

Review

Untied efforts: The challenges for improved research, extension and education linkages

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Ethiopian agriculture is characterized by smallholders farming whose access to modern technology and basic education is very limited. Research, extension, education and farmers are the main pillars of agricultural knowledge systems and their effectiveness largely depends on strong linkage among each other. However, the existing research-extension-education linkage has not been effective. This very weak linkage has been a major limiting factor to increased food productivity, agricultural transformation and sustainable development. Thus, the purpose of this review is to point out the major challenges for effective linkage between Research, Extension and Education (REE) and propose some recommendations for better linkages. Much of the problems bounce around limited implementation capacity and lack of commitment. Specific challenges include unnecessary competition and duplication of efforts, lack of decentralized approach, failure to involve poor farmers and inefficient monitoring and evaluation system. 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.

Key words: Farmer, innovation, extension, research, education, Ethiopia.

INTRODUCTION

There is a growing consensus that Sub-Saharan Africa (SSA) urgently needs an agricultural productivity revolution if it is to achieve food security goal (Kimenyi, 2006). Persistent low agricultural production, coupled with increased population growth, has meant that imports of agricultural products have been rising faster than exports since the 1960s. If current trends persist, the numbers of undernourished will increase by 2015, in contrast to the other developing regions (FAO, 2005). The number of people living below the poverty line in SSA is over 180 million, and is expected to exceed 300 million people by the year 2020. New agricultural technologies are generated by research institutes, universities, private companies, and by the farmers themselves. In many countries the insufficient agricultural development has been attributed, among other factors, to poor linkages

between Research-Extension-Farmers and to ineffective technology delivery systems, including poor information packaging and lack of communication systems (FAO, 2004).

Achieving agricultural growth and development and thereby improving rural household welfare will require increased efforts to provide yield enhancing and natural resources conserving technologies. Agricultural education, research and technological improvements are therefore crucial to increase agricultural productivity and thereby reduce poverty. The future of Africa should be based on technology, science and innovation (Caselli, 2005; Romer, 1990). Yet, sub-Saharan Africa ranks the lowest in the world in terms of yield-enhancing practices and techniques, like mechanization, use of agro-chemicals (fertilizers and pesticides) and increased use

of irrigated land. In the case of mechanization, the continent has an average of only 13 tractors/100 km² of arable land, versus the world average of 200 tractors/100 km² (ERA, 2009). Irrigated land is only 3.6% of total cropland on the continent compared with the world average of 18.4%, while the use of fertilizers is minimal at 125 gm/ha compared with the world average of 1,020 gm/ha (ERA, 2009). Use of improved seed varieties is on the rise, although supply remains a bottleneck in the system (Davis et al., 2010).

Ethiopia is in the process of transforming its agricultural sector from subsistence to market orientation. A number of variables are necessary for achieving market orientation and key among these are technologies and service delivery. Service delivery includes generation and introduction of new technologies, the supply of inputs and financing of inputs, and marketing, by both public and private service providers (EIAR, 2006). If Ethiopia follows a standard pattern of high growth (agricultural growth at 6% per year), in 20 years the real size of the agricultural sector will have increased more than three-fold, but its share of GDP will have declined from 43 to 26%, as the urban sector expands more than six-fold (Mellor and Dorosh, 2010). Though making a progress in recent years, Ethiopia must reverse the long term trend of growing rural poverty, deficient food production systems and a lack of food security, while sustaining the natural resource base (Tesfaye et al., 2011).

Research, extension and farmers are three main pillars of agricultural system and their effectiveness largely depends on strong linkage among each other. However, the existing research-extension-farmer relationship has not been effective in many parts of the developing world including Ethiopia. The lack of strong linkage causes disruption in technology flow and low adoption rates, increased time lags between development and adoption of new technology, reduced efficiency in the use of resources, unnecessary competition and duplication of efforts, and increased cost of agricultural research and extension activities (Ashraf et al., 2007). Flow of information from agricultural research to farming communities and vice versa requires that continuous contact be maintained for information to be useful to farmers. If the link is weak the agricultural productivity will not increase. Several criticisms of public agricultural extension services that weaken the link between research and production include supply-driven, technical weakness, patronizing only big farmers, insufficient coverage of farmers, practicing top-down administration, poor dissemination of improved agricultural technologies (Belay and Abebaw, 2004; Farooq et al., 2010; Fisseha, 2009; Qamar, 2002; Ponniah et al., 2008).

Research and extension organizations in developing nations generally compete over the same scarce government resources and frequently, leaders of these institutions do not see themselves as part of a broader system (Swanson et al., 1998). Instead, they try to increase the

flow of resources coming to their respective institutions and to solve day-to-day management problems, rather than ensuring that their respective organizations contribute to the broader goal of getting improved agricultural technology to all major categories of farmers. The challenge for extension and research organizations therefore, is how to better empower smallholder farmers to exploit emerging opportunities and to deal with the challenges of the food security. New learning needs of farming communities are emerging as the world enters into an era of globalization, privatization, decentralization and market-liberalization, while the traditional public extension services have not yet transformed in order to meet those needs satisfactorily (Van Crowder, 1996).

Considering such a problem, there had been various attempts both by extension and research organizations to invigorate linkages. Yet, the linkages remain as weak as the number of times solutions were sought to further strengthen them. Similarly, the linkage between research, extension, and education (REE) is very weak.

While there have been many studies of extension-research relations, there is far less research on their linkage with educational system. Therefore, the aim of this paper is to assess the challenges of REE linkages through extensive literature review and point out areas of improvement for effective linkages. The rest of this paper is organized as conceptualizing linkage, results and discussions and conclusion.

CONCEPTUALIZING LINKAGE

The concept of linkage implies the communication and working relationship established between two or more organizations pursuing commonly shared objectives in order to have regular contact and improved productivity (Agbam, 2000; Sadighi, 2005). The conventional argument for linkages is that by working together actors stand better chances for establishing the institutional relationships that can facilitate access to technology, information, capital and marketing arrangements, which can in turn enable farmers to be competitive (Kimenye, 2006). For development of agriculture, an effective linkage between the research, extension and clients is the prerequisite as well as meeting the other variables of input supply, market outlet and related infrastructure (Kumar et al., 2001).

Linkages are facilitated when research institutions, extension agencies and education organizations recognize the value of shared or complementary information and promote group or team approaches to problem avoiding duplication of efforts and ensuring critical tasks which do not fall through the institutional cracks. Research should start and end with the farmer (Sadighi, 2005). In Agricultural knowledge and information systems, the three major knowledge and information sources solving. Linkage helps to improve resource use by are

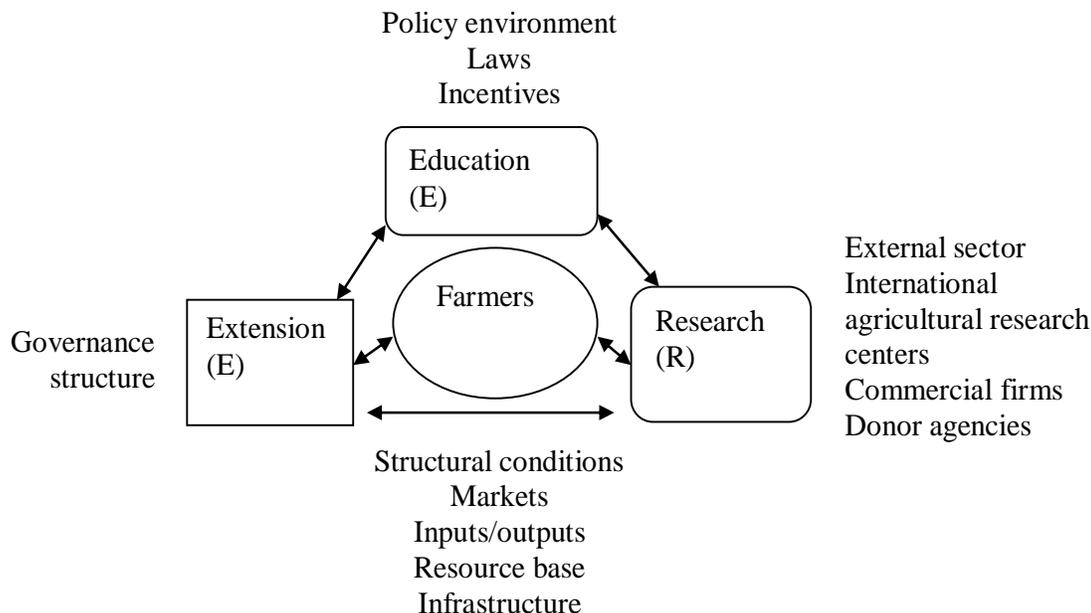


Figure 1. REE linkage adapted from Anandajayasekeram et al. (2008).

linked as shown in Figure 1. It presents the policy environment, which formulates the laws and incentives that influence agricultural performance; structural conditions like markets, inputs/outputs, and resource base; the governance structure that influence the system; and external influences like market, international and policy affect the pattern of linkage among REE which influenced farmers (Anandajayasekeram et al., 2008). The essence of agricultural extension is to facilitate interplay and nurture synergies within a total information system involving agricultural research, agricultural education and a vast complex of information-providing businesses (Neuchatel Group, 1999).

RESULTS AND DISCUSSION

Research- extension linkage

Research and agricultural extension are dependent on each other for their successful operation. Extension needs research findings as production recommendations to provide solutions to the technical problems of the farmers. Extension should serve as a main source of research to develop an orientation to maintain an awareness of actual farmers' problems. Research focuses on the technical aspects for generating useful technologies, while extension focuses on the acceptance and adoption of those technologies by users (Agbam, 2000; FAO, 2005).

Over the past sixty years, several extension Approaches have been followed in Ethiopia and various

programmes implemented to provide farmers with relevant agricultural information and appropriate technologies, notably improved crop varieties that could improve productivity and household income. Among such extension approaches were community development approach (1958-1967), the Comprehensive package programs (1967-1975) and minimum package projects approaches / MPP I and MPP II/ (1971- 1985), Peasant Agricultural Development Extension Project (PADEP), and the Training and Visit (T & V) system (1983-1995). Since mid 1990s, the Participatory Demonstration and Training Extension System (PADETES) were promoted as the national agricultural extension system (Amanuel et al., 2003; Fasil and Habtemariam, 2006; Waddington et al., 2010).

In Ethiopia, the public sector is the primary source of extension, education and research services (World Bank, 2004). Government monopoly is not the most favored option in the developed countries, especially in matters of development when competent nonpublic institutions are present in the country (FAO, 2005). Extension services should be a part of a larger decentralization agenda that engages grassroots organizations (Rivera and Qamar, 2003). In practice, public service provision has not been strongly client oriented or demand driven. Historically, services have been provided via a top-down, command-and-control mode, in which extension agents receive relatively hard quotas for signing up farmers for fixed technology "packages," and farmers are expected to serve as passive vessels for the knowledge transferred to them. The research-extension linkage has been very poor and extension agents have been involved in

Table 1. Key challenges of research- extension linkage.

Core challenges	Explanation
Top down and non-participatory approach	Both research and extension approaches are centralized and follow a top down approach. Extension programs and policies have been formulated without due consideration to the farmers' opinion (Belay, 2002; Davis et al., 2010). As a result, farmers lack adequate opportunity to decide on research and extension priorities.
Paying attention to model farmers	Many of the attempts to involve farmers in research and extension activities are limited to model farmers; who are relatively rich and successful. This however discriminate poor farmers.
Competition rather than cooperation	Each of the research and extension organizations are competing over scarcest resources of the country towards their organization rather than cooperating with shared vision. Agricultural research institute and extension organizations are managed as separate entities and thus the prioritization of research agendas does not always closely reflect farmers 'priorities (Feder, et al, 2010). Added to this, there is an inefficient monitoring and evaluation of the existing linkage systems.

different activities which are not related to their normal duties (Belay, 2003; Fasil and Habtemariam, 2006). Agricultural research agendas re-main largely academic unless extension workers provide input in terms of the identified and yet unsolved field problems of the farmers (FAO, 2005). They suspect that either there is few appropriate technologies developed by the agricultural research system or the available technologies are not communicated well in Ethiopia (Fasil and Habtemariam, 2006).

There had also been various attempts both by the extension and research organizations in devising linkages. A linkage strategy was developed by a task force comprising of staff from the Ethiopian Institute of Agricultural Research and the then Ministry of Agriculture. However the arrangements failed to work satisfactorily due to various reasons such as frequent restructuring of organizations, poor farmer representation, high staff turnover, budgetary limitations, lack of commitment, and rivalry of institutions as if they were competing with each other rather than complementing to attain a common development goal (Table 1) (Fasil and Habtemariam, 2006). The establishment of the Regional Research Extension and Farmer Linkage Councils (RREFLCs) and Zonal Research Extension and Farmer Linkage Councils (ZREFLCs) has improved matters in some regions, but more progress could be made. In particular, the ZREFLCs need to foster local communities' empowered involvement in planning, prioritization, monitoring, and evaluation of the programs and institutions that affect them (Davis et al., 2010).

Extension-education linkage

The very meaning of extension is extending university education to the surrounding community. Extension is a non formal education. Extension originally was conceived

as a service to "extend" research-based knowledge to the rural sector to improve the lives of farmers (Davis, 2009). A meaningful science education involves transforming the way in which students think in both their attitudes and their approaches to the discipline and problem solving (Wieman, 2004). Linkage between research and farmers cannot be realized without well qualified, highly trained extension agents. Ethiopia has a strong foundation for agricultural education at both the university and college levels and is producing a large number of graduates. Literature has witnessed that Ethiopian agricultural educational institutions have contributed to the agricultural sector through training high level agricultural professionals, enhancement of indigenous research capability, and generation and dissemination of technologies. However, the capacities of these institutions are severely stretched in terms of physical, financial and human resources. The curriculum has remained largely of a technical nature meaning that students do not adequately developed the marketing, innovation and 'soft' competencies that are increasingly recognized as an important complement to technical capacities (Belay, 2008; CDI, 2010 Mamusha and Hoffmann, 2006).

The education policy explicitly stated that the participation of teachers and researchers in getting the necessary field experience in various development and service institutions and professionals of such institutions in teaching will be facilitated (FDRE, 1994). The extension service has a role in helping the education specialists develop their curricula so that the students meet the needs of the industry now, and are able to adjust to the inevitable changes that will occur (Adams, 2001). However, the efforts to establish university-extension linkage are very limited in the country and unlike research; practical application of extension is not acknowledged in higher education. Compared to research and teaching extension is less rewarding (Mamusha and Hoffmann, 2006). There is also mismatch between field level

Table 2. Key challenges of extension-education linkage.

Core challenges	Explanation
Limited practical orientation of agricultural trainings	The agricultural educational systems were under criticism for their lack of sufficient practical orientation. Many of the agricultural graduates were also criticized for not having the appropriate practical skill (Mamusha and Hoffmann, 2006). Although new efforts have witnessed the need for enhancing university industry linkage, few efforts have been underway
Shelved research reports of agricultural universities	Much of the researches conducted by academic staff and students were shelved due to either their inappropriate contribution to real world problem or lack of linkage or ways to extend their outcomes.
Insufficient knowledge networking	The way of communicating and extending university knowledge's was practiced mainly through workshops to scientific communities. There is either little attention by universities on extension of results to the wider beneficiaries or lack of visible means/linkage

extension work and formal agricultural educational institutions (Table 2). Moreover, universities neither have a systematic linkage with the extension system that absorbs its products, nor have effective linkages with research centers. These poor linkages mean the university graduates will not receive the necessary feedback to help them adjust and deliver the services that are the most up-to-date and relevant to the extension system.

Extension –farmer linkage

Extension activities are more effective when farmers are directly involved in defining, managing and implementing programs (Neuchatel Group, 1999). Centralized and standardized national extension systems do not produce satisfactory results if the approach is prescriptive, supervisory, and propagating a standardized model (Tewodaj et al., 2009). Extension traditionally has played a role in providing information and promoting new technologies or new ways of managing crops and farms (Davis, 2009; FAO, 2009). The success of rural development programs depends largely on decisions by rural people based on questions of what to grow, where to sell, how to maintain soil fertility, and how to manage common resources (Davis, 2009; World Bank, 2004). Extension and advisory services bridge the gap in developing informal and formal farmer organizations, and rural youth organizations, and helping them to articulate their demands (Nahdy et al., 2011).

Extension policy in Ethiopia has been exclusively production-focused, institutionally monolithic, centrally directed, and organised on the premise that public sector extension structures can effectively reach down to village level (Table 3). The historical review reveals that extension programmes and policies have been formulated without due consideration to the farmers' opinion and traditional knowledge system (Belay, 2003). It indicates that farmers have to be trained at each Farmers Training

Centers (FTCs). However, only model farmers have been consulted by extension agents while the marginalized and poor remain ignored. The problem is aggravated by the fact that farming systems are often complex (Feder et al., 2010).

Limited farmers' capacity and lack of subsidy is also a problem of extension farmer linkage. For instance, fertilizer consumption was only 13 kg per ha in sub-Saharan Africa in 2002, compared to 73 kg in the Middle East and North Africa and 190 kg in East Asia and the Pacific (FAO, 2009). Access to credit is one way to improve farmers' access to new production technology and increased productivity. If appropriate technology is available but not being used by farmers, then the way credit is handled by government may be part of the problem. It is also no longer adequate for extension agents merely to be accountable upwards within a line department. Overall, weak political commitment and support at local levels for two reasons determine the success of extension agents. First extension agents are not motivated to permanently serve local community due to absence of incentives and second the focus given on non agricultural activities by local authorities for which they are accountable. Thus, in a context of limited fiscal resources, decision makers tend to assign low priority to extension (Table 3).

CONCLUSION

This paper has provided an overview of research-extension-education linkages for farmer success in Ethiopia. The overall review entails that the linkage between extension, research and education organizations was very low. Among the factors that challenge effective linkages, lack of policy framework, competition over resources and inability of involving farmers in the development process, lack of effective monitoring, and shortage of incentives to strengthen both extension

Table 3. Key challenges of extension farmer linkage.

Core challenges	Explanation
Weak accountability to farmers	Extension workers are accountable to their supervisors than customers/ farmers. Thus, they are rarely questioned for any mistake they commit. In smallholder-dominated farmers are often not sufficiently organized or empowered to be able to exert influence on extension management. One of the extended criticism of extension was its one size fits all prescription. Farmers sometimes are asked to adapt technology packages of not their choice
Input supply remains a bottleneck	Due to inadequate availability of qualified service providers, agricultural input supplies do not reach farmers timely, with preferred quality, quantity and price, even without proper coordination (Belay, 2002).
Bureaucratic procedures.	As in many government organizations, bureaucratic management and personnel procedures make it difficult for extension agents to respond flexibly to local demands. Likewise, bureaucratic structures often discourage the coordination of agricultural extension with other departments. As pointed out previously, even links to the agricultural research system are often weak in spite of their obvious importance (Feder et al., 2010).
Public duties other than knowledge transfer.	Extension workers are mostly civil servants. They are expected to perform non extension duties, whether as routine additional assignments or as ad hoc tasks (Belay, 2002; Feder et al., 2010).
Inadequate incentives	At the field level the incentives for extension workers to stay in their position and to perform as expected is often weak. As a result, extension workers are continuously leaving the extension systems and looking for better paying jobs. Further, the incentives mechanisms for farmers to actively use the training centers are also not necessarily effective (CDI, 2010; Davis et al., 2010).
Limited capacity in planning and implementation	Implementation capacity is limited by the virtue of lack of technical skilled manpower and appropriate incentive mechanisms. The provision of extension services too has not been adequate in terms of coverage and quality of service (FDRE, 2003)

workers and organizations are some of the key challenges for effective linkage.

RECOMMENDATION

The major policy option to bring the three actors into effective linkage is establishment of a taskforce that comprises each institution representatives to draw a policy framework that guides effective linkage. In this regard, joint problem diagnosis, joint priority setting and review meetings are in order to minimize misunderstanding and have shared vision. Specifically;

Engaging the Research, Extension and Education Advisory Services and scientific community is critical to developing the new and innovative agricultural approaches required to meet successful linkages.

The incentives for extension workers to stay in their profession are often weak. Thus, improving extension workers' compensations and incentives is a necessary step towards improved and sustainable extension systems.

The major bottleneck to the extension system is the

top-down approach flow of information that little links with farmers preferences. Therefore, a policy direction that lets the extension autonomy, and ensure decision making at the grassroots need to be devised.

Linkage between the four actors cannot realize without well qualified, highly trained extension agents. Therefore, expanding extension workers' skill mainly in practical aspects and market-driven activities should be prioritized. The extension systems so far has focused on model and well doing farmers. Thus, future efforts must pay due attention to marginalized and poor farmers.

Extension staff turnover has become a big challenge for sustainable extension systems in the country. The major reasons for staff turnover and professional shift are lack of incentives at least incomparable level to health extension workers. Thus, paying attention to staff retention and provision of incentives will improve the service quality of extension agents.

Agricultural universities should enhance their effort to extend scientific findings, technologies, and practices to farmers through field visits, demonstration centers, and farmers' training centers beyond workshops.

The private sector involvement is one of the key

elements

to success in extension and advisory services delivery. Specially, efforts should be made to increase government extension system efficiency through hiving off some of agricultural services delivery to the private sector.

REFERENCES

- Adams G (2001). Effective management in extension advisory services in Central and Eastern European countries Geoffrey, Reading . UK. Food and Agriculture Organization of the United Nations, Rome.
- Agbamu JU (2000). Agricultural research–extension linkage systems: an international perspective Odi, agricultural research and extension network paper number 106a.
- Amanuel A, Seied A, Solomon L, Aklilu T, Ashagre G (2003). Extension strategy final working Document, Addis Ababa Ethiopia. Agri-Service Ethiopia.
- Anandajayasekeram P, Puskur R, Sindu W, Hoekstra D (2008). Concepts and practices in agricultural extension in developing countries: A source book. IFPRI (International Food Policy Research Institute), Washington, DC, USA, and ILRI (International Livestock Research Institute), Nairobi, Kenya. p.275.
- Ashraf I, Muhammad S, Chaudhry KM (2007). Effect of decentralization on linkage among research, extension and farming community. Pak. J. Agric. Sci. 44(4)-660-663.
- Belay K (2002). Constraints to agricultural extension work in Ethiopia: the insiders' view S. Afr. J. Agric. Ext./S. Afr. Tydskr. Landbouvoorl. Vol. 31.
- Belay K (2003). Agricultural Extension in Ethiopia: the case of participatory demonstration and training extension system. J. Social Dev. Afr. 8(1)49-84.
- Belay K, Abebaw D (2004). Challenges Facing Agricultural Extension Agents: A Case Study from South-western Ethiopia. African Development Bank 2004, Published by Blackwell Publishing Ltd 2004.
- Belay K (2008). Linkage of Higher Education with Agricultural Research, Extension and Development in Ethiopia. Higher Educ. Policy 21:275-299.
- Caselli F (2005). Accounting for Cross-Country Income Differences. In: Aghion P and Durlauf SN (Eds.), Handbook of Economic Growth. Amsterdam: North Holland.
- CDI (Centre for Development Innovation) (2010). Policy Brief Market Linked Innovation Systems Opportunities for Strengthening Agricultural Development in Ethiopia Wageningen University, Netherlands.
- Davis KE (2009). Agriculture and Climate Change: An Agenda for Negotiation in Copenhagen For Food, Agriculture, and the Environment. The Important Role of Extension Systems IFPRI Focus 16 Brief II.
- Davis K, Swanson B, Amudavi D, Daniel A, Flohrs A, Riese J, Lamb C, Elias Z (2010). In-Depth Assessment of the Public Agricultural Extension System of Ethiopia and Recommendations for Improvement IFPRI Discussion Paper 01041 December 2010.
- Economic Report on Africa (ERA) (2009). Challenges to Agricultural Development in Africa. Developing African Agriculture through Regional Value Chains.
- EIAR (2006). Alternative modes of agricultural service delivery for innovation and impact held at EIAR, Addis Ababa, Ethiopia 9-11 October 2006.
- FAO (2004). FAO/GTZ Workshop: "Effective Communication between Agricultural Research, Extension and Farmers" Research Centre of Agriculture and Forestry Laimburg 18-22 October 2004 Ora, Italy.
- FAO (2005). Modernizing national agricultural extension systems: a practical guide for policy-makers of developing countries, Food and Agriculture Organization of the United Nations.
- FAO (2009). The special challenge for sub-Saharan Africa. High Level Expert Forum on How to feed the world 2050, Rome Italy.
- Farooq A, Ishaq M, Shah NA, Karim R (2010). Agriculture extension agents and challenges for sustainable development. 9600 Garsington Road, Oxford, Sarhad J. Agric. 26(3):419-426.
- Fasil K, Habtemariam K (2006). Assessment of the Current Extension System of Ethiopia: A Closer Look at Planning and Implementation, Addis Ababa Ethiopia. Issue Paper Series No. 2/2006.
- Federal Democratic Republic Government of Ethiopia (FDRE) (1994). Education and training policy E.E.P-86, Addis Ababa Ethiopia.
- FDRE (2003). The new coalition for food security in Ethiopia food security programme Volume I, Addis Abeba, Ethiopia.
- Feder G, Anderson JR, Birner R, Deininger K (2010). Promises and Realities of Community-Based Agricultural Extension IFPRI Discussion Paper 00959.
- Fisseha T (2009). Problems and prospects of farmers training centers: the case of Ada'a woreda, east Shewa, Oromia region MSc. Thesis Haramaya University.
- Kimenye LN (2006). Research-extension-farmer linkages for market orientation. A paper presented at the second networking symposium on innovations in agricultural advisory services in Sub-Saharan Africa, 24-27 September 2006, Kampala, Uganda.
- Kumar S, Kumar R, Sah U (2001). Linkages among research, extension and farmers- a review Agric. Res. 22(3/4):215-222.
- Mellor JW, Dorosh P (2010). Agriculture and the Economic Transformation of Ethiopia Development Strategy and Governance Division, International Food Policy Research Institute –Ethiopia Strategy Support Program 2, Ethiopia Working Paper No. ESSP2 010.
- Mamusha L, Hoffmann V (2006). Taking a systems approach to agricultural education, research and extension: Analysis of the extension role and the Practical Attachment Program of Mekelle University, Ethiopia Conference on International Agricultural Research for Development Bonn, October 11-13, 2006.
- Nahdy SM, Olupot M, Davis K, Zwane E (2011). Role of Extension, the Regional Extension Association, and their strategic partners in feeding the region in the 21st Century Paper to ASARECA General Assembly 2011.
- Neuchatel Group (1999). Common Framework on Agricultural Extension Paris. France.
- Ponniah A, Puskur R, Sindu W, Hoekstra D (2008). Concepts and practices in agricultural Extension in developing countries: A source book Improving Productivity and Market Success (IPMS) of Ethiopian farmers project International Livestock Research Institute (ILRI), Addis Ababa, Ethiopia.
- Qamar KM (2002). Global trends in agricultural extension: challenges facing Asia and the Pacific region Extension, Education and Communication Service FAO Research, Extension and Training Division Bangkok.
- Rivera WM, Qamar MK (2003). Agricultural Extension, Rural Development and the Food Security Challenge Food and Agriculture Organization of the United Nations Rome, 2003.
- Romer PM (1990). Endogenous Technological Change. J. Political Econ. 98(5):S71-102.
- Sadighi H (2005). Research, Education, and Extension Linkages: An Analysis of Institutions in Developing Countries Proceedings of the 21st Annual Conference San Antonio, TX pp.117-125.
- Swanson BE, Bentz RP, Sofranko AJ (1998). Improving agricultural extension. A reference manual. Strengthening research-extension-farmer linkages Chapter 19 FAO.
- Tesfaye LT, Azage T, Hoekstra D (2011). Capacity for knowledge-based smallholder agriculture in Ethiopia Linking graduate programs to market-oriented agricultural development: Challenges, opportunities and IPMS experience.
- Tewodaj M, Cohen MJ, Birner R, Mamusha L, Randriamamonjy J, Fanaye T, Zelekawork P (2009). Agricultural Extension in Ethiopia through a Gender and Governance Lens Ethiopia Strategy Support Program 2 (ESSP2) Discussion Paper No. ESSP2 007.
- Van Crowder L (1996). Agricultural Extension for Sustainable Development Agricultural Extension and Education Service (SDRE) FAO Research, Extension and Training Division.
- Waddington H, Snilstveit B, White H, Anderson J (2010). The Impact of Agricultural Extension Services 3ie Synthetic Reviews – SR009 Protocol January 2010. International Initiative for impact Evaluation.
- Wieman C (2004). Professors who are scholars: bringing the act of discovery to the classroom, presentation at The Reinvention Center, Conference, November 2004, Integrating research into

undergraduate education: the value added. Available at www.sunysb.edu/Reinventioncenter/.
World Bank (2004). Extension Reform for Rural Development Volume 1. Decentralized Systems Case Studies of International Initiatives Agriculture and Rural Development Discussion Paper 8.