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Review on Adoption of Modern Beehive Technology and Determinant Factors in Ethiopia

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Abstract
Though beekeeping is a common farming enterprise and incomes generating activity and promotional efforts have been made by providing modern beekeeping technologies to the beekeeping sub-sector by regional bureau and other nongovernmental organizations in Ethiopia, but rate of adoption and dissemination of the technology is found to be very minimal. The determinant factors affecting adoption of the modern bee hive technology were broadly categorized as personal factors, economic factors and institutional factors; and these all factors were more powerful in explaining farmer's adoption of modern beehives technologies. However, there is a big gap and no adequate compiled information that clearly indicates on promotional efforts and people's response to these modern beehive technologies. Thus, this review was sought to ascertain determinants of adoption of modern beehives technology and put highlight policy implication for further extension of modern beehives technology.
Keywords: Adoption, Determinant Factors, Modern beehives, Technology

1. Introduction

Ethiopia is home to some of the most diverse flora and fauna in Africa that provide surplus nectar and pollen to foraging bees (Chala *et al*., 2012). It has the largest bee population in Africa with over 10 million bee colonies, out of which about 5 to 7.5 million are estimated to be hived while the remaining exist in the wild (CSA, 2009). This makes Ethiopia a leading in Africa and ninth in the world in honey production, respectively. Similarly, it stands first in Africa and third in the world in beeswax production (FAO, 2005).

As it is known traditional beekeeping practice is the major and oldest type, exercised for more than thousands of years in Ethiopia. It is characterized mainly by forest beekeeping that is common in the forest covered the south and southwest Ethiopia and backyard beekeeping which is practiced in the majority of the country (Nuru, 2007). This way of beekeeping, especially by hanging over the long tree in the forest is not convenient for female farmers. With all other its problems traditional beehive additional problem of low productivity with production per hive averaging 5–8kg/per colony/per annum compared to modern beehives, which has average production of 30kg / per colony/per annum (MoARD, 2007).

By realizing the potential of apiculture subsector and the problem associated to traditional beehive, Ethiopian government tried to introduce different beekeeping technologies to beekeepers. For instance, the establishment of beekeeping demonstration stations at different areas like Holleta, Nekemte, and Jimma etc. in 1965 to introduce improved beekeeping technologies (box hives, casting mold, honey extractor, honey presser, smoker, water sprayer, veil, glove etc.) imported from abroad to the beekeepers and to offer beekeeping training for farmers and experts can be mentioned (EBA, 2005).

Even though large number of improved beehive technologies have been introduced and promoted by the regional bureau and other nongovernmental organizations over the past 10 years, however, the amounts of modern beehive technologies used by farmers were very limited (Akinwumi *et al*., 2001). In addition, although attempts have been made to improve the adoption and productivity of beekeeping by various organizations, some social, ecological and climatic factors were identified as constraints which hinder farmers from adopting the available beekeeping technologies (Cramb, 2003). But, there is no compiled adequate information on the adoption status and its determinant factors of modern beehive technologies. Therefore, the objectives of this review paper are:

- To review the determinant factors that affect adoption of modern beehives technology
- To highlight policy implication for further extension of modern beehives

2. Definition and Concept of Adoption

Adoption was defined by Feder *et al*. (1985) as degree of use of new innovation by a farmer when he has got full information about the new innovation and its potentials. The authors classified adoption of new technology into two as individual and aggregate adoption. Accordingly, they defined Individual adoption as the farmer's decisions to incorporate a new technology into the production process and the aggregate adoption as the process of diffusion of a new technology within a region or population. Furthermore, Rogers and Shoemaker (1971) defined technology adoption as the decision made by a farmer to use a new technology as best course of action he ever practiced. Adoption of new technology in agriculture which occurs due to behavioral changes like

desirable changes in knowledge, understanding and ability to apply technological information, changes in feeling behavior such as changes in interest, attitudes, aspirations, values and the like; and changes in overt abilities and skills, is determined by many socio-economic factors (Salim, 1986; Ray, 2001).

Adoption is not a simple and overnight activity, but it is a mental process which an individual farmer (decision maker or group of decision maker's family members) goes through for decision-making. To ensure adoption of new innovation the fulfillment of specific economic, technical and institutional conditions are required. From the farmers' perspective, the new technology should be economically more profitable than the existing alternatives. Moreover, the new technology should also be technically easily manageable by small holders and adaptable to the surrounding socio-cultural situations and availability of the new technology and all other necessary inputs to small holders at the right time and place and in the right quantity and quality are necessary conditions (Ehui *et al*., 2004). In general adoption is a function of five characteristics of the technology which are relative advantage or profitability, compatibility or riskiness, complexity, triability/divisibility, or initial capital requirements, and observability or availability (Olana, 1993 cited by Gebiso, 2015).

3. Factors Affecting Adoption

Introduction of new technology to smallholder farmers by itself does not guarantee for a widespread adoption and efficient use of technologies. Adoption decisions of farmers are influenced by different factors. Factors associated with economic, institutional, demographic and physical characteristics can influence farmers' decisions on adoption of agricultural innovations. Past studies have documented some demographic and socioeconomic factors that influenced the adoption of different technologies among smallholder farmers in developing countries. Studies by Croppenstedt and Demeke (1996) in Ethiopia and Naseem (1995) in sub-Saharan Africa identified plot size, previous experience with fertilizer, supply of fertilizer, farm size, amount of rainfall, household size, and the ratio of price of main crop to cost of fertilizer as well as accessed to credit as factors constraining fertilizer demand among arable crop farmers. Feder *et al.* (1985) in their research report stated that credit, farm size, risk, labor availability, and human capital, land tenure and education are main factors affecting technological adoption. For ease of grouping, the variables identified as having relationship with adoption are categorized as household personal, economic factors, institutional factors, and intervening (psychological) factors (Wongelu, 2014).

3.1. Personal factors

Age is an important household characteristic influencing the adoption behavior of subsistence farmers. It is usually considered with the assumption that older farmers will have more knowledge and skill with farming which enables them to easily understand the benefits of the technology better than others. Research conducted by Gebiso (2015) indicated the increase in adoption of technology with age may be due to the reason that most resources are in the hands of older and most young farmers have no enough back yards for beekeeping and are living around the town in most cases.

Farmers with large family size might significantly adopt the technology, to satisfy the need of their family. Hence, it was hypothesized that household with large family would adopt the technology more (Workneh, 2011).

Exposure to education is generally supposed to increase a farmer's ability to obtain, process, and use information relevant to the adoption of improved agricultural technologies. Tesfaye *et al.* (2001) revealed that education level contributed positively to adoption of improved wheat varieties and chemical fertilizer. Improved box hive technology utilization involves technical applicability; Feder (1985) noted that education improve the decision making process and thereby influence the level and/or composition of anther inputs. Hence, education would increase the understanding of the technology and anticipated to increase adoption. Literate farmers have more exposure to the external environment and information which helps them easily associate to technology sources (Kerealem, 2005). Similarly, the level of education and adoption of technologies have strong and direct relationship with each other (Teferi, 2003; Workineh, 2007).

Farming experience is another important household related variable that has relationship with adoption. Longer farming experience implies accumulated farming knowledge and skill, which has contribution for adoption (Wongelu, 2014). Makokha *et al*. (1999) confirmed that farmers' characteristics such as participation in field days and demonstration enhance adoption of farm technology. Visiting apiary sites of other beekeepers or demonstration site help the beekeeper to develop his/her insight in bee-keeping. Farmer to farmer experience sharing visits also contributes towards developing positive perception towards an innovation or a new technology (Million and Belay, 2004).

Training is very important to create awareness on the technology as well as to make the beneficiary more productive. Rahman (2007) stated that training might have inculcated technical competency, more exposure to the subject matter and convinced to adopt the improved technologies in the farms. Participation of beekeepers on demonstration and training of modern beehives were among the most significant determinants of adoption

(Gebiso, 2015). Farmer's training about the technology arranged in this case about modern beehives technology has a positive contribution to adopt it since the proportion of the adopters who were trained was much higher than non-trained adopters (Adeday *et al*., 2012). The acquisition of technical skills and knowledge of bee farming through training were likely to contribute positively to farmers' adoption decision (Welay and Tekleberhan, 2017).

3.2. Economic Factors

Livestock holding is an important indicator of household's wealth position. Livestock are also an important income sources which enables farmers to invest on adoption of improved agricultural technologies. It influences the adoption of improved technologies differently by different people across different areas. In most cases, it has positive contribution to household's adoption of agricultural technologies (Wangelu, 2014). Many adoption studies reported positive effect of livestock holding on adoption (Kidane, 2001; Taha, 2007; Gidey and Mekonen, 2010).

Land related variables influence farmers' adoption behavior, as land holding is an important unit where agricultural activities take place. Concerning land holding many adoption studies reported that farm size was positively related to the adoption of improved technology (Yishak, 2005 and Taha, 2007).

Availability of credit to purchase agricultural technologies is another factor. Those farmers who had access to credit sources will be able to buy modern beekeeping equipments better than others that who didn't have access to credit. Farmer's involvement in off-farm/non-farm activities will relieve their financial constraints to purchase inputs such as modern beehives equipments. Therefore, credit affects adoption of modern beehives technology positively and significantly (Sisay *et al.,* 2013).

3.3. Institutional factors

3.3.1. Frequency of contact with extension agents

Extension provides farmers with information related to agricultural technologies. Feder *et al.* (1985) noted that extension efforts increase the probably of new technology by increasing the stock of information pertaining to modern production increment. Effective utilization of improved box hive technology requires close follow up of the extension workers. Many adoption studies showed that access to extension service increases farmer's likelihood of adopting improved agricultural technologies (Abrhaley, 2006; Rahmeto, 2007).

3.3.2. Attendance in extension events

Attendance in extension events like demonstration, training and participation on field day are also crucial in improving farmers' experience, building capacity and developing confidence on the advantages of improved agricultural technologies. A study by Asfaw *et al.* (1997) revealed that participation on field days had influenced adoption of agricultural technologies positively and significantly. On the other hand, Tesfaye and Alemu (2001) reported that participation in on-farm demonstration and attendance of training contributed positively to farmers' adoption decision. Similar studies found that participation in extension events had positive and significant relationship with adoption (Minyahel, 2007; Rahmeto, 2007).

3.3.3. Availability of honeybees' equipments

An introduction of improved hives and working tools to the rural community are beyond the pockets of farmers and not so easily available even for those who could afford it (Tessega, 2009). The availability of the new technology and all other necessary inputs to small holders at the right time and place and in the right quantity and quality should be ensured (Ehui *et al.,* 2004). Lack of capital and non availability of modern beehives and its packages accessories (honey harvesting and processing equipments like wax-stumper, queen excluders, honey extractor, bee smoker and others) around the beekeepers are also among the other major problems(Gebiso, 2015). Beekeeping requires protective clothes (over all suit, bee veil and glove) and equipments like smoker to operate the hive with honey bee colony. The availability of the above materials influences the adoption of the technology (Wongelu, 20014).

3.4. Psychological Factors

3.4.1. Perception of beekeepers

The rate of adoption is influenced by the farmers` perception of the characteristics of the innovation (Melaku *et al*., 2008). Positive perception of beekeepers about the technology favorably influences adoption decision. Perception with the way the attribute of innovation is perceived and the respondent's perception of the technology attributes such as (I) awareness of relative advantages, (II) awareness or concern of disadvantages. Then the differences between the two are taken as total perceived attribute of the package (Taha, 2007; Wongelu, 2014).

3.4.2. Knowledge of the technology

Knowledge is the function in which an individual is exposed to the innovation's existence and gains some understanding of how it performs. Having knowledge of the technology is crucial for effective and efficient

utilization of the technology (Workneh, 2011). Improved beekeeping technology requires knowledge on its practical activities. The knowledge source could be farm experience, research and extension. Knowledge of application of the technologies influences adoption behavior of farmers positively (Degnet and Belay, 2001).

4. Conclusion and Policy Implications

This paper reviewed the adoption rate and determinants of decision's of beekeepers to adopt modern beehives. Although the government of Ethiopia gives great attention to the beekeeping sub-sector to promote modern beekeeping technologies, but rate of adoption and dissemination of the technology is found to be very minimal. Adoption of modern beehives technology has very significant effect on hives productivity as beekeeping can also be used as one of income diversifying mechanism and even can be the basic occupation for most rural dwellers. But the number of beekeepers started using modern beehives (numbers of adopters) is almost insignificant and they are still using local beekeeping technologies. Even though almost all beekeepers know the presence of modern beehives technology, they did not adopt because of different reasons like personal, economic, Institutional and Psychological factors. Therefore, based on the above conclusion the following policy implications and area specific solution can be drawn:

- Provision of different information towards increasing or improving the saving capacity or culture of beekeepers as saving increases the wealth of beekeepers and the wealth category of the beekeepers in turn have effect on determining adoption probability of modern beehives.
- Provision of adequate and relevant agricultural extension services (such as training on modern beekeeping technologies and demonstration and beekeepers to beekeepers experience sharing).
- Training should also be given by giving attention to wise way (timely application) of using different chemicals specially herbicides to minimize the death of honey bees.
- Provision of credit services to beekeepers to widen the financial bases of poor beekeepers. Beekeepers can use the loan to buy modern beehives and access to modern beehives accessories like honey extractor, smokers, brush, gloves, wax stumper and others.
- Facilitating access to modern beehives and its accessories especially honey extractor and wax stumper which can increase beehives productivity which in turn can positively affects beekeeper's capacity of adoption.
- Special adult education programs must be promoted and expanded especially for rural dwellers as a precondition for facilitating technology adoption and awareness training supported by practical demonstration must be arranged to farmers before any technological intervention is taken place either by government or non-governmental organizations.

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