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*Full Length Research Paper*

# Analysis of research-extension-farmer linkage in finger millet technology development and delivery in Mecha District of Amhara Region, Ethiopia

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**The study examines research-extension-farmers linkage in relation to participatory finger millet technology development and delivery in Mecha district of the Amhara regional state, Ethiopia, due to the fact that the present research-extension-farmers linkage scenario in the country in general and in the study area in particular has been inefficient and ineffective in achieving the prescribed goal of increasing food production and improving the quality of life of farmers. In this study, random and purposive sampling procedures was used to select 5 sample kebeles (villages) and 100 sample farm households. Moreover, 18 researchers from three research organizations and 26 extension agents from three extension organizations were selected purposfully. The requiered data were collected using both primary and secondary sources, and subjected to descriptive statistics for analysis. Results of the study revealed that the influence and participation of farmers, extension agents, and researchers in the generation, transfer, and adoption of new finger millet technologies have been minimal. Farmers' awareness of improved finger millet vareties and researcher's awareness of best farmers' finger millet vareities and practices were low. Moreover, participation of farmers, researchers, and extension agents in setting both research and extension agenda; use of collaborative activities such as joint adaptive trials, and surveys, has been a bare minimum. Likewise, their mechanisms of exchange of knowledge and information, and feedback of agricultural innovations were found to be weak. The low use of such activities underscores the lack of complete or partial linkage existing between researchers, extension agents and farmers. The overall finding of the study underlined the high importance of a responsible body, which manages linkages in a system perspective with transparent and agreed-upon linkage policy that fosters successful research-extension-farmers linkages with well formulated, properly defined, and institutionalized linkage strategies and mechanism. It should be noted that policy makers, managers, and research and extension personnel should recognize that research and extension are part of a single system and that the mission of this system is to make relevant technologies available to farmers. Therefore, policy and development interventions should give emphasis to linkages, and should treat it as an integral part in the technology generation and transfer process through provision of better incentive mechanisms, adequate financial, physical, and human resources. What is more, effective leadership that makes research and extension accountable for their actions is also needed.**

**Key words:** Research, extension, farmer, linkage mechanism, participation, finger millet.

## INTRODUCTION

Generally, the existence of weak linkages among the major institutional actors in the Agricultural Knowledge and Information Systems (AKIS) – researchers, extensionists and farmers have been identified as a major drawback to generation, wider testing, dissemination and adoption of improved agricultural technologies in developing countries. For agro-technologies to be relevant to local needs these actors must be present in identifying research problems, adapting the recommendations to local conditions and

providing feedback to researchers about the innovations that have been developed (JB Ogunremi et al., 2011; Akinnagbe et al., 2010; Rathore et al., 2008; Oladele, 2001).

In Ethiopia, the agricultural research and extension organizations both at the national and regional levels were established as instruments for promoting agricultural development and improving the quality of life of farmers. As a result, the agricultural extension system has been frequently re-structured and re-organized to fulfill these goals (Elias and Agajie, 2001). In line with this, several attempts have been made to improve the effectiveness of agricultural research at both the national and regional levels and various approaches to regional cooperation, ranging from informal networks to regional organization.

Despite the fact that the linkage organizations are heavily invested in by the government, the problem of weak linkages, existing gaps and poor inter-organizational relation still exist (Belay, 2003; Teklu, 2001). Therefore, the constraints that hinder research-extension-farmers linkage can potentially affect the agricultural output of farmers, especially, the majority of small, subsistence, and resource poor farmers. This paper illustrates the seriousness of this predicament using the case of the development, extensive dissemination, efficient utilization and adoption of improved finger millet *(Eleusine coracana)* varieties in Mecha District, Amhara Regional State of Ethiopia. The study district was selected for several reasons. Firstly, finger millet is the most important staple food in the district. Besides, it is one of the district with high access to extension and research service due to its high engagement in linkage activities with research and extension since 1990s and it is also the nearest district mandated by five agricultural research organizations, namely: Amhara Regional Agricultural Research Institute; Adet, Andasa Livestock, Baihr Dar Mechanization, and Fishery Agricultural Research Centers, respectively. In particular, the district hosts research station and it is highly known for its lions share both in area and volume of finger millet production in the region (Alemayehu et al., 2008) hence may provide useful information on the nature and extent of the research-extension farmers' linkage in finger millet technology development, transfer and utilization.

Hence, this paper assessed the scenarios of research-extension-farmer linkages in finger millet cultivation through four basic research questions: 1) What major sources of ideas do researchers and extension agents' use for setting their research and extension agenda, and what major sources do farmers use for obtaining improved finger millet technologies and farming information? 2) How is the involvement of researchers, extension agents, and farmers in the prominent linkage mechanisms of finger millet technology development and delivery? 3) Are researchers and extension agents aware of, and do they possess correct knowledge of, farmers' best local finger millet varieties; and are farmers' aware of the major recommended improved finger millet varieties? 4) What factors perceived by researchers, extension agents, and farmers' as the critical factors limiting farmers' adoption of improved finger millet varieties?

## MATERIALS AND METHODS

The conceptual framework of this study was adapted from the Research and Technology Transfer Linkages Framework and Participatory Technology Development Model developed by ISNAR (1993).

Mecha district, where the study is based, is located at about 540 km north of the country's capital city, Addis Ababa and whiles the capital town of the district is Merawi. It is located between 11° 10' and 11° 25' North latitude and 37° 2' and 37° 17' East longitude in Blue Nile Basin, within the Highland of Ethiopia (Figure 1). Based on 2010 CSA result, the total area of the district, is 1,481.64 $km^2$ with a population of about 308,444, of which 155,799 were males and 152,645 were females. Close to 92.85% of the district's population lives in rural areas. Crop-live stock mixed farming is the dominant production system in the district, while its agriculture is virtually small scale, subsistence oriented and crucially dependent on rainfall. The main crops cultivated are finger millet, maize, tef, horticultural and oil crops, spices, pulses, wheat and barley. It has three major agro-climatic zones, that is, dega (above 2300 m asl), woinadega (15002300 m asl), and kola (below 1500 m asl). The temperature ranges from 13 to 35°C. The annual rainfall ranges from 1200 to 1500, of which 90% falls in months of May through October. The dominant soil type is red soils (93%), followed by brown (4%) and black (3%). The district has 39 rural kebele's (villages) and three-urban kebele administrative. Among, the study was conducted in five villages or kebeles called Enamerit, Enguti, Ambomesk, Pikolo Abay, and Kudemie.

### Sample, sampling procedure and sample size

The study population comprised of researchers in three public agricultural research organizations, extension personnel in three extension offices and bureaus of agriculture and rural development, and the client system, i.e. finger millet farmers (the end users of technology).

Five of the 39 kebeles (villages) of Mecha district were selected randomly. Subsequently, eighteen (18) farmers and two (2) key informants, per the selected kebeles are respectively selected randomly and purposefully. All in all, a total of hundred (100) farmers are selected.

Three of the extension organizations that are found in the technology system of the area are included for the study. At district, Zonal, and Regional levels, Mecha District Office, West Gojam Zone Bureau, and Regional Bureau of Agricultural and Rural Development are selected, respectively. Meanwhile, due to their limited number all or

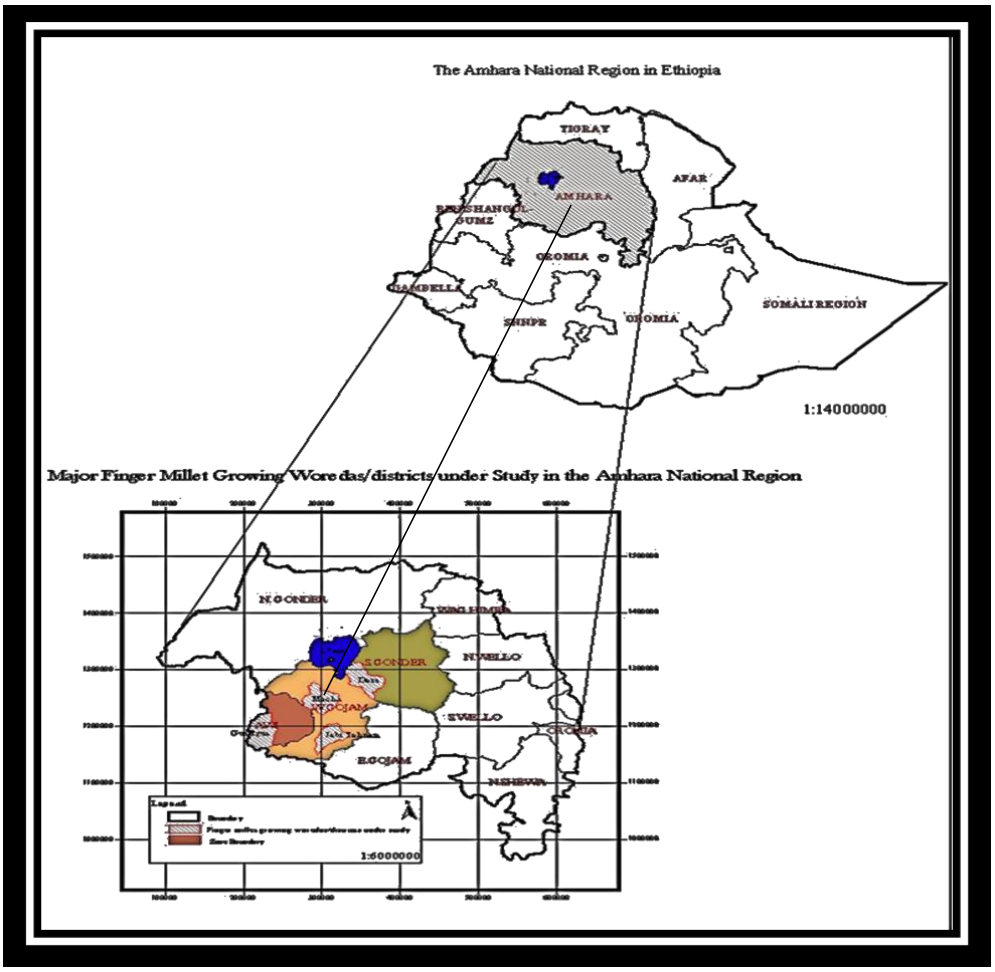


**Figure 1.** Topography maps of Ethiopia, Amhara region and Mecha District. Source: Alemayehu et al., 2008.

fifteen (15) extension staff whose work mandate covers finger millet technology transfer are targeted, and further, eleven (11) key extension agents who involved in research-extension-farmers linkage activities and act as managers or department heads in the unit of analysis are selected purposefully. All in all a total of twenty-six (26) extension staff are included.

Three out of the existing five research organizations found in the study area are selected purposefully. Accordingly, Amhara Regional Agricultural Research Institute, Adet Agricultural, and Bahirdar Mechanization Research Centers are selected, respectively as a sample because they have been engaged on linkage activities with extension and farmers for a long time and also known for the lion share of generated finger millet technologies in the study district. The other two research centers were not included because the one has been established in recent years while the mandate of the other covers fishery sector research activities. Meanwhile, due to their limited number all or eleven (11) researchers whose work mandate covers finger millet technology generation, adaptation, and transfer are included, and further, seven (7) experienced researchers who involved in linkage activities and act as managers, coordinators or department heads in the unit of analysis are selected purposefully. All in all, eighteen researchers (18) were included.

In sum, eighteen (18) researchers, twenty-six (26) extension staffs, and hundred (100) finger millet farmers was targeted. Thus, the sample size is 144 in order to allow ample time to conduct the study.

## Data collection instruments

Both qualitative and quantitative primary data are collected from researchers, extension staff, and farmers using key informant interviews, focus group discussions, and questionnaires during a three-month period (January - March 2010).

Key informant interviews (KII): In depth interviews were conducted with seven experienced researchers and eleven extension workers holding no managerial roles and which are not targeted as a sample. Moreover, ten (10) key

informant farmers (2 from each kebeles) comprised of leaders, women's, and progressive farmers had participated in the KII's.

***Survey questionnaires***

Three separate sets of questionnaires, closed and open ended questions, were prepared, pre-tested to obtain data from researchers, extensionists and farmers.

Focus group discussion (FGDs): one each with researchers and extension agents, and two with farmers using check lists-were formed. The researchers group had ten (10) senior technical assistants, senior and less experienced researchers, while the extensionists group had eight (8) experienced transfer agents. The other two FGDs had thirteen (13) and seventeen (17) farmers groups with different characteristics – age, farming experiences, their prior position and membership in farmers' development groups, and women headed households.

Relevant books, journals, proceedings, minutes and official reports of research and extension agencies in the areas of research-extension linkage was used as secondary data sources.

**Data analysis**

The study employs descriptive statistics to analyze the research-extension-farmers linkage in finger millet technology development, deliver, and utilization. The qualitative data generated using FGDs, and KIIs are analyzed thematically. The quantitative data analysis and presentation involves the use of frequency distribution and percentages.

**RESULTS AND DISCUSSION**

**Characteristics of the respondents**

Of the 100 household heads interviewed, only 12% were females, indicating that most of the households were headed by men. The farmers had an average of 20 years of farming experience. Only nineteen percent of the farmers had formal education.

All the researchers surveyed were males, suggesting probably the presence of high gender disparity in the research organizations in one reason or could be the presence of few and young women researchers in the organizations. On average, the researchers had 13.17 years of working experience. Mean while the majorities (38.9%) had M.Sc degrees, followed by B.Sc (33.3%), and PhD (27.8%).

Majorities (88.5%) of the extension agents were males. On average, the extension agents had 15.31 years of working experience. The majorities (46.2%) were Diploma holders followed by B.Sc, (26.9%), and M.Sc degrees (26.9%).

**Farmers' awareness of improved finger millet varieties**

Forty three percent (43%) of the farmers claimed to be aware of improved finger millet varieties. However, only 15% of them had been cultivating at least one improved varieties of finger millet, namely 'Degu' (13%), 'Tadesse' (2%), and 'Padet' (0%) in their farming experience. When asked whether they had been cultivating at least one of the improved finger millet varieties in 2008 and 2009 cropping season, only 7% and 6% of farmers claimed the cultivation of only 'Degu' variety in the respective years. On the contrary, majorities (57%) of the households had no awareness or understanding information that new finger millet varieties were exist in the technology system of the study area. Thus, it depicted the existing gap between researchers, extension agents, and farmers in developing and delivering sound finger millet varieties and practices.

The group discussion and key informant interviews held with the farmers, researchers, and extension agents revealed that the improved varieties that were developed, demonstrated and transferred to the study district in the last ten years were, 1) Degu variety in 2005, 2) Padet variety in 2002, and 3) Taddesse variety in 2003 cropping seasons. However, the farmers claimed the rejection of two of the improved finger millet varieties (Padet and Taddesse) by indicating that their local finger millet varieties, especially the best-preferred variety (Deqe) were superior to the improved varieties almost in all traits, with respect to grain yield, straw quality, grain color, early maturity, quality for local consumptions, weed tolerance, easy of threshing, and preference in market. It implied that research output for finger millet variety were minimal and lagged behind the farmers need for the staple crop.

**Researchers awareness of farmers best local finger millet varieties**

To determine whether researchers were really knowledgeable about farmers' local finger millet varieties and practices, they were asked to respond to questions related to farmers' practices or varieties that were perceived to be interesting and better than some of the recommendations from the research organizations, and to cite the best local finger millet varieties that were rated highly by farmers.

Only six or about 33% of the researchers claimed to be aware of local finger millet varieties that were superior to some of the practices recommended by their research organization. When asked to name at least one local finger millet varieties that farmers rated highly, five out of the six (83.3%) of the researchers correctly mentioned any such varieties (Deqe (2 of them), Tiukur dagusa (2), Necho (1 of them). On the contrary, twelve (about 67%) of the researchers claimed that they were not aware of best local finger millet varieties or practices that

**Table 1.** Researchers sources of ideas for setting research agenda.

| Researchers sources of idea | Responses | | | |
|---|---|---|---|---|
| | N% Yes | N% No | N% Total | N Total |
| Research community itself, including fellow research staff members | 38.9 | 61.1 | 100 | 18 |
| Research objectives determined by the research institute thematic area | 72.2 | 27.8 | 100 | 18 |
| Farmers as a source of ideas | 27.8 | 72.2 | 100 | 18 |
| Stakeholders meeting | 38.9 | 61.1 | 100 | 18 |
| Based on problems identified by regional bureau of agriculture and rural development | 77.8 | 22.2 | 100 | 18 |
| Based on personal observation | 22.2 | 77.8 | 100 | 18 |

Source: Own computational result, 2010.

**Table 2.** Extension agent's sources of ideas for setting extension agenda.

| Extension agents sources of ideas | Responses | | | |
|---|---|---|---|---|
| | N% Yes | N% No | N% Total | N Total |
| Extension community itself, including fellow extension staff members | 19.2 | 80.8 | 100 | 26 |
| Extension objectives determined by the extension organization thematic area | 57.7 | 42.3 | 100 | 26 |
| Farmers as a source of ideas | 30.8 | 69.2 | 100 | 26 |
| Stakeholders meeting | 34.6 | 65.4 | 100 | 26 |
| Based on problems identified by regional bureau of agriculture and rural development | 61.6 | 39.4 | 100 | 26 |
| Based on personal observation | 3.8 | 96.2 | 100 | 26 |

Source: Own computational result, 2010.

outstands the improved finger millet practices.

Generally, focus group discussion held with farmers and extensionists revealed that four local finger millet varieties of' names, Deqe, Necho, Angedie, and Tikur dagussa, respectively are grown in the study district.

**Extension agents awareness of farmers best local finger millet varieties**

As with researchers, extension agents were also asked about their awareness of best local finger millet varieties. Eighteen or the majority of the extension agents (69.2%) claimed that they were aware of local finger millet varieties that were better than the recommendations from the research organizations. Moreover, fourteen out of the eighteen (77.8%) of the agents correctly mentioned any such varieties (Deqe, 8 of them), Tiukur dagusa (4), Angede (2). On the contrary, 30.8% of the extension agents were not aware of best local finger millet varieties that were superior to improved finger millet varieties or practices.

**Major sources of ideas used by researchers and extension agents for setting their research and extension agenda, and sources farmers use for obtaining improved finger millet technologies and information**

Researchers reported that 77.8% of their research ideas come from the problems identified by the regional bureau of agriculture and rural development, whereas 72.2% based on research objectives determined by their research institute thematic area (Table 1). The researchers surveyed were more balanced in their use of stakeholders meeting (38.9%) and research community itself, including fellow research staffs (38.9%) as sources of their research agenda. Similarly, 27.8 and 22.2% of their research ideas come from farmers and personal observation, respectively.

The extension agents in their part claimed 61.6% of their work ideas come from the problems identified by the regional bureau of agriculture and rural development, whereas 57.7% based on objectives determined by their extension organization thematic area (Table 2). Also, stakeholders meeting (34.6%), farmers (30.8%), extension community itself (19.2%) were claimed as sources of extension agenda setting. However, only 3.8% of their work priorities identified from personal observation.

Extension staffs (77%), neighbors (77%), religious organizations (76%), and parents/relatives (64%) are the four most farmers sources of obtaining finger millet variety information and practices (Table 3).

**Participation of researchers, extension agents, and farmers in prominent linkage mechanisms of finger millet technology development and delivery**

Through reconnaissance survey and discussions with

**Table 3.** Farmers sources of obtaining improved finger millet technologies and information.

| Farmers sources | Responses | | | |
|---|---|---|---|---|
| | N% Yes | N% No | Total% | Total N |
| Neighbors | 77 | 23 | 100 | 100 |
| Parents/children/relatives | 64 | 36 | 100 | 100 |
| Farmers own experience | 56 | 44 | 100 | 100 |
| Extension Staffs | 77 | 23 | 100 | 100 |
| Research Staffs | 17 | 83 | 100 | 100 |
| NGO Staffs | 1 | 99 | 100 | 100 |
| Cooperatives | 38 | 62 | 100 | 100 |
| Churches | 76 | 24 | 100 | 100 |
| Demonstrations | 19 | 81 | 100 | 100 |
| Farmers exchange visit | 8 | 92 | 100 | 100 |
| Community leaders | 35 | 65 | 100 | 100 |
| Market place | 39 | 61 | 100 | 100 |
| Trainings/workshops/seminars | 14 | 86 | 100 | 100 |

Source: Own computational result, 2010.

**Table 4.** Distributions of researchers, extension agents and farmers by participation in prominent finger millet linkage mechanisms

| Actors | Researchers | | Extension agents | | Farmers | | Average | |
|---|---|---|---|---|---|---|---|---|
| Linkage mechanisms | Yes (N%) | No (N%) | Yes (N%) | No (N%) | Yes (N%) | No (N%) | Yes | No |
| Joint Problem Identification | 11.1 | 88.9 | 0 | 100 | 3 | 97 | 4.7 | 95.3 |
| Joint priority planning, setting, programming and review meetings | 77.8 | 22.2 | 30.8 | 69.2 | 10 | 90 | 39.5 | 60.5 |
| Joint technology release meetings | 5.6 | 94.4 | 0 | 100 | 5 | 95 | 3.5 | 96.5 |
| Joint adaptive trials | 27.8 | 72.2 | 11.5 | 88.5 | 17 | 83 | 18.8 | 81.2 |
| Joint demonstration trials | 50 | 50 | 26.9 | 73.1 | 36 | 64 | 37.6 | 62.4 |
| Joint surveys/diagnostic survey | 5.6 | 94.4 | 0 | 100 | 2 | 98 | 2.5 | 97.5 |
| Publications | 11.1 | 88.9 | 0 | 100 | 1 | 99 | 4.0 | 96.0 |
| Seminar/ workshop | 38.9 | 61.1 | 42.3 | 57.7 | 9 | 91 | 30.1 | 69.9 |
| Joint technical reports | 11.1 | 88.9 | 11.5 | 88.5 | 1 | 99 | 7.9 | 92.1 |
| Farmers exchange tour | 11.1 | 88.9 | 15.4 | 84.6 | 4 | 96 | 10.2 | 89.8 |
| Field days | 61.1 | 38.6 | 69.2 | 30.8 | 37 | 63 | 55.8 | 44.2 |
| Trainings | 25 | 75 | 15.4 | 84.6 | 37 | 63 | 25.8 | 74.2 |
| Evaluation meetings | 22.2 | 77.8 | 34.6 | 65.4 | 5 | 95 | 20.6 | 79.4 |
| Evaluation field visits | 25 | 75 | 46.2 | 53.8 | 15 | 85 | 28.7 | 71.3 |
| Grand mean of participation | 27.4 | 72.6 | 21.7 | 78.3 | 13 | 87 | | |

Source: Own computational result, 2010.

farmers, extension experts, and researchers working in the study area, 14 prominent research-extension-farmers linkage mechanisms, which the actors use for participatory agricultural technology development and delivery, were identified.

In order to understand whether the stated linkage mechanisms were really functional to foster participatory finger millet technology development and delivery; and to address the technological needs of farmers through their active participation; researchers, extension agents, and farmers were requested whether they had been participated at least once in 2008/9 and 2009/10 cropping seasons in the 14 prominent linkage mechanisms. Accordingly, the variables were measured in such a way that a researcher, a farmer, and an extension worker who had participated in a particular linkage mechanism at least once in the two production years would be considered as a participant, otherwise a non-participant. Similar procedure was followed for all linkage mechanisms. Accordingly, the grand mean participation of each respondent researchers, extension workers, and farmers was grouped and developed as a sum of status of participation on each linkage mechanisms divided by the number of linkage activities (14 in this case).

As indicated in Table 4, joint participation of researchers, extension workers, and farmers were

relatively prominent in finger millet linkage mechanisms of field days, joint priority setting, planning and programming, and joint demonstration trials, with mean participation of 55.8, 39.5 and 37.6%, respectively. Moreover, evaluation field visits (28.7%) and attending seminar or workshop (30.1%) were also prominent. On the contrary, joint participation of the three actors were the least in linkage mechanisms of joint surveys (2.5%), joint problem identification(4.7%), joint technology release meetings (3.5%), joint technical reporting (7.9%), publications (4%), and farmers exchange tour (10.2%). Among others, disseminations of knowledge and information, given the dominant role of field days are the most effective linkage mechanisms where by researchers, extension workers, and farmers were jointly participated at least once in 2008 and 2009 cropping seasons.

**Researchers, extension agents, and farmers' participation in field days**

Table 4 shows, 69.2% of the extension agents claimed that they had participated field days regarding finger millet technologies with researchers and farmers at least once in the two production years, whereas over half of the researchers (61.1%), and 37% of the farmers indicated that they had attended field days at least once in the same years.

**Researchers, extension agents, and farmers' participation in trainings**

37% of the farmers claimed to have been involved in farmers training programs with an extension or research staff at least once in 2008 and 2009 cropping seasons, whereas only quarter of the researchers (25%) had participated in such programs. However, only four (15.4%) of the extension agents surveyed reported being a participant on farmers training programs at least once in 2008-2009.

**Researchers, extension agents, and farmers' participation in joint demonstration trials**

Joint demonstration trials were also one of the prominent linkage activities where by researchers, extension workers and farmers were participated collaboratively regarding finger millet technologies. As indicated in Table 4, half of the researchers (50%) had attended joint demonstration trials with farmers and extension workers at least once in 2008 and 2009 cropping seasons, whereas 26.9 percent and 36 percent of extension agents and farmers respectively indicated that they had attended such activities.

**Participation in joint priority planning, setting, programming and review**

Planning and review functions of linkage mechanisms were also the prominent activities whereby on average 39.5% of researchers, extension workers, and farmers were participated at least once in 2008 and 2009 production years. Majorities (77.8%) of the researchers claimed to have been involved in such activities regarding finger millet technologies, however only 30.8 and 10% of the extension agents and farmers had participated in such planning and review mechanism, respectively.

Generally, the results of the comparative analysis (Table 4 above) of the mechanisms, which were used to link researchers, extension agents and farmers for finger millet technologies generation and delivery, are summarized as follows.

Researchers' participation was low in most linkage activities, specifically rare in joint technology release meetings (5.6%), joint surveys (5.6%), joint problem identification (11.1%), publications (11.1%), joint-technical report writing (11.1%), and farmers exchange tour (11.1%). On the contrary, researchers had high participation in joint priority planning and review (77.8%), field days (61.1%), and joint demonstration trials (50%).

Similarly, extension agents' participation was low in most linkage activities, specifically rare in, joint adaptive trials (11.5%), joint-technical report writing (11.5%), trainings (15.4%), and farmers exchange tour (15.4%). However, none of the extension agents surveyed reported being a participant in joint problem identification, joint technology release committee meetings, joint surveys, and publications at least once in 2008 and 2009 cropping seasons. Their low or non-involvement in such activities underscores the existing gap between researchers, extension agents and farmers in finger millet technology generation and delivery. On the contrary, extension agents had high participation only in field days (69.2 %) and relatively in evaluation field visits (46.2%).

Regarding farmers participation, three types of linkage activities are prominent, field days (37%), trainings (37%), and joint demonstration trial (36%). The acquisition of knowledge associated with these activities and their frequent usage by research and extension could be responsible for their prominence. However, farmers were less involved in priority planning and setting (10%), joint technology release meetings (5%), evaluation meeting (5%), farmers exchange tour (4%), workshop (9%), and joint adaptive trial (17%). Nevertheless, they were not involved almost at all in joint-report writing (1%), joint problem identification (3%), joint survey (2%), and publication (1%) at least once in 2008 and 2009 years. It showed that farmers' participation in setting both research and extension agenda has been limited.

In general, there is a difference in the participation of researchers, extension agents and farmers in finger millet linkage mechanisms. The grand mean participation on the fourteen prominent linkage mechanisms (at least once in 2008 and 2009 years) showed that researchers (27.4%) are mostly participated followed by extension agents (21.7%) and then farmers (13%). The participation

is thus represented as Researchers > Extension agents > Farmers (Table 4). The implications of this is that the gap for developing and delivering a basket of sustainable finger millet technological options that is, products that are technically, socio-economically and environmentally solutions to the needs and problems of farmers will continue to remain; since researchers, extension agents and farmers were not collaborate as equals, emphasising linkages through an exchange of knowledge, different contributions and a sharing of decision-making power during the innovation process.

**Perceptions of researchers, extension agents, and farmers on the factors limiting farmers' adoption of improved finger millet varieties**

Researchers and extension agents are unanimous inciting these as the five major factors limiting farmers' adoption of improved finger millet technologies in the study area. 1) Absence of sound seed production and delivery system; 2) Lack of awareness of improved finger millet varieties; 3) Lack of consistent demonstration and popularizations of the technologies; 4) Poor research-extension linkage and chronically weak extension services; and 5) lack of completeness of the technology package.

Similarly, the farmers for their part indicated these as the five most limiting factors; 1) lack of awareness of improved finger millet varieties, 2) Limited promotion or lack of consistent demonstration and popularization; 3) quality seed shortage, 4) Poor performance of generated improved finger millet technologies, 5) Weak research and extension linkage.

## CONCLUSION AND RECOMMENDATION

The linkage between research, extension, and farmers are extremely important areas, which are currently underemphasized by the actors of the technology systems of the study area. How well researchers, transfer agents, and farmers communicate and cooperate has a strong influence on whether agricultural science succeeds or fails as a catalyst of national development and as a tool for eliminating poverty. This study reveals the research-extension-farmers linkages in relation to efforts to increase finger millet technology development and delivery. From the results of the study the following inferences could be drawn:

Farmers' awareness of improved finger millet technologies and researchers' awareness of best farmers' finger millet varities are low. Thus, further work is required to create awarness and improve thier perceptions through joint partcipation in linkage actvities for sound generation, transfer, and adoptions of new finger millet technologies.

The influence and participation of farmers, researchers, and extension agents in the generation and transfer of finger millet technologies have been minimal. To express, the linear model, which regards finger millet technology generation, transfer, and adoption as sequential and stresses a clear division of labor between research and extension services is used. The interface between research, extension, and farmers is reduced to field days and demonstration trials. On the contrary, their participation in setting both research and extension agenda such as joint problem identification and joint technology release meetings is a bare minimum. Besides, their participation in execution of collaborative activities such as joint adaptive trials, and surveys, has been limited. Moreover, their mechanisms of evaluation, exchange of knowledge and information such as via wide range of publications, and coordination of the overall activities and systems performance are weak. Further, formal training of technology transfer workers and farmers by researchers, is not a wide spread practice in the study area. The infrequent contacts among researchers, extension agents and farmers do not provide adequate opportunity for feedback of information from farmers to researchers there by hindering the flow of generated finger millet technology (one variety) in one hand, and the rejection of two improved finger millet varieties by farmers, in the other hand. Thus, suggest the need to modify the current top-down research approach that exists to encourage more active participation by farmers and extension agents in the process of developing sound finger millet technologies in line with the needs of farmers.

Therefore, research, extension, and relevant actors must identify the systems linkage needs and choose agreed-up on mechanisms. That is, potential gaps need to be identified, alternative solutions need to be evaluated and designed, and selecting and implementing the best appropriate mechanisms and constant evaluation is needed. Consequently, they must participate in planning and review; executions of collaborative tasks; exchange of resources, knowledge and information; and joint evaluation and feedback of agricultural innovations. To this end, provisions of quality and quantity of human, physical and financial resources coupled with better incentive mechanisms to research and extension in line with the mandate and mission should be emphasized. Moreover, both research and extension should enhance or create special units, such as research-extension liaison positions, which specifically in charge of linkages, to ensure appropriate level of integration and effective operation of the technology systems. Equally important, all the actors, from policy makers to grassroots-level agents, need to be made aware that linkages are important and that their participation is crucial to the effectiveness of the agricultural system in one hand and for demand-driven, multiple-stakeholder, group-based agricultural technology generation and transfer system in the other hand. In a nut shell, a responsible body, with a

transparent, accountable, and agreed –upon linkage policies and mechanisms, that monitors and evaluates the action of research and extension is needed and pre-requisite for the country's overall agricultural development strategy.

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