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Research-Farmers Linkage in Agricultural Innovation System: Challenges and Intervention Options in Ethiopia

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Abstract
The main objective of this paper was to review different challenges that had hindered researchers' and farmers' linkages, and proposed alternative interventions that are effective in the linkage between different relevant agricultural actors in agricultural innovations system in Ethiopia. Based on finding results of different literature reviews, six critical dimension factors that are hindering farmers participation from AIS to improve food security of household in Ethiopia emerged. Those dimension challenges were; researchers' characteristics, farmers' characteristics, researchers' and farmers' interaction, type of research project, research approach, and researchers' and farmers' benefit from interaction. For the weak researcher- farmer linkage, it is imperative that policy makers and planners should; pay attention to allocate adequate funds, create conducive environment for both parties, focus on attitudinal change, expanding infrastructure and provide on the job training for development agents. Thus, policy framework that synergizes the relevant actors' linkage in a sustainable manner should be in place to bring the intended growth and transformation in agriculture through technology and innovation. The agricultural extension system of the country should be revised and involve the farmers in all developmental research process.
Keywords: Research, Farmers, Linkage, Agricultural Innovation system, Challenges, Intervention Options, Ethiopia
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INTRODUCTION

Ethiopia is a low-income country with a population of 102 million and a GDP per capita of USD 767. Roughly, 20% of the population dwells in urban areas. Estimates by The Economist (2015) revealed middle class society represents a mere 2 % of Ethiopians. Agriculture is the mainstay of the economy, contributing about 35% to GDP and 68.2% to employment, and 90% of export value. Industry and services contribute around 23 and 42% to GDP, respectively, the two sectors employing about 9.4 and 22.4% of the labour force, in that order [1].

Conventional approaches to agricultural development in Ethiopia have tended to regard innovation as the result of research, and see its dissemination as linear technique limited to researchers, extension staff and farmers. This does not result in increasing agricultural production and productivity and resulted in food insecurity. The research findings, once packaged for extension workers, are expected to be inherently suited to transfer to farmers in which farmers do not learn from the production of knowledge since they are not involved. Researchers have been separated from farmers in production of knowledge and technology. This is due to lack of direct linkage between researchers and farmers in knowledge and technology production, diffusion and utilization. More recent approaches to improving the impact of research on farmers live through effective collaboration put greater emphasis on partnership in which researchers do have strong linkage with farmers to conduct research which is relevant to farmers need to alleviate poverty from the country [3].

Over recent decades, the Ethiopian government has made various efforts to build the capacity of the research and extension systems and strengthen their linkages to improve adoption and productivity. The linkage between research and extension systems plays a significant role in the generation and dissemination of appropriate technologies. Strengthening research and extension linkages must mean cultivating greater and more effective interaction among the stakeholders in the agricultural sector. To this end, several linkage initiatives have been tried out at different times with different levels of effectiveness. Therefore, the main focus of this review paper is to assess the current status of Agricultural Research and Farmers Linkage in Ethiopia and its Challenges and Intervention Options in Ethiopia. The study is also based on a systematic review of existing literature on agricultural research and Extension linkage works in the country. The rest of this paper contents are organized as review and discussion of literatures and conclusions and recommendations.

LITERATURE REVIEW

Historical background of agricultural research in Ethiopia

The beginning of agricultural research in Ethiopia dates back to the 1930s and even before. Earlier to this time, activities focused on germplasm collection, scientific expeditions, characterization and identification of crops.

The introduction of exotic wheat germplasm and testing under local situations began in the early 1930s in Ethiopia. But until the early 1950s formal national research programme was not established. The commencement of formal research in agriculture began with the establishment of Ambo and Jimma Agricultural College in 1947 (now Ambo University and Jimma University respectively) and then Imperial College of Agriculture and Mechanical Arts (IECAMA) (now Haramaya University) central experiment station at Debre Zeit (known this time Debre Zeit Agricultural Research Centre) in 1955. In the decade following its formation, IECAMA was active in building the national agricultural research systems. The college and its central experimental station at Debre Zeit had a national obligation to conduct and organize agricultural research. The government shifted the responsibility for research in agriculture to the newly established Institute of Agricultural Research (IAR).

Technologies that are developed with limited involvement of farmers are not usually relevant to farmers since there is little opportunity to consider the agro-ecological circumstances and socioeconomics of the end users. There has been increasing dissatisfaction with the poor rates of adoption of agricultural technologies for resources poor farmers. This poor adoption has resulted as technologies are developed with little input from poor farmers [4].

At present, the Ethiopian agricultural research system is characterized by a decentralized research structure in which there are federal and regional research institutes composed of a number of research centre's spread across the various agro ecologies of the country. There are 69 agricultural research canters under the federal, regional and university research institutes. Until recently, there was no umbrella organization coordinating research in Ethiopia (currently, the Ethiopian Agricultural Research Council is being established, modelled after the Indian Agricultural Research and Extension Linkages in the Amhara Region, Ethiopia 117 Council for Agricultural Research). The federal agricultural research institute known as the EIAR (Ethiopian Institute of Agricultural Research) itself is engaged in applied research not much different from what the regional institutes do and is not serving as a national agricultural research coordination or governing body. The relationship between the federal and region research institutes was largely competitive than collaborative. Structurally, the research institutes are under the Ministry or Bureaus of Agriculture, but they enjoy considerable autonomy and there is no direct reporting or accountability between the federal and region agricultural research institutes. However, there are, in fact, some collaborative research projects and voluntary research collaboration on some commodities.

The existence of weak linkages among the research, extension and farmers have been identified as a major drawback to generation, wider testing, dissemination and adoption of improved agricultural technologies. If the linkages among the agricultural knowledge system actors are weak, the flow of information is hampered either from research to extension or from extension to farmers thereby agricultural production and productivity will be adversely affected [5].

Theoretical Framework

This chapter discusses about the theoretical framework of the study. In this chapter: innovation systems, the role of research in AIS, the importance of partnership between farmers and researchers and the critical challenges for effective collaboration between farmers and researchers in the world in general and in the country in particular are discussed.

Concepts of innovation systems

Innovation is nowadays seen as a process of network building, social learning and negotiation. The linear technology transfer model with clear task division between various actors; some actors supposed to specialise in the generation of innovations, others concentrating on the transfer, while the farmers‟ role is merely to apply innovations has been criticized [6]. Moreover, the idea of research organisations as the only sources of innovations has been contested. It is recognised that innovation emerges from the complex interactions among multiple actors and is about fostering combined technical, social and institutional change [3]. Consequently, linkage and partnership are vital.

To this end, facilitators such as ARDPLAC have an important contribution in facilitating linkage among different actors and in the process of developing demand driven innovations. In the history of actors‟ linkage in agriculture in Ethiopia, the linkage advisory councils have been contributing in facilitating linkage platforms for better innovation and improving extension service. The councils have passed different phases of changing names and scope to be more inclusive by incorporating relevant actors in their linkage platforms.

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of direct linkage between researchers and farmers in knowledge and technology production, diffusion and utilization. More recent approaches to improving the impact of research on farmers live through effective collaboration put greater emphasis on partnership in which researchers do have strong linkage with farmers to conduct research which is relevant to farmers need t alleviate poverty [3].

The role of research in agricultural innovation system

The relationship between farmers and researchers is changing since the linear process is ineffective and this change created agricultural innovation approach. The conventional institutional view to researchers has been looking as a source of new agricultural knowledge and transferring the knowledge to farmers separately through extensions. This centralized model separate researchers from farmers which limit the productive collaboration of researchers and farmers. Because of this linear problem, agricultural innovations come from different actors including research staff and farmers to have impact on making research relevant to farmers need by involving them in knowledge and technology production, diffusion and utilization. Effective linkage of researchers and farmers solved the problem of farmers in many countries like Indian farmers from post-harvest loss. Direct and effective linkage of researchers with farmers brings practical solution since farmers are involved in the actual innovation process of knowledge and technology development. From innovation systems perspective, innovation emerges from systems of actors. These systems are rooted in an institutional setting that affects how individual actors (researchers and farmers) behave and interact with each other. Learning is the critical part of the system which comes from the interaction of researchers and farmers involved in knowledge production and use. Collaborative relationships are important in innovation since the benefits in innovative performance derived from productive relationships between researchers and farmers in the use of new knowledge in economic production [7].

The importance of partnership between Research and Farmers

In the past, innovations were seen purely as discovery or invention and many believed that innovations for solving societal problems only come from science and research organization. However, according to innovations are not only about new inventions but also include social and institutional aspects [6, 9].

Effective linkage of researchers with farmers for collaboration results in utilization and acceptance of knowledge which is intended for farmers [8]. From AIS outlook, farmers are important in making contribution in terms of articulating knowledge demands and adding knowledge to the innovation process. Agricultural innovation system helps to investigate the interface between researchers and farmers [7].

Partnership as a collaborative relationship between researchers and farmers in decentralized manner is highly important to create innovation and learning. But hierarchal institutional arrangements centralized agricultural research systems which created difficulties to deal with the needs of farmers at the grassroots levels. The institutional view of research is the arrangements of different actors at different levels which either include or exclude and determine the role of these actors. Open information transfer system in combination with interactions among the stakeholders is necessary for improved agricultural information transfer system [10]. Involvement of all innovation actors in the information/ knowledge exchange, the use of farmers' indigenous knowledge and farming systems are crucial to enhance information transfer, technology adoption rate of farmers, and make genuine decision on agricultural investment. Strengthening the linkage between all the innovation actors is important to hasten the information/knowledge or technology transfer system and also to increase the effectiveness of the developed and disseminated agricultural technologies [11].

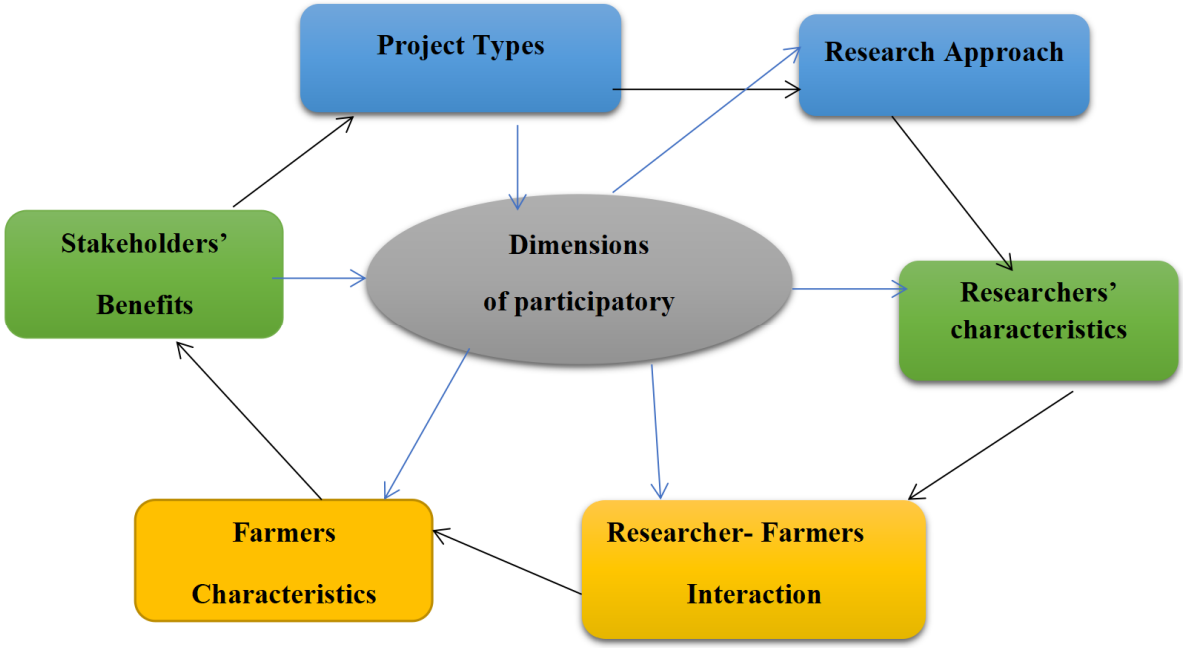
Factors affecting farmers and researchers' linkage

The interaction and collaboration of researchers and farmers are affected by a number of factors. These linkage limiting factors include incentives and attractive salaries for both farmers and researchers that enhance the collaboration of researchers with farmers, share vision in agricultural development, adequate market for farmers to sell their produce, the level of linkage established between farmers and researchers, legislatives and policy environment, information flows between researchers and farmers, political stability in the country, merit based employment and position appointment, hierarchal approach between the actors, well-developed capital, difference between farmers indigenous knowledge and researchers formal scientific knowledge, social status, cultural differences which exclude farmers from working with the educated researchers, intellectual property rights, professional status that affect the relationship of the actors, political interferences and ideological difference among the actors in the country [3].

Collaboration of researchers and farmers to bring development can be affected by a number of factors. Collaboration is related to participation of farmers in research process. Farmers' participation in research process can affect collaboration of researchers and farmers positively or negatively. According to farmers' participation in agricultural research can be affected by various factors which are interrelated to each other. The authors identified six dimensions of participation which affects collaboration and partnership of researchers and farmers.

These dimensions of participation which affect collaboration through participation are researchers' characteristics, farmers' characteristics, researchers' and farmers' interaction, type of research project, research approach, and researchers' and farmers' benefit. In the following sections, these dimensions of participation which affect collaboration of researchers and farmers are discussed [12].

Figure 1: Theoretical Framework



Main challenges for improving Researchers and farmers Linkages

The review findings revealed that the linkage of farmers with researchers in agricultural research was hindered by a number of factors. These linkage inhibiting factors knocked active participation of both farmers and researcher in research to bring social learning and innovation. These critical factors that held up linkage are listed and discussed as follows

Research-project types: this dimension includes problems of the research type, weak technology demonstration by researchers, weak documentation about the whole research process, top- down designing research plans and objectives are some of the key challenges that hindered weak linkage between research and farmers in the country. According to research findings revealed that, one of the causes for irrelevant type of research was due to lack of farmers' participation in the research process. Moreover, the research had little room for farmers' engagement in the research because of the nature of the research type. This view was widely shared among researchers, development agents and farmers in the study areas [13]**.** Research institutions and universities do not have the culture of research process documentation. There is a problem of getting data about what was done in the past regarding farmers problems, methods used, the successful and unsuccessful technologies, challenges in adopting technologies, introduced technologies from abroad, farmers' best practices, farmers practices in specific areas, farmers attitudes about research and sources of research funds [14]. In addition to this, lack of information about research and farmers is a challenging for beginners in the research institutes. Lack of appropriate information about the farming practices created gap between farmers and researchers in creating strong linkage between farmers and researchers.

Furthermore, Top-down research planning approach greatly hindered farmer's involvement in agricultural research. Likewise, limited forum for experience sharing among researchers was seen as a great problem besides limited interest among stakeholder to learn from one another to bring innovation in agriculture to enable the country to assure national food security especially for the poor and marginalized farmers [13]. The Author also indicated that, researchers spend most of their time in laboratories or in office writing proposals or research results. Some researchers do not often demonstrate their research results to beneficiaries. This is because of lack of time to do so and lack of mandate to demonstrate research results to farmers. Since the developed technology is not properly demonstrated to the users of the technology, farmers do not trust the new technology and result even in failure since farmers have not properly seen the technology from the beginning to the end [14].

Research Approach: It affects collaboration through research methodology, planning and epistemology. Research methodology could be reductionist which has little room for farmers' participation or it could be system oriented holistic approach which invites farmers' participation which increases collaboration of famers

and researchers in research process. Research epistemology, the adherence to scientific paradigm (constructivist vs. positivist) can affect collaboration in different angles. Researchers could have positivist world view and can assume that reality exists independently of the observer and farmers' participation has no value in research since the research results do not depend on farmers' context and shows general validity. Researchers can have constructivist world view assuming that reality is constructed by the observer and validity depends in a given context and give room for farmers' perspectives from different angles. This world view gives wider room for farmers' participation to increase collaboration and partnership between farmers and researchers. This world view also gives room for integrating local knowledge with the scientific knowledge, meaning that, it integrates farmers' knowledge with expert knowledge [12].

However, there is a big gap between scientific and indigenous knowledge. Because of the gap, researchers are not integrating indigenous knowledge into the scientific knowledge. Researchers assume that local knowledge has no capacity to solve farmers' problem. Farmers have suspect on the scientific knowledge and think that it does not bring solution to their existing problems. Researchers use the scientific knowledge to produce new technology without integrating with farmers' knowledge. Lack of indigenous and scientific Knowledge integration is due to lack of experiences sharing among the different stakeholders. There is insufficient time and culture for sharing experiences to learn from each other and researchers lack experiences in local knowledge to incorporate it to the scientific knowledge to conduct demand-driven research. This knowledge gap creates loose linkage between farmers and researchers [14].

Regarding to priority setting, there were problems of priority setting during research planning to alleviate farmers' problems. Moreover, researchers selected potential areas that would give better results for their research. There were limitations of knowledge and skills to conduct research that was relevant to the needs of farmers emanating from inadequate student's exposure to the actual field condition while they were in universities. The research findings also showed that some of the researchers did not have sufficient experiences of working with farmers and other stakeholders to bring national food security. Furthermore, most of the researchers did not have good attitude about the philosophy of participating farmers in agricultural research. Furthermore, the Author also added that, lack of proper problem prioritization to use the scarce resources to alleviate farmer's problem is a bottleneck among the different stakeholders involved in development [13].

Researchers' characteristics: Lack of sufficient practical skills to conduct research, researchers' attitude for farmers and their knowledge, researcher's attitude and experience about participation. However, literatures stated that strong linkages between research and farmers cannot be realized without well qualified, highly trained extension agents [15]. From this it is easy to understand that the presence of less qualified and incapable extension workers is the cause of weak linkage. The other author stated that to create effective linkages among research, extension and farmers hiring professional extension workers who have adequate training in extension methods and communication skills is essential [16].

The result of the finding indicated that, scientists' attitude for farmers was not encouraging to bring national food security through the integration of the different stakeholders in agricultural research. Researchers thought that farmers were passive and needed solutions for their agricultural problems from agricultural scientists and they also did not have the necessary skills and knowledge to solve their own agricultural problems. This mentality from researchers showed that farmers did not have the necessary knowledge and skills to be partners with researchers to be engaged in agricultural research to bring innovation that can be obtained from the interaction of different actors working in agricultural development [14].

Similarly, researchers' attitude radically affects the perception that they have for farmers and their knowledge. This type of researchers' perception for farmers and their knowledge greatly affect their linkage with farmers [3, 12].

Research plan can affect participation of farmers and collaboration between farmers and researchers. Flexible research plans do have the room for farmers' priorities, experiences and perspectives and give opportunity for farmers to negotiate with researchers. Such types of researchers see farmers' knowledge as an important part of producing scientific knowledge and methods of accessing local knowledge are the critical part of their research approach. This type of approach increases famers' participation in research and increase collaboration between farmers and researchers to bring food security [12].

According to the finding result the researcher stated that, researchers do not have the interest to work with farmers by engaging them in the research process stating from planning to evaluation of research results. Researchers do not involve farmers in problem identification, problem prioritization, implementation, decision making and evaluation in the research processes. Since farmers do not involve in research processes, they do not learn from the research to solve their own problem in the future in sustainable manner. Because farmers are not involved in research process, it is difficult for farmers to trust the technology and to develop good relationship with researchers. Researchers invite farmers to visit on-station research trials which may not give similar performance under farmers' farm conditions [14].

Researcher - Farmers interaction: Resource limitation, problems of the extension system, problems of

integrity among the different stakeholders, government policy. In a resource-limited situation, linkage activities suffer most, as they have to compete with research and extension functions to obtain a share of the available resources [17].

The country has a scarcity of resources to conduct demand driven research relevant to stakeholders need to bring national food security. The limited resources include researchers both in quantity and quality who are concerned and committed for the welfare of the society [14]. Furthermore, the Author indicated that, the number of researchers in the country is limited both in quality and quantity. This problem is a commonly shared idea among researchers including the government. The number of educated manpower in the country is not sufficient to make research at different agro-ecological locations establishing many research stations to involve farmers in research closely. Because of the limitation of researchers both in number and quality, there is limited number of research institutes or canters to work closely with farmers to form strong linkage. The proportion of researchers to farmers is very low. Financial limitation is also another factor which hinders farmers from using the new agricultural technologies to improve their live. The analysis indicated that, farmers do not have sufficient money to buy technologies. Technologies are expensive for poor farmers to use under their condition. Because of money limitation for farmers to use, farmers are forced to use the new technologies by extension agents without interest, knowledge and skills about the new technology.

In line of extension problem, Extension policy in Ethiopia has been exclusively production-focused, institutionally monolithic, centrally directed, and organized on the premise that public sector extension structures can effectively reach down to village level. Thus, the bureaucratic nature of extension management and personnel procedures make it difficult for extension agents to respond flexibly to local demands [17]. Moreover, the extension systems so far has focused on model and well doing farmers in Ethiopia. The marginalized and poor farmers are not included in extension planning, implementation and evaluation activities [15]. These create a great confusion to have a collaboration and coordination among the research, extension and farmers. The researcher defines these linkages mechanisms as they may be informal and temporary differentiating from structural linkage mechanisms which are formal and institutionally recognized [18]. These findings are in line with the findings of in study on researchers, extension and farmers‟ participation in linkage mechanisms for finger millet technology development conducted in Amahara region, Ethiopia [19].

Extension workers are given assignments from the government besides technology dissemination to farmers for implementation. Extension workers are busy with government assignment and they do not have sufficient time to properly identify farmers' problems for researchers. There is high attention diffusion on the parts of extension workers since they are engaged in extension and non-extension activities. Moreover, extension workers get lower payment and incentives. These discourage extension workers from putting their maximum efforts to properly work with research [14]

Farmers Characteristics: Attitude of farmers for researchers, farmers' attitude for research, bad experiences of farmers in the past, lack of sufficient time, and farmers' expectation. As the author indicated that, the perception that researchers had for research was different from farmers' perception for research. Farmers were using the traditional method of rearing animals and farming that they obtained from their family. For farmers, research work was the western method of working in agriculture. Moreover, research was conducted by someone who was educated in universities. Research was complex and difficult for them. Farmers had thought that their contribution in research was little in technology development since they thought that they were illiterate [13].

Farmers perceive researchers as people who talk things in theory without demonstrating things in practice. Farmers evaluate researchers' skill based on their long-term experiences inherited from their fathers and grandfathers over centuries. For farmers, researchers are white collars who do need to touch soil, teachers who talk mostly things in theory, and people who ignore farmers' knowledge and have less interest to hear farmers' ideas. Farmers look researchers as bosses and fear them to work with them. Farmers perceive researchers as educated people and see them as a higher class. Researchers are not working with farmers in friendly manner. For farmers, researchers are working their own business and selling the results of their research which they collect from farmers. These attitudes create gap between farmers and researchers to establish proper linkage to bring national food security. The research finding also indicated that farmers look research as a complex process and think that working in research is beyond their capacity since they did not attend university and do not have university degree as researchers. Farmers think that they cannot contribute anything to research since they do not know about scientific knowledge and they do not have western mentality. Farmers perceive that to conduct research somebody should have university degree. Since farmers in the country are poor, they are engaged in different agricultural and non-agricultural activities to support their live. Ethiopian farmers are socially active and spend their time on social affair and daily routine activities. Because of these routine activities, farmers do not have sufficient time to engage themselves in research. This create gap between farmers and researchers to establish strong linkage [14].

Farmers expect monetary aid from NGOs and government for technology subsides since they do not afford the cost of the technologies. Farmers also expect positive returns from the use of the technology. They do not

need to see failure in their farm since they do not have other opportunities to support their life if they lose the on-season for their crop production and rearing of animals. Farmers also expect coffee, sugar, and other type of payments and incentives from researchers when they fill questionnaires. Non-fulfillment of the expectation creates gap between farmers and researchers to form linkage [16].

Researchers - Farmers benefits. This dimension of participation for effective collaboration and linkage looks at the benefits that researchers and farmers can obtain from the research project. This is the most critical factors since the actors are involved in the research process to obtain some benefits from the project. Even though the primary focus of research is generation of technical and institutional innovations and improved practices, creation of knowledge and awareness can be the benefits for farmers and researchers obtained from the research process to bring food security. Collaboration helps farmers and researchers to combine local knowledge with expert scientific knowledge in synergetic or complementary way as well as increases farmers' skills like technical skills, managerial or organizational skills, experimental skills, and problem solving skills for farmers. Effective linkage can increase or improve the livelihood of farmers [14]. The research project can improve the resilience of farmers' livelihood to unforeseen external shocks and improve the capacity of institutions and farmers to adapt to changing conditions [12].

Availability of time for farmers is another factor which hinders collaboration since linkage needs a major commitment on the part of farmers in terms of labour and time. Poor farmers are concerned with meeting their basic needs for their family and may not have sufficient time to get involved in research projects. Farmers' scope of action is a limiting factor for effective collaboration. Farmers know that they need to change some of the practice but not in a position to change it. This indicates constraints that farmers are facing in changing land use system or soil conservation in high land areas. In some instances, farmers do not see any scope for changing the management systems of practices due to lack of access to credit or market, extreme poverty, unfavorable agro ecological conditions or a repressive institutional environment. At the other side, farmers collaborate with researchers since they enjoy the favorable agro ecological conditions, good economic resources, good access to rural finance and markets and a highly supportive institutional environment [12].

Table 1: Summary of key challenges of researcher and Farmers Linkage

Main Dimension	Key challenges of farmers participation in Research systems
Project type	• Problems of the research type, • Weak technology demonstration by researchers, • Weak documentation about the whole research process, • Top- down designing research plans and objectives
Research Approach	• Lack of indigenous and scientific knowledge integration, • Problems of priority setting
Researchers' characteristics	• Lack of sufficient practical skills to conduct research, • Researchers' attitude for farmers and their knowledge, • Researcher's attitude and experience about participation
Farmers---Characteristics	• Attitude of farmers for researchers, • Farmers' attitude for research, • Bad experiences of farmers in the past, • Lack of sufficient time, and farmers' expectation
	•
Researcher – Farmers Characteristics	• Resource limitation, problems of the extension system, • Problems of integrity among the different stakeholders, • Government policy
Research-Farmers interaction benefits	• Problems of changing technologies to materials wealth, • Lack of good rewarding system for researchers

Source: Own constructed, (2022)

Interventions options for research and farmers linkage in Ethiopia

Based on the above review result finding of this paper, the authors were suggested the following policy interventions options direction to improve the effectiveness of both linkage in Agricultural Innovation Systems in Ethiopia.

Table 2: Summary of key interventions options for Researchers and Farmers linkages

Main Dimension	Key interventions options
Project type	• Researchers should conduct practical type of research that has a room for farmer's engagement to bring mutual learning among them • All research-project should be based on bottom-up and demand-drive rather than focusing on supply-drive extension systems • Concerned institutions/Educational institution/ should be provide quality education with practical or community-based problem-solving research activities • The overall research objectives should be consistent with farmers problems
Research Approach	• Integration of the local/indigenous knowledge with scientific knowledge sources is critically important to efficiently utilize the scarce resources that the county do have and realizes the importance of farmers as research partners in agricultural development.
Researchers' characteristics	• Special attention should be given for capacity building of the researchers in order to improve their practical skill and knowledge about the value of local communities' participation in all developmental program • Researchers should be committed to bring national food security for the welfare of the society and development of the country.
Researcher – farmers interaction	• Allocating adequate funding for linkage activities at all levels • Different stakeholders working for the welfare of the society should work in harmony having a common vision. • Great attention should be paid for participatory extension system • Governing rule and regulation of the linkage council should be revised and updated regularly adapting into the context it operates.
Farmers Characteristics	• Researchers should be considered farmers as development partners than looking them as illiterate and objects that have no role in the development of the country • Researchers should give wide room to involve farmers in research process to build their development partners • Research activities in agriculture should be conducted based on practice local circumstances rather than copy from the abroad.
Research-Farmers interaction benefits	• The rewarding system for researchers who show outstanding performance from the government should be given and encouraging. This creates strong competition among researchers to conduct demand driven and outstanding research

Source: Own constructed, (2022)

Conclusions

From the research review findings, the following conclusions were given. The low agricultural productivity in the country is one the major problems to bring national food security to feed the society. This is caused by weak linkage between researchers and farmers which was originating from a number of factors. Most of the research was basic type and has little room for engaging farmers in the research for mutual learning to bring innovation in agriculture.

Agricultural innovation system is not strong to bring national food security in the Ethiopia. There were a number of challenges that hindering the linkage between farmers and researchers such as the research types and approaches, characteristics of farmers, characteristics of researchers, research and farmers interaction as well as their interaction benefits. From the review findings, it can be concluded that the research system in the country is weak. The top-down model of technology transfer is mostly used for technology transfer in the country. There is a gap in integration of farmers' knowledge with researchers' knowledge in knowledge production. The research system is not bottom-up based approaches. However, researchers mostly conduct research ignoring farmers' participation in research processes and they do not have good attitude and experience about participation to engage farmers in research process as well as their insignificant impact of research on farmers live. There is also a problem of integrity among the different stakeholders to bring national food security. Furthermore, there is a lack of good rewarding system for researchers who show outstanding performance. The promotion system in universities does not encourage demand driven research. Researchers conduct for their publication which helps them for their promotion demanding less effort and resources.

The overall findings of the reviewed literature underlined that the top-down nature of research and extension management, administration of research and extension in separate institutions, lack of incentives for linkage activities, high turnover of development agents, poor infrastructural development, lack of budgets for

linkage activities and lack of adequate employees' skills are the main causes of weak research extension farmer linkages in Ethiopia.

In the light of the above causes of weak researchers and farmer linkage it is imperative that policy makers and planners should;

- Pay great attentions to allocating the adequate funds for linkage activities,
- Working on researchers and farmers interaction in order to create conducive environment for both parties by considering the capacity of researchers and farmers (designing research types which are equally participating both researchers and farmers.
- Focusing on attitudinal change. Meaning that, Researchers should be considered farmers as development partners than looking them as uneducated and objects that have no role in the development of the country as well as farmers should be considered researchers as development partners rather than perceiving them as enemy.
- Expanding infrastructural services like access roads, Information communication technologies and construction of farmers training centers,
- Providing adequate incentives for linkage activities,
- Adopting more decentralized research extension management systems,
- Provide on the job trainings for development agents, and employ capable research and extension staffs or capacity building.

Furthermore, as it is impossible to expect success from the design and formulation of rural development interventions without the active participation of the target population, farmers should be empowered and encouraged to participate in the planning and execution of extension and research programs. What is more, Strong formal liaison, coordination and cooperation among research centers, development agents and farmers need to be created.

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