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Rural Farmer Network Analysis Under The Modernizing Agriculture In Ghana Project:

Gendered Perspective

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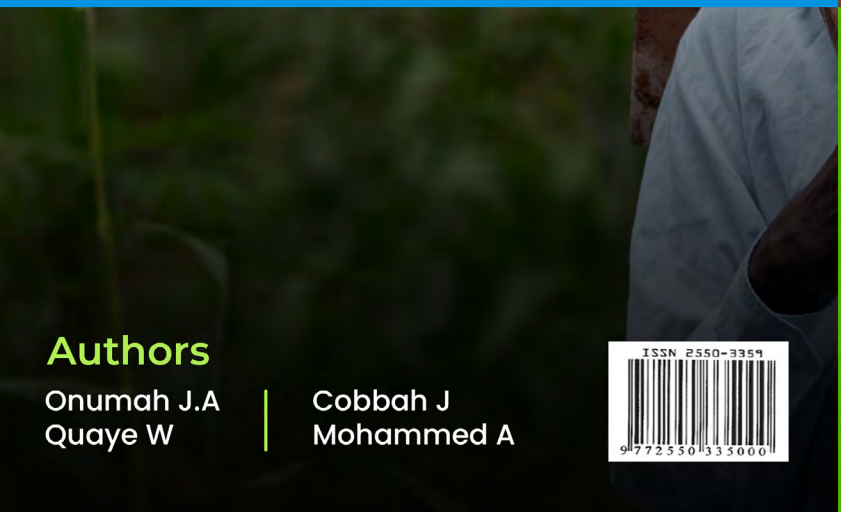

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The Forum for Agricultural Research in Africa (FARA) is the apex continental organisation responsible for coordinating and advocating for agricultural research-for-development. (AR4D). It serves as the entry point for agricultural research initiatives designed to have a continental reach or a sub-continental reach spanning more than one sub-region.
FARA serves as the technical arm of the African Union Commission (AUC) on matters concerning agricultural science, technology and innovation. FARA has provided a continental forum for stakeholders in AR4D to shape the vision and agenda for the sub-sector and to mobilise themselves to respond to key continent-wide development frameworks, notably the Comprehensive Africa Agriculture Development Programme (CAADP).
FARA's vision is to "Reduced poverty in Africa as a result of sustainable broad-based agricultural growth and improved livelihoods, particularly of smallholder and pastoral enterprises" its mission is the "Creation of broad-based improvements in agricultural productivity, competitiveness and markets by strengthening the capacity for agricultural innovation at the continental-level"; its Value Proposition is the "Strengthening Africa's capacity for innovation and transformation by visioning its strategic direction, integrating its capacities for change and creating an enabling policy environment for implementation". FARA's strategic direction is derived from and aligned to the Science Agenda for Agriculture in Africa (S3A), which is in turn designed to support the realization of the CAADP vision.

Disclaimer

Abstract

This study sought to analyze farmer networks in the Northern zone of the Modernizing Agriculture in Ghana project's implementation areas. Qualitative data was obtained using focus group discussions. For the analysis of the data, thematic and social network analyses were employed. It was found that the main actors connected to the famers' network at the local level included research actors; private sector actors, including NGOs, development partners, input dealers and aggregators; local government actors; and finally individual farmers and farmer-based organisations. Though no gender discrimination was found in the way actors connected to the individual farmer networks, male and female farmer groups connected to one or more actor that the other did not. The role of extension officers in the formation and functioning of farmer networks was brought to light in this study, as they were the main actors who championed farmer group formations, both male and female groups. FBOs are key knowledge sources, providing interactive platform and a self-help support for its members and farmers are therefore encouraged to be part. Both male and female farmers were found to be very influential and prominent in their networks, which gives them much power over their activities. It will be imperative for the institutional support under MAG to contribute in building the capacity of farmers, extension agents, input dealers, and the District Assemblies as they have the great potential of sustaining the MAG network at the local level.

Social network analysis; gender; farmer networks; modernizing agriculture

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Introduction

The Modernizing Agriculture in Ghana (MAG) project provides budgetary support and technical assistance in response to the objectives of the Food and Agriculture Sector Development Policy (FASDEP), the Medium-Term Agriculture Sector Investment Plan (METASIP), and the Ghana Shared Growth Development Agenda (GSGDA). The project aims at addressing productivity and value chain management issues for increased farmer incomes and enhanced rural livelihoods. The project focuses on demand-driven research and alternative methods of extension delivery that facilitate the dissemination of technologies to individual farmers, Farmer Based Organisations (FBOs), out-growers of nucleus farms, among others. Among the key activities of MAG is the repackaging and dissemination of improved production and post-production technologies to beneficiaries who are mainly farmers and processors. The project also pays particular attention to gender inclusion and empowerment through training and technology dissemination.

There are four (4) components of the project, each driving a pathway to realize the project's objectives. Component 1 seeks to provide support to increase the efficiency of local farmers through value chain development. It also provides direct support to District Departments of Agriculture to provide general agricultural extension services to farmers at the local level. Among other deliverables, this component will focus on enhancing farmers' business management skills and financial literacy. Component 2 provides support to specialized agricultural services to build national market linkages and promote efficiencies in commodity development along value chains. This component assists regions in the coordination of regional programming monitoring and evaluation of national level agricultural policies and in assessing challenges as part of a feedback loop to inform future policies, legislation, and agricultural standards. It will also support research extension activities in promoting effective research response to identified farmer issues. Support to agricultural research in strengthening agricultural

extension services and improving agricultural productivity is executed under the Component 3. It will help identify the production needs and demands of smallholder farmers and define appropriate agricultural research and innovations that can be efficiently rolled out. Funds are provided via the Ministry of Environment, Science, Technology, and Innovation (MESTI) to the Council for Scientific and Industrial Research (CSIR). In addition, funds will be provided to the Human Resources Directorate and Extension Services Directorate at the Ministry of Food and Agriculture (MOFA) for capacity and extension package development and the curriculum revision. Support will also be provided to the Monitoring and Evaluation Directorate within MOFA for overall program monitoring. Component 4 aims at improving Ghana's competitiveness in international agricultural markets.

Farmers are the main beneficiaries of the project and it provides support for farmer network formation as interventions are only delivered at farmer group and not individual levels. Therefore, this study was carried out to assess at first hand, the functioning of the various farmer networks, popularly referred to as Farmer Based Organisations (FBOs) under the project. Farmer Based Organizations are important networks and media through which knowledge sharing occurs through interactions. These actions contribute to breaking information asymmetry between farmers and other actors in the agricultural value chain (Bernard & Spielman, 2009; Hellin, et al., 2009). Previous studies have also found that FBOs play prominent roles in agricultural platforms as they are the means through which other actors reach other farmers (Onumah, Asante, & Osei, 2021). These suggest that assessing farmer networks is important to provide options in strengthening and maximizing the gains from such networks. However, there could be gendered differences in terms of knowledge acquisition and participating in these networks (Zossou et al., 2017) and so this study sought to assess whether the composition and power relations in farmer networks under the project is gendered or not, and how it can be strengthened. Such analysis is important for the programme managers to understand how the positions of each actor play out in facilitating interactions to achieve the project's outcomes at the local level.

This paper is organized in three (3) sections. Following Section 1, which introduces the study, Section 2 presents the methodology adopted for the study, and Section 3 presents and discusses the findings from the study.

Methodology

Study area and data collection approach

The study relied mainly on qualitative data obtained from focus group discussions with farmers under the MAG project. The beneficiaries under the project are nationwide and two regions were selected from Northern Ghana for the study, given the time and resources available. Most of the assessments under the project, including exploring the adoption and impact of disseminated technologies, had been in Southern Ghana and hence Northern Ghana provided a very good case for an unbiased outlook of the project. Two districts, each from the Northern and Upper West regions were selected for the Focus Group Discussions. These areas were selected based on the concentration of MAG activities led by the key actor in Northern Ghana, the CSIR-Savannah Agricultural Research Institute (SARI). In the Northern region, SARI together with the extension officers have carried out capacity building and technology dissemination in four districts, namely Tamale, Kumbungu, Savelugu, and Mion and so Savelugu and Mion Districts were selected to represent the project areas of the Northern region. In the Upper West region however, Wa West, Sissala West and East were the operational districts and the team selected Sissala East and West as the study districts.

For the selection of farmers, the extension officers in each of the Districts guided the process. Since the extension officers worked directly with these farmers under the project, they were the first point of call to get representative farmers. The criteria for selecting these farmers were based on their beneficiary period status. Due to the gender focus of this study, the focus groups were divided into male and female groups to assess their heterogeneous network support systems, if any existed. Between 8 and 10 female and male farmers who have been beneficiaries of the project for not less than 1 year were selected to participate in the focus group discussions in each of the Districts. In total, 12 focus group discussions (6 female and 6 male groups) were held in the 4 selected districts for the study. A semi-structured interview guide was developed and used to collect data through Focus Group Discussions with the farmers.

Data analysis

Thematic analysis

The study adopted both qualitative and quantitative analytical approaches using the qualitative data obtained from the field. Thematic analysis and the Social Network Analysis (SNA) were employed in analysing the objectives of the study. Consent was sought from participants to record the discussions. Participants were also assured of anonymity so in the results and discussion we used codes to identify the voice of an actor. There were multiple stages of the analysis which included, data transcription, data formatting by broad headings for auto-coding in NVIVO, first-level coding, second-level coding, and finally generation of themes and subthemes from these codes. The themes and subthemes generated were then used to discuss the findings in Sections 3.1, 3.2, 3.3, 3.4, and 3.6 in the narrative section of this study.

Social Network Analysis

Responses regarding actor connections in the network were used to generate the network data for the social network analysis. Two (2) network maps were drawn; one for female farmers and the other for male farmers' networks. The farmer networks were disaggregated to analyse if there were any differences in farmer network support systems based on gender.

Social Network Analysis (SNA) is an analytical method that analyses relationships among a wide range of actors through measurement and visualization (Borgatti ***et al.,*** 2009). The tool has been mostly applied in the industrial sector and scholars in the agricultural sector have adopted it for the analysis of relationships in the sector (Spielman ***et al.,*** 2011). Network data for the MAG network analysis were compiled in a square (nxn) matrix of actors. A relational score of 1 or 0 is assigned to actors depending on whether there is an interaction or not between them, respectively. Assuming there is a relation between actor k and j, a value of 1 is assigned; n_{kj}=1 or n_{jk}=1. The former is when the interactions flow from k to j and vice versa for the latter. If ***k*** initiates all the interactions and ***j*** does not, then n_{kj} is assigned a value of 1 but n_{jk} is assigned 0**.** However, if there is no relationship, a value of 0 is assigned; n_{kj}=0 or n_{jk}=0. This implies that the relational matrix is not necessarily symmetric and these details were carefully obtained from the farmers before the matrices were drawn.

Actors in social network analysis are referred to as nodes and ties define the linkage between them. The degree of connectedness of an actor is indicated by the node size in the network map. To further measure the strength of relations among actors, the Freeman degree of centrality (C_d measured in equation (1) was adopted:

$$C_d(n_i) = \frac{\gamma_i(n_i)}{N-1}$$

Where n_i is the node or actor of interest; γ_i is the number of ties to an actor n_i ; **N** is the size of the network, and $N-1$ is the size of the network less the node of interest. Centrality indices include betweeness, effect size, coreness, and in/out degrees as used by other authors such as Weyori, Amare, Garming, and Waibel (2018) and Spielman ***et al***. (2011). Actors who have the highest betweeness score indicate the degree to which those actors provide a bridge for connecting others in the MAG network. Effect size measures how big an actor is in the network and gives an indication of the source of a network's structural holes. How close an actor is to the core of the network is given by the degree of coreness. The in-degree and out-degree measure the level of linkages an actor receives from and gives to others, in a network, respectively. Prominent actors are those with high in-degree scores whilst influential actors are those with high out-degree scores (Borgatti ***et al***., 2009; Freeman, 2004). A network's overall centralization measures the degree of unequal distribution of interaction among actors. Results from the SNA analysis are discussed in Section 3.5.

Reciprocal ties

The UCINET software was used to generate the farmer network maps and the measures of centralization. The results of the thematic and social network analysis are presented in Figures (word cloud, smart art, and text boxes) and Tables, which are discussed accordingly.

Findings

Actors in the farmers' network

Discussions with the various farmer groups highlight weak linkages with some actors in the agricultural value chain. The actors are categorised into research, private sector, local government, and others. Farmers under the MAG project only connected mostly with the Extension officers from MOFA, popularly referred to as the "agric people". Research actors from the CSIR-SARI were however mentioned by only male farmer networks as one of their key network actors (Figure 1b). The women groups mostly work directly with the extension officers and this could account for why there was no mention of CSIR-SARI.

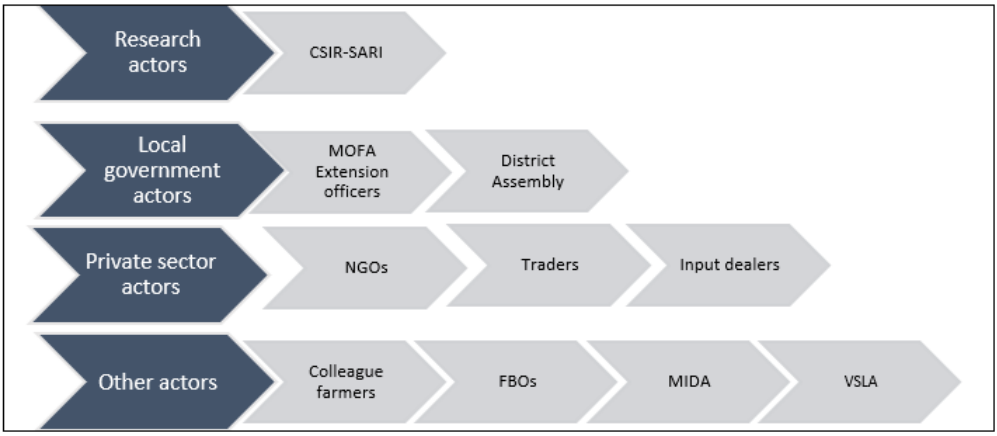


Figure 1: Actors connected to farmers in the Northern MAG zone
Source: CSIR-STEPRI/MAG field interviews (2020)

There was the strong mention of input dealers as one of the main actors that farmers connected to as seen in **Figures 1a and 1b**, even more with women FBO networks. Input dealers are connected to the farmers through the intermediary role of the extension officers under the MAG programme. As part of the support offered, seed and fertilizers are supplied to farmers, leveraging on the fertilizer and seed subsidy programme of the government. However, farmers also connect with input dealers at their individual levels. Input dealers are noted to play important role in local agricultural systems as noted in Hornum and Bolwig (2021) and Singh ***et al.,***(2021) and it is good to note that both male and female farmer networks make good mention of them.

Figure 1a: Women's FBO Network

Figure 1b: Men's FBO network

Source: CSIR-STEPRI/MAG field interviews (2020)

Apart from input dealers in the private sector actors' category, there was also the mention of Non-Governmental Organisations (NGOs) who mostly come in to build farmers' capacity in various areas of their agricultural production. There were more mentions of NGO actors by female FBOs (Figure 1a) as compared to male FBOs (Figure 1b) which could be associated with the call for women capacity building due to the marginalisation tendencies they mostly face (Banyen & Kotin, 2015; Viswanath, 2019).

> *"A certain NGO came to help us to farm groundnuts, so they organized and met with us to have separate meetings…" (Mion Women FGD).*
>
> *"Apart from MOFA, we have CSIR-SARI, MIDA, and TUDRIDEP (Catholic NGO)" (Sissala East Men FGD).*

The connection to the Village Savings and Loans Association (VSLA), though mentioned by both men and women groups, was more prominent with the latter. The VSLA, operated by an NGO but worked through the District Assembly is a scheme that builds the financial endowment of farmers. Given the financial challenges of farmers, especially women who are mostly resource-constrained, strengthening such local financial schemes could go a long way to remove some of the bottlenecks faced by farmers in accessing resources as opined by Adegbite and Machethe (2020) and Saha (2014).

An important actor that was not prominently mentioned during the various discussions were traders/aggregators. The marketing chain is very important if we want to pursue a modernized agriculture that improves the livelihoods of smallholder farmers. The market linkage component of MAG should therefore pay equal attention to linking farmers to markets. Connecting farmers to markets will still be sustained even after the intervention since farmers will continue to produce. That way, beneficiaries would be able to appreciate the intervention even after the programme

has been rolled up. Fostering the power of farmer collective actions could also be used to leverage improved market access as envisaged in Ochieng, Knerr, Owuor, and Ouma (2018).

Farmer Network Formation

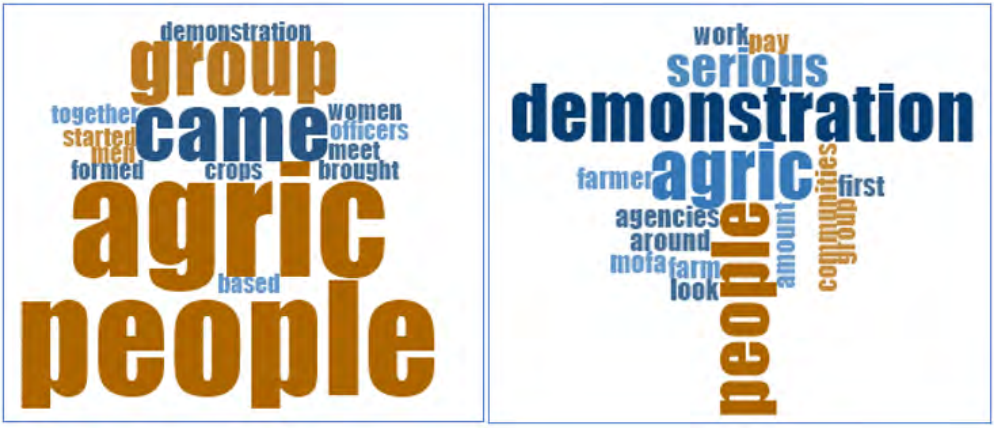
Group champions

It was evident from the discussions that the formation of farmer networks, also known as Farmer Based Organisations (FBOs) was purely based on purpose or specific interventions. Even for some of the groups that were formed by farmers themselves, the idea and motivation stemmed from seeing the benefits being enjoyed by other communities with such groups. The various channels to forming FBOs in the communities visited included:

- Interventions that required farmers to be in groups
- Farmers own need to come together (this is purposely to help themselves)
- Practical evidence of group's benefits (e.g. demonstrations carried out by the extension officers)

Figure 2: Sources of FBO group formation

Figure 2a: Women's FBO Network **Figure 2b: Men's FBO network**



Source: CSIR-STEPRI/MAG field interviews (2020)

However, the formation of FBOs for both male and female famers was found to be largely championed by the extension officers from the Ministry of Food and Agriculture (MOFA), who are popularly referred to in the local parlance as "***agric people***" as seen in Figure 2, and supported by the following quotes:

> *"...the agric people helped us form the group..." (Mion Men FGD).*

"It was through the intervention of MOFA and also the other agencies" (Sissala East Men FGD).

"We were here when the agric people came and started doing their demonstration and put us together (Mion Women FGD).

As indicated in Taylor and Bhasme (2018), extension agents play key role in mobilizing agricultural knowledge sharing through group actions and the use of model farmers from farmer networks. Therefore, farmer network formations are mostly influenced by extension agents.

Field demonstrations usually conducted by the network champions (extension agents) were found to be one pathway that motivated male farmers to come together in groups. Most of the responses from the discussions pointed to the fact that evidence from the demonstration fields, coupled with the advice given by extension officers on the importance of group formation was the main trigger. As previous works (BenYishay & Mobarak, 2019; Tisenkopfs ***et al***., 2015) have established, farmer learning through platforms like demonstrations can facilitate cohesion and adoption of new technologies and should be promoted. The farmers who went to witnessed the activities on the demonstration fields therefore came together to form their current group. They were later joined by other farmers who were not privileged to be part of the demonstrations, as indicated by this group:

"...those of us already in the demonstration started. If anyone wants to join the group, we go and look at his or her farm to see if h/se is a serious farmer first, then he or she will pay an amount to the group. That way he is committed to the group" (Mion Men FGD)

This clearly indicates that farmers are motivated by the benefits they perceive to gain from being a member of a group before making that decision. This signals that to encourage group participation, it has to be purpose and goal-driven and the gains should be evident for non-members to see and be encouraged to join as well. On groups that are formed based on intervention, it will be necessary to put in sustainability measures that will allow the survival of the group even after the intervention elapses. Since there was less mention of demonstrations as a trigger to group network formation by female farmers could be a signal of less participation of women farmers in field demonstrations. This could be due to both time and cultural constraints on the part of female farmers.

Gender-based groupings

Given the cultural uniqueness of Northern Ghana, it was no surprise that though some of the farmer groups were mixed (both men and women), there were also a number of gender-disaggregated groups. Separate women and men groups were quite evident. Even though the discussions were separated into male and female focus groups, it was not the case that we specifically interviewed

women FBOs and men FBOs. However, when asked if the groups they belonged to were gender-disaggregated, the general response in both male and female focus groups was that "***women had their groups***" as projected in the word cloud in Figure 3.

The advantage of having separate groups, especially for the womenwas to give them the freedom to speak and have a common voice. Nikam ***et al.,*** (2019) have suggested the need to have male and female farmer groups as male dominance in mixed FBOs could potentially reduce the chances of equal participation of women. Some of the women's group were found to be formed based on the crops grown. For example, women farmers who planted groundnuts would want to be together as a group separate from say, maize farmers. For these women, the reason for having crop-based groupings was for all members to have a common interest as indicated in this quote:

> *"The reason for the different groupings is we are not the same. Birds of the same feather flock together. This group wants to sow maize, my group wants to sow ground-nut, the other group wants to sow soya beans" (Sissala West Women FGD).*

The reason given to forming different groups based on crops is quite laudable as they will be able to address their needs as specific crop farmers. It will also provide tailor-made solutions to specific challenges of the crop. In instances where a farmer is likely to belong to more than one crop group, knowledge spill-overs from the other group could also be leveraged. More so, in the cases where the FBOs were gender-aggregated, it appeared the women were still comfortable having their separate group, as intimated by the response of this group:

> *"...they separated the group. Sometimes we do get lumped together and then teach them the group technologies. But when it comes to practical things, they will send them to the farm and teach them how to plant, how to apply fertilizer, and everything in separate groups. But we prefer a separate group (Sissala East Women FGD).*

Though support could be leveraged upon by having both men and women in one group, it will also be important for the MAG project, or any other intervention to pay attention to cultural peculiarities for all group members to enjoy the full benefits of belonging to such networks.

Roles played by the FBO network

The roles played by FBO networks under the MAG programme in the districts include the following:

- Serving as a platform for interaction
- Being source of self-help support group (production and post-production activities, financial support)
- Being a knowledge source for improving their farming activities

The FBO networks formed in the various Districts were found to provide the main platform through which interactions took place between farmers and other project actors in the MAG network. The FBO network, according to farmers interviewed, allowed the agricultural extension agents (AEAs) to have easy access to them anytime they visited. The FBO networks were also a source of help in the production and post-production activities of farmers, which was evident in both male (Figure 3b) and female (Figure 3b) groups, even more prominent in the latter. Knowledge sharing was also highly mentioned among female farmer networks. Other studies have also established the role of FBOs in improving production efficiency (Abdul-Rahaman & Abdulai, 2018) and adoption of technologies (Abdul-Hanan et al., 2014), which is among the many roles FBOs play in rural agricultural systems.

Figure 3a: Women's FBO Network

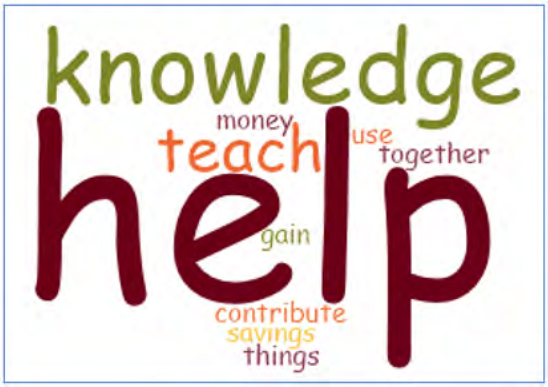


Figure 3b: Men's FBO network

Source: CSIR-STEPRI/MAG field interviews (2020)

We were made to understand that without being in a group, it is difficult to get help. So we got ourselves together (Sissala East Women FGD)

We have weekly and monthly to discuss issues affecting us and how to improve on our farms. We also help each other out during planting and harvesting. The help is given to only group members and we also sit to discuss ways by which we can adopt good practices (Savelugu Men FGD)

First and foremost, the group serves as a unifying force for all of us. It brings us together so that it is easy for the AEA to have interactions with us since he cannot effectively visit us individually (Mion Men FGD)

One of the women groups also indicated they usually make monetary contributions (***susu***) which a member can access if in need. Another source of financial support that some of the groups have resorted doing is the sale of produce they pool together as opined by this group's response:

> *"Sometimes, we contribute things together then we later sell them and use the money to help ourselves" (Sissala West Women FGD).*

Just as observed in the connection of women FBOs to the VSLA actors as discussed earlier, the same can be observed here as the women group find an innovative source of financing for the farm and non-farm needs. This implies that women groups can become a powerful force in generating additional income to improve their livelihoods through local innovative financing.

FBOs' Interaction Channels

The community radio broadcasts, mobile phone calls, house-to-house visits, interpersonal communication, and the use of "organizer" were the main channels through which members used to communicate among themselves (Figure 4).

Figure 4: Word cloud showing the mode of interactions in FBO networks

Figure 4a: Women's FBO Network **Figure 4b: Men's FBO network**

Source: CSIR-STEPRI/MAG field interviews (2020)

This is, however, not to say that they do not have physical meetings. However, to communicate any information regarding meetings or anything of the sort that required them to come together, these were the various channels being used. There were differences in the most frequently cited channels of interactions between male and female farmer networks as observed in Figures 4a and 4b.

The importance of Information and Communication Technology (ICT) can be evidently seen here as phone calls and the community radio broadcasts were effectively used by male farmers to communicate among themselves. Female farmer network members however relied on phone calls, group meetings and the use of organizers for interactions among themselves with less of radio. Some of the male farmers however indicated that they are unable to read nor write and hence do not rely much on text messaging but rather phone calls. This is an important finding that signals actors in the ICT support role to consider all these challenges in designing ICT programmes and tools for these farmers.

> *We go to the person's farm if we need assistance or call the person. We don't use texting because not everyone can read* (Sissala West Men FGD).
>
> *We exchange messages through the organizers (inter-personal) and also make phone calls* (Sissala East Women FGD).
>
> *We do house-to-house and phone calls to pass on information. Majority of us can't read so texting is not used* (Savelugu, Men FGD).
>
> *We also use radio broadcasts to share the agric information in our dialect and allow people to call when they don't understand anything* (Savelugu, Women FGD).

The use of extension visits was also slightly mentioned as a one of the channels interactions among the male farmers. One worrying finding that was observed was that whilst some of the male groups were active in initiating interactions, it was not so for some of the female groups as reflected in this group's response:

> *"…unless the agric people want to meet us, we do not meet on our own" (Mion Women FGD)*

Even though this is one unique case found in all the groups interviewed, it gives some source

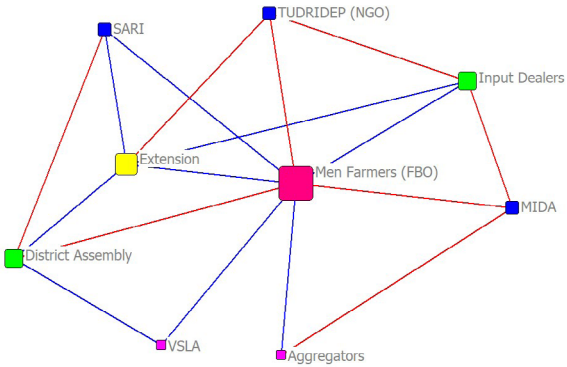
of worry regarding the sustainability of these groups once the MAG intervention or any other intervention ceases to operate. It will be expedient for the extension actors to educate these farmers, especially female famers on the importance of FBO interactions and the additional benefits and help they can provide for each other, aside from extension support.

Farmer-Network Analysis

Actor-network linkages

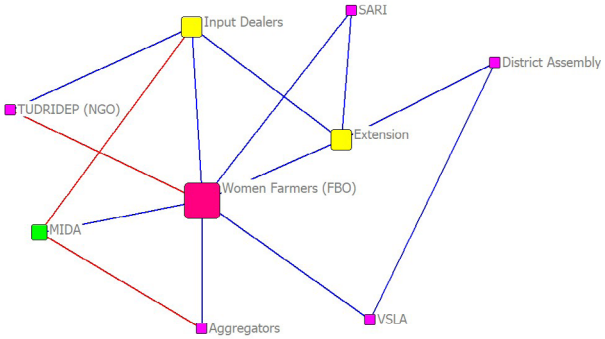
The farmer network analysis under the MAG project in Figures 5 and 6 reveal, that FBOs at the local level formed the core of the network.

Figure 5: Male farmers network mapping



Source: CSIR-STEPRI/MAG field interviews (2020)

Figure 7: Female farmers network mapping



Source: CSIR-STEPRI/MAG field interviews (2020)

From Figure 6 and Figure 7, it is observed that both men and women farmer groups received many interactions compared to other actors at the local level they interacted with. The next actor at the local level with many network interactions in the farmer's network was found to be the extension service providers in the case of the male farmers' network.

However, extension and input dealers were seen to have good connections at the same level in the network of the female farmers. The resource and input constraint faced generally by women at the local level could trigger an urge to have more interactions with input dealers in order to level that challenge, thereby possibly accounting for this finding. The other twist to this finding could be that even though input dealers have more connections in the female farmers' network, it may not have really translated into addressing the challenge of input access by these women.

The District Assembly was also more connected in the male farmer network compared to the female farmer network. The District Assembly may work through the extension officers and other agents to reach the women group. Male farmers on the other hand could have direct access to the District Assembly and interact with them. SARI was found to have low connections in both networks, mostly because they work more directly with the extension officers than they would with farmers. The Millennium Development Authority (MIDA) and an NGO found at the local level who are not directly part of the MAG network, were also seen to have some level of interaction with the farmers, which is a good thing as more actors are needed to support the farmer network. Aggregators were least connected in both networks, emphasising the poor market linkage faced by these farmers. The Village Savings and Loan Association (VSLA), also a non-MAG actor was found to be connected to farmers through the District Assembly.

Strength of actor-network interactions

The scores from the centrality measures depict an interesting picture in both men and women farmers' networks, as they dominated their networks (Table 1 and Table 2). This reiterates the point that at the local level of MAG, unlike at the institutional level analysed in the earlier report, one cannot marginalise the role of farmers. This is an apt finding given that one of the main beneficiaries of the project is the farmer. The discussion of the measure in Tables 1 and 2 are elaborated in the pro ceding sub-sections of 3.5.2.

Table 1: Male Farmers Network Centrality indices

Actors	Out-degree	In-degree	Betweeness	Coreness	Effect size
Men farmers (FBO)	5.00	8.00	28.75	0.49	6.04
Extension	4.00	5.00	5.67	0.46	3.11
SARI	3.00	2.00	0.92	0.37	1.30
TUDRIDEP (NGO)	3.00	0.00	0.00	0.34	1.00
District Assembly	3.00	3.00	1.50	0.33	2.17

Actors	Out-degree	In-degree	Betweeness	Coreness	Effect size
Input dealers	2.00	4.00	0.75	0.26	2.08
VSLA	2.00	2.00	0.92	0.22	1.50
MIDA	2.00	1.00	0.50	0.19	1.67
Aggregators	2.00	1.00	1.00	0.18	1.17
Network centralization index	**47.49%**				

Source: CSIR-STEPRI/MAG field interviews (2020)

Table 2: Female Farmers Network Centrality indices

Actors	Out-degree	In-degree	Betweeness	Coreness	Effect size
Women farmers (FBO)	6.00	7.00	32.83	0.68	5.85
Extension	4.00	4.00	10.33	0.37	3.00
Input dealers	3.00	4.00	8.67	0.33	2.71
MIDA	3.00	1.00	0.00	0.29	1.50
SARI	2.00	2.00	0.00	0.26	1.00
TUDRIDEP (NGO)	2.00	1.00	0.00	0.25	1.00
VSLA	2.00	2.00	3.17	0.19	2.00
Aggregators	1.00	2.00	0.00	0.16	1.00
District Assembly	2.00	2.00	1.00	0.13	2.00
Network Centralization index	**53.46%**				

Source: CSIR-STEPRI/MAG field interviews (2020)

Power relations of actors

In the farmer network, farmers played both influential and prominent roles as they gave out (out-degree) and received (in-degree) many interactions, compared to the other actors. Therefore, in terms of power play, farmers are considered very powerful in their network. MAG should therefore be able to leverage this powerful position of farmers at the local level of implementation to maximize the gains they can obtain from the project. Extension and input dealers also played a prominent role, with extension playing a second-best influential actor in both networks. In terms of the network's core, farmers and extension agents were again seen to be present, signifying their important role and position in the network, as already highlighted.

Bridging role of actors

Farmers (both male and female groups) served as a bridge in connecting other actors to their network with their high betweeness scores. This implies that if any actor would want to connect to the farmers' network, they will have to go through the farmers themselves. The bridging role of farmers could explain why we see several programmes and interventions by different actors and agencies at the local level, which sometimes has been seen as a duplication of efforts. This is because since the beneficiaries (farmers) themselves serve as the bridge, they are likely to receive any actor who comes to them with any form of intervention. Though this position of farmers gives them some form of power and autonomy within their own network, having a mediating actor will not be out of place to manage their connections and activities. This can only be possible if these farmer group networks are well organised and institutionalised with the local government (District Assembly) playing a major role in that regard, given the decentralised system of the agricultural sector currently. Works of Onumah ***et al***. (2021) and Weyori ***et al***. (2018) have also established the key role of farmer groups in serving as bridges to farmer networks.

Actors with stronger connections

The top 3 actors in the male networks with large effect size are male farmers, extension agents, and the District Assembly. Female networks on the other hand have the strongest presence of input dealers in addition to female farmers and extension agents as observed in the male networks. This implies that these actors hold both farmer networks (male/female) under MAG together and their absence will largely create a structural hole in the networks. Extension agents and the local government services, led by the District Assembly were found to play instrumental roles in the implementation of MAG activities at the farmer level. It is therefore not surprising that these actors have been found to have a larger effect size in the male farmers' network. They additionally can attract other actors to the network, making the network stronger. Farmers are the key beneficiaries of the project and hence it is not out of place that we found their effect size larger than the rest of the actors in the respective networks.

Level of Network centralisation

The male and female farmer networks had centralisation scores of 47% and 53%, respectively. This implies that power is about 43% and 47% evenly distributed in both male and female farmer networks, respectively. The level of power distribution in such networks could be either a merit or demerit depending on who is controlling much of the power, given the earlier scores on the influential/prominent/core actors. In our analysis, we find that farmers and extension agents consistently topped both networks on these indices, and hence can be said that 47% and 53% of the interactions in male and female farmers' networks, respectively are centralised on farmers and extension agents. This is good for the success of the project since farmers are the main beneficiaries with extension officers being the main bridging actors in the entire MAG project. It is therefore expected that these core actors will take advantage of their influence to make the farmers' network stronger in achieving its objectives.

Challenges faced at the farmer network level

Though farmers reported some level of benefits and gains from their participation in the MAG project, there were some challenges they were bedevilled with. These challenges ranged from inputs availability and their timely accessibility to financial and post-harvest challenges, as illustrated in Figure 8. Women groups had access to tractor services and finance as the most mentioned challenge (Figure 8a) with the men groups having inadequate training, information access, low yields and seeds as their most mentioned challenge (Figure 8b). Whilst some of the women had a challenge with accessing the service because of financial challenges, others also faced the challenge with the late arrival of tractor service providers during the production season. If these tractor services are not assessed early, farmers reported their inability to prepare their lands on time to meet the onset of rains for a good production season. The challenge of access to tractor services and other production resources has also been noted in Vercillo (2021).

Figure 8: Challenges faced by farmers

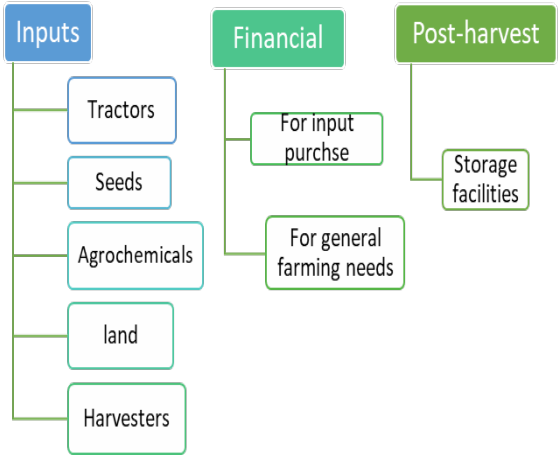


Figure 8a: Women's FBO Network

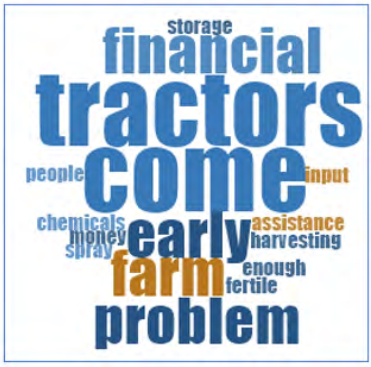


Figure 8b Men's FBO network

Source: CSIR-STEPRI/MAG field interviews (2020)

The other set of challenges indicated financial and post-harvest challenges. Farmers reported having the inadequate financial support to expand their farms and accessing input services (mainly tractors and chemicals). The lack of improved storage facilities was also one challenge bedeviling farmers as they had to resort to using an available room in the house to store their produce. Where there were no such rooms, farmers were then left to their fate, contributing to high post-harvest losses, thereby negating the gains they would have otherwise made from the participation in the project. These findings add to the existing literature which have attributed key challenges of women participation in agriculture to underlying cultural norms (Mudege ***et al.,***2015). The study has shown that beyond cultural norms, resource a c cess is equally important to the success of women in agriculture as established in Akter ***et al***. (2017)

Conclusion

With the overall aim of analyzing the networks under the MAG project, this study sought to analyze farmer networks at the local level in the Northern zone of the project implementation areas, with a gendered dimension. Using responses from 12 gender-based focus group discussions, the study found that at the local level, the main actors connected to the farmers' networks included research actors; private sector actors, including NGOs, input dealers and aggregators; local government actors; and finally individual farmers, and FBOs. No gender discrimination was found in the way actors connected to the individual farmer networks, which is good for gender mainstreaming developments. Except for the village savings and loans association with women farmer networks, other formal financial service actors were missing at the local level and few of the farmers were also connected to aggregators or other market linkages. Male and female farmer network groups in the Northern zone of the MAG project appear to be connected to the similar actors. The only difference lies in the degree to which each actor of these actors connects in the respective networks. Whilst some play the same influential, prominent, bridging, and structural support roles in both male and female networks, some unique cases such as the district assembly differs. It will be important for each of the networks to focus on the strength that each of these actors brings to the table and leverage that to support their activities. Attracting more actors in the farmers' network, whilst strengthening the weaker connections such as those with Aggregators will be very beneficial. Extension service providers can also serve an additional bridging role aside from these farmers and hence should be taken advantage of that window of opportunity given their experience in playing a linking role in the agricultural space.

Strengthening of the only local financial service, VSLA will therefore be important for farmers, especially women farmers to leverage support as they are mostly constrained. The role of extension officers in the formation and functioning of farmer networks was brought to light in this study, as they were the main actors who championed farmer group formations, both male and female groups. In as much as the presence of these extension officers facilitated the formation of groups under MAG, the demonstrations conducted by them have also served as a key motivation for group formation. Women farmers' networks however appear to participate less in field demonstrations and. We therefore flag this for the attention of extension service providers to be intentional about their participation in such programmes as it has proven to facilitate group cohesion and technological adoption. FBOs are key knowledge source, provide an interactive platform, and self-help support for their members, and farmers are therefore encouraged to be part and be proactive in sustaining such networks with frequent purposeful interactions.

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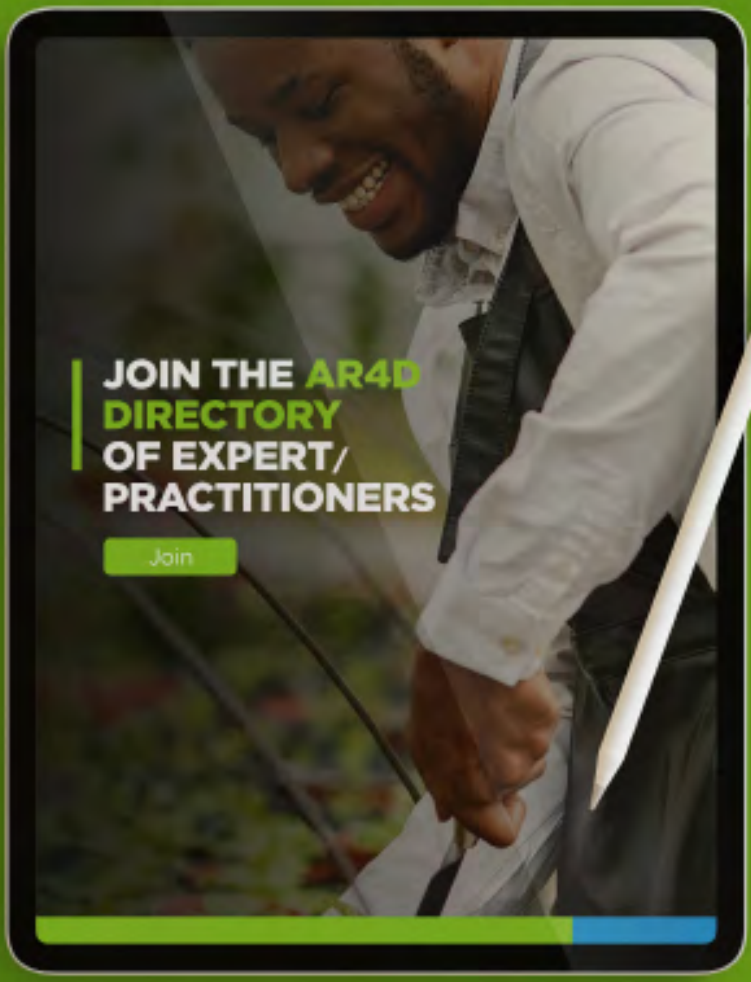

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