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Review

Determinants of the utilization of agricultural inputs and transfer of agricultural technologies. A review of literature on agricultural extension model

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The agricultural production system in Ethiopia is highly dominated by traditional farming and the application of modern agricultural inputs has been extremely limited. As a result, yields of various crops are very low. The country severely suffers from the inability to feed them and to depend on food imports and food aid. Farmers' continuous use of low yielding varieties will make it difficult for the government to achieve maximum agricultural growth. Designing appropriate intervention programs to address the continuing challenges of limited use of improved agricultural inputs requires an adequate understanding of the physical, technological, and cultural and socio- economic constraints associated with improved inputs use. Thus, this paper focused on review of determinant of the utilization of agricultural inputs and technology transfer *in Ethiopia. Reviewed literature showed that* the extent to which farmers utilize available technology and the speed by which they do so determines the impact of innovations in terms of productivity growth.

Keywords: Agriculture, Inputs, Technology

INTRODUCTION

Agriculture is an important economic sector in Africa that constitutes the backbone of most African economies; provides 60 percent of all employment; accounts for about 40 percent of the continent's foreign exchange earnings; and in most countries, it is still the largest contributor to Gross Domestic Product (GDP); and the dominant provider of industrial raw materials (NEPAD, 2003). Notwithstanding the importance, agricultural productivity is low and subsistence production is dominant in Africa, partly on account of limited use of improved technologies in production (World Bank, 2007).

As part of developing countries in general and Sub-Saharan Africa in particular, Ethiopia is an agrarian country that predominantly relied on subsistence agriculture. According to Ministry of Finance and Economic Development (MoFED, 2003), since 1990s as a national strategy, Ethiopia has espoused Agricultural Development-Led Industrialization (ADLI) which predominantly advocates smallholder agriculture and their transformation in to commercial agriculture by employing agricultural technologies. Supporting this, Ministry of Agriculture and Rural Development (MoARD, 2010) inferred that majority of the country's total production is been produced by smallholder farmers; and the sector contributes 90% of the foreign earnings and 70% of the raw materials for industry.

However, Ethiopian agriculture is characterized by the use of inadequate production technologies that in a variable climate produces important fluctuations in crop yields, uncertainties, and food insecurities. In addition to the above, access and availability to improved production technologies including seed, fertilizers, mechanization and markets are limited. The Ethiopian Central Statistical Agency (CSA, 2009) indicates that, from a total cultivable area of 12.8 million ha, only about 8 million ha is under cereal crops. The improved seeds are used in less than 3% of the total cultivated area. For smallholder farmers, the main constraints are availability and affordability to quality seeds.

Utilization of improved technology in agriculture has attracted considerable attention among development

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economists because the majority of the population of less developed countries derives their livelihood from agricultural production and a new technology, which apparently offers opportunities to increase production and productivity. The extent to which farmers utilize available technology and the speed by which they do so determines the impact of innovations in terms of productivity growth (Diederen et al., 2003).

Strategies of economic development give increasing attention to the need for significant improvements in agricultural productivity in order to achieve food security and poverty reduction goals in particular and economic development in general. Much of the research on Ethiopia agriculture demonstrates that farmers' failure to intensify agricultural production is a key component of inefficiency and lower productivity (Crawfordet al., 2006).

Over the past two decades, decision makers in Ethiopia have pursued a range of policies and investments to boost agricultural production and productivity, particularly with respect to the food staple crops that are critical to reducing poverty in the country. A central aim of this process has been to increase the availability of improved seed, chemical fertilizers, and extension services for small-scale, resource particularly those cultivating food staple crops (David al, 2010).

Introduction to technology utilization

Technology: Various authors define the term "technology" in a variety of ways. Rogers (1995) uses the words 'technology' and 'innovation' synonymously and defines technology as the design for instrumental action that reduces the uncertainty in the cause-effect relationship involved in achieving a desired outcome.

A more meaningful definition may be that a technology is a set of 'new ideas'. New ideas are associated with some degree of uncertainty and hence a lack of predictability on their outcome. For a technology to impact on the economic system, blending into the normal routine of the intended economic system without upsetting the system's state of affairs is required. This entails overcoming the uncertainty associated with the new technologies. It therefore comes as no surprise that several studies set out to establish what these factors are, and how they can be eliminated (if constraints) or promoted (if enhancers) to achieve technology adoption.

Perhaps a clearer definition of the term 'technology' can be obtained from the work by Enos and Park (1988), who, in their study of adoption of imported technology, define technology as "the general knowledge or information that permits some tasks to be accomplished, some service rendered, or some products manufactured" (p.9). Abara and Singh (1993) explain that it is the actual application of that knowledge that would be termed 'technology'. Although in the Enos and Park (1988) study, the focus was nonagricultural, this definition fits agricultural technologies too. From their definition, it is clear that technology is aimed at easing work of the entity to which it applies. Most technologies are therefore consequently termed 'labor-saving', 'time-saving', 'capital-saving' or 'energy-saving' and so forth. To economists this implies saving on resources that are scarce.

In Technology Transfer, the IPCC defined technology transfer as a broad set of processes covering the flows of know-how, experience and equipment for mitigating and adapting to climate change amongst different stakeholders such as governments, private sector entities, financial institutions, NGOs and research/education institutions.

Improved agricultural inputs

Improved Agricultural inputs are the factors of production which have undergone some form of amendment from their original state with the intent of enhancing their performance. Agricultural inputs divided into four principal types including biological, chemical, mechanical and management. Biologically improved inputs include high yielding varieties, disease resistant varieties and drought resistant varieties. Chemically improved inputs include chemical fertilizer, pesticides, fungicides, insecticides and herbicides while mechanical inputs include farm machinery and equipment used in tilling, weeding, irrigation, spraying and transportation. On the other hand management concerned with the decision-making abilities and management of farming activities for the improvement of agricultural production (Knight et al., 1972).

Modern agricultural inputs/technologies constitute the introduction and use of hybrids, the green house technology, genetically modified (GMO) food, chemical fertilizers, insecticides, tractors and the application of other scientific knowledge (Matunhu, 2011).

One of the strategies for poverty reduction through increased agricultural productivity is to promote the production of high yielding crop varieties and animal species (Nkonya et al., 2004). To improve productivity in the agricultural sector will, among other things, require a concerted effort in providing the farming community with high yielding varieties that are drought and pest resistant. Higher crop yields leads to the sustainable development of the arable sector because they reduce costs per unit of output (Mazonde, 1993).

Determinants of improved agricultural inputs utilization

Although use of improved inputs in production is

desirable and very important, not all farmers use the improved agricultural inputs due to various reasons. Langyintuo and Mekuria (2005) broadly categorize the factors that influence farmer use of improved inputs as: farmer characteristics, institutional factors and characteristics of the input. Farmer characteristics among others include sex, age, education, and household size while institutional factors include farm size, membership to association, access to information, access to credit, and access to infrastructure such as roads or storage. Characteristics of the production input relate to the subjective attributes of the input as perceived by the farmer.

Farmer characteristics

Farmer's characteristics like sex, age, education level and marital status etc. by itself have their own effects on the farmer's decision to use agricultural inputs. For instance Okoboi (2011) found that in Uganda, a higher proportion of male headed households than female headed households used different agricultural inputs in agriculture. The higher probability of male headed households using fungicides/ herbicides in maize production than female headed households may be related to economic status and/or level of information access by households.

Studies that have examined the relationship between age and use of improved inputs in production have reported different results. While Kassie et al. (2010) report a negative relationship between age and use of compost manure and stubble tillage technologies in Ethiopia. Tabi et al. (2010) also report a negative relationship between age and improved inputs use in Nigeria. Explanations offered for the mixed results regarding age and improved inputs use are that on the one hand, young farmers may have lower income and wealth, limited access to credit and extension services, and face labour constraints, all of which may make them less prepared to adopt and use improved agricultural technologies than older farmers, hence age having a positive relationship with adoption (Langyintuo and Mekuria, 2005). On the other hand, young farmers are sometimes thought to be more open to change and hence eager to try out new ways of doing things, thus a negative relationship between age and improved inputs use (Langyintuo and Mekuria, 2005).

The role of education in farmer use of improved inputs is widely discussed in literature. Educated farmers are believed to have higher ability to perceive, interpret and respond to new information about improved technologies than their peers with little or no education (Langyintuo and Mekuria, 2005; Tabi et al., 2010). More educated farmers are thus more likely to access information and advice from extension workers which influence their adoption and use of improved inputs.

Different results have also obtained regarding the relationship between family size and the use of improved agricultural technologies. On the one side, large family size affects improved agricultural inputs utilization because farmers with large households especially in rural areas are very poor and the limited financial resources are mostly spent on basic needs, leaving little or nothing for purchase of farm inputs. On the other hand, a large household may encourage adoption of improved inputs such as fertilizer and pesticides whose application is labour-intensive Perz (2003).

Institutional issues

The effect of institutional factors such as access to credit, access to information, access to infrastructure and membership to association on farmers' use of improved inputs has received great attention in the literature. Langyintuo and Mekuria (2005) observe that for lumpy inputs such as tractor or animal traction to plough land, farmers with large farms are more likely to use as compared to farmers with small farms. On the other hand Zhou et al. (2010) found an inverse relationship between use and farm size. This suggests that the relationship between farm size and improved inputs use may not be straight forward.

The role of credit in financing farmer investments in improved technologies such as high yielding seeds, fertilizer and machinery particularly in developing countries where smallholder farmers are generally financially constrained cannot be overstated. Constraints to credit access have been identified as some of the barriers to adoption and use of improved agricultural inputs in developing countries (Feder et al., 1985). A survey of literature by Feder et al. (1985) found that most studies report a positive relationship between farmers' access to credit and use improved technologies.

Extension agents are some of the most important sources of agricultural information in any country. Farmer access to information on agricultural technologies through increased government investment in extension services is crucial in revealing the opportunities of using such technologies, thereby reducing the subjective uncertainty on one hand and fostering increased adoption on the other (Langyintuo and Mekuria, 2005).

Infrastructures such as roads, storage and irrigation are critical in agricultural production process. Roads are important in access to input and output markets while storage is important for storage to maintain the quality of crops to postpone immediate sale to a future date. Ransom et al. (2003) show that availability and access to these infrastructures increases the likelihood of use of improved technologies.

Characteristics of the agricultural inputs

The characteristics of factor inputs on their own have an influence on farmers' perception and ultimately the

decision to utilize these inputs in production. The taste of variety, market competitiveness, and fuel wood value of an improved variety affects farmer's decision to use an improved variety (Okoboi, 2011). Smale et al. (1995) found that farmers in Malawi, favored cultivation of local maize varieties to hybrids due to their better food processing and on-farm storage characteristics compared to most hybrid maize varieties. The yield risk associated with use of some seeds, for example, their tolerance to agro-climatic conditions, pest and diseases, has been shown to have a strong influence on the farmers' choice of seed varieties (Zeller et al., 1998). Furthermore, the income risk associated with market preferences for certain attributes can also influence input use. Adesina and Baidu- Forson (1995) found that in addition to yield, farmer's subjective perceptions of the grain milling and cooking attributes of new rice varieties played a significant effect on their level of adoption.

CONCLUSIONS AND RECOMMENDATIONS

A review of literature reveal that Ethiopian agriculture is characterized by the use of inadequate production technologies that in a variable climate produces important fluctuations in crop yields, uncertainties, and food insecurities. Furthermore, although use of improved inputs in production is desirable and very important, not all farmers use the improved agricultural inputs due to various reasons. From reviewed literature farmer's characteristics like age, sex, education level, technology use training, frequency of extension contact, family size and distance from market have their importation effects on the farmer's decision to use agricultural inputs.

In addition to this the effect of institutional factors such as access to credit, access to information, access to infrastructure, affordability of agricultural inputs and membership to association on farmers' use of improved inputs has received great attention. Finally, characteristics of agricultural inputs by itself determine the adoption of agricultural technology and then utilization of agricultural inputs.

Based on above review different determinants were found to be determine utilization and transfer of agricultural technology. Therefore, government organization, non government organization and other agricultural institutions have to work hard on teaching farming community about agricultural technology and input utilization.

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