



A Review on Factors Affecting Adoption of Agricultural New Technologies in Ethiopia

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Abstract

The study specifically aims to review factors affecting adoption of Agricultural new Technologies in Ethiopia. The objective of this review was to assess the factors affecting adoption of agricultural new technologies. Development programs in Ethiopia over the past two decades have included several new technologies. Among the most recently introduced are improved seed, pesticides, improved on farm storage techniques, methods of small scale irrigation and fertilizer usage. However, there has not been a wide-spread provision and adoption of these technologies in Ethiopia. Various socio-economic factors and the degree of risk aversion may be the causes of adoption rates.

Keywords: Adoption; Agriculture; New technologies

Introduction

Background

Agriculture is the supplier of basic human need, nutrition is the world's largest user of land, occupying more than one third of Earth's terrestrial surface and using vast amounts of water. It affects our daily life in many ways, both directly and indirectly. Humans expect agriculture to supply sufficient nutrients, economically and culturally valued foods, fibers and other products. Agriculture is essential for inclusive development because it produces food as well as economic wealth for many of the world's poorest people that allows for improved livelihoods through better health care, education, infrastructure improvements and greater investment in environmentally sound practices. For Sub Saharan Africa, growth generated by agriculture is eleven times more effective in reducing poverty than GDP growth in any other sectors [1].

Despite the improvements made over the last four decades in the agricultural sector, a combination of declining soil fertility, population growth, low uptake of external inputs, and climate disruption has resulted in a dramatic fall in per capita food production [2]. In addition, the new agricultural technologies are hardly successful in Sub-Saharan Africa, where hunger is on the increase. Important pockets of poverty remain in areas characterized by rain fed agriculture or fragile soils and which affects close to one billion people.

Similarly, the agricultural sector is the principal engine of growth of the Ethiopian economy employs 83% of the labor force, contributes about 90% of exports and 45% of gross domestic product (GDP), and provides about 70% of the country's raw material requirement for large-and medium scale industries [3]. To increase the production level of agriculture sector, we need to enhance the adoption of new technologies. However, in Ethiopia the practice is still limited due to different factors. Different studies have been conducted on adoption of agricultural technologies in Ethiopia. These review paper focuses on the possible inter-relationships between the various practices and

intensity of adoption of a package of technologies rather than a single commodity or technology. These include (a) seeds of high-yielding varieties, (b) inorganic fertilizers, (c) pesticides, and (d) row seeding, improved breed dairy cow, improved poultry breed use, improved feed and forage utilization and use of Artificial Insemination (AI) [4].

Method of Data Collection and Interpretation

For this review paper, a variety of documents were reviewed, and the data were collected from records, articles, journals and original research papers. The collected data were organized and compiled for interpretation. The arguments of different researchers were taken, and the reviewer supports accordingly and made interpretation.

Literature Review

Definitions and concepts

Adoption: According to Feder et al. [5] adoption may be defined as the integration of an innovation into farmers' normal farming activities over an extended period. Adoption, however, is not a permanent behavior. Dasgupta [6] noted that an individual may decide to discontinue the use of an innovation for a variety of personal, institutional, and social reasons one of which might be the availability of another practice that is better in satisfying farmers' needs. Feder et al. [5] classified adoption as an individual (farm level) adoption and aggregate adoption. Adoption at the individual farmers' level is defined as the degree of use of new technology in long run equilibrium when the farmer has full information about the new technology and its potential. In the context of aggregate adoption behavior, diffusion is defined as the spread of new technology within a region. This implies that aggregate adoption is measured by the aggregate level of specific new technology with a given geographical area or within the given population.

Overall, to explain adoption behavior and factors affecting technology adoption, three paradigms are commonly used. The paradigms are: the innovation-diffusion model, the adoption perception and the economic constraints models. The underlying

assumption of the innovation-diffusion model is that the technology is technically and culturally appropriate, but the problem of adoption is one of asymmetric information and very high search cost [5]. The second paradigm, the adopters' perception paradigm, on the other hand, suggests that the perceived attributes of the technology condition adoption behavior of farmers. This means that, even with full farm household information, farmers may subjectively evaluate the technology differently than scientists [7]. Thus, understanding farmers' perceptions of a given technology is crucial in the generation and diffusion of new technologies and farm household information dissemination. The economic constraint model contends that input fixity in the short run, such as access to credit, land, labor or other critical inputs limits production flexibility and conditions technology adoption decisions [8]. Recent studies have shown that using the three paradigms in modeling technology adoption improves the explanatory power of the model relative to a single paradigm.

Agricultural new technologies: Agricultural new technologies constitute the introduction and use of hybrids, the greenhouse technology, genetically modified food, chemical fertilizers, insecticides, tractors and the application of other scientific knowledge [9]. Agricultural new technologies are the factors of production which have undergone some form of amendment from their original state with the intent of enhancing their performance.

Factors Affecting Adoption of Agricultural New Technologies in Ethiopia

Empirical review of the literature on technology adoption in developing countries reveals that the various factors that influence technology adoption can be grouped into the following three broad categories (1) factors related to the characteristics of producers i.e., the farmers; (2) factors related to the characteristics and relative performance of the technology and (3) program and institutional factors [10]. The factors related to the characteristics of producers include education level, experience with the activity, age, gender, level of wealth, farm size, plot characteristics, labor availability, resource endowment, risk aversion, etc. The factors related to the characteristics and performance of the technology and practices include food and cash generation functions of the product, the perception by individuals of the characteristics, complexity and performance of the innovation, its availability and that of complementary inputs, the relative profitability of its adoption compared to substitute technologies, the period of recovery of investment, local adoption patterns of the technology, the susceptibility of the technology to environmental hazards, etc. The institutional factors include availability of credit, the availability and quality of information on the technologies, accessibility of markets for products and inputs factors, the land tenure system, and the availability of adequate infrastructure, extension support, etc. Enabling policies and programs, market linkages, access to institutional support and credit were found to play a positive role in stimulating farmer investment in and adoption of sustainable technologies [11].

Demographic factors

Sex differential between household heads is a very important explanatory variable in studying factors of adoption. The prevailing social set up of rural households placed a varying responsibility among male and female members. In most parts of rural Ethiopia women are disfavored groups of the society who couldn't easily access technology information. Thus, numerous adoption studies had come up with

results showing being a female headed negatively influencing technology adoption decisions. Due to the prevailing socio-cultural values and norms males have freedom of mobility, participate in different meetings and trainings. Consequently, those male headed households who have more access to information to use innovation than female-headed households, which have a capacity to influence by the cultural norms and traditions. The existence of wealth difference among female headed and male headed households could be also the possible reason forwarded for the difference in adoption of agricultural new technologies. Those male headed households who do have more wealth can easily afford the price of agricultural new technologies.

Age of the household head is another variable in explaining farmers' technology adoption behavior which plays an important role through influencing farmers' information access and shaping their ability to change the available information into action. Older farmers may have experience and resource that would allow them more possibilities for trying a new technology. On the other hand, younger farmers are more likely to adopt new technology because they have had more schooling than the older generation. Different agricultural technology adoption studies revealed conflicting results on the influence of age in adoption. Some of the findings confirmed that age negatively influencing adoption behavior of farmers. On the other hand, other agricultural technology adoption studies by other researchers indicated that age positively affected adoption. But, the reviewer supports the argument if age has a negative relationship with adoption of agricultural new technologies. When we see the adoption category of farmers in adoption of agricultural new technology, younger farmers categorized under the first category and they are characterized as innovative which enables them to make decision on adoption of agricultural new technologies. In addition, the reason probably due to their exposure to access to information than older farmers.

Socio-Economic factors

Education status of the household head is the most common and important variable that is found to explain farmers' agricultural technology adoption behavior. Various studies confirmed that it has a significant positive influence on adoption of technologies. For instance, Mahadi et al. studied factors affecting adoption of improved sorghum varieties in Somali Region of Ethiopia. They have found out that more educated farmers are more likely to adopt improved sorghum varieties in the study area. This finding is in line with other results. In other studies, Shiferaw et al. household head's level of education was found to enhance awareness and decision-making, which was likely to increase the probability of adoption of SWC practices. Educated household heads may have enhanced practical awareness and understanding of an erosion problem and apply measures to control it rather than considering erosion as a curse. I strongly agree that education has positive and significant relationship with the adoption of agricultural technology. This is due to education has the power to change the knowledge, skill and attitude of farmers. It also enhances the analytical and problem-solving skills of farmers. In addition, Education enhances a locative ability of decision makers by enabling them to think critically and use information sources efficiently. Farmers with more education should be aware of more sources of information, and more efficient in evaluating and interpreting information about new agricultural technologies than those with less education. That is why I agree those farmers who have better education status have higher probability to adopt agricultural new technology than those we do not have [11,12].

Many studies conducted in different parts of Ethiopia showed that farm land, livestock holding and access to different productive assets have been affecting food security status of rural households in Ethiopia. Availability and amount of family labor plays a vital role in determining adoption and intensity of use of agricultural technologies. The existence of active work force in rural households usually encourages them to show interest in trying some agricultural technologies. Of course, the influence of labor availability on adoption depends on the characteristics of the technology to be adopted. When the new technologies in relative to the older ones are more attractive and labor intensive, farmers with more labor would tend to adopt those technologies. Some new technologies are relatively labor saving and others are labor using. For example, when a technology is labor saving like tractors, harvesters, pesticides and the like, its impact will be negative. For those labor-using technologies, like improved varieties of seeds and fertilizer labor availability plays significant role in adoption. Plenty of adoption studies found out a positive impact of family labor on technology adoption such as Solomon et al. [13]. The reviewer argues that higher family labors increase the probability to adopt agricultural new technologies. Most of Ethiopian farmers have not used labor saving technologies like tractors, harvesters in their production system. They depend on labor-using technologies and this agricultural new technology require human resource from sowing to the final harvesting of the crop.

The impact of Farm size on adoption and intensity of use agricultural technologies on the other hand, is not consistently similar in various adoption studies. Some of the studies showed a positive influence of the variable on adoption decision. For instance, studied determinants of adoption and intensity of use of improved Maize varieties in the Central Highlands of Ethiopia and found a significant positive effect. Similar, results by other researchers such as Ogada et al. [14] also found a reverse effect of land size on the joint adoption of inorganic and improved maize varieties. It is reported that there is positive relationship of farm size with adoption. The reviewer supported the argument provided by those researcher's farm size has positive relationship with adoption of agricultural new technologies this is because most of Ethiopian farmers have grown different varieties of crops in turn requires larger farm size. In addition, most of Ethiopian farmers involved in mixed farming (crop and animal production). According to Diiro off-farm income is expected to provide farmers with liquid capital for purchasing productivity enhancing inputs such as improved seed and fertilizers. In another study conducted by Ibrahim et al. annual income of the respondent had a significant positive relationship with the adoption of recommended technologies in Bangladesh i.e., the higher the annual income of the respondents, the more they adopted recommended technologies. The influence of annual gross income was robust in our analysis and statistically significant in the adoption of teff, maize, wheat, barley and sorghum technology package [15].

Institutional factors

Institutional factors deal with the extent or degree to which institutions impact on technology adoption by smallholders. Institutions include all the services to agricultural development, such as finance, insurance and information dissemination. They also include facilities and mechanisms that enhance farmers' access to productive inputs and product markets. Extension service is a very crucial institutional factor that differentiates adoption status among farmers. In the existing situation much of agricultural technology delivery is undertaken by the extension system. Access to participate in training,

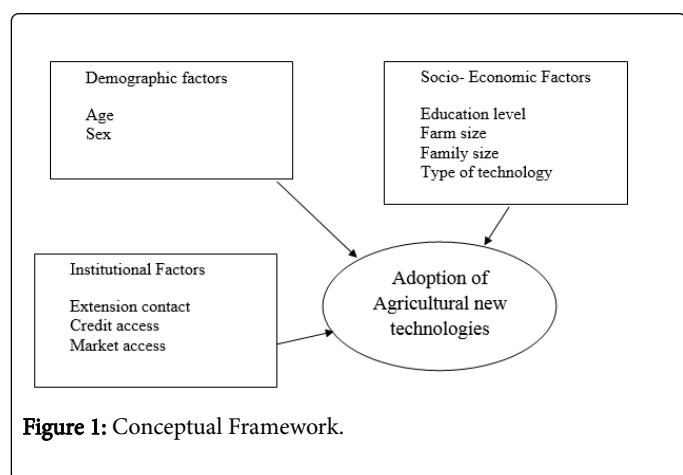
demonstration, field day and other extensions services therefore creates the platform for acquisition of the relevant information that promotes technology adoption. Several studies have used different variable to measure farmers' access to extension services. A study conducted in four regions of Ethiopia show that farmers who had more frequent contact with extension agents were more likely to adopt wheat technology as compared to farmers who had low frequent contact [4]. Similar study conducted by Mahdi [15] has also found a negative influence of distance from farmers' residence to DAs office on technology adoption. Another important measure of extension is farmers' experience in extension service. Farmers' experience with agricultural extension is expected to increase their demand for yield. The introduction of new technologies creates demand for information useful in making decisions. Therefore, agricultural extension organizations supply useful information about new agricultural technologies. Access to such sources of information can be crucial in adoption of improved varieties [16].

Market distance of the respondents is important for the producers to get attractive market price through reduction of transportation cost. The increase in market distance make farmers to get out-dates market information and becoming out of adopting agricultural new technologies. The findings [4] showed that maize and teff technology package adoption improved as the households' residences became closer to market while the reverse held true for wheat technology package adoption. The market pulled technology adoption, and these findings agreed with results of Bayissa [17]. The negative relationship between distance of the residence from an all-weather road and fertilizer adoption was reported by other studies. For instance, Gebresilassie and Bekele [18] found that distance to market centers was negatively and significantly related to adoption of fertilizer. Decreasing the distance from the market decreased the transportation cost of agricultural inputs. Hence market distance and use of inorganic fertilizer had a negative relationship [14]. Access to credit service is the source of finance for the medium and lower income households to buy inputs for agricultural production. In Ethiopia, the credit service given in kind and cash form especially credit services delivered for agricultural production system. Different Authors conformed that farmers who have access to credit service had more probability to adopt the agricultural new technologies than otherwise. Daniel and Kafle confirms access to credit can increase the probability of adoption of agricultural new technologies by offsetting the financial shortfall of the households [19]. Similar finding indicates financial resources was necessary to finance the uptake of new technologies [14]. They indicated that households who had more access to formal and/or informal sources of credit significantly adopted technology.

Conceptual framework of adoption of agricultural new technologies

Adoption of agricultural technologies is influenced by several interrelated components within the decision environment in which farmers operate. For instance, Feder et al. [5] identified lack of credit, limited access to information, inadequate farm size, insufficient human capital, tenure arrangements, absence of adequate farm equipment, chaotic supply of complementary inputs and inappropriate transportation infrastructure as key constraints to rapid adoption of innovations in less developed countries. However, not all factors are equally important in different areas and for farmers with different socio-economic situations. Socio economic conditions of farmers are the most cited factors influencing technology adoption. The variables

most commonly included in this category are age, education, household size, landholding size, and other factors that indicate the wealth status of farmers. Farmers with bigger land holding size are assumed to have the ability to purchase improved technologies and the capacity to bear risk if the technology fails [5]. Some new technologies are relatively labor saving and others are labor using. For those labor-using technologies, like improved varieties of seeds and fertilizer labor availability plays significant role in adoption (Figure 1).



Conclusion

Agricultural technology development is an essential strategy for increasing agricultural productivity, achieving food self-sufficiency and alleviating poverty and food insecurity among smallholder farmers in Ethiopia. In Ethiopia, farmers have been adopting and using different agricultural technologies, the adoption of technologies has not completely optimal yet. Therefore, it is needed to further promote agricultural new technologies by designing based on farmer's problem and need. The variables significantly affect the adoption of agricultural new technologies by farmers are age, education level, family size, farm size, extension service provision and credit access. To solve problems of inadequate use of production technologies, decision makers have pursued a range of policies and strategies to boost agricultural production and productivity.

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