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Understanding Factors Affecting the Performance of Agricultural Extension System in Ethiopia

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Abstract

This study is assessing the performance of the agricultural extension system and identifying factors explaining it. The paper used both quantitative and qualitative data collection methods. Quantitative data gathered based on a questionnaire survey of 143 development agents (DAs) in Minjar Shenkora and Ada'a districts. Qualitative data were collected from 25 key informants and eight separate focus group discussants. Quantitative data was analyzed by both descriptive statistics and econometric model while qualitative data were analyzed through categorization, narration and interpretation. Results show that, despite huge government investments and having one of the highest DA-to farmers' ratio, Ethiopia has not been able to achieve the desired goals of agricultural advancement. This is mainly

because of weak and limited interactions, synergies and partnership among actors, lack of adequate facilities of FTCs, lack of physical resources for mobility, DAs lack of work motivation, lack of strong supervision, lack of technical competence of DAs, and lack of involvement of DAs in the decision making process. The Econometric model results reveal that systems of rewards and sanctions, enforcement of performance targets, interaction and partnership among relevant actors, supervision, donor funding, number of motorbikes, and DAs capacity building trainings are most significantly influenced the performance of agricultural extension service. This research showed that number of DAs is not a sufficient condition of enhancing extension performance, but an effective extension system needs to focus on the enabling environment for DAs to be motivated to work as mandated.

Keywords: Agricultural extension, development agents, Ethiopia, motivation, performance

Introduction

Efficient, effective and demand driven agricultural extension and advisory services have significant importance for agricultural development and rural transformation (Gerba, 2018; CTA, 2012). It has a tremendous potential to improve agricultural productivity and household food security through transfer of improved agricultural technologies and knowledge (Feder *et al.*, 2010; Swanson and Rajalahti, 2010). However, various empirical studies in different countries indicate that mixed results in terms of performance and impact of agricultural extension systems. Empirical studies conducted by Davis *et al.* (2012); Benin *et al.* (2011); Van den Berg and Jiggins (2007) agricultural extension system has high contribution for rates of return and socio-economic contributions and impacts. Other studies Birner *et al.* (2009) and Rivera *et al.* (2001) on the contrary regarded it as inefficient and unproductive in addressing the technological demands and agricultural related constraints of the rural poor. So, there are various viewpoints on assessing performance and impact of extension systems and understanding the factors and specific components that explain them (Ragasa *et al.*, 2016).

Agricultural extension in Ethiopia helped to improve agricultural production and productivity to meet the growing demand for food, industrial raw materials, and foreign currency earnings (MoANR, 2017; Gerba et al., 2017). Agricultural extension system as a policy instrument and appropriate tool for the government to bring about anticipated changes in socio-economic, political, cultural and environmental aspects (Abate, 2008). Efforts have been made to improve agricultural productivity and rural transformation through extension services (Kassahun and Poulton, 2014; Gerba *et al.*, 2017). The government of Ethiopia has shown strong commitment on the agriculture sector through the consistent allocation of over 10% of the national budget (ATA, MoA, EIAR, 2015). Moreover, Ethiopia is among the countries which have the highest development

agents to farmer ratio compared to other developing countries establishing more than 12,500 farmers training centers (FTCs) located across national regional states of the country (MoANR, 2017; Lefort, 2012).

Despite the government huge investment and commitment to the agriculture sector, significant change in the delivery of extension services has not been achieved (ATA, 2014; Spielman *et al.,* 2012). Agricultural extension created demand among the farm households to adopt the technologies but fails to associate this with the important agricultural inputs such as improved seeds variety, fertilizer, irrigation, and crop pest- and disease-management practices (Gerba *et al.,* 2017). The extension system has not been effective to bringing large scale adoption of improved technologies and knowledge (Belay and Dawit, 2017). Low agricultural productivity is still a critical challenge for the agriculture sector in Ethiopia (Menale *et al.,* 2018; Asfaw *et al.,* 2012). As a result, poverty and household food insecurity still remain a key challenge to the country (Stellmacher, 2015; Oxfam, 2016). WFP and CSA (2019) about 20.5% of households are estimated to be food insecure in Ethiopia. The Global Food Security Index ranked Ethiopia 91 out of 113 countries (GFSI, 2019).

Therefore, improving the performance of the agriculture extension systems has paramount importance. Since it is regarded as a policy instrument and appropriate tool for the government to bring about anticipated changes in socio-economic, political, cultural and environmental aspects (Abate 2008), it is important to identify constraints that hinder performance of the extension system and making it effective and efficient for enhancing productivity and household food security. According to Nagel (1997) improving the performance and impacts of the agricultural extension systems has brought about dramatic changes in the livelihoods of many rural poor. Although agricultural extension is widely studied in Ethiopia, most of these studies explicitly or implicitly assess the contribution and impacts of agricultural extension to productivity and food security. There are hardly any researches conducted in Ethiopia that assess performance of the agricultural extension systems and understand the factors explaining it.

This study attempts to analyze factors affecting low performance of agricultural extension system in Ethiopia by answering the specific question “What factors explains the low performance of Ethiopia’s agricultural extension system? Therefore, the research result of this paper contributes knowledge to the empirical literatures on agricultural extension by assessing the current performance of the extension system and identify factors that explain variations in performance; providing insights on how to improve the country agricultural extension system; and illustrating how a well-cited conceptual framework by Birner *et al.,* (2009)

can be implemented empirically to provide policy options for a country like Ethiopia.

Conceptual framework

Since agricultural extension and advisory services have been changed in recent times from only disseminating new technologies and practices to more of a facilitation role, these changes pose major challenges for performance assessment and impact evaluation (Ragasa *et al.*, 2016). Although there are many studies on agricultural extension, there is large knowledge gap in measuring the performance of the extension system and the factors explaining the performance of the system. Therefore, this study focused on measuring the performance of the extension system and factors affecting the performance of the extension system by adapting the best-fit conceptual framework.

Measures of performance

Birner *et al.*, (2009) presents a conceptual framework that can be used as a best-fit solution to design the agricultural extension services. This framework can be used to assess the performance of agricultural extension services, depending on the local context. In order to assess the performance of agricultural extension service, we use Birner et al. framework in the Ethiopian context. The ultimate goal of strengthening agricultural extension system is to improve their performance in order to enable them to facilitate technology adoption, enhance agricultural productivity, and improve incomes and food and nutrition security in a sustainable way (Ragasa *et al.*, 2016). Therefore, this paper mainly focused on performance of agricultural extension organization (AEO) and individual DA and factors explaining the performance, rather than attempt to measure the impacts of extension.

In this study, a number of indicators were collected based on the framework to measure the performance of AEO (FTC based institution) and individual DAs. This include the number of technologies and practices disseminated, number of farm demonstration organized, monitor farmers adoption, monitor the impact of technology adoption on farmer's livelihoods, and number of training materials produced and promoted. For all of these indicators, there is a clear dichotomy between those who performed these activities and those that did not, therefore prompting us to estimate binary response models instead of continuous variable regression models. Hence, performance of DA is represented as dummy variables and is measured in terms of (a) whether DA has disseminated at least one technology or practices; (b) whether DA monitored how many farmers adopted the technology or knowledge they promoted; and (c) whether agents monitored the impact of technologies on farmers livelihoods in the last two years. Similarly, performance of organization is represented as dummy variables and is measured in terms of (a) whether the organization has disseminated at least one improved

technologies and practices; (b) whether organization has organized farm demonstrations; and (c) whether the organization has produced and promoted training materials in the last two years (Ragasa *et al.*, 2016).

Factors affecting performance

In Figure 1, the framework indicate that how different factors act together to influence the organizational and an individual DA's performance. Moreover, we describe these factors more in detail below. Table 1 shows the synthesis of these common themes and specific hypotheses formed based on the previous studies; and how they are used to develop specific indicators for the qualitative and quantitative analysis in this study and a brief summary of results using the data from the study woredas in Minjar Shenkora and Ada'a. These are grouped into: (a) governance structure and enabling environment; (b) partnerships and linkages, consistent with the agricultural innovation systems (AIS) perspective; (c) organizational capacity, management, and learning; and (d) advisory delivery methods.

Table 1: Major themes, hypotheses based on literature and indicators used in this study

Themes	Descriptions	Hypotheses/Assumptions	Measurement indicators
Governance and enabling environment	• Successful AEOs have clearly-defined and commonly shared policy or strategy • Presence of performance targets • Decentralization is a process of bringing extension services closer to the farmers	• Extension policy and strategy, as well as performance targets, are embodiment of vision, thinking, and commitment is a key determinant	• Clearly defined and commonly shared policy or strategy. • Performance targets • Enforcement of these targets • Level of decentralization
Linkages and partnership	• An integrated approach required interactions and partnership among actors • Strong interactions among actors are very crucial for AEOs and DAs performance	• DAs and their AEOs are increasing required to form and cultivate interaction and partnership with sources and users of knowledge.	• Existence of interaction, partnership and communication among actors • Factors influencing the linkages
Capacity, management, and learning	• Test which measures of organizational capacity, management, and learning are significant factors in explaining the performance of individual DAs and AEOs in Ethiopia • Capacity in terms of staff numbers, staff qualification, gender composition and motivation is an important dimension	• Adequate and sustainable resources are important for organizations to perform well • Capacity includes not only physical and financial capacity but also effective management system to run the operations	• Number of staffs and qualification • Average ratio of DA to farmers • External/donor funds received • Availability of motorbikes and vehicles • Enforcement of penalty and rewards • Quality of the supervisors • Leadership style • Strategies to promote leadership
Agricultural extension delivery methods	• The methods used in the provision of agricultural extension services	• Mixed extension delivery methods works better than single approach	• Types of training or technology transfer • Participatory approach • Types of media used

Source: Birner *et al.*, (2009); Birner *et al.,* (2006); Gerba *et al.* (2017); Ragasa *et al.,* (2016); Faure *et al.,* (2012)

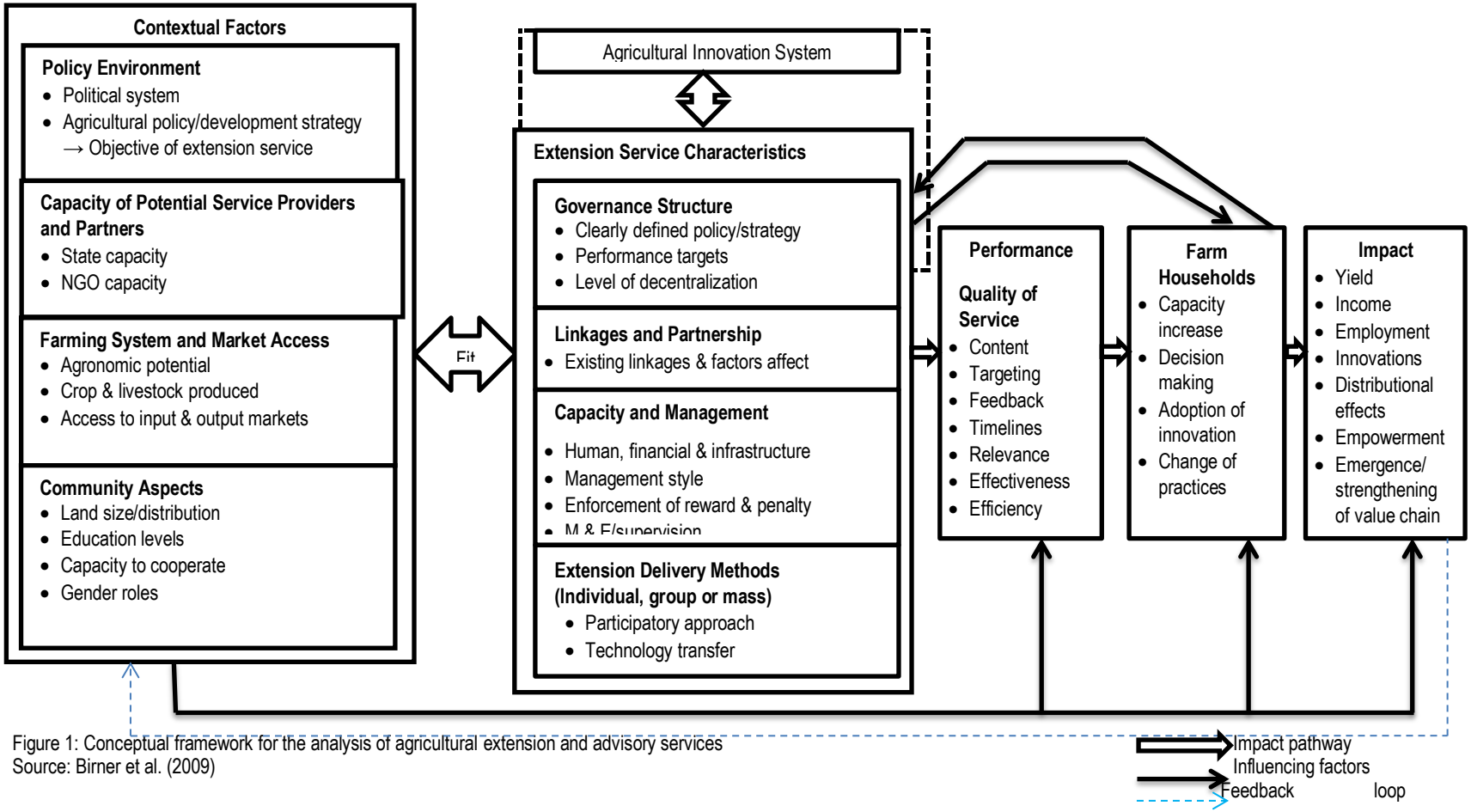

Figure 1: Conceptual framework for the analysis of agricultural extension and advisory services
Source: Birner et al. (2009)

Material and Methods

Data used for this study were collected from the survey of individual DAs, supervisors and heads of district of agriculture (DoA) involved in the extension system. The survey was conducted in Minjar Shenkora district of Amhara National Regional State and Ada'a district of Oromia National Regional State. Two types of structured questionnaires were implemented for this study, namely (1) organization level, with supervisors, heads of DoA and DAs in AEO as respondents; and (2) individual level, with DAs as respondents. The questionnaires were designed to capture indicators that allow assessment of the performance of the system as well as factors explaining the system performance. Face-to-face interviews were conducted with a Computer Assisted Personal Interview (CAPI) to improve the quality of data collection and remove errors during the process of data entry. Enumerators were selected based on their experience in using the CAPI. Field based training was given to all enumerators on how to administer and complete the questionnaire. After training, the questionnaires were pretested in one village outside the sample kebeles. The objective of the pilot survey was to enable enumerators to practice the interview in the field and to get constructive feedback on the contents of the questionnaire.

Bothe quantitative and quantitative data were generated for this study from those having knowledge and experience in the extension system. Quantitative data were collected from face to face interviews with all DAs (except few for long time absent for his/her work station) and supervisors and heads of DoA. A total of 143 respondents (127 DAs and 16 supervisors and heads of DoA) were included in the sample. Qualitative data were collected from key informants and focus group discussants to triangulate and substantiate the quantitative data. Key informants were identified from agricultural extensionist (3), heads' of DoA (2), DAs (8), farmers' organizations (2), model farmers (6), and community elders (4). All the key informants were well experienced and knowledgeable in the extension system in the study areas. Eight separate focus group discussions, each group comprised of 4-6 participants, were held with DAs, community elders and farmers. Moreover, secondary data sources were used from peer-reviewed articles, books, and annual reports, and published and unpublished documents from relevant sources. Quantitative data was analyzed by both descriptive statistics (frequency, percentage, mean, and standard deviation) and econometric model (binary logistic regression). Qualitative data generated from key informants and focus group discussants were categorized, summarized, narrated and then interpreted and discussed.

Econometric estimation: Binary logistic regression model

We analyze the observed differences across the extension organizations and agents to explore what factors explaining strong or weak performance within the

extension system using econometric model. Various options of econometric models are available for analyzing the factors influencing the categorical dependent variables. Linear regression model is one of a commonly used method in many studies; however, it was applied when the dependent variable is measured on a continuous scale. For a dichotomy variable, discriminant analysis and logistic regression method are usually used but have their own shortcomings. Discriminant analysis is used if all predictors are continuous and normally distributed. Logistic regression is often chosen if predictors are mixed and/or if they are not nicely distributed. The probit model is an alternative to logistic model because either of them can be used for a categorical dependent variable. But, probit is based on standard normal distribution, and the logit is based on standard logistic distribution. These two models are often lead to the same conclusion and mostly difficult to make a choice between the two on theoretical bases (Greene, 2008). Given the binary nature of the outcome variables, this paper follows the widely used logistical regression model to estimate the marginal effects and statistical significance of the factors described on the probability of good performance among extension organization and agents. Moreover, given the hierarchical nature of the data, multilevel model was also employed to estimate the factors explaining the performance, but results were similar to those of the simple logit regression.

The functional form of logit model can be specified as follows where P_i denotes the probability of respondents who performed those activities that is $Y_i = 1$ and $\exp^{(Zi)}$ stands for the irrational number to the power of Z_i (Gujarati, 2003). The model can be written as:

$$P_i = E\,(Y = \frac{1}{X_i}) = \frac{1}{1 + e^{-(\beta 0 + \beta 1 X 1)}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

For the case of explanation, equation (1) is written as;

$$P_i = \frac{1}{1 + e^{-Zi}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

The probability that a given respondents is decided to perform those activities properly is expressed as by equation (2), while the probability of those that did not perform the activities is expressed by equation (3).

$$P_i = \frac{1}{1 + e^{Zi}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

Therefore, equation (3) can be expressed as follow

$$\frac{1}{1 - Pi} = \frac{1 + e^{Zi}}{1 + e^{-Zi}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4)$$

Finally, taking the natural logarithm of equation (4) we obtain:

$$L_i = \ln\left(\frac{Pi}{1-Pi}\right) = Z_i = \beta_o + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_i X_i \ldots\ldots\ldots\ldots\ldots (5)$$

Where P_i= is a probability of respondent's performed those activities ranges from 1 to 0,

Z_i = is a function of i explanatory variables (X),
β_o is an intercept,
$\beta_1, \beta_2, \beta_i$ are slopes of the equation in the model,
L_i= is log of the odds ratio, which is linear in the parameters,
X_i= is vector of relevant respondents' characteristics.

If the disturbance term (ε_i) is introduced, the logit model becomes

$$L_i = \ln\left(\frac{Pi}{1-Pi}\right) = Z_i = \beta_o + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_i X_i + \varepsilon_i \ldots\ldots\ldots\ldots (6)$$

Results and Discussions

This section analyzes the performance of the extension system in the following order. At first, assessing the performance of the agricultural extension system based on the indicators. This is followed by identifying factors that affect the performance of AEO and individual DAs' through econometric model. Finally presents the conclusions and implications.

Assessing the agricultural extension system

Governance structures and enabling environment

Successful organization or systems have clearly-defined and commonly shared mission, vision, and measurable performance targets, based on their agricultural extension policy or strategy (Ragasa *et al.*, 2016). Because, these targets are very helpful for the system to closely monitor and evaluate the progress and interventions. However, till 2017 the extension system of Ethiopia has not clearly defined and commonly shared country agricultural extension strategy, rather it used different approaches or methods to deliver extension services. This lack of clear national extension strategy on the system is mirrored in the absence of measurable performance targets and goals in most of extension system for long time. According to the survey result, of the total interviewed, only about 44% reported any performance target set by supervisors, heads of DoA.

Agricultural extension services can be improved when the extension system relies on a decentralized supply of extension services and private providers (Anderson and Feder, 2004). Since 1991 Ethiopia has been introduced a decentralized political system of the federal and national regional governments (Belay, 2003;

Kassahun and Poulton, 2014). However, the extension system still largely followed linear path approach of supply-driven. The balance between the top-down and bottom-up planning is greatly limited (Gerba *et al.*, 2017). The aim of decentralization and power sharing is to empower the national regional governments to develop their own approaches to implement their agriculture programmes based on the country policy and strategy. But, the power sharing of the administration with agricultural sector tends to create uniform political opinion between the agriculture sector and the administration. Every regional state agricultural offices is structured in similar patterns to that of the federal MoA, though, decentralized governance system, regional states can reform the structure to suit their own context up to kebele level (FARA, 2016).

Interaction and partnership

Interactions and partnership among actors are very important for transferring not only shelved technologies in the research system but also extension and advisory services to the end users. It is collaborative relationships among actors in decentralized manner and highly important to create knowledge, innovation and learning relevant to farmers. However, limited interaction and partnership among relevant actors was reported by DAs with researchers, input suppliers, NGOs and other DAs. Of the total respondents, only 38% of DAs reported that they have interacted with others DAs, however, the large majorities (77%) have never interacted with the researchers in the last two years. About 55%, 72%, and 78% of surveyed respondents reported that the extension organization has weak interactions and partnership with other extension organization working for farmers (NGOs), traders or buyers and research centers. Contrary to this, 85% of respondents reported that the extension organization has strong interactions with local political authorities. This indicates that either the local authorities have close support to the extension service delivery or they may use the extension service for political motives. According to key informants the political authorities urges DAs to advocate the interest of the ruling party program and organized farmers for political purposes. Dessalegn (2009) argue that the Ethiopia extension system operate in not politically neutral. Moreover, experts are assigned based on the political loyalty to the ruling party rather than their relevant professional qualification (Kassahun and Poulton, 2014). Therefore, all these constraints impede the efficiency of the extension system, thereby reducing its performance.

Majority of DAs (83.6%) reported that existing linkages in the study areas were field days (Figure 2). This is followed by on farm demonstration, training workshops, informal personal contacts and planning meetings, respectively. Key informants and focus group discussants acknowledge field days are the most common means of creating linkages among actors. Although previous studies by Chiligati (2010); CSIR and MOFA (2013) shows planning and meeting with

different actors were very important to develop linkages among actors, only 5.7% of agents reported planning meeting with actors were means of creating interactions in the study areas. Informal personal contacts with relevant actors are given much emphasis by scholars to create interactions among actors, because it has potential to improve interactions as they are less costly and arise based on felt needs. 34.4% of DAs reported that informal personal contacts are one of the existing interactions in the study areas.

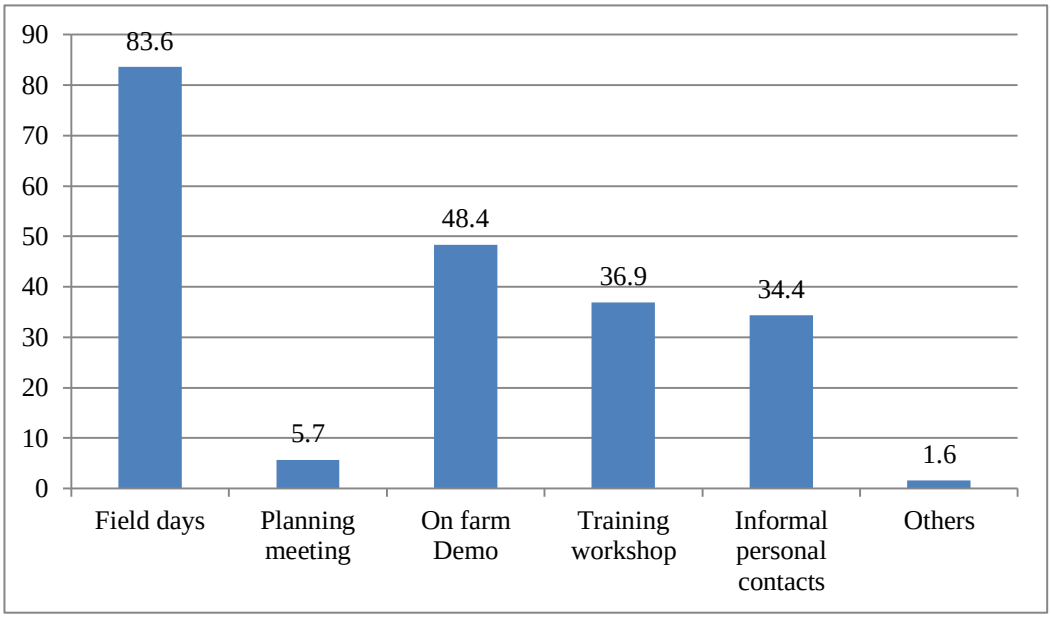

Figure 2: Existing interactions among actors in the study areas
Source: Own calculation based on the survey

As reported by respondents, the most pressing factors of linkage and partnership are poor coordination, limited involvement of actors in technology dissemination, weak M & E system, and inadequate funds for linkages. Results in Table 2 show that 92.9% of DAs reported that poor coordination and collaboration among actors was the major limiting factor of the interaction. This is followed by limited involvement of actors in technology development and dissemination, untimely availability of agricultural inputs, inadequate fund for interactions, weak M & E system, low knowledge in participatory approach, weak farmers' organizations. Key informants and focus group discussants complemented the limiting factors of interactions such as remoteness, lack of commitments among actors, lack of adequate personnel at all level to facilitate the interaction, and lack of transportation are the most pressing factors affected the interactions with actors in the study areas.

Table 2: Factors identified by development agents to inhibit interaction among actors

Inhibiting factors	Score	Score %
Poor coordination among actors	118	92.9
Low involvement of key actors in technology dissemination	107	84.3
Weak M & E system	98	77.2
No/inadequate funds	100	78.7
Low education of farmers	64	50.4
Low income of farmers	24	18.9
Weak farmers' organizations	65	51.2
Low knowledge in participatory approaches	81	63.8
Low wages /lack of incentives	24	18.9
Weak extension services	65	51.2
Improper diagnosis of farmers' problems	45	35.4
Untimely availability of input	116	91.3

Note: Score % = $\frac{\text{No (yes)}}{\text{No (yes)+ No (no)}}$ * 100
Source: Own calculation based on field survey

Organizational capacity, management, and learning

Our document analysis indicated that Ethiopia has the highest DA-to-farmers ratio as compared to other countries. DA-to-farmers ratio has been increased over time and reached to 1:472 in 2017, which is 30% higher than the world standard (MoANR, 2017). In our study woredas, the ratio ranges from 1:209 in Golo-Dertu to 1:312 in Dhenkaka kebele, Ada'a woreda of Oromia Regional State and 1:234 in Agerate to 1:239 of Adama kebele, Minjar Shenkora woreda of Amhara Regional State. In both woredas, the ratio was higher than the country average. Three DAs specialized in crop, livestock, and natural resource management and one animal health assistant and one cooperative expert to serve the surrounding three to five kebeles. It implies that the number of DAs may not be a problem in Ethiopia rather guiding and supervising the available human resources for a better achievement and performance.

There is a discrepancy between the relatively large number of DAs and their relatively low technical competence in the extension service (MoANR, 2017; Gerba *et al.,* 2017; Belay *et al.,* 2012). Results in Table 4 show that large majority of DAs (69%) have a three-year ATVETs diploma or certificates, only 31% have university degree. Among the BSc holders, the majority of DAs received their degree from non-agriculture profession. Results further show that the profile of staff also shows that lack of diversity in the skill of DAs and most DAs are specialized on specific commodity rather comprehensive and applied skills and knowledge required combining crop, livestock, and natural resource management. According to key informants and focus group discussants most DAs lack both hard skills (marketing, post-harvest, value chain analysis and agricultural intensification and diversification), and soft skills (process facilitation,

communication, and organization of farmer-producer groups) which are important for farmers and it is consistent with the previous studies of McGguire (2012).

In addition to the number and competence of DAs, the work motivation and job performance are very important in the extension service delivery. Motivated DAs enjoy with their work, committed more to not only their extension organizations but also the clients' farmers, less insubordination and grievance, and contributing to the long-term success of the extension system. However, the survey result indicates that 68.9% and 21.3% of DAs had medium and low levels of work motivation, respectively. This result is consistent with the previous studies by Dessalegn and Nuri (2018); Belay *et al.*, (2012); Ifenkwe (2012); Khalil *et al.*, (2009). Farmers focus group discussants affirmed that most DAs in their study areas had average work motivation due to poor working facilities, lack of recognition, lower salary, far working locations, limited opportunities for further education, working for longer hours a day, and poor infrastructure.

Investment in the provision of agricultural extension services has been important for agricultural development. Amongst few African governments, the Ethiopian government has been invested heavily from its own resources for agricultural extension and rural transformation. The public investment significantly increased and reached 15% what African leaders have been agreed in Maputo Declaration of 10% of the annual budgetary appropriation (EIAR-IFPRI, 2018; Demese, 2015; Kassahu and Poulton, 2014). Ethiopia was one of a few countries in Africa to meet that target. There has been support for investment in extension from multilateral, bilateral and other donors (World Bank, SG-2000, IFAD). Lack of adequate infrastructure in Ethiopia has been hindering the performance of the extension system. DAs reported that mobility to their operational area is difficult because of lack of motorbikes, or vehicle for their extension activities. DAs reported that the average distance to their operational areas is 13.23km. This is mainly because most DAs lived in cities and travel daily rather than lived in their working stations, except Adama kebeles of Minjar Shenkora woreda where all DAs lived in the dormitory given by the kebeles. However, 89% of DAs reported no motorbike for their operational activities. According to their estimation on average 33% of their time is spent for getting to the work station and to operational areas (fields) per month due to poor infrastructures and lack of motorbikes.

FTCs in Ethiopia serve as an entry point to bring about behavioral changes among farmers, however, most of them are found at varying levels of functionality, and some of them are not functioning. During our filed observations, FTC in Golo-Dertu kebele was closed and not serving the farming community due to lack of the required physical facilities and faming material for demonstrations. According to DAs most FTCs are poorly equipped and lack of sufficient facilities for providing the required services to the farmers, which is the most pressing constraints of

FTCs (Figure 3). This is followed by lack of long term vision and plan of FTCs (95.9%), and no policy support to re-use the internal revenues (94.3%). Each kebeles are expected to establish their own Management Committees (MCs) for the continuous follow up and support of FTCs. Farmers, however, perceive FTCs as government institutes rather than their own and lack clarity on the basic advantages of FTCs. Therefore, farmers do not adequately support FTCs for the better functionality, and they always expected governments to furnish FTCs. Well-functioning FTCs have their own capacity to generate internal revenues, however, key informants and focus group discussants reveals that FTCs do not have legal right to re-use the generated internal revenues. Therefore, it is one possible alternative for the government to consider FTCs as a business entity to run by themselves from their own internal revenues for the better functionality of service delivery.

The analysis indicates that the way in which the extension system is managed has been received little attention in Ethiopia as compared to governance structures and service delivery methods. Although it seems that there are positive responses from DAs on the time spent with their supervisors and the support from them, 43% of DAs were not satisfied with the overall supervision received from their supervisors. There is also a general lack of performance-based management system and reward and sanction system based on performance within the extension system. 16% of respondents reported that any actual sanction or disciplinary actions for poor performance while 52% of the surveyed DAs reported there is rewarding system for good performance of staff with the extension system. Organizations who using rewards and sanctions in their management system believed to be improved their performances (Deloitte and Touche LPP, 2008; Sefton et al., 2006). NAO reported that by employing the rewards and sanctions system in their organizations, the system can improve the organization performance by more than 60% (NAO, 2008).

Agricultural extension methods

FTC-based extension approach is used as a key instrument for providing extension services in Ethiopia. It serves as an entry point for providing effective and efficient extension services and also serves as hubs for knowledge and information sharing and centers for promoting best agricultural practices. Although FTC-based extension system is a key instrument for delivering extension services, the survey result shows that the large majority of respondents (94.3%) reported that farm visit or farmers' house visit is the most common approach used in the study areas. This is followed by FTC-based on-farm demonstration (66.4%), combination of different methods (40.2%), meeting with farmers grouping (37.7%), and invite farmers to office (21.3%). However, there is limited use of ICT (internet, mobile,

radio, or television) for delivering extension services. Only 8.2% of DAs reported mobile based extension service provision.

The result further shows that the average number of DA contacts with an individual farmer to provide the extension service is 3.3, with minimum 0 and maximum 75. More than half of DAs reported that having 1–5 numbers of contacts (visits) to farm households in last year. Only 11% having had more than five contacts while 32% not having a single contact to an individual farmer. According to key informants, farmers' house to house contact was difficult to DAs because the infrastructure and transportation problems made the problem serious. This clearly indicates the main challenges of the current extension system to promote and provide extension services to rural communities.

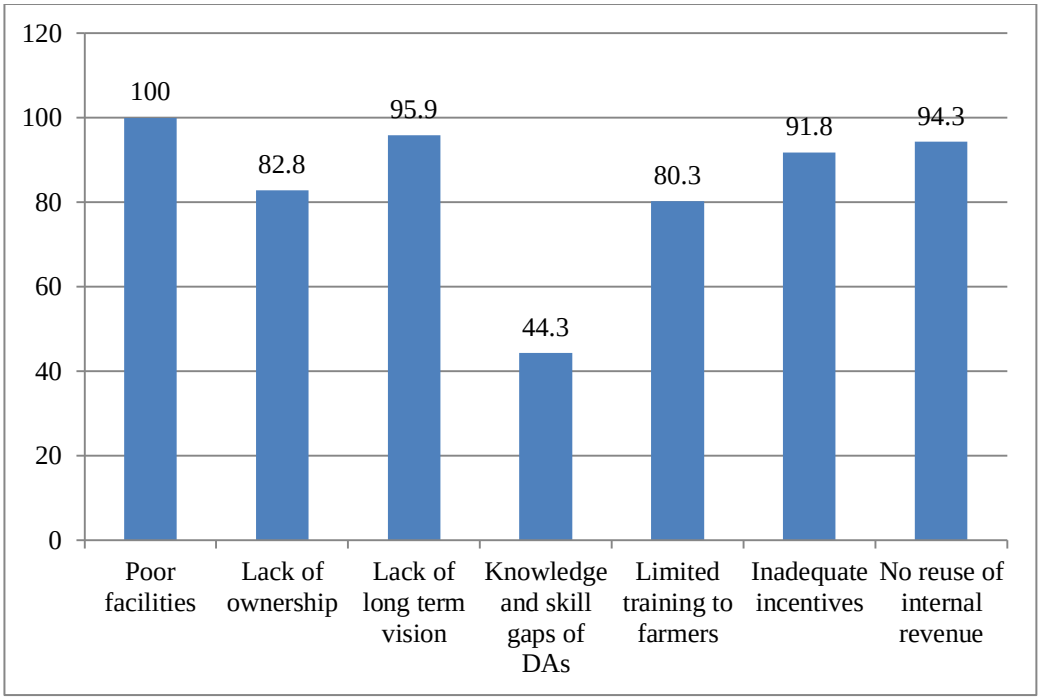

Figure 3: Percentage share of constraints of FTCs rated by respondents in the study areas
Source: Own calculation based on survey data

Table 3: Descriptive statistics of variables on district agriculture office performance

Variables	Description	Mean	SD
Dependent Variables			
TECHNOLOGY	1= if the AEO disseminated at least 1 technology	0.46	0.50
MATERIAL	1= if the AEO produced and promoted training materials	0.50	0.50
DEMO	1= if the AEO organized farm demonstration	0.38	0.48
Explanatory Variable			
DAs (+)	Number of DAs in each *kebele*	3.17	0.59
FEMALE_DAs (+)	Number of female DAs in each *kebele*	0.19	0.39
OPER_PLANNING (+)	1= if organization has annual planning	0.85	0.36
PERF_TARGET (+)	1= if organization has performance targets	0.34	0.48
SUPERVISION (+)	1= if the organization has strong regular supervision	0.43	0.50
DONOR_FUND (+)	1= if the organization received donor funding	0.27	0.44
SANCTION (+)	Organization enforces punishment (1-5 scale)	0.16	0.37
REWARD (+)	Organization has reward system (1-5 scale)	0.52	0.50
MOTORBIKES (+)	Number of motorbikes per staff (ratio)	0.28	0.45
TIMESPENT (+)	Proportion of DAs' time spent on getting to the field (%)	32.66	11.13
LINK_OTHER_EXT (+)	Linkages with other extension organizations (1-5 scale)	2.66	0.86
LINK_INPUT (+)	Linkages with input suppliers (1-5 scale)	2.58	0.78
LINK_TRADERS (+)	Linkages with buyers/traders (1-5 scale)	2.13	0.72
LINK_RESEARCH (+)	Linkages with research organization (1-5 scale)	1.92	0.75
LINK_FBO (+)	Linkages with farmers based organization (1-5 scale)	2.58	0.89
LINK_AUTHOR (+)	Linkages with local political authority (1-5 scale)	3.99	0.75

Source: Own calculation based on survey data

Table 4: Descriptive statistics of variables explaining a DA performance

Variables	Description	Mean	SD
Dependent Variables			
TECHNOLOGY	1= if DA taught at least 1 new technology	0.38	0.49
MONITORED	1= if DA monitored farmers' adoption	0.33	0.47
IMPACT	1= if DA monitored the impact of adoption	0.18	0.39
Explanatory Variable			
SEX (+/-)	1= if sex of the respondent is male	0.70	0.46
AGE (+)	Age of the respondent in years	26.70	3.35
EDU_CER (+)	1= if education level of DA is certificate holder	0.07	0.24
EDU_DIP (+)	1= if education level of DA is diploma holder	0.62	0.49
EDU_BSC (+)	1=if education level of DA is first degree	0.31	0.47
EXPERIENCE (+)	Working experience of DAs in years	4.50	2.91
DIS_WORK (-)	Distance to the working area in km	13.23	8.65
CONTACTS (+)	The frequency of DAs contact to farmers	3.30	6.74
PERF_TARGET (+)	1= if organization has performance targets	0.34	0.48
TRAINING (+)	1= if DA received training	0.72	0.45
MOTORBIKE (+)	Number of motorbike per staff	0.11	0.32
LINK_OTHER_DAs (+)	1= if DA interacted with other DAs	0.38	0.49
LINK_RESEARCHERS (+)	1= if DA interacted with researchers	0.29	0.44
ACHIEVEMENT (+)	Level of DA achievements (1-5 scale)	3.66	0.63
REWARDING (+)	Rewarding system (1-5 scale)	2.42	1.01
FACILITIES (+)	Working facilities (1-5 scale)	2.45	0.95
COM_SALARY (+)	Competitive salary of the organization (1-5 scale)	2.11	0.99
SUPERVISION (+)	Level of supervision (1-5 scale)	2.88	1.09
JOB_SATISFACTION (+)	Level of job satisfaction of DA (1-5 scale)	2.69	1.08
WORKLOAD (+)	The work load level of DA (1-5 scale)	2.29	0.92
INVOLVEMENT (+)	Involvement of DA in decision making (1-5 scale)	2.24	0.91

Source: Own calculation based on survey data

Factors affecting the performance of the extension service

A critical part of any regression analysis involves the diagnostics checking before fitting the model. As such, the likely existence of multicollinearity among the explanatory variables was checked by computing the Variance Inflating Factor (VIF) and Contingency Coefficients (C). The regression diagnostics result of VIF for each of the explanatory variables was found to be significantly less than the standard cut off value of 10 and revealed the non-existence serious multicollinearity problem among the explanatory variables included in the model. The 1/VIF column is the tolerance and it ranges from 0 to 1, with 1 being the absence of multicollinearity. In our case, all of the VIFs are below 4 and all of the tolerances are close to one indicating that there is no problem of multicollinearity in the data. Similarly, from the Eigen values and condition indexes no severe problems of multicollinearity were noted except for the last two variables. As a rule of thumb, a condition index below 15 is indicative of the absence of multicollinearity problem (Gujarati, 1988). The diagnostics check results of C also shown very lower values than the standard value and hence confirmed that there was no serious problem of multicollinearity among independent variables included in the model.

From the empirical result we observed that there are different contributing factors explaining the performance of the extension organization and individual agents. We also observed differences among agents to explore what factors matter in explaining the performance within a given extension system. 38% of individual DAs reported having well understood and taught at least one new technology in the last two years while 33% of DAs reported that having monitored the adoption status of farmers' of these improved technologies and practices (Table 4). Only 18% of them reported that having monitored the impact of the adopted technologies on farmers' livelihoods. The extension organization also reported that 46% having disseminated at least one new improved technology or agronomic practices to the farmers. And 38% of the respondent reported that the extension organization was organized FTC-based demonstrations in the last two years. More than of half of the respondents reported that AEO developed and promoted training materials for the farmers (Table 3).

Governance and enabling environment

Weak extension system can be transformed into an efficient system through commonly shared and clearly defined visions with measurable performance targets. Extension organizations with performance targets and agents in organizations with performance targets are more likely to perform well for disseminating improved technology and practices, developed and promoted training materials, and organized farm demonstration. However, the results in Tables 5 and 6 shows that large majority of respondents reported that there are no performance targets set for AEO and DAs. Consequently, there is no effective

monitoring and evaluation system to assess the performance of extension services provision. AEOs with performance targets have 50% higher probability to disseminate improved technologies and practices, 19% to promote training materials, and 42% to organize farm demonstration compared to those without performance targets (Table 5). Similarly, DAs in organizations with performance targets have 18% higher probability of being active and responsive to monitor farmers' adoption status than those agents in AEOs without performance targets (Table 6). Moreover, AEOs with operational planning have 9% more likely to disseminate improved technologies, 18% to produce and promote training materials, and 33% to organize FTC-based demonstration compared to those without operational planning (Table 5). The negative sign indicates that there is an inverse relationship between operational planning and technology dissemination, produced training materials and organizing FTC-based demonstration. This result is not in line with our assumption and the previous studied conducted by Ragasa *et al.* (2016).

Linkages and partnership

Although interactions among key actors in the extension system are important for disseminated improved technologies, linkages and partnership with other extension organizations, NGOs, farmers' organizations, and agro dealers, and local authorities are tending to operate and function mostly in isolation. Results show that there is weak interaction and partnerships among actors in the agricultural extension system in Ethiopia. AEOs that interaction with agricultural input suppliers are 24% more likely to perform well in organizing farm demonstration compared to those who did not have any interactions (Table 5). Similarly, AEOs that have interaction with traders or buyers are 22% more likely to perform well to disseminate improved technologies and practices, 14% to develop and promote training materials, and 30% to organize farm demonstration than those did not have any linkages and partnership. Individual DAs that have interaction with other DAs are 31% more likely to perform well to understand and disseminate improved technology and practices than those who did not have any interactions. And, agents with good interaction with agricultural researchers are 14% more likely to be active and perform well to evaluate the impact of agricultural technology adoption than those who did not have interactions and partnership. This implies that good interactions and partnership among actors are very important for AEOs and individual DAs performance. To be effective in their role of brokering of information, the extension system and DAs should be able to connect different stakeholders together. This result in agreement with the previous studies that by Ragasa *et al.,* (2016); Belay and Dawit (2017) and Gerba *et al.,* (2017).

Organizational capacity, management, and learning

Result shows that the number of DAs in the study areas is statistically insignificant factor in explaining the performance of extension service provision. Nevertheless, the gender balance in staffing and training received by DAs are matter in performance. AEOs with female DAs are 2% more likely to be active and perform well in disseminating agricultural technology and 3% more likely perform well in organizing farm demonstration than AEOs without female DAs (Table 5). Ragasa *et al.,* (2016) indicate that female DAs more likely perform well in agricultural extension service provision. Moreover, individual DAs performance could be influenced by the quality of training they received. DAs' training focuses on technical skills and most DAs are lack the comprehensive and applied skills required to combine crop, livestock, and natural resource management (Gerba *et al.,* 2017). DAs who received modular and refreshing training are 40% more likely to be effective and perform well in taught and disseminate improved technologies, 22% to monitor farmers' adoption and 18% to assessed the impact of improved technologies on farmers livelihood than those who did not receive one (Table 6).

Enforcement of sanction/penalty and rewarding system are significant factors in explaining the performance of extension service provision. The entire success of an organization is based on how an organization keeps its employees motivated and in what way they evaluate the performance for rewards or sanctions. An organization with strong reward and sanction system and regular performance reviews can maintain and improve the service delivery (NAO, 2008). However, lack of immediate rewards or penalty impacts negatively on employees' performance. The survey shows that AEOs with rewarding system are 28% more likely to perform well in technology dissemination, and 37% in organizing farm demonstration than those without enforcing the rewarding system. Moreover, DAs who rewarded for the good performance are 21% more likely to perform well to monitor farmers' adoption and 1.3% to assess the impact of technology adoption likely than those who did not rewarding.

Supervision is one of the most important factors influencing the performance of AEO and the work motivation of DAs (Belay *et al.,* 2012). Table 3 shows 43% of respondents reported that there is regular and adequate supervision in AEO. Result shows AEOs with regular and adequate supervision are 37% more likely to perform well to disseminate improved technology, 24% to develop and promote training materials, and 54% to organize farm demonstration than those without regular and adequate supervision. Likewise DAs with regular and adequate supervision is 8% more likely to be active and perform well to monitor the impact of technology adoption on farmers' livelihood. This result is in line with the previous studies conducted by Debebe et al. (2016), Belay *et al.,* (2012), Tesfaye

(2012), Zelalem (2011). According to key informants there are supervisors lacked how big supervisions benefits and motivated DAs, they considered supervision as a mechanism of finding faults. Moreover, they spent a significant amount of time in political engagements and they did not have adequate time to support DAs. During their supervision also they did not want to go down to the grass root level for solving our challenges arose from the farming community.

Receiving donor funding is a statistically significant factor in explaining the performance of AEOs. Table 5 shows that AEOs who received donor funding are more likely perform well in extension service provision compared to those without donor funding. A 1% increase in the proportion of donor funding for AEOs associated with 34% increase in the probability of good performance to produce and promote training materials compared to those without donor funds. Among the surveyed DAs, 90.2% used their own means of transportation for delivering the extension services (walking or private transport). Results show the ratio of motorbike to number of staff is statistically significant in explaining the performance of AEOs. AEOs that adequate accesses of motorbikes are 36% more likely to perform well for disseminate agricultural technology and 54% to organize farm demonstration than those without access to motorbikes. DAs that have closer distance to the work location are 1% more likely to perform well for taught and understand the technologies and disseminate to the farmers than those who far from the working location.

Another significant factor explaining the performance of individual DAs is the degree of involvement in planning, implementation and evaluation process in AEOs. Hence, a better participatory planning and evaluation process would help the DAs to own the AEOs with higher sense on involvement, with more commitment and satisfaction (Belay et al., 2012). Results in Table 4 indicate that the degree of involvement of DAs in planning, implementation and evaluation process is on average level. DAs being involved in planning, implementing and evaluation process are 5% more likely to be active and perform well to understand and disseminate improved technologies than those who do not involved in the decision making process (Table 6). This result is in line with the previous studies conducted by Belay et al. (2012), Tesfaye (2012), and Yohannes (2009), individual DAs with higher involvement and participation in the organization decision making process have great performance. Focus group discussants and key informants DAs are mostly considered as implementers, and a channel of technology transfer, then most of the time they ignored in the decision making process.

Advisory delivery methods

Farm visit or farmers' house visit is the most common approach used to deliver agricultural extension services. Hence, the number of contacts to farmers is one of the fundamental variables that affect the provision of extension services, thereby the performance of individual DAs. The model shows that the frequency of DAs' contacts with farmers is statistically significant factor in explaining the performance of individual DAs. Agents who have a higher contacts with farmers are 0.4% more likely to be good and perform well in monitor the adoption status of farmers and 3% more likely to be active and perform better in assessed the impact of improved technologies on farmers livelihood than those who did not have contacts (Table 6).

Table 5: Factors affecting performance of extension organization- binary logistic regression model results

	Disseminated at least One Technology		Produced & Promoted Training Materials		Organized FTC-based Demo	
Explanatory Variable	Marginal effect	Std. Err	Marginal effect	Std. Err	Marginal effect	Std. Err
NUMBER_DAs	-0.0125	0.0175	-0.0161	0.0143	-0.0332	0.0218
FEMALE_DAs	0.0202	0.0106*	0.0130	0.0097	0.0266	0.0136*
OPER_PLANNING	-0.2431	0.0858***	-0.1793	0.0757**	-0.3272	0.1087***
PERF_TARGET	0.4990	0.1064***	0.1870	0.1065*	0.4213	0.1286***
SUPERVISION	0.3717	0.1185***	0.2363	0.1017**	0.5430	0.1287***
SANCTION/PENALTY	0.0287	0.2085***	0.0578	0.1641	0.2561	0.1788
REWARDING	0.2750	0.1124**	0.0276	0.0920	0.3659	0.1338***
MOTORBIKES	0.3646	0.1188***	0.0503	0.0774	0.5425	0.1529***
TIMESPENT	0.0045	0.0052	0.0017	0.0042	0.0071	0.0064
DONOR_FUND	-0.2048	0.1770	0.3375	0.0770***	-0.1646	0.2057
LINK_OTHER_ORG	-0.0936	0.1204	0.1007	0.0921	0.0388	0.1349
LINK_INPUT	-0.0724	0.0758	-0.0241	0.0615	0.2362	0.1170**
LINK_TRADERS	0.2165	0.0787***	0.1403	0.0610**	0.3008	0.1125***
LINK_RESEARCH	0.0893	0.0856*	-0.0196	0.0695	-0.1585	0.1032
LINK_FBO	0.0851	0.1125	0.0011	0.0828	0.0399	0.1246
LINK_AUTHORITY	0.0263	0.0710	-0.0181	0.0657	0.0771	0.0900
% correctly predicted the model	71		75		63	
Pseudo R^2	0.39		0.28		0.48	
Number of observations	143		143		143	

Source: Own calculation based on field survey

Note: *, **, *** denotes significance level at 10%, 5%, and 1%.

Table 6: Factors affecting performance of development agents- binary logistic regression model results

Explanatory Variable	Understood New Technology and Taught		Monitored Farmers' Adoption		Monitored Adoption Impact	
	Marginal effect	Std. Err	Marginal effect	Std. Err	Marginal effect	Std. Err
SEX	0.1797	0.1228	0.1905	0.0903**	0.0563	0.0711
AGE	0.0006	0.0308	-0.0082	0.0292	0.0002	0.0170
EDUCATION	0.0340	0.1166	0.0160	0.1004	-0.0091	0.0778
EXPERIENCE	0.0135	0.0318	-0.0334	0.0328	0.0180	0.0209
DIS_WORK	0.0093	0.0069**	0.0058	0.0060	0.0027	0.0052
ACHIEVEMENT	-0.1492	0.0964	-0.1075	0.0810	-0.0581	0.0604
REWARDING	0.0614	0.0941	0.2070	0.0856***	0.0128	0.0626**
PERF_TARGET	0.0215	0.1188	0.1822	0.1070**	0.0403	0.0825
TRAINING	0.3978	0.1048***	0.2155	0.0842***	0.1755	0.0982*
MOTORBIKE	-0.1476	0.1466	-0.0102	0.1281	0.0957	0.1381
FACILITY	-0.1301	0.0911	-0.0591	0.0843	-0.0480	0.0628
JOB_SATISFACTION	-0.0571	0.0597	-0.0095	0.0484	-0.0165	0.0367
COM_SALARY	0.0358	0.0636**	-0.0157	0.0596	0.0054	0.0472
SUPERVISION	0.0978	0.0643	-0.0619	0.0560	0.0752	0.0383**
CONTACTS	0.0016	0.0062	0.0039	0.0115*	0.0281	0.0138**
WORKLOAD	-0.0044	0.1022	0.0494	0.0919	0.0139	0.0650
BEING_INVOLVED	0.0505	0.0874**	-0.0956	0.0742	-0.0049	0.0533
LINK_OTHERS_DAs	0.3144	0.1086***	-0.0791	0.1032	-0.0762	0.0822
LINK_RESEARCHERS	0.0222	0.1196	-0.0472	0.1007	0.1692	0.0723***
% correctly predicted the model	76		65		78	
Pseudo R^2	0.19		0.18		0.23	
Number of observations	127		127		127	

Source: Own calculation based on field survey

Note: *, **, *** denotes significance level at 10%, 5%, and 1%.

Conclusions and Implications

The most explicit goal of the Ethiopian agricultural extension system is to increase food security and to improve farmers' livelihoods through adoption of improved technologies (Gerba *et al.*, 2017). Based on the national goal, the regional, zonal and woreda level extension system are responsible to increase the adoption rate of improved technologies through training and awareness creation. The agricultural extension service provision is predominantly operated by the public sector, with limited support from NGOs, small and scattered donor-supported as well as farmers' organizations, and emerging commercial seed farmers. Despite strong government commitments and investment to the agriculture sector, the extension system has not been able to achieve the desired goals of agricultural advancement. Therefore, we assess the performance of the agricultural extension system and factors explain it by using Birner *et al.*, (2009) framework. The following five lessons have emerged from this paper for the wider extension service provision and enhance the performance of the extension system. Some of these are not new

but our results re-emphasize and to give more sounds to their importance in developing countries like Ethiopia.

Despite the extension service provision is predominantly operated by the public sector, the involvement of relevant actors are very crucial. However, their interactions and collaboration for provision of extension services are very limited and weak. The public extension services are remains very important countries like Ethiopia even in areas with very weak government institutions. Hence, improve the performance of the extension system through strengthening the interaction and partnership among actors is vital by offsetting the limiting factors. An important attention should be given to strengthen the existing ADPLAC platform for a better functioning of the extension service provision. This could be also very helpful to avoid a mismatch between the demand of extension service by the end users and the provision of extension services by the extension system.

Technical competence of DAs is very important in addition to number of DAs for an effective extension service provision. Moreover, gender balancing in extension staffing also required attention in the extension system. Therefore, not only the quantity and quality of DAs, but also gender balancing are very crucial through capacity building and creating enabling environment for motivated and committed for their work. Enabling conditions such as rewarding and sanction systems, enforcement of performance targets, gender balancing, and skills development and training are found to be statistically significant. Therefore, the agricultural extension system should not only focus on the number of DAs and getting a good ratio of DAs-to-farmers, but more significantly, it will be central to look at the quality and competence of DAs.

DAs are the key source of appropriate information to farmers since they are working closely with farmers beside to their profession than other stakeholders in agriculture. For smooth extension service delivery DAs need means of transportation for reducing the time and transaction costs for field and farm visits. However, most DAs working under difficult conditions–lack of vehicles, lack of incentives, basic facilities in FTCs to provide trainings, minimum budget to conduct trainings, demonstrations and exhibitions. Hence, appropriate measures should be taken to tackle all those problems to enhance the performance of the extension services. These include furnish adequately the FTCs to give services at full capacities. We suggest reuse of their internal revenue is one of the mechanisms to strength the capacity of FTCs rather fully depend on government budget allocation. And encourage and support FTCs to generate their own income from demonstrations and crops in the land allocated for FTCs. In addition to this, motivate FTCs to search their own donor funding to strengthen their capacities. There are some FTCs supported by projects such as AGPs in the study areas (Denkaka) which could show higher performances.

Improving the efficiency and effectiveness of the extension service provision through the rewarding and sanctions mechanisms at the grassroots level and familiarize with different actors can improve awareness about the change and enable farmers' access its benefits. Strengthening the existing ADPLAC platform is very important to enhance interaction and cooperation among actors for large coverage of the extension services. Hence, all relevant actors in the agriculture value chains should be should work collaboratively to improve the performance of AEOs and individual DAs that they can transfer technologies and knowledge appropriately to the end users. Further, streamlining the roles of DAs and model farmers, involve or collaborating with other actors across can improve the reach, quality, and sustainability of the extension services.

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