this is not the case. I had always seen researchers from Tanzania Agricultural and Research Institutes come and involve us in their grape technology trial plots while training us on how to use them. Some researchers, like you, simply come to interview us and then leave.

Processors had the third highest value of 75.000 and 65.500 of outdegree and indegree respectively. Interviewed processors indicated to have interacted with six nodes of stakeholders namely policymakers, researchers, extension workers, financial institutions, consumers, traders, and farmers (Figure 4). On the other hand, interviewed policymakers, extension workers, financial institutions, and input suppliers indicated to have no interaction with processors in the GIS. The other nodes such as farmers, traders, consumers, and researchers were revealed to have been interacting with processors. Their strength of interactions ranged from medium ($\bar{x}$ = 2) to strong ($\bar{x}$ = 3).

Moreover, the results demonstrated that traders and input suppliers had moderate interactions with other nodes of stakeholders of 50.000 and 62.500 outdegree and indegree respectively in the system (Table 3). However, their moderate interactions revealed to be much contributed by the fact that processors and traders interacted more strongly among themselves than they did with other stakeholders in the GIS. This was because they all shared the common interest of purchasing and selling grapes and wine in the system. This was later confirmed by a key informant who said:

Processors and traders share a common interest in making money through business in the GIS. They buy grapes from farmers and sell grapes and wine to the consumer. Hence, they have a strong interaction amongst themselves.

The findings also revealed that policymakers had the lowest outdegree (62.500) and indegree (50.000), implying that they interacted with fewer stakeholders. They reported interacting with six nodes namely farmers, research and extension, input suppliers, processors, and financial institutions in the GIS. Surprisingly, while policymakers indicated and rated their interaction with farmers, research, extension, and input suppliers as strong ($\bar{x}$ = 3), the full social network analysis results revealed that input suppliers indicated to have no interaction with policymakers at all. As a result, the study reveals that policymakers interacted with only five GIS nodes. Research and extension rated their interaction with policymakers as strong ($\bar{x}$ = 3), processors as medium ($\bar{x}$ = 2), and farmers and financial institutions as weak ($\bar{x}$ = 1). These findings suggest that the lack of interaction between policymakers and many other stakeholders is evidence of disconnect between agricultural policy and stakeholders' practice in GIS. According to the findings of the Head of the Extension Department of the Ministry of Agriculture, Director of Makutupora Agricultural Research Institute, and Deputy Permanent Secretary of the Ministry of Agriculture, many policymakers from the Vice President's Office, line ministries, and Parliament do not make many field visits to local areas, primarily due to time and financial constraints, which hinders their ability to understand the realities and monitor the implementation of policies.

Moreover, the study's findings revealed that the extension system interacted with only five of the GIS's nine nodes (farmers, researchers, policymakers, processors, and input suppliers). They reported having no collaborative relationships with financial institutions, consumers, and traders (Figure 4). Correspondingly, financial institutions, consumers, and traders reported that had not been working with extension workers. Similarly, Figure 4 depicts that extension workers rated themselves as having strong interaction with farmers and policymakers ($\bar{x}$ = 3) and medium interaction with research and input suppliers ($\bar{x}$ = 2). Only the incoming ties of the research system and policymakers to the extension system, on the other hand, had a mean score of 3, whereas the incoming ties of nodes of processors, farmers, and input suppliers had a mean score of 1. According to these findings, only researchers and policymakers rated themselves as having a strong interaction with the extension system in the GIS. Processors, farmers, and input suppliers rated their interaction with extension as weak, implying that they were merely recipients of innovations brought to them by extension workers.

This was later confirmed by farmers during the FGDs in Mpunguzi and Mbabala wards when they revealed that the participation of extension agents in the GIS is very weak. Similarly, one of the key informants had also the following to say: *Extension workers are unable to establish interaction platforms, which would have increased the flow of information and ideas required in the grape innovation process. In this regard, the lack of extension interaction in the GIS prevented farmers from providing feedback to researchers for further grape innovation improvement.*

Finally, the node of consumers was among the nodes in the GIS with least outdegree (50.0 and indegree (62.50). This is supported by the findings in Figure 4, which show that consumers interacted with only four nodes (farmers, research, processors, and traders). Furthermore, consumers rated their interaction with traders as strong ($\bar{x}$ = 3) and with farmers, researchers, and processors as weak ($\bar{x}$ = 1). Subsequently, traders, farmers, researchers, and processors rated their interactions with consumers as strong ($\bar{x}$ = 3). Although these four nodes indicated to have strong interaction with consumers, still the finding is contrary to IS approaches which required all stakeholders to work together for the sake of "guidance of the search". In the context of this study, the search guidance refers to areas of an innovation that have been identified as requiring additional modification or investment for improvement.

Perceived Challenges of Interactions among Various Stakeholders in the GIS

Table 4 indicates that lack of platforms ($\bar{x}$ = 2.9) ranked as the first challenge impeded stakeholders to interact in the GIS. All stakeholders pointed out that the lack of commodity value chain platforms challenged

them to have frequent and strong interactions in the system. The same was reported during the FGDs in all wards that lack of platforms was a major issue that requires serious consideration. Participants pointed out that an innovation platform is critical, especially in this era when various stakeholders in the agricultural sector are expected to participate in all innovation processes in order to produce relevant innovation that can be widely scaled up and adopted by end users.

Table 4

Mean distribution of perceived challenges of collaboration between stakeholders along the grape value chain (minimum mean = 0, Max. mean = 3)

Challenges	Stakeholders									
	Policymaker	Research	Extension	Financial institution	Consumer	Trader	Processor	Farmer	Input supplier	Total average
Lack of platforms	3.00	3.00	3.00	3.00	3.00	3.00	3.00	2.5	3.00	2.944
Communication barriers	3.00	3.00	3.00	1.00	3.00	2.33	1.50	2.50	1.33	2.416
Inadequate financial resources	3.00	3.00	3.00	0.00	3.00	3.00	2.00	1.5	3.00	2.389
Lack of time	3.00	3.00	3.00	2.00	0.00	3.00	1.50	0.00	2.33	1.981
Limited number of staff	3.00	3.00	3.00	2.00	0.00	0.00	0.00	0.00	0.00	1.222
Lack of trust	0.00	0.00	0.00	3.00	0.00	1.68	2.00	1.50	1.67	1.094
Lack of will to collaborate	0.00	0.00	0.00	0.00	0.00	3.00	2.00	0.00	1.67	0.741

Key: 0 = Not a challenge, 1 = Less serious challenge, 2 = Challenges; 3 = Serious challenge

Also, the results in Table 4 show that almost all stakeholders identified communication barriers ($\bar{x}$ = 2.4) and insufficient financial resources (2.4) as serious challenges that hampered them from having frequent and high-level interactions in the GIS. Participants in the FGDs, on the other hand, revealed that most stakeholders, particularly consumers, traders, processors, and farmers, had not yet strongly connected to information and communications technologies such as mobile phones, internet, tablets, computers, televisions, and print technologies for facilitating interaction without physical contact. As a result, stakeholders were required to interact in person through workshops, seminars, field days, and so on. Face-to-face interactions, according to researchers, policymakers, and extension workers, required adequate staffing, transportation, and funding. The Director of Makutupora Agricultural Research Institute summarized: "*We don't meet because, to bring people here, I have to cover per diems, travel expenses, and meals.*"

Policymakers, researchers, extension, financial institutions, traders, processors, and input suppliers all reported a lack of time ($\bar{x}$ = 2) as a challenge hindered them to work with other GIS stakeholders. Policymakers, researchers, extension and financial institutions linked the challenge of lack of time with limited number of staff ($\bar{x}$ = 1.2) (see Table 4). Besides, lack of the will and trust to collaborate scored the smallest means of $\bar{x}$ = 1.1 and $\bar{x}$ = 0.7 respectively, in the GIS. The lack of the will to collaborate was mainly reported by traders, processors, and input

suppliers meanwhile lack of trust was reported to exist between financial institutions and market stakeholders (traders, processors, and input suppliers), and farmers.

Discussion

The findings of this study revealed that farmers were the focal point of interaction in the GIS. It was found that farmers and research institutions interacted with nearly all key stakeholders in the GIS. These findings revealed that almost all GIS stakeholders were aware that farmers were the primary targets in the grape innovation process. These findings are consistent with those of a study conducted by Kamara (2018), which highlighted the importance of farmers in networks as the primary target beneficiaries of agricultural technologies as well as disseminators of the same to their fellow farmers.

In measuring the strength of interaction, although farmers interacted with almost all actors in the GIS, the findings revealed that their interaction was weak. It was weak because their interaction with other actors was characterised by a one-way directional flow of information and knowledge. Thus, policymakers, researchers, extensionists, financial institutions, and input suppliers always provided knowledge and supportive services to farmers. Farmers participated in the GIS by being informed what has already been decided by researchers and policymakers about grape innovations. This finding aligns with the findings by Suchiradipta and Raj (2015) who found that even though farmers were key stakeholders in the network, they were excluded from decision-making at the top level, which is typically a characteristic of agricultural systems in developing countries.

Also, the findings of this study suggest that grape innovations were developed by the research system without taking into account the needs of other stakeholders such as farmers, consumers, processors, and input suppliers. This finding is identical to what was observed in innovation generation during the traditional linear model epoch. Other empirical findings from other study areas both in the global of north and south have shown the same that, despite the emergence of AIS oriented thinking, there is still a strong adherence to the transfer of technology approach and its practices, with thinking on farming systems remaining disconnected from the broader systemic views on innovation (Klerkx *et al.,* 2012). Kamara *et al.* (2019) noted that "there is still limited use of the AIS framework by practitioners in the design and implementation of renewed research and extension programmes, as well as of innovation policy strategies and instruments." Similarly, Singh *et al.,* (2019) show that the AIS in Asia has evolved over time but suffers from a linear approach which affected smallholder and marginal farmers in getting enough food and many of them resorted to committing suicide. The lack of institutional support and interaction results in non-viability of smallholder and marginal farmers, and thus they were facing exclusion (Singh and Gill, 2019). It is still a challenge especially in developing countries, therefore, to turn AIS oriented thinking into practice need supporting the development of new practices, strategies and policies to encourage productive multi-actor interactions so that innovations can emerge, develop and diffuse successfully (Aerni *et al.,* 2015; Maru *et al.* 2018; Toillier *et al.,* 2022).

Also, the findings support Staver *et al.* (2007)'s argument that, while we advocate the utility of IS in agriculture, many agricultural institutions and development organizations continue to use the traditional linear model. Similarly, Wambura *et al.* (2015) assert that farmers in Tanzania are still viewed as passive recipients of agricultural technologies in the IS era. According to Fagade (2001), research has always been shaped by western agendas and methods. As a result, this goes against the IS requirement of empowering all stakeholders, including farmers, to participate in defining, generating, and disseminating innovations.

Moreover, the finding revealed the existence of weak interaction of policymakers with farmers and financial institutions and no interaction with consumers, traders and input suppliers in the system. This goes contrary to the requirements of the IS and is a disincentive to the development of the grape industry. According to the IS perspective, policymakers must actively participate in multi-stakeholder activities in

order to learn how policies influence the system and what changes are required. These findings are similar with that of Onumah *et al.,* (2023) who found that the main agricultural policy support institution and local financial institutions had fewest ties, indicating that they had weak interactions with many other stakeholders on a cocoa innovation system in Ghana. Furthermore, the position of local financial institutions at the periphery of the system, with fewer linkages to other stakeholders, confirms the findings of Charles *et al.,* (2022a) and Charles (2024) on how agricultural financing continues to remain a key challenge in Tanzania's agriculture.

Furthermore, although the extension advisory services found to be provided by diverse input suppliers, non-governmental organizations, and public extension agents, extension system was rated to have no collaborative relationships with financial institutions, consumers and traders as well as weak relationship with processors, farmers, and input suppliers in the GIS. The findings indicated that extension system had only strong relationship with research system and policymakers. The lack of interaction of extension system with consumers and traders as well as weak relationship with farmers implies that farmers were merely recipients of innovations brought to them by extension workers. Under this circumstance, farmers were concerned that it would be difficult for them to tape and use the newly developed grape technologies. According to AIS a perspective, researchers require consumer feedback in order to modify or develop new relevant innovations (Nybakk *et al.,* 2008). This study contends that policymakers, researchers, and extension workers lacked consumer feedback on existing grape innovations for further modification or development of relevant new innovations along the grape value chain. The findings of this study were contrary to the findings by Onumah *et al.,* (2023) in Ghana whereby extension actors had the highest out-degree score, indicating that they were the most influential and initiated more interactions in the cocoa network.

The study went further by examining the challenges hinder stakeholders to interact in the GIS. The findings indicate that one of the major challenges impeded stakeholders to interact in the GIS was lack of innovation platforms. Following the implementation of the Agricultural Sector Development Programmes I and II, which encourage the establishment of commodity value chain platforms to improve interaction among stakeholders at the local government authority level (URT, 2016), this study expected commodity value chain platforms to be already in place in the GIS. However, the findings of this study revealed that commodity value chain platforms had yet to be established in GIS. Therefore, interaction of stakeholders in GIS was limited because there were no innovation platforms in place. This finding supports the conclusion made by Charles *et al.,* (2022b) that innovation platforms are just reflected in government documents but not in reality in developing countries. The finding is also consistent with the findings of Bayissa (2015), who discovered that weak interactions among stakeholders in innovation activities were caused by a lack of innovation platforms and institutionalized bodies for stakeholder coordination. These findings show that a lack of innovation platforms for interactions of stakeholders remains a common challenge in developing countries and Tanzania in particular.

Similarly, communication barriers, insufficient financial resources, lack of time and limited number of staff (insufficient capacity) were found to be among the serious challenges hindered stakeholders to interact in the GIS. Policymakers, researchers, extension agents, and financial institutions associated a lack of time with a limited number of employees in their offices. Interviewees from these institutions reported that owing to the limited number of staff, most of the time they were limited to travel and interact with other key stakeholders involved in the GIS. Insufficient capacity and limited resources hinder all actors from performing their roles efficiently and effectively. Budget constraints affect the ability to organize or attend meetings and workshops, limiting opportunities for collaboration and learning. These findings are consistent with those of Charles *et al.,* (2022b), who discovered that insufficient staff prevented policymakers, researchers, and extension workers from interacting with other actors in the improved rice variety innovation system.

The study's findings show that traders, processors and input suppliers reported to lack time of collaborating with other actors especially those who were not involved in business. These stakeholders indicated to have had low interactions with most other stakeholders as they were more engaged in money-making activities. This finding implies that there was a low level of collaboration between market stakeholders with policymakers, researchers, and extension workers in developing market strategies for grapes and wine. In this connection, it was difficult for policymakers to obtain new ideas from market stakeholders and reform the market policies and strategies accordingly. This study argues that the efforts of the government of Tanzania to strengthen poor farmers' access to markets might not succeed without strengthening the collaboration between market stakeholders and policymakers. According to the IS perspective, the chance of success and finding solutions to the market problems is enhanced through sharing knowledge and experience among all required stakeholders.

Finally, the findings show that in most times, market stakeholders and farmers complained about the unfavourable procedures and conditions of accessing loans from financial institutions, especially commercial banks. Also, participants in FGDs bitterly complained that the interest rates charged by the banks were too high. However, interviews with loan officers from a commercial rural development bank and a national microfinance bank revealed that the banks had put in place strict conditions because they did not believe that farmers could repay the loans. This mistrust and fear emanated from the fact that most farmers depended on rain-fed farms. Hence, conditions put by financial institutions lowered their rate of interaction in the system.

Conclusion and Recommendations

This study concludes that the multi-stakeholder interactions and networks in the GIS were limited. Lack of innovation platforms, communication barriers, insufficient financial resources, lack of time and limited number of staff (insufficient capacity) were found to be among the serious challenges hindered stakeholders to interact in the GIS. The findings indicate that the GIS does not work according to the perspectives of AIS which calls that each stakeholder has to collaborate vigorously with other system actors in order to achieve the desired common goal.

In light of the findings and conclusion above, the study recommends for strengthening of links among all key stakeholders in the GIS, as they rely on one another to function and achieve the goals of improved grape production. The Tanzanian government should make an extra effort to transform the research system from a linear model to the practical AIS. The system that will necessitate a strong link between stakeholders, as well as improved coordination and networking capacity among all key stakeholders involved in grape innovations. Finally, the Tanzanian government should collaborate with stakeholders in their organizations to develop financial resource mobilization strategies that will increase the availability and accessibility of finance by stakeholders, allowing for policy implementation, multi-stakeholder platforms, increased staffing, and advancement of information and communication technologies. However, because our study did not address the issue of gender innovations in GIS, more research is needed to learn more about the grape production community, specifically who is involved based on gender and wealth.

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