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The Overlooked Knowledge: Exploring Knowledge Circulation in the scaling up of Local Innovation: The case of Beehive Construction and Queen Replacement in Enebsie District, Ethiopia

A Research project Submitted to Larenstein University of Applied Sciences in Partial Fulfilment of the Requirements for the Degree of Master of Management of Development, Specialization in Training, Rural Extension and Transformation

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Acronyms

ASE	Agri Service Ethiopia
CBI	Community Based Institutions
COLF	Community Learning Forum
CSA	Central Statistics Authority
DF	Development Facilitators
FFS	Farmers Field School
FTCs	Farmers Training Centres
GO	Government Organization
IFSP	Integrated Food Security Programme
MOA	Ministry Of Agriculture
NGO	Non-Government Organization
PO	Programme Office
PRA	Participatory Rural Appraisal
PROFIEET	Promotion of Farmer Innovation and Experimentation in Ethiopia
PROLINNOVA	Promotion of Farmers Innovation
PTD	Participatory Technology Development
TLU	Tropical Livestock Unit
ToT	Transfer of Technology
TREAT	Training Rural Extension and Transformation

ABSTRACT

The study here is set out to explore the facilitating and restraining factors for knowledge circulation in the scaling up of local innovation taking beehive and queen replacement innovation as case of the study in Enebsie district, Amhara region, Ethiopia. Appreciating farmers' innovations and participating farmers in research process in Ethiopia is not yet well thought-out for the development of appropriate technology and dissemination. However, there is growing trend of considering farmers as major stakeholder in technology generation and dissemination by some NGOs. Agri Service Ethiopia is one of the NGOs that have been working closely with the community towards encouraging innovativeness and scaling up of local innovations at wider scale. ASE has been appreciating the knowledge and experience of farmers in its communication and innovation strategy but the scaling up of farmers innovation is limited to few individuals and the approach has not yet been institutionalized by other actors.

Triggering factors, existence of supportive approach, the documentation and the learning process during the development of the two innovations was assessed through focus group discussion with field extension workers, district agriculture experts, ASE project office staffs and interview with the innovative farmers and the beekeepers. Research findings indicated that the triggering factors for the generation and development of these innovations are the problems that the innovative farmers have been facing during the engagement in beekeeping activities. Besides, exposure to others' knowledge and innovations has also contributed for the generation of beehive innovation. Information communication between actors that are assumed to be involved in the generation of those innovations was very limited. The relevant actors do not have functional network to circulate and access information about the two innovations. The poor linkage and network with those relevant actors has affected negatively the knowledge circulation and scaling up of local innovation.

The existing extension approach in the country is not supportive to the enhancement of local innovation. The approach consider scientific research as the main driver for creating new knowledge and technology that can be transferred and adapted to different situation. However, from experience and empirical findings of this study, it is confirmed that knowledge and experience of the local people have vital role in technology generation if it is well managed and utilized. ASE has supportive strategy that encourages innovativeness and promotes local innovation but only ASE's approach did not bring significant change in scaling up of local innovation and innovativeness.

Documentation of experiences and findings remains the major limitation of actors in the process of local innovation development. Both innovations have not been documented by any actors that ultimately affected the knowledge circulation and scaling up of local innovation. One of the most important issues in innovation development is the existence of social learning between actors for generation of viable innovation; nevertheless, the social learning process was limited except exchange of information between innovators and ASE. This has affected the circulation and generation of new knowledge during the interaction and reflection of actors.

Knowledge circulation and scaling up of local innovation has been restrained by attitude and perception of extension worker, the existing GO extension approach, cultural barrier, budget constraints for innovation, and lack of transparency of innovators. The existing facilitating factors like existence of CBI, CoLF and FTCs have not been used by any actor for knowledge circulation and scaling up of local innovation. In the course of the two innovations development, ASE has not played a role in protecting intellectual property right of farmers and there is no rewarding system including allocating innovation fund for research, which has also affected innovativeness and scaling up of local innovation.

In accordance with the analysis, it is recommended that ASE should work aggressively on demonstration of the farmers' innovation through organizing workshop in the presence of innovative farmers and government officials to integrate local innovation in public extension program to enhance the scaling up of local innovation and knowledge circulation among the relevant actors. Moreover, the organization should revise its communication and innovation strategy in view of fund allocation for innovators, rewarding system, protecting intellectual property right to bring out other innovators on board and share their knowledge to the wider community.

CHAPTER 1: INTRODUCTION

As to my experience, agricultural extension service in Ethiopia is characterized as top-down approach. The dominant approach to research, extension and education for rural development still follows the pattern of 'transfer of technologies.' It relies on research stations based standard recommendation overlooking the knowledge and experience of local people and the realities of local situation. The existing extension approach in the country did not consider experience and knowledge of the local people and actors in the area of rural development are not working closely to learn and share experiences among themselves. Knowledge circulation and experience sharing among the community and extension workers is limited. According to Beshah (2003) agricultural extension system in Ethiopia remained delivery oriented in terms of its extension service rather than encouraging local innovations

Ethiopian rural community in the marginalized areas did not benefit from the introduced technologies due to inappropriateness of the technologies, unable to afford input cost and unpredictability of the environment for agricultural activities (PROFIEET, 2004). However, these community members survive for decades using their own knowledge and innovation. In the area where socio economic problem is complex, the appropriate interventions for sustainable resource management are not only external inputs but labour, knowledge and local management capacities (PROFIEET, 2004). Nevertheless, most rural development efforts in Ethiopia often fail to mobilise and enhance these internal inputs and knowledge of the local people. To the contrary, farmers forced to use package of technologies developed by outsiders out of their locality and reality.

According to Grenier (1998) more and more indigenous knowledge is being lost because indigenous knowledge is transmitted orally, and it is vulnerable to rapid change especially when people are displaced or when young people acquire values and life styles different from their ancestors. He also present a proverb on the disappearance of valuable knowledge as "when the knowledgeable old dies the whole library disappears" .This proverb give insights that valuable knowledge are at risks to vanishes if not they are identified, documented and shared to others. The traditional extension system has high emphasis for the promotion of outsiders' technologies overlooking the local innovations and knowledge that makes some innovations at risk to vanish when the elders passed away. Documenting and sharing local innovation and knowledge of the local people has not considered in knowledge circulation and technology generation process. In the course of technology generation and innovation development process, building networks and participating actors is critical to develop and reach at coherent innovation. Moreover, creation of networks and participating of relevant actors at every stage of innovation development process has high contribution for the scaling out and scaling up of innovation (Leeuwis, 2004).

Agri Service Ethiopia is one of the local NGOs that have been working with the rural community since 1969. Currently ASE is operating its development intervention in five districts of three Regional State. ASE encourages the local community to participate in technology evaluation and generation in the context of the local situation. Participatory research is one of the core strategies of the organization that creates an enabling environment to involve farmers in the generation and development of innovation. ASE has strong belief that a country like Ethiopia where natural calamity is frequent and agricultural technologies are not easily available to the poor, scaling up and encouraging local innovation is crucial for sustainable development.

Taking in to account this significance, Agri Service Ethiopia has been striving to create space for the involvement of innovative farmers in the generation and development of local innovations in its operational area. Consequently, ASE identified innovative farmers with their precious innovations. Some of the innovations identified in ASE operational; area includes: prevention of bacterial wilt on false banana (ensete ventricous), improving soil fertility using

silt trap during the first shower rain and improving productivity of honey through queen replacement. In addition to promotion of local innovation, ASE has been facilitating the introduction of agricultural technologies from outside to the area. Intermediate beehive was one of the technologies introduced to operational villages and provided to experienced bee keepers. Among bee keepers, an innovative farmer who has rich experience in bee keeping activities evaluated critically the introduced beehive and came up with constructive comments on the drawbacks of the introduced improved beehive. Moreover, innovative farmer has pointed out modern beehive requires extra accessories that are neither affordable nor available for bee keepers. Considering these shortcomings, the innovative farmer has developed locally made beehive improving the drawbacks of the traditional, intermediate and improved beehives.

As compared to the introduced technologies, locally constructed beehive innovation is inexpensive and easily available to the local community. Currently the innovative farmer has transferred 22 bee colonies from traditional beehive to the newly made beehive, which is designed and generated by the innovative farmer. Improving the productivity and characteristics of beehive through replacing the queen from productive colony to unproductive colony and from docile to aggressive colony has been also used for long years by other innovative farmer. However, the knowledge of these innovative farmers has not circulated to the wider beekeepers in their villages and remained within themselves for long years. Circulating knowledge of innovative farmer and scaling up of these innovations will be vital to activate the existing knowledge and to enhance learning among actors.

Ethiopia is endowed with diverse and unique flowering plants, thus making it highly suitable for sustaining a large number of bee colonies and the long established practice of bee keeping. A bee colony in Ethiopia is estimated to be 7.5 million in the traditional and 20,000 in framed beehive (MoARD, 2006). Ethiopia, having the highest number of bee colonies and surplus honey sources of flora, is the leading producer of honey and beeswax in Africa. On a world level, Ethiopia is fourth in beeswax and tenth in honey production (MoARD, 2006).

The most common type of beehive in the area is traditional beehive with cylindrical shape made from mud, bamboo and grass. Currently, modern beehive and intermediate beehive have been introduced in the government extension program throughout the country. Besides, NGOs have also intervened in introducing intermediate hive for the poor to support their livelihood. The productivity of modern beehive is better than the other two but the accessories required are not affordable and accessible for small scale farmers. To that effect Agri Service Ethiopia has been promoting intermediate beehive in its intervention areas and farmers were given the opportunity to use or leave the hive after they evaluate the performance and suitability of the hive to their situation. Accordingly, experienced bee keeper evaluated beehive technology provided by ASE and MoA and develop new model of hive that comprises a mix of intermediate and modern beehive after strong and continuous trail. However, the beehive and queen replacement innovation did not scale up as intended among bee keepers. Circulation of knowledge about the two innovations within the community and extension workers are very low despites these innovations are economically feasible and accessible to the small scale farmer. This has worried me while I was working in my organization how valuable innovations and knowledge be it scientist or farmers can be circulated and shared to the society at large.

Therefore, I have decided to do my thesis on exploring the circulation of the overlooked knowledge between actors taking locally made beehive and queen replacement innovation as case of my study in two Agri Service Ethiopia's operational villages. This study therefore explored the characteristics and benefits of beehive and queen replacement innovation, role and interaction of different actors, social learning and documentation of learning experience The scope of this research was identifying the restraining and facilitating factors for knowledge circulation and scaling up of locally made beehive and queen replacement

innovations. The significance of this research is believed to come up with possible options to ASE in encouraging innovativeness and scaling up of local innovation in its communication and innovation strategy.

1.1 Statement of the problem

Agri Service Ethiopia has been concerned about the extinction of valuable innovation and limited circulation of farmer's knowledge as equally scientific knowledge. ASE has been working closely with the rural community aiming at encouraging innovativeness and scaling up of local innovations at wider scale. To that effect, valuable local innovations were identified that the local people have been using to mitigate their problems related to crop, livestock and natural resource management. The beehive and queen replacement were among the identified innovations that were developed by experienced bee keepers. The beehive was designed in a way to improve the drawbacks of the modern beehive (langstroth), the intermediate beehive (Kenya top bar) and the traditional beehive. As compared to modern beehive, this locally made beehive is inexpensive and easily available to the local beekeepers. Improving productivity and aggressive characters of bee colonies through replacing the queen from the productive and docile colony to low productive and aggressive colony is one of the precious innovations, which has been practised by an innovative beekeeper.

ASE has been striving to make use of these types of innovation at wider scale by encouraging innovativeness across its operational areas. However, these innovations have remained for long in the hand of the two innovative farmers. The rate of knowledge circulation and scaling up of local innovation was low that might lead to the extinction of the above indicated and other precious innovations when the innovator passed away. Therefore, it was relevant to explore the restraining and facilitating factors for scaling up of locally made beehive and queen replacement innovations at wider scale and knowledge circulation among local bee keepers, innovative farmers and extension workers. Besides, this research was believed to come up with strategic issues for ASE in encouraging innovativeness and scaling up of local innovation for wider use of the society.

1.2 Objective

The objective of this research was to do recommendation for ASE's communication and innovations strategy by identifying the restraining and facilitating factors for knowledge circulation in the scaling up of local innovation.

1.3 Main and sub research questions

S/N	Main Research questions	Sub research questions
1	What are the restraining and facilitating factors for innovativeness and knowledge circulation in the scaling up of beehive and queen replacement innovation?	1.1 How is the idea of beehive and queen replacement innovation generated and communicated among actors in the network?
		1.2 What policy support is in place to generate viable innovation and knowledge circulation among the different actors?
		1.3 How is the documentation process of beehive and queen replacement innovation carried out and shared to actors?
2	What are the roles of the different actors in the process of innovation development and knowledge circulation of beehive and queen replacement?	2.1 How were stakeholders identified in the network of beehive and queen replacement innovation development process?
		2.2 How do the bee keepers, innovative farmers and extension workers facilitate social learning and knowledge circulation of local innovation?
		2.3 How are actors involved in resource mobilization, knowledge generation and circulation in the course of developing viable innovation?

CHAPTER 2: CONCEPTUAL FRAMEWORK AND LITERATURE

For this research, theoretical concepts on innovation, documentation, social learning, network building, and farmers to farmer communication for innovation were reviewed from the literature to provide insights and guidance during the research process. A framework and criteria has been developed and presented at the end of the literature review section to analyse and interpret data that were collected during field work.

2.1. Innovation

An innovation involves new ways of doing things or 'doing new things' however, doing things differently can only be considered as an innovation if the *new things* work in everyday practice (Leeuwis, 2004). Innovations can only be said to be complete when there is an appropriate mix and balance between the technical aspects and socio-organisational arrangements (Leeuwis, 2004). Innovation is anything new successfully introduce in to economic and social process, which goes beyond the traditional linear thinking centred on research system (Kristin et al, 2008). Similarly PROFIEET (2004) explained it as a dynamic of indigenous knowledge that grows within the social group incorporating learning from own experience over generation. It is knowledge that gained some time from other source but has been completely internalized in local way of thinking and doing.

Innovation is a broad terminology that comes in to picture in the research and development efforts. Gebremichael (2000) explained as it refers to a completely different way of doing something or to modification of an existing technology. Farmer innovation has to start within the life time of the farmer and not something inherited. Farmer innovation may arise from indigenous knowledge or modern scientific knowledge. The unique characteristic of farmer innovation is that the innovator is adding value to the body of knowledge, which its origin might be scientific knowledge or local wisdom of farmers. In this connection, Gebremichael (2000) explained innovation process is an effort made by farmers to make the technology fit to own reality or improve effectiveness, efficiency, productivity, profitability, durability, marketability, adaptability and sustainability. In brief farmer innovation as a process is all about conducting informal experimentation by farmers and the innovation product is the value change that may take place in the middle or at the end of the process.

Local innovation provide an entry point in to participatory Agricultural Research and Development (ARD), combining local and external knowledge, with the aim of increasing capacities with in the local innovation system to adapt quickly to changing conditions and thus to improve livelihood of the rural poor (PROLINNOVA) [online]. Encouraging local innovation and experimentation can be a key to link formal research with local initiatives (.Gonfa,E and Water – Bayer, 2005). According to Leeuwis (2004) combining technical innovations with collective action initiatives significantly enhance social learning among actors. He also explained that collective action is useful in sharing knowledge, setting priorities, and experimenting with, evaluating, and disseminating technologies. Innovations that are initiated by scientist without the involvement of farmers will not be successful sustainable and productive. Leeuwis (2004) stated that innovations process is not likely to be successful if they are scientist owned and/or initiated. He also indicate that participatory innovation development can play a role in joint fact-finding geared towards answering shared questions and reduce uncertainties that affect innovation process.

Among the definition discussed above for local innovation, I adopted the definition given by PROFIEET as stated as "it is the dynamics of indigenous knowledge that grows in the social group incorporating learning from own experience over generation but also knowledge that was gained at some time from other sources that has been completely internalised within the local ways of thinking and doing". I adopted this definition for the following reasons: the base of scientific innovation is indigenous knowledge, it incorporates learning and it also considers

modification of outsiders' knowledge to own reality. All these concepts are treated under this definition that convinced me to adopt the definition of local innovation given by PROFIEET.

With regard to technology and innovation adoption, Leeuwis (2004) argue that it is not an individual process, but results from a coordinated effort and action in a network of independent actors. Innovation has been confused as a technical output of research. However, according to Leeuwis (2004) the recent insights in innovation studies indicate that neither originate from research nor science only but rather is the application of all types and source of knowledge to achieve the desired social and /or economic outcomes. The process of designing an innovation is therefore not straightforward and controllable, rather it is a network building, social learning and negotiation to develop shared understanding to solve problem or overcome the tension in a given situation (Leeuwis, 2004).

Innovation cannot be transferred from one source to other in the form of Transfer of Technology (ToT) approach (Dorman, 2006). He also argued that locally developed innovation and knowledge cannot be transferred from one location to other locations due to the fact that innovation is location specific and their redesign and adoption is collective effort by different sets of actors. This argument gives insights about scaling up of local innovation to different context requires new elements of learning and negotiation to fit specific circumstances.

2.2 Social learning

In this paper, learning in the context of innovation and knowledge circulation, refers dealing with adults in the rural settings who confronted with changing circumstances and problems where innovation is required to acclimatize the changing environment. According to Wales (edi 2007), learning as general is defined the process of acquiring knowledge, skills, norms, values or understanding through experience, imitation, observation, modelling practice or study by being taught or as the result of collaboration. Caffarella (2002) explained that learning is an integral part of everyday life; we all act and receive feedback from our environment which in turn leads us to adapt our cognition. According to Leeuwis (2004), social learning is a move from multiple to collective or distributed cognition. For the purpose of arriving at coherent innovation, it is clear that individual learning is not suffice but simultaneous learning of interdependence is needed; that is in order to arrive at coherent practices, multiple actors are needed to develop complementary and overlapping understanding (even fully shared) understanding about the learning fronts (Leeuwis, 2004). In social learning process, people come together at some place (sites) to understand a particular issues where they have to engage with others from similar or different background having diversity of knowledge that create information environment and the learning process becomes complex as different knowledge types need to be interplay with each other in some common purpose (Crawford et al, 2007).

According to Leeuwis (2004), learning takes efforts, energy and time that make learning as scarce resources. In other words people are selective in their investment during the learning process and has direct link with diverse human interests and changes in professional practices. Because of the immediate relation with practices, Kolbs (1984) model of experiential learning is widely used as a basis for organising communication for innovation. The models explain how people learn through experience. This type of learning is powerful since it appears that conclusion drawn by people themselves on the basis of their own experience tend to have a greater impact than insights formulated by others (Leeuwis, 2004).

Breaking institutional barriers that separate farmers and other stakeholders from each other makes it possible for the long-term exchange of knowledge and information between them. This barrier includes cultural, attitude, financial resources, centralisation of research, lack of training in participatory approach and the top down extension service (Beshah, 2003). Social learning is not learning among few individuals in a community but it is a society wide

process whereby scientist, experts, and the community play decisive role in the process (Beshah, 2003).

Learning can be considered as practice that affected by different factors like frame of reference, social pressure and self efficacy. The interrelated factors and process that may influence people's motivation to learn include relative importance, seriousness of experienced problem, urgency, self efficacy and environmental efficacy, complexity, observe-ability and clarity about the nature of the problem (Leeuwis, 2004). Factors that could motivate the engagement in learning include the relative importance of experienced problems and the urgency of finding solutions. Besides, when peoples have confidence in the possibility of solving the problem they can be better motivated (Leeuwis, 2004). This explanation indicates individuals/community participate in the learning process if they realise that they could manage technically, socially and economically by their own after the end of the learning event.

2.3 Documentation

Documenting the process of own and other experience has become scaling-up strategies of development intervention or innovation. Much has been said and written about the need to document the experience of development initiative to learn from failure or success for future uses (Chavez-Tafur et al, 2007). Documentation of the knowledge and practical field experience of small scale farmers has been overlooked in the development initiators. In line with this (Chavez-Tafur et al, 2007) emphasis that if achievements, difficulties, lessons and the learning process are not documented in some form, it is very difficult to share them and to circulate knowledge and lesson gained from practical experience.

Documentation process can help us to better understand what we were doing as well as to circulate information and knowledge about our work to others for network building and lobbying others. According to (Chavez-Tafur et al, 2007) documentation process should consider compiling as much information on the identified issue for documentation and as well as the experience and opinion of those who have been involved in the intervention or those who have been affected by the project.

Documenting what has been done alone did not contribute for new knowledge generation unless there is an interaction and reflection with stakeholders during the documentation process. In view of that, (Chavez-Tafur et al 2007) indicated that documentation process should follow the following procedures: organize the information and make available, analyse the detail to understand what has happened, draw conclusion which help to generate new knowledge and present the result in the chosen format. The result of documentation can be presented in various forms like in the form of article, video or electronic presentation. However, many development practitioners fail to establish effective documentation process that affected knowledge circulation among actors and development partners. Farmers have rich experience and knowledge that they have been using to mitigate their socio economic and environmental problems however, experience and knowledge of farmers has become at risk to vanish when the knowledge owner passed away due to absence of responsible body to document and share these valuable innovations and practical experience.

2.4 Networking

Networking is powerful and cost effective way of sharing information and achieving various other goals those individuals cannot achieve alone (Carine et al, 1993). Networking in the context of knowledge circulation, communicative intervention and innovation play significant role to facilitate the learning process. According to Leeuwis (2004) contributing to innovation can be equalled to establishing novel, effective relationship between multiple human and none human entities. Networking is making spider web of related individuals and organizations all of whom contribute something to the application of new or existing

information and knowledge (Kristin et al, 2008). In other words, innovation is about network building and/or reconfiguring the existing network. The key task and activities to that effect are social learning, and negotiation as well as process management (Leeuwis, 2004). However, such process can not start from a vacuum that require relevant stakeholders know and recognize each other as relevant partner in the innovation development process. Now a day, creating networks with relevant stakeholders has become indispensable for facilitating learning and circulating knowledge from different source and to make use of it in own context. In connection to this, (Leeuwis, 2004) explained that networking as an activity widen the options and/or increase chances for actors to become involved in network building, and which revolves around the creation of new social and technical arrangement through learning and negotiation. He also proposed the important aspect of networking that include: personal contact, making one known, maintaining contact and relationship and gathering information about other actors' networks. These steps indicate us in creating networks identifying and having full information about the individual or organization is vital and prior task in network building to be mutually benefited from the networks.

2.5. Farmer to farmer communication for innovation

Farmer-to-farmer communication for innovation can be seen as an approach developed with an intention that an appropriate technological options can be best transferred and experimented in small scale in order to adapt and disseminate to the large number of farmers. In the rural community, individual farmers have much expertise based on experience, on farm experimentation and/or training which could be relevant to other farmers. The rural community has informal way of exchanging information and knowledge using different means like markets, work parties, funerals, celebration, community meetings and church service (Leeuwis, 2004). Besides, observation of fellow farmer's practices is also an important mechanism of communication for innovation. The role of communication workers will also be vital in stimulating farmer to farmer exchange of innovation in various ways. However, their role in this case should not be as a consultant or expert but rather a facilitator of the learning process and creating network (Leeuwis, 2004).

The experience of the Tigray region, northern part of Ethiopia, can be cited as evidence in soil and water conservation. Some innovative farmers started to conserve water and soil following the natural canal of temporary water and they become effective to maintain soil fertility and produce good harvest. Communication workers facilitate the circulation of knowledge experienced by that community through organizing field visit program to the innovative farmer's village to exchange knowledge and information among themselves. Following the field visit, participants scaled out the practice in their village (Reij& Waters-Bayer, 2001).

According to different authors and my experience on the concepts used for this study, I had summarised the concepts and developed criteria for the analysis and interpretation of the empirical data. A model was developed (see fig 1) before data collection to analyse and interpret the data and how these concepts were linked each other for generation of viable innovation and knowledge circulation as indicated below.

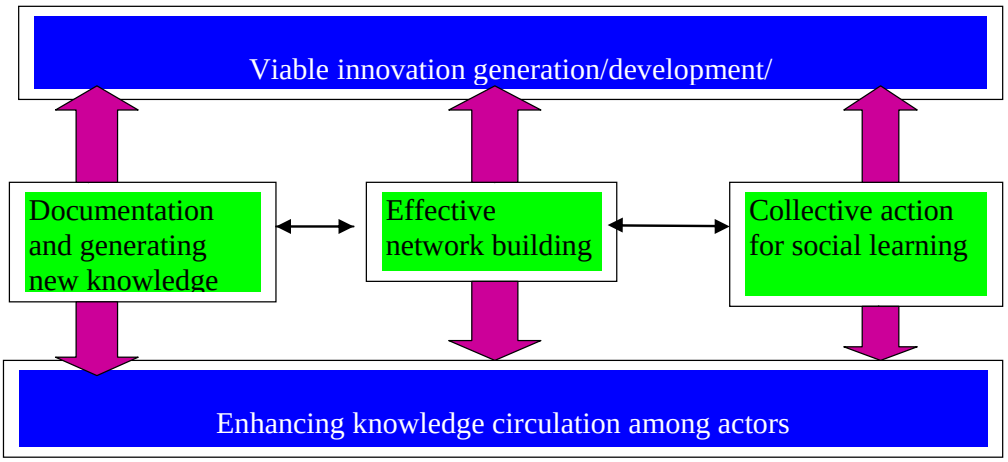

Figure 1.Viable innovation generation and Knowledge circulation model
Source: Author

Criteria set to examine the two types of innovations

- process of innovation development
- Policy support for local innovation
- Relative importance/advantage and sustainability of the innovations
- social learning and knowledge circulation among actors in innovation development process
- Involvement of actors in the documentation process
- existence and functions of network of actors in the innovation development process
- adoptability of the two innovations taking compatibility, complexity, affordability and sustainability as a criteria for adoption of the two innovations

Compatibility of the two innovations with the existing beekeeping activities, technical complexity or simplicity to test, affordability in terms of cost and sustainability of the two innovations has been analysed in the respective innovations. Adoptability criterions were used if adoption and social learning about the two innovations have been affected by compatibility, complexity, affordability and sustainability of the two innovations.

CHAPTER 3: RESEARCH METHODLOGY

3.1 Study approach

Both primary and secondary data sources were used to generate information for the study. This section describes the systematic approach to the study and how information for the study was generated and analysed. An interview was carried out using open ended questions with sampled bee keepers and other stakeholders who have direct link in the scaling up and development of local innovation. The response to the interview questions and focus group discussion was captured and grouped according to their category to make analysis. Beekeepers and innovative farmers were interviewed and focus group discussion was conducted with field extension workers, experts of MoA and ASE project staffs as a way of gathering information.

3.2 Study area

This study was carried out in Ethiopia, Amahara Region Eastern Gojam zone, Enebsie district in two ASE's operational Villages namely Ansa and Egirsebra where the organization has been conducting integrated food security program from 2001 to 2006. Currently, ASE has phased out from these intervention villages and started community empowerment program in other seven villages. The study areas were selected due to the fact that two innovative farmers generate an innovation and have been using for their own for long years in those two villages. The dissemination and scaling up of these innovations to other bee keepers is limited and knowledge circulation of these innovations to other actors is very low that also made the two villages to be selected for this study.

Enebsie Sar Midir district is one of the 14 districts of eastern Gojam zone of the Amhara National Regional states (ANRS). The capital of the district *Mertole Mariam* is found 370Km far to the south of Addis Ababa, the capital city of the country. The altitude of the district ranges from 900 to 3500 meter above sea level. The district is divided into 35 village administration. A very rugged and undulated terrain typically characterizes the geographic feature of the district. 43% mountainous, 38% undulating and 19% plain lands describe the district. According to PRA finding of (2001), socio economic and topographic feature of the study villages is described as follows:

Ansa village is one of the 7 previous ASE's operational KAs, which is located 9 km south of metule maraim, the capital city of the district. Total population of this village is 4553 (2294 female) and 760 households (154female). The topographic feature of the village is characterized as 55% mountainous, 25% undulating and 5 % plain land and 15 valleys. The village has an area of 1447 hectare of land having the land use of 21ha grazing, 926 ha farming, and 135 ha settlement, 75 ha marginal and 96 ha forest. The village has livestock potential of 1866 cattle, 970 shoats, and 498 equines and 204 poultry. 32 bee keepers having 186 traditional beehives, 20 intermediate beehive 12 modern beehives and 22 the new locally made beehives reside in the village. The village is favourable for beekeeping activities due to existence of natural forest and bushes.

Egirsebra, It is the other village selected for this study, which is located 22 km north-east of mertule mariam. This village has total population of 3490 (1567F) and household of 615 (155F). Topography of the village is characterized as 33.3% mountain, 26 % undulating 16.7 % plain and 23.3 valley. The village has an area of 1350 and the land use is 85 ha grazing land, 826 ha farming, and 130 ha settlement, 174 marginalized and 135 forests. The village has livestock of 1842 cattle, 3200 shoats, and 158 equines and 2500 poultry. In this village there are 236 traditional beehives, 20 intermediate beehives and 10 modern beehives. In both villages, the rainfall pattern is characterized as erratic and unpredictable that affects the farming practice. Generally the two villages have Mono modal rain fall pattern that covers June to mid of September. Altitude of the two villages ranges from 900 to 1200 m above sea

level. Haricot bean, sorghum, Teff, field peas and horse beans are the major crop grown the study areas.

The communities of the study areas are mainly subsistence farmers and engaged in mixed farming system. The land holding of a household ranges between 0.25-1.75 ha. Grazing and forest lands are being used in common. In those villages, moisture stress, crop pest, crop disease, and poor soil fertility status seriously challenge crop production. The study areas have the potential for livestock production; despites productivity is still challenged by shortage of feed, poor management and livestock diseases. Beekeeping in the study villages is being considered as the major occupation for the landless poor and youths but it is seriously challenged by spray of chemicals for pesticides and herbicides (Enebsie Program office, 2004).

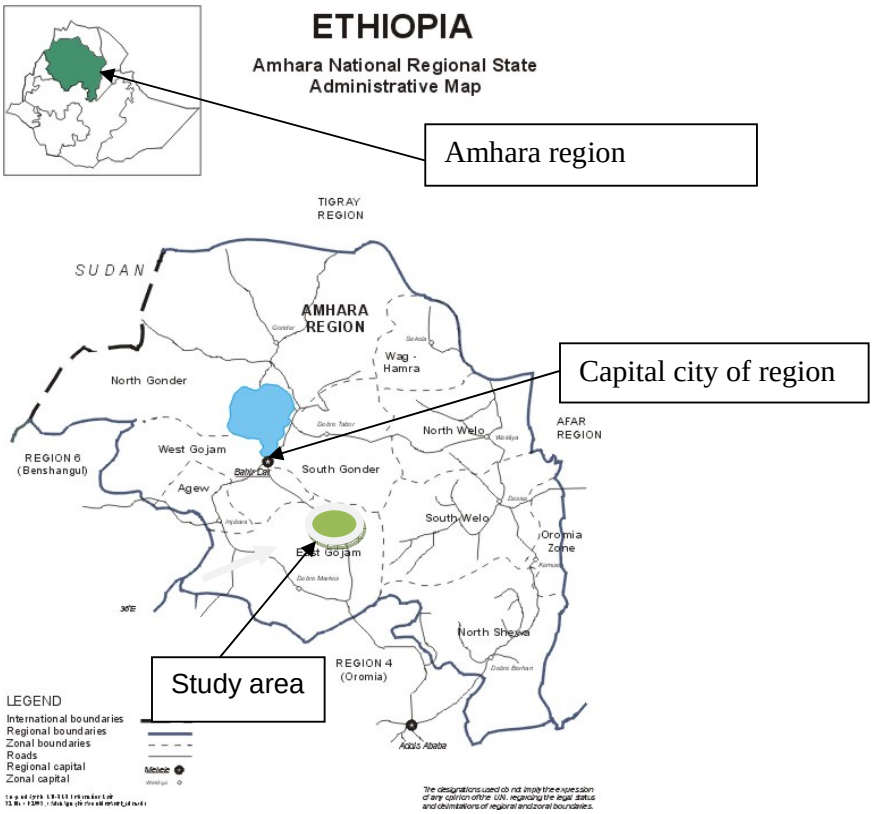

Figure 2: Map of Ethiopia and study area

Source: http://www.maplibrary.org/stacks/Africa/Ethiopia/Amhara/index.php

3.3. Data collection

Secondary data

This research was started from desk study by reading scientific books, journals, articles and searching of internet to develop conceptual framework of the study. Besides gray literatures, workshop proceedings, reports and strategic document of ASE and MoA office were reviewed to get supportive secondary data for the triangulation of primary data.

Primary data

Primary data was generated through interviewing respondents and conducting focus group discussion with 13 field extension workers, 3 experts working for MoA and project staff of ASE. A total of 18 out of 80 bee keepers were randomly selected in both villages for both cases. 8 out of 32 bee keepers for the case of beehive innovation and 10 out of 48 bee keepers for queen replacement innovation were randomly selected and interviewed. Interview questions and checklists for discussion were developed and categorized taking in to consideration, which interview questions, could be answered by which respondents or interviewee as seen in the annex.

3.4. Data Analysis:

Data that have been collected from the interview and focus group discussion was analysed qualitatively. The analysis of the data was conducted based on the criteria described in the conceptual framework focussing on viability of the innovations, process of documentation, social learning and networking in facilitating knowledge circulation and scaling up of beehive and queen replacement innovation.

CHAPTER 4: RESULTS

This chapter discusses the empirical findings focussing on background of interviewee and the innovative farmers like sex, age group, the bee colony they owned. Besides, the process of innovation generation and development, description of the innovations, benefits/added value of the innovations/, the social learning process, documentation and the existence and functionality of networks between actors in the process of the innovation generation have also discussed in this chapter. The results that are presented in this document are based on the interviewee and focus group discussion with farmers and extension workers of the study area.

4.1 Back ground information of interviewees

This section discusses the background information of the interviewee both the beekeeper and the innovative farmer. In this study 18 beekeeper, 2 innovative farmers, 6 field extension workers of Ministry of Agriculture, 7 field extension workers of Agri Service Ethiopia 3 experts of ministry of agriculture and 1 program director of Agri Service Ethiopia were participated.

Background information of interviewees that comprise sex, age bee colony size they owned in the respective innovation is presented in the table below.

Table 1: Beehive innovation interviewee by sex, age, and beehive owned

Interviewees	Sex			Age group		Bee colony size		
	M	F	T	25-50	>50	1-4	5-10	>10
Beekeepers	6	2	8	5	3	6	2	-
Beehive innovator farmer	1	-	1	-	1	-	-	28
Total	**7**	**2**	**9**	**5**	**4**	**6**	**2**	

From experience, beekeeping as an intervention was the occupation of men in the area but during my study, it is found out that there were 2 female beekeepers among 8 interviewees of beehive innovation. The age of the interviewee ranges from 36 to 70 for the beekeeper and most of interviewee fall from 36 to 50 years old. Most of them has limited amount of beehives that ranges from 1-4 with an average of 4 beehives for all interviewees. Nevertheless the innovative farmer has 28 bee colonies as indicated in the table 1. As it was indicated from the empirical study, bee keeping as an activity is decreasing from time to time due to uncontrolled chemical spray for prevention of pests and weeds.

Table 2: Queen replacement interviewees by sex, age and beehive owned

Respondents	Sex			Age group		Beehive owned		
	M	F	T	25-50	>50	1-4	5-10	>10
Beekeepers	10	-	10	7	3	6	2	2
Queen replacement Innovator	1	-	1	-	1	-	-	35
Total	**11**	**-**	**11**	**7**	**4**	**6**	**2**	

Unlike the beehive innovation interviewees, all respondents were male and majority of them fall in the age range of 29-50 but varied from 29 -68. The beehive owned by interviewees varied from 2-13 among the beekeepers with an average of 4.7 and the innovative farmer has 35 beehives. Like the beehive interviewees, beekeepers are getting out of this business due to the uncontrolled chemical spray in the area. From my observation I have identified that 3 beehive innovation interviewees have practised intermediate beehive but in the queen replacement interviewee there was no any interviewee who practice intermediate beehive or

modern beehive. However, it was identified from the field observation that both innovative farmers have practiced intermediate and improved beehive innovation.

4.2 Triggering factors

During the field study, interview with the innovative farmer and focus group discussion with field extension workers was conducted to find out the triggering factors for the generation and development of the two innovations. The result of triggering factors for generation and development process of the two innovations are presented here under

4.2.1 Beehive innovation

- Inaccessibility of modern beehive
- High price of modern beehive
- Training provided on beekeeping
- Inconvenience of traditional beehive
- To make easier the management practice
- Low productivity of hives
- Difficulty of top bar preparation for intermediate beehive
- Experience from ancestors

4.2.2 Queen replacement innovation

- Low productivity of hives
- Aggressiveness of bee colonies
- Existence of frequent swarming
- Experience of ancestors in beekeeping

Beehive innovation was triggered by many factors but queen replacement innovation has few triggering factors. However, they have common triggering factors for the development of the respective innovations.

4.3 Description of the two innovations

From the field observation and interview with innovative farmers, the two innovations were described as depicted below.

4.3.1 Beehive innovation

The newly generated beehive was designed by an innovative farmer and constructed from local materials. This innovation is characterized as a mix of modern and intermediate beehive. It is constructed from bamboo, pieces of timbers and string plastered with mud and cow dung. It has three chambers or partitions like modern beehive with the dimension of 64 cm height 30 cm length and 48 cm width. Like modern beehive, it has one brood chamber and two partitions for honey production. In each partition there are three pieces of timbers having fixed bamboo splits on it keeping the natural distance between combs. Each timber has 8 fixed strips of bamboo splits on it and 24 honey combs can be constructed in one partition. The fixed top bar has prepared from the split of bamboo. The split of bamboo lined on piece of timber has been smeared with wax to guide honey bees during honey comb construction. Each pieces of timber has a dimension of 15 cm width and 29 cm length that contained 8 strips at the distance of 3 cm between strips. The picture of this innovation was collected during field observation and visit of the garden of the innovative and portrayed as indicated below.

Figure 3: Beehive innovative farmer with his innovation
Photo: Author

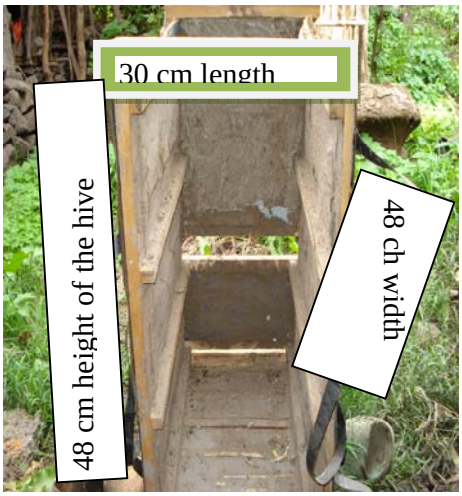

Figure 4: front view of beehive innovation and its product constructed on fixed top bar
Photo: Author

4.3.2 Queen replacement innovation

Queen replacement innovation is not like technologies that can be seen physically but it is a practice and idea generated by the innovative farmer as the result of the problems he faced in beekeeping activities. It is described as improving the productivity and characteristics of the bee colony through replacing the queen of productive and docile colonies to the aggressive colonies. The innovative farmer generates an idea of replacing the queen from one colony to other colony to improve the characteristics and productivity of his hives by making selection among his beehives. He found out that some of his hives behave as aggressive but productive and others behave docile and productive and the remaining swarm frequently during brooding. During the interview the innovative farmer explained as he has 13 docile and productive, 12 aggressive but productive and 10 tending to frequent swarm. To

that effect, the innovative farmer has been thinking for long years about the improvement of his hive production and characteristics in stinging and swarming. Accordingly, he generated queen replacement innovation and reduces the identified problems in relation to productivity, swarming and stingy behaviour.

Figure 5: queen replacement innovative farmer with working material at his garden.
Photo: author

4.4. Benefits of beehive and queen replacement innovation

Relative advantages of the two innovations were discussed during the individual interview with beekeepers and focus group discussion with extension workers and ministry of agriculture experts working at district level. The result obtained during the field study is presented in the table below.

Table 3: Benefits of the newly designed beehive

Respondents	Added values of beehive innovations/benefits			
	Convenient for management	Cost effective	Improve productivity	Improve honey quality
Innovative farmer	✓	✓	✓	✓
Extension workers	✓	✓		
Beekeepers	8	8	4	4
Experts of MoA	✓	✓		

During the interview the innovative farmer explained his innovation has significant added values/relative importance in terms of improving beekeeping activities and convenient for the small scale farmer. Focus group discussion with the extension workers, experts and beekeepers in that village confirm the beehive innovation is convenient for management and affordable to the poor in terms of cost which is similar response with the innovative farmer but extension workers and experts of MoA were reserved to give response on the productivity and honey quality improvement. As can be seen from table 3, 50% of beekeepers showed reservation on the added values of the innovation in improving honey productivity and honey quality like that of the extension workers.

Table 4: Benefits of queen replacement innovation

Respondents	Added values of beehive innovations		
	Improve bee behaviour	Reduce swarming	Improve productivity
Innovative farmer	✓	✓	✓
Extension workers	✓	✓	✓
Beekeepers	6	5	4
Experts of MoA	✓	✓	✓

In the focus group discussion and individual interview, participants have the same understanding on the added values of the queen replacement innovation. As can be seen from table 4, they agreed to a large extent on the benefit of being improved behaviour, reduce swarming and improve productivity.

4.5. Adoptability of the two innovations

8 and 10 interviewees of beehive and queen replacement innovations respectively were interviewed on the nature of the innovations to what extent are those innovations adoptable and can be scaled up by taking; compatibility with the existing beekeeping activities, complexity to be tested by ordinary beekeeper, affordability/feasibility in terms of cost and sustainability of the two innovations. The response of the interviewees is presented here in figure 6 in the respective innovations.

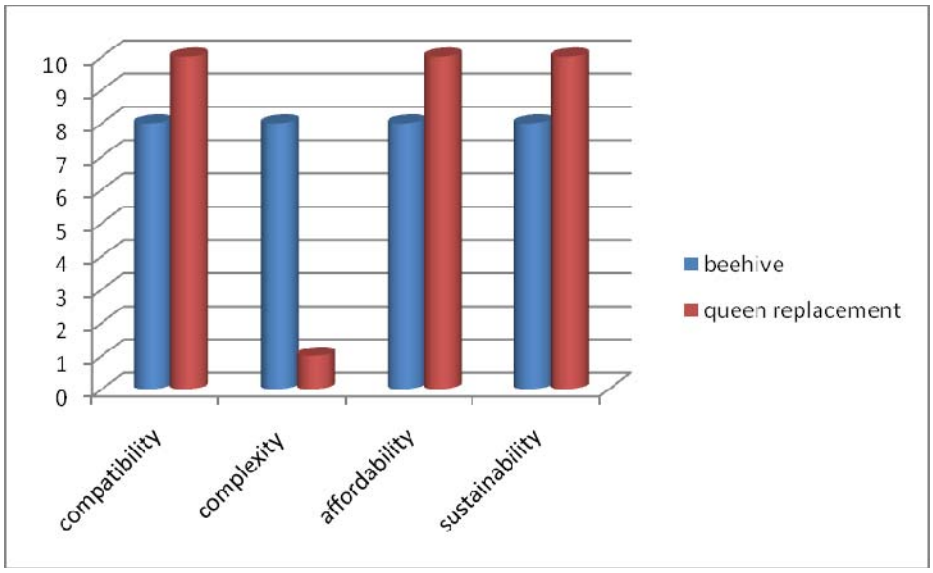

Figure 6: Compatibility, complexity, affordability and sustainability of the two innovations

According to the information obtained from the interviewee, 100 % of respondents of beehive innovation agreed that beehive innovation is compatible, affordable and sustainable. Nonetheless, as can be seen from above figure, 87 % of beehive innovation interviewee explained beehive innovation is complex to ordinary beekeeper to construct and test the innovation at individual level. All queen replacement interviewees explained this innovation is compatible, affordable and sustainable. Only one respondent explained this innovation is complex but 90 % of them confirmed that it is not complex to test after the idea is generated and communicated

4.6 Information communication on the two types of innovation.

Circulation of information about the two innovations among beekeepers, innovative farmers and extension workers was discussed and interviewed to measure the accessibility and availability of the information about the two innovations for the relevant actors. As it was indicated in the empirical study, availability and accessibility of information to relevant actors was not to the anticipated level. Specifically, accessibility of information during the development process of the innovation was very low and some of the interviewees explained it was the first time to hear about the existence of the innovations. The pattern of information communication about the two innovations among beekeepers is presented in figure 7.

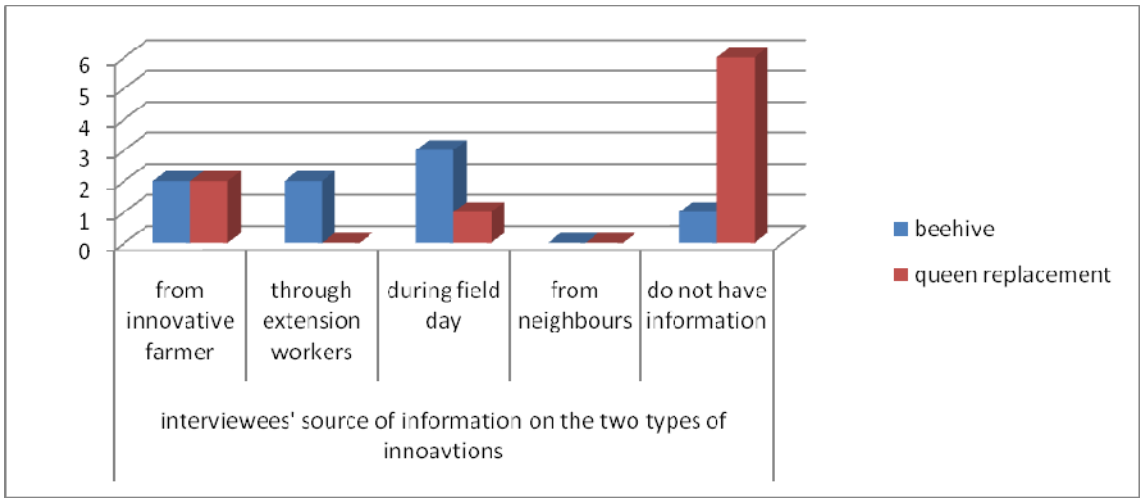

Figure 7: Sources of information access on the two types of innovations

As can be seen from above figure, 60 % of interviewees of queen replacement innovation did not have information access about that innovation. It has been also discussed during focus group discussion with extension workers most of them were not aware about the existence of queen replacement innovation in their working place. On the other hand, beehive innovation respondents indicated that field extension workers communicate 37.7 % of the interviewees about existence of beehive innovation and the remaining saw on the field day conducted in their village. From the interview and focus group discussion, it is illustrated that neither the beekeepers nor the extension workers participated in the process of the two innovation development. This was also confirmed by the innovative farmers as; they did not communicate to any one during the process except involving their sons for labour support and provision of the required materials. Nevertheless, the beehive innovator explained as there was frequent contact with ASE project staffs in getting some technical advice and material support during the development of his innovation.

4.7 Policy support for the generation of local innovation

In relation to the existence of favourable approach for the generation and dissemination of local innovation, beekeepers and innovative farmers were interviewed. All interviewees responded that the current extension approach is not supportive to the enhancement of local innovation. The approach is designed in favour of scientific innovation and extension workers in the area are assigned to promote research centre based technologies. Extension workers in their focus group discussion have also confirmed that they have no focus for local innovation as equally scientific innovations. This is evidenced by views of queen replacement innovative farmer as no extension workers have visited his garden and discussed about his innovation. From the interview with the innovative farmer and beekeepers, farmers' knowledge has no space in extension approach design and this knowledge has been overlooked for decades. Extension workers of ministry of agriculture have also pointed out as they have never raised issues related to scaling up of local innovation other than

technologies and knowledge generated and developed in the research centres. From the focus group discussion and secondary information, it is identified that ASE has a strategy related to scaling up of local innovation and encouraging innovativeness across its operational areas. The interviewees emphasise that the intervention of ASE in the area enable the innovative farmer to get recognition by the community and the government official.

According to the discussion with program director of the program office, the organization has strategic direction for scaling up and encouraging innovativeness using the following approach

- Giving recognition for the innovative farmers
- Provide material and technical support
- Linking with other stakeholders
- Facilitate demonstration and presentation of their findings
- Documenting findings
- Sharing the results
- Provision of capacity building training

From the discussion with ASE staffs, ASE has been striving to integrate farmers' innovation in public extension system but it was not successful to win the attitude of government officials. The traditional extension system that favours to transfer technologies from researchers to farmers employed as main extension approach hindered the inclusion and consideration of farmers' innovation to be the part of the public extension approach.

4.8. Documentation of the beehive and queen replacement innovation

Innovative farmers were interviewed on the documentation process of their innovation. In response they explained as did not document the process and the findings other than telling and demonstrating their innovation. During my field visit to the garden of the innovative farmer, I have confirmed that there were no records and documents in any format to share for others about the process of their innovation but the innovative farmer were conversant in describing the nature and the process of their innovation. Queen replacement innovator explained that "I have no interest to document the process and the result of my innovation, since my intention is to use for my own''. During focus group discussion, field extension workers confirmed as there was no their involvement and support in documenting the process of the innovation development. ASE project staffs have also pointed out the organization has no well organized document on the two innovations except little attempt in taking photos of the innovative farmer and their innovation.

4.9 Actors and their role in the innovation development process

In the process of generating the two innovations, the proposed relevant actors as indicated from the focus group discussion are ministry of agriculture, ASE, innovative farmers, beekeepers, research institutes and community based institutions on the bases of the potential they had to the development and generation of these innovations. Among those, only ASE and the innovative farmer were involved through the process. During interview with beehive innovator, it is confirmed that he was the main actor from idea generation to the development of the beehive innovation. However he confirmed that ASE has been involved in providing material support and ideas for the development of the beehive innovation. Research institutes as the main actor in technology generation and beekeepers as end users of the innovation were not involved through the process. From focus group discussion, participants agreed as there was no responsible body to coordinate and bring those actors in the innovation development process. As indicated from strategy document of ASE, the organization has role in identifying and bringing different actors for the generation of viable innovation but it was not applied in beehive innovation development process.

In the case of queen replacement innovation, there was also no actor involved in the process except the innovative farmer. The innovative farmer explained as he generated the idea of queen replacement innovation 25 years ago and he kept it secret till the intervention of ASE in the area. From the interview with beekeepers and focus group discussion with extension workers, it was explained that they have little or no information even for the existence of beehive innovation leave alone to participate in the process.

4.10 Networking for innovation development

The existence of functional network between different actors that are relevant for the innovation development was discussed with extension workers, innovative farmer, ASE and MoA. All findings indicate that there was no active and functional network between ASE, innovators, research institutes, MoA and CBI. It is also indicated that there was no responsible body to coordinate the network and bring actors in the network forum of innovation development. For the two innovations, the only functional network was between the innovators and ASE. The expected role of all actors in the network was discussed how they would have been involved and contributed for the generation and scaling up of the two innovations. The proposed role of each actor from focus group discussion is presented below.

Table 5: Proposed role of actors in local innovation development process

Actors	proposed roles
Innovative farmer	-Problem identification -Generate idea and proposed solution -Communicate with extension workers about his idea -Willing to share and introduce his idea/innovation -willing to involve others in the innovation development process -Work closely with CBI
ASE	-Identify indigenous knowledge -Recognize knowledgeable farmers -Facilitate network building with relevant actors -Create the link between innovative farmer and other relevant actors -Provide required resources to the innovative farmer
Research institute	-Recognize farmers knowledge -Provide technical support -Contribute for scaling up local innovation
Beekeepers	-Willing to share and learn from fellow innovators -Assist and support innovators when need arises -Test the innovation and provide feedback how it perform
CBI	-Identify the innovative farmers -Motivate farmers to bring out their innovation -Facilitate the link between farmers and other actors -Provide financial support -Play role in the scaling up of the innovation
MoA	-Recognize farmers knowledge -Provide technical support -Facilitate the link between farmers and research institutes -Play role in scaling up of local innovation

4.11. Social learning for innovation development

The involvement of different actors in innovation development process was interviewed whether the innovation development process has involved many people with their different capacities in connection to the identified learning topics/issues. As it is indicated on section 4.9 relevant actors for the innovation development process were not involved and social

learning in the absence of different actors cannot be carried out. From the interview with innovative farmer, it is indicated that there was social learning between the innovative farmer and ASE in exchanging ideas and experiences on the development of beehive innovation. Other actors did not participate in the learning process. During the interview with beekeepers, it was stated they are motivated to learn from the innovative farmer. Respondents explained also there was lack of information about those innovations to learn and share with the innovative farmer. As mentioned by the interviewees, the existing cultural barrier to visit the garden of the innovative farmer restrains them to learn what the innovative farmer has been doing in his garden. From the interview it is also confirmed all queen replacement innovation interviewees did not get lesson to practice the innovation in their garden. Similarly except one out of eight respondents of the beehive innovation interviewees have not also practiced drawing lesson from beehive innovative farmer.

From the focus group discussion with the extension workers, all participants agreed they did not play their role in facilitating learning between the innovators and beekeepers in the respective village. The innovative farmer has explained as they are willing to share their experiences and knowledge if they are requested. This has been also confirmed by beekeepers on the already identified and developed innovation. On the other hand the beekeepers and extension workers complain as innovative farmers lack transparency in participating beekeepers and extension workers during the development of the innovation. In connection to scaling up of the two innovations, innovators explained the low focus of extension workers for promotion of their work, absence of motivation mechanism for the innovative farmer and financial constraints for experimentation were among major constraints they face.

4.12 Restraining and facilitating factors for knowledge circulation/sharing

Facilitating factors: all the respondents of the two innovation and extension workers agreed on the following as facilitating factors.

- Interest of the farmers to learn from fellow farmer
- Existence and willingness of the innovative farmers to share their knowledge
- Establishment of Community Based Institutions (CBI) in the respective village
- Establishment of Community Learning Forum (CoLF) in each village
- Establishment of Farmers Training Centre (FTCs) in each village

Restraining factors:

- Attitude and perception of extension workers towards local innovation
- The existing extension approach , which overlook farmers knowledge
- Cultural barrier to learn and exchange experience in the area
- Absence of responsible body to coordinate learning on local innovation
- Budget constraints to facilitate action oriented learning
- Lack of transparency of the innovative farmer

CHAPTER 5: DISCUSSION

This chapter discusses the empirical findings focussing on the process of the study, background of interviewees, description of the innovations and process of development, the learning process among actors, documentation of the innovation and the existence of functional networks in the course of beehive and queen replacement innovation generation.

5.1 Reflection on the process of the study

This research started with a desk study to develop the theoretical framework that has been used as a guide for data collection and analysis of the findings. Following the approval of the proposal and granted by the university to do my research, data collection was conducted in Ethiopia, Amhara region, Enebsie district, which is one of ASE's operational district specifically in two villages out of 35 villages in that district. The sampled villages were small as compared to the other villages of the districts and the availability of innovative farmers in different discipline in those villages.

This research constrained by the time duration we have been in the field. Therefore, it may be difficult to draw conclusion from these sampled villages about all types of local innovation. On the other hand, sampled beekeepers were relatively sufficient among beekeepers residing in the respective villages. However, if I had adequate time for field work, I could have reached more villages and innovative farmers that may possibly help me to get more views on facilitating and constraining factors for knowledge circulation and scaling up of local innovation.

This research was conducted during the critical time for farming activities that affected my work plan to work in each village as I planned. However, through discussing with extension worker and interviewees, data collection was completed smoothly. During data collection, I found one interviewee reserved to tell me the exact number of beehive he has to show his disappointment on beekeeping due to uncontrolled chemical spray for pest and weed control that seriously devastated bees. He told me as he has 4 beehives abut I confirmed from his garden 12 hives. Hence on the information, which I suspect some deviance from what I know and the information given from others, I have been triangulating from different sources and field observation to minimize the deviation and to reach at realistic generalization/conclusion.

The data collection of this research lasted 12 days for interview with the beekeepers in those two villages of which 8 days for interview and 4 days for travelling on foot. Besides, focus group discussion with extension workers, experts and ASE project staffs took 6 days. Review of the strategy documents of ASE and MoA took 2 days. In general, the information I had about the area, culture of the community, and those innovations helped me to dig out the relevant information by making triangulation from different sources throughout my study. Finally, the research grant fund offered to me for producing good abstract during proposal development inspired me to be committed and dedicated to work in that challenging rainy season and ups and downs terrain. To sum up, the process of the study was conducted with close support of my organization at field level that enabled me to carry out the study as per planned. Besides, the research methods I used for the study was found to be appropriate to extract in-depth information about those innovation in that limited period of time.

5.2 Background information of interviewees

From experience as extension worker, beekeeping activity in that locality was occupation of men. Nevertheless, women are also engaged in the occupation though the proportion is low as compared to men. The attention given for gender equality in every aspect of development arena and gender based skill training programs provided by ASE may contributed for the participation of women in the beekeeping activity. Besides, the introduction of improved beehive technology that can be managed and handled by both sex is believed to improve the

participation of women in beekeeping and other development activities. As per the empirical findings the older age category of the interviewee has more bee colony size than the young ones. In the rural settings, beekeeping as an activity is referring to the occupation of the older households this is due to the fact that beekeeping requires relatively low labour and time with the exception of breeding and harvesting season. Beekeeping can be considered as appropriate employment opportunity for those who are not able to go far from their vicinity for farming work and for those who have no adequate land for farming. The older age have rich experience and knowledge, which enables them to manage the activities effectively and owned more colony size than the younger. During the discussion with the respondents the younger age group lack attention and explanation about the problem of beekeeping and their experience in beekeeping activities where as the older age group have rich experience in explaining about their hive and problems related to beekeeping. This explanation is supported with the age category of the innovative farmers of the two innovations. Both of the innovative farmers are found at the older age category that enables them to accumulate rich experience and knowledge in beekeeping.

Beekeeping as an occupation have continued to decline from time to time due to inadequate support to participants and continued use of chemical spray. From my experience and field observation, the study areas have the potential for bee keeping but the recurrent drought and uncontrolled chemical spray seriously damaged the sector and, the trend of practising bee keeping reduced significantly. During my study, one of the interviewee explained his colony size has declined from 56 to 8 in ten year's time. This indicated that the future fate of the sector is at risk and the foreign currency generated from this sector will also decrease. A country like Ethiopia, where landless youths are high, beekeeping as a sector is appropriate employment opportunity but the focus given to the sector is limited. Beekeepers are disappointed by uncontrolled chemical spray for the prevention of crop pests and weeds that may force them to get out of the business. The extension system does not consider the problem and concern of beekeepers to provide support or to design approach that can address the problem or need of majority of the farmers. There is no coordinated effort between different actors to harmonize problems and demands of beekeepers in connection to abandon of chemical spray.

5.3. Triggering factors and process of innovation development

5.3.1 Beehive innovation

From experience, noble ideas and local innovations have been generated from the problems and/or opportunities that the farming communities have been facing. The bases of farmer innovation can be either a challenge/opportunity they face or being exposed to outsider's knowledge and technology. In view of that, beehive innovation was generated in response to solve the drawbacks of traditional beehive in connection to low productivity and inconvenience for management. According to the empirical finding during my study, the opportunity to be exposed for improved beehive has also contributed for the development of his model of beehive innovation. As it was confirmed from the field study, the innovative farmer has long years of experience in beekeeping activities. He was striving to improve productivity and management practices realising that management practices and harvesting of honey from traditional beehive is difficult and needs much time and labour. In the earlier time, he has been managing up to 45 traditional beehives. Hence, inspection of honey bees and honey harvesting from the traditional beehive was tedious and hard work for the innovative farmer.

Beekeepers in the rural setting suffer all over the night to harvest the honey since all hives reach for harvesting on the same time. During harvesting period, the innovative farmer has been working all over the night before the honey sucked by the bees. Harvesting honey has a critical time before the bees suck the honey. Nevertheless, traditional beehive is not

convenient to harvest since honey combs are fixed on the cylindrical hive through which bee keeper cannot see the honey to be harvested or left. As it was explained from the innovative farmer he gets illness for some days after harvesting of the entire hives due to hard work during that critical period. To that effect, he was looking for solutions to improve the management aspect and productivity of traditional beehive. The exposure to modern beehive was an opportunity to innovate and explore solutions for the problem he has been facing. After he received this information, the innovative farmer was motivated to buy and test the new technology on his garden. However, getting the improved beehive at affordable price was challenging to the innovative farmer.

Inaccessibility of modern beehive in terms of price and requiring extra accessories for honey extracting and comb moulding triggered the innovative farmer to construct modern beehive from local material in his design. As he explained during the interview, he took the dimension of modern beehive and he tried to construct as per the design and dimension of the modern beehive demonstrated by ministry of agriculture. The innovative farmer constructed the copy of modern beehive from local material and transferred honey bees. Few days after transferring, the transferred bee colony absconded leaving the constructed hive empty. In the first trial, the innovative farmer was not successful, which indicates that innovation generation is an interactive process that needs the involvement of different actors. Meanwhile, ASE has intervened in the area and started to introduce intermediate beehive. Before introduction of the hive, training program was organized and the innovative farmer was one of the trainees and provided the intermediate beehive. The innovative farmer found out the intermediate beehive has also drawbacks in managing beekeeping activities like feeding and harvesting of honey. Besides, preparation of top bar from the local material was difficult at farmers' level. Then the innovative farmer decided to design by his own improving the draw backs of the modern, intermediate and traditional beehive using fixed top bar on pieces of timber.

Finally he came up with his own new model of beehive with the mix of modern and intermediate beehive, which is constructed from the local material. To sum up, the whole process that the innovative farmer passed through contributed to the generation and development of the beehive innovation that fits and suits local situation. In this connection, Gebremichael (2000) explained innovation process is an effort made by farmers to make the technology fit to own reality or improve effectiveness, efficiency, productivity, profitability, durability, marketability, adaptability and sustainability. He also explained local innovation as a process is all about conducting informal experimentation by farmers and the innovation product is the value change that may take place in the middle or at the end of the process.

This innovation has generated through incorporating the knowledge of other sources but through completely modifying and internalizing in the local way of thinking and doing. In line with this finding, Leeuwis (2004) stated that innovation is neither originates from research nor science only but rather is the application of all types and sources of knowledge to achieve the desired social and economic out come. In the process of this innovation development, other actors were not involved in technical, financial and material support except little support of ASE in terms of experience sharing, training and material. To summarise the triggering factor for the development of the beehive innovation, can be grouped as problem led and opportunity driven that the innovative farmer has passed through it. Exposure to training and improved beehive, as an opportunity and inconvenient management practices and low productivity of traditional beehive as a problem have contributed significantly for the generation of the beehive innovation. However, it took long time and resource to generate the beehive innovation. Had it been with interaction of other relevant actors, the time taking for technology generation would have not taken such a long process.

5.3.2 Queen replacement innovation

From time immemorial farmers have not waited for the researchers to improve their farming system through innovation (PROFIEET, 2004). When farmers face with problems that are threatening their survival, they get courage and capacity to experiment and innovate. In view of that, the innovative farmer was faced problem in managing his hive due to the swarm, low productivity and stingy behaviour of his bee colonies. From field observation and group discussion, it has been identified that the innovative farmer has rich experience in bee keeping that gained from practice and from his parents. He knew the characteristics of his colonies in terms of productivity, aggressive/docile behaviour and tendency of swarming. As indicated in section 4.3.2 the characteristics of beehives owned by the innovative farmer grouped as 12 are productive but aggressive, 10 tend to frequent swarm and 13 were docile and productive that has honey at any time. The aggressive character of his bee colonies worried him for long years since those bee colonies affected children and animals during harvesting season. He used to move his children and animals during the honey harvesting period to protect his children and animals from bee stings. This is an extra work and displacement for the innovative farmer.

According to the information obtained from the innovative farmer, one day night in the year 1985 he was in deep contemplation to look for solution to reduce the aggressiveness of his bee colonies and improving productivity like that of the docile and productive colonies. Abruptly, the idea of replacing the queen of the docile and productive colony to the aggressive and unproductive colony comes in to his mind. In the following day, both the docile and productive colony and the aggressive colony that has swarm nature brooded on the same day. Taking this advantage, the innovative farmer replaces the queen of the colony from productive and docile colony to aggressive and swarming colony. The newly replaced colony kept in the garden for two years and exhibited more production and reduced swarming. He improved the productivity of the colony by 50 % and reduced the swarm nature of the bees.

In scientific research, through breeding it is possible to improve productivity and behaviour through transfer of genetic potential of one trait to the other which the innovative farmer did in his innovation development process. The triggering factors for this innovation development are the problem he experienced. Low productivity, aggressiveness of the bee colonies, existence of frequent swarming are the main triggering factors for the generation of queen replacement innovation. During the innovation development process, he was the only to innovate and experiment on this innovation. Within the household, his sons were assisting him in providing the necessary working tools but other actors were not involved in the process that affects the learning process and knowledge circulation among actors.

5.4. Description and relative importance of the two innovation

5.4.1. Beehive innovation

As it is described from the findings of this study, the newly generated beehive is designed in a way to suits to the small scale farmers. It is constructed from the local material that beekeepers can access in their vicinity. This hive is constructed after repeated trial of the innovative farmer. It has cupboard like shape having three partitions of which two chambers are for honey production and the bottom chamber is for brooding where the queen is living and breeding. The hive shares the characteristics of improved beehive and intermediate beehive. As modern beehive, it has three chambers where breeding and honey production is carried out. It has also queen excluder to protect the queen from laying eggs in the honey chambers during honey production season. It is cost effective and manageable by beekeepers. As is indicated in the result section, the dimension of the hive is 64cm height, 30 cm width and 48 cm length.

Unlike the improved beehive, this hive has fixed top bars attached on the pieces of timbers that significantly solved the problem of preparing top bar at farmer's level. In each pieces of timbers 8 strips of bamboo splits are fixed and attached by keeping the space between two top bars and natural distance of honey combs. This hive shares the characteristics of intermediate beehive with existence of top bar. The physical description of this hive has already explained in the result part but the emphasis given for this technology in this section is about the relative advantage of the hive as compared to the improved and intermediate beehive. According to the information obtained from the beekeepers, innovative farmers and extension workers and my field observation, beehive innovation has the following relative advantage as compared the existing beehive in the area.

Convenient to smoking during harvesting: The newly designed beehive has adequate spaces for smoking that enables bee keepers to remove bees from combs during harvesting. The innovative farmer has created smoking hole and improved the direction of the smoking hole parallel to the honey comb that exposed bees to the smoke during harvesting and internal inspection. Modern beehive and intermediate beehive introduced in that area have no smoking hole that resulted damages on bees and affect the quality of honey. Smoke in nature moves in a vertical direction but not down ward that smoking makes difficult in modern and intermediate beehive since they do not have smoking hole. Beekeepers in modern and intermediate beehive smoke from the top by removing the upper cover that create some times damage on bees due to fall of fire from the smoker. Realizing that smoking is the first step during opening of beehives and important in bee keeping activities, the innovative farmer did significant improvement on the smoking hole and the direction for smoking parallel to the combs. From my field experience, most introduced beehives have no smoking hole or perpendicular to the comb.

Unlike those types of beehives, the newly designed beehive has smoking hole which is parallel to the comb direction that enables beekeepers to readily remove bees from the comb by little smoke since bees are exposed easily to the smoking direction. Therefore, honey can be harvested without the damage of bees that improves the quality of honey as the result of using optimum volume of smoke to take away bees from honey comb. Therefore, the innovative farmer has solved the problem of bees' damage during harvesting and he has also contributed for the quality of the honey by reducing the damage of the bees that would have been mixed with honey during harvesting. This smoking hole has enabled the beekeeper to use optimum volume of smoke that contributes to maintain the natural flavour of the honey and reduce bee damages. Besides, he has also reduced the time for harvesting since the bee keeper can easily take away bees so that he/she can carry out inspection or harvesting in short time.

Convenient to feeding and adapting small size bee colony: as one of the management practices in bee keeping activity, provision of supplementary feed is fundamental when bee forages are not available. From the interview with the innovative farmer, some bee keepers in that locality prepare artificial bee feeds during the dry season. However the traditional way of feeding bees is outside the hive, which has more likelihood to be stolen by other strong bee colonies or ants. Outside feeding creates competition and fighting between different bee colonies that might result the significant death of bees of different colonies. Incognizant of that, the innovative farmer created space for feeding inside the upper partition of the hive. From the interview with the innovative farmer and my field observation, I comprehend that the newly designed beehive is convenient to adapt small size of bee colony by adjusting the spaces according to the size of the colony and by introducing fixed top bars having larva from strong hive. During the study, it is confirmed the innovator farmer has adapted more than 8 small sized bee colonies using the newly designed beehive using the above indicated management practices.

Improving productivity: From field observation and interview with the bee hive innovative farmer, the productivity of the newly designed beehive increased from time to time due to the relative advantage of the hive in terms of feeding, inspecting and reduction of bee damages during harvesting. According to the information obtained from the interview of the innovative farmer, he has harvested 32 kg of honey from one time harvest from two chambers of the hive excluding the honey from the brood chamber. Productivity of beehives in the area in each hive type ranges 5-15 for traditional and 15 -22 kg intermediate and 20-35 kg modern beehive (Enebsie MoA, 2007). This productivity varies from year to year depending on the availability of bee forages and management practices. Honey can be harvested by the beekeeper from the newly designed beehive without technical and material support of the beekeeping experts but improved beehive cannot be harvested by the beekeeper alone but needs the technical and material support like honey extractor to extract honey from the frame hive and it is not affordable for small scale farmer.

Reduce cost for beehive purchase: According to the information obtained from the interview and focus group discussion, the current price for modern beehive is Eth Birr 465, which is equivalent to 51.5 US dollar excluding all the required accessories for it. Accessories like wax moulding and honey extractor are not totally affordable with the small scale bee keeper. The innovative farmer explained his hive is constructed from the local material and costs maximum of Eth Birr 58 (5.5 US dollar) and it can be managed by the small scale farmer since the required materials for construction are available at local level. This innovation has also alleviated the problem of preparing top bar from local material keeping the design and accuracy of the top bars for intermediate beehive. One hive has 28-32 top bars depending on the dimension of the hive and each top bar costs about Eth Birr 4-5 that amounts a total of Eth Birr 140-160 (15.5-17.75 US Dollar) per hive excluding the main body of the intermediate beehive. To sum up this innovation has reduced cost of labour and material without affecting the productivity and quality of the hive. In connection to the relative advantage of the beehive innovation, extension workers and experts are agreed as this hive is convenient to management and cost effective but they were reserved to respond on the productivity and honey quality. This reservation may rise due to low involvement through the process. However, beekeepers explained as this hive has significant importance in simplifying management practices, cost effectiveness, productivity and improve honey quality.

5.4.2 Queen replacement

As it is indicated from the findings of this study, queen replacement innovation is not like technologies that can be seen physically but it is a practice and idea generated by the innovative farmer. This innovation works on improving the productivity and behaviour of bees through replacing queens from one colony to the other colony. After long years of beekeeping experience, the innovative farmer screened and categorized his beehives as productive, aggressive and tends to swarm. From this finding, one can understand how farmers are knowledgeable to conduct research. The innovative farmer generates an idea of replacing the queen from one colony to other colony to improve the characteristics and productivity of his hives by making selection among his beehives. The relative importance of this innovation is depicted below.

Improving productivity and behaviour: As it was discussed in the description of this innovation, the innovative farmer has three types of beehives in terms of productivity and characteristics. Some of the beehives produce less but docile character and other have high production but aggressive. The remaining behaves swarming every brooding time. These were the problems of the innovative farmer faced in his bee keeping business. From the discussion and interview with the innovative farmer, it is explained that the innovative farmer has improved productivity from 5 kg to 10 kg per hive. In other words he has increased income generated from sale of honey as a result of increasing productivity per hive. The innovative farmer has also improved the aggressive behaviour of his hives through replacing

the queen of docile colony to the aggressive colony. This may be happened due to the improvement of the genetic make of the aggressive colony as a result of the replaced queen. This was great achievement for the innovative farmer since he has settled his big worry during harvesting of the aggressive colony.

According to the information obtained from the innovative farmer, he sometimes forced not to harvest the aggressive hives due to afraid of bee sting during and after harvesting. The innovative farmer has also explained as he reduces the smarmy nature of his colonies. Currently one bee colony costs about Eth birr 300 to 500 (33.3 to 45.5 US Dollar) that the innovative farmer and other bee keepers have been losing every swarming. In total, the innovative farmer increased the number of bee colonies and the income through improving the genetic makeup of bee colonies. The relative importance/added values of this innovation are supported by respondents in the interview and focus group discussion.

5.5. Compatibility, complexity, affordability and sustainability

As it is indicated from the result section 4.5 the views of interviewees on the social learning and adoptability of the two innovations have been gauged taking compatibility, complexity, affordability and sustainability as parameters. All the beehive innovation respondents agreed the beehive innovation is compatible, affordable and sustainable but they gave due emphases on the complexity of the hive to be tested and adopted by the ordinary bee keepers. The views of beekeepers on the nature of the beehive innovation indicates that beehive innovation needs to be further developed or the innovative farmer should participate the beekeepers and other relevant actors from the start of the innovation generation to the development process for smooth scaling up of the innovation at wider scale.

As it is confirmed from the focus group discussion, construction of beehive innovation is time taking that makes the innovation more complex. The skill and the time it requires for construction has also constrained the scaling up and scaling out of the beehive innovation. Social and technical dimension of the innovation determine acceptance or rejection of innovation. Innovation should be technically sound and socially accepted to be adopted in the respective locality. In this connection Leeuwis (2004) explained that “we can only speak of complete innovation if an appropriate mix and balance exist between technical devices and social organizational arrangements and practices”. Farmers did not accept innovation only for one advantage but also they consider the technical competence to manage and social dimensions and consequences of the innovation against their context. All respondents of beehive innovation agreed that beehive innovation is compatible, affordable and sustainable but complex to ordinary beekeeper to construct and test the innovation at individual level. They specifically emphasis that the preparation of the internal partition of the hive and fixed top bar need accuracy and adequate time to prepare.

On other hand all queen replacement interviewees agreed queen replacement innovation is compatible, affordable and sustainable. Only one respondent explained this innovation is complex but 90 % of them confirmed as the innovation is not complicated to test once the idea is generated and communicated. As compared to beehive innovation, queen replacement innovation has high acceptance by the beekeepers for practicing and testing. From this finding we comprehend that there are farmers’ innovations that can be scaled up among farmers without further improvement and involvement of other actors and there are also to be further developed and improved in the involvement of relevant actors. In connection to this Dorman (2006) argued that local innovations cannot be transferred from one location to other through ToT model due to that fact that innovation is location specific and their redesign and adoption is collective efforts by different set of actors. This argument may not work for all types of innovation since my findings for the idea of queen replacement innovation indicates queen replacement innovation can be adopted and tested by beekeepers that oppose Dorman generalization. Hence it has to be taken in to consideration as there are innovations that can be emerged and transferred within the community without

the involvement of other actors. However, Dorman argument fit with the findings of beehive innovation which was identified by beekeepers as complex to practice and transfer from one location to other location through ToT model.

5.6 Information communication on the two types of innovations

Availability and accessibility of information is vital for development initiatives or to induce innovation. As it is indicated from the finding, circulation of information about beehive and queen replacement innovation was not to the anticipated level. Actors were not involved in the process despite the fact that innovation is network of actors with different background knowledge and experience. According to Leeuwis (2004) communication is an important process used by people to exchange experience and ideas and hence a vital trigger for altering knowledge and perception of various kinds. This explanation can be confirmed if the communication pattern is all directional and the information is communicated timely. Information circulation about the development of this innovation was limited. As it is indicated from previous chapter of result section, 60% of queen replacement innovation interviewees were not aware even the existence of that innovation. It is not only the beekeepers that lack the information but also extension workers who are responsible and assigned as communication workers in that village do not have the detailed information about queen replacement innovation. This information gap has created due to the fact that the innovative farmer was not transparent and the communication workers were not proactive to seek and identify knowledge and experience of the local people.

From the group discussion, it is confirmed that extension workers used field day as means of exchanging information and demonstrating technologies that have to be disseminated to the community. In line with this, communication workers in the village of beehive innovation have organized field day and demonstrated beehive innovation in the presence of beekeepers in that locality. It is confirmed that 50 % of the beehive interviewee responded as they have seen the beehive innovation during the field day. Farmers in the rural community have means of communication among themselves using different forums and events but those means did not apply to exchange information on the development process of the two innovations. However, 25% of the beehive and 20 % of queen replacement innovation responded as they accessed to information on those innovations from the innovative farmers.

In the innovation development process, communicating the relevant actors and sectors is vital to generate coherent innovation. Nevertheless, findings from the interview and focus group discussion indicated there was no communication between actors from the start of the innovation generation. In the case of beehive innovation development, it is indicated as there was frequent contact with ASE to get material and technical support. However, exchange of ideas, experience and knowledge only with ASE has not facilitated and enhanced the scaling up of the innovation. Other relevant actors should have been communicated and get adequate information about the innovation from the commencement to the generation of the final innovation product.

5.7 Policy support for local innovation

The existence of favourable approach for generation and promotion of local innovation is vital to build confidence and enhance experimentation capacity of small scale farmers. As it is indicated from the findings, however, the existing government extension approach has not considered the knowledge of farmers for technology generation and dissemination. All the respondents and focus group discussion participants confirmed that the extension approach is not supportive to the enhancement of local innovation. The approach is designed in favour of scientific innovation and staffs working in the rural are assigned to promote and disseminate technologies that are generated by scientist from research institutes. It has been considered that scientific research is the main driver of creating new knowledge and technology that can be transferred and adapted to different situation. In view of that research

based technologies have been disseminated for decades but their outcome on livelihood change of the rural poor is not satisfactory.

In the area where socio economic problem is complex, the appropriate intervention to get out of the poverty trap should not be only knowledge and technology of scientist but the knowledge and experience of the local people have a vital role if it is well managed and utilized. According to (Ponniah et al 2008) extension that is not in touch with and does not significantly contribute to the improvement of the life situation of its client has lost its legitimization. Historically, Ethiopian extension approach has not been in touch with the clients but it has been designed from the top by adopting others approach and have been implemented across country, however, the livelihood of the rural poor has not improved and the legitimacy of government extension approach is under question in view of the farmers.

As it is indentified from the focus group discussion, extension workers have no attention for the development and utilization of local innovation but they are sympathizing only with scientific innovation. There is no assumption that an innovation process starts with research or that knowledge feeds directly or automatically into new practices, processes, or products. Instead, the knowledge and information flows at the heart of an innovation system are multidirectional (World Bank 2006). Extension workers of MOA pointed out as they have never mentioned the issue of promoting local innovation other than science born technologies. Respondents confirmed the current government extension system follows top down approach in which the need and concern of bee keepers are not considered in the designing and implementation of the existing extension approach.

According to the information obtained from innovative farmer and bee keepers, the extension system is designed in favour of crop production and overlooked the livestock sector in general and beekeeping in particular. On the other hand government has extensive program on provision of modern beehive but chemical spray as crop production package promoted by extension workers has seriously affected the beekeeping activities. Findings from this study also pointed out field extension workers assigned in each village have no common goal and lack coordination in serving the rural community. Crop expert promote prevention of pests and weeds using pesticides and herbicide where as livestock expert working in the same village prevent spray of chemicals for prevention of pest and weeds. As a result, beekeeping activities become at risk and some of the beekeepers have left and others are going to leave from the engagement.

The discussion with the program director of ASE indicated that, the organization has approach and strategic direction in identifying farmer innovators and supporting innovation development. As it is indicated from the finding in section 4.7, the approaches that are being used by ASE for the scaling up and encouraging innovativeness includes: giving recognition for the innovative farmer, provision of required support, create linkage with SHs, facilitate demonstration and presentation of findings, documentation, sharing the result and capacity building training. These approaches as a strategy of promoting farmers knowledge are appropriate to scale up and encourage innovativeness across the farming community but the empirical findings indicated that most of the approaches are not fully implemented. Designing attractive strategy and development approach by its own cannot be an end but the most important part of it is implementation strategy, which requires time and energy to put in to practice. The effort of ASE alone may not bring change in promoting and enhancing experimentation capacity of the local farmers but it requires compatible approach and coordinated effort to integrate other stakeholders. ASE has been working with MoA to integrate farmers' innovation with the public extension but the public extension does not so far adapted farmers' innovation in its extension approach. From this finding, it is clear that ASE should intervene in approach influence about the significant importance of local innovation by digging out the overlooked knowledge and demonstrate them in the presence of policy makers.

5.8. Documentation

The empirical findings indicated that the innovative farmers and other actors did not document the process of beehive and queen replacement innovation. Documenting own experience and process is indispensible for scaling up and sharing experience to others. Only when the documentation process is carried out with relevant actors through group dynamics new knowledge can generate from the process (Chavez-Tafur et al, 2007). However, the documentation process of the two innovations was not conducted even by the innovators or extension workers. During the field observation, it was not possible to get documented or recoded data about the process and results of the two innovations. It is important to note that piece of knowledge or innovation is considered worth if it is documented and recoded well to share for others. Without proper documentation through the involvement of relevant actors, it may be difficult to share and generate new knowledge from experience. Documentation can serve as source of knowledge to learn from experience both success and failure that other can draw lesson from it. As it is indicated from the 2007-2011 strategic plan document of the ASE, documentation of the research findings and sharing the results is one of the activities stated boldly under participatory research and development. However, the organization has no well documented information about beehive and queen replacement innovation. This may be happened due to lack of attention or limited knowledge and skill of the field extension workers, experts and other relevant actors for documentation.

As it is pointed out from the findings, the innovative farmers are conversant to explain about the nature of their innovation and the process how they reach in to the stage of final product but when the innovator are not there no one can explain about these valuable innovation. In this regard Grenier (1998) discussed that more indigenous knowledge are being lost because these knowledge are transmitted orally and it is vulnerable to rapid change especially when people are displaced or when young people acquire values and life styles different from their ancestors. This explanation indicates how valuable innovations are at risk to vanish due to unavailability of proper documentation for local innovations and knowledge of farmers.

As indicated from the queen replacement innovator, he has no interest to document the process and the result of his innovation since the prior intention of the innovator was to use the innovation for his own. From this explanation one can understand actors in development and research should give due emphasis to enhance the knowledge of the farmers about the importance of documenting experiences and findings. Besides, findings and process of research and development initiatives need to be documented to evaluate the process, learn from experience and to share for others. Knowledge can be circulated or shared from generation to generation and between different actors if there is proper documentation. According to (Chavez-Tafur et al, 2007) documenting own learning experience facilitate lateral learning and speed up the process of innovation change where formal system has not been very successful. In documenting the process, new knowledge can be generated as the result of the interaction and reflection of different actors. But the culture and experience of actors in the study area in documenting local innovation development process seems limited that may affect knowledge sharing and circulation, which ultimately hindered scaling up of beehive and queen replacement innovation.

5.9 Actors and their role

As I realize from the long journey of the queen replacement and beehive innovation development process, participation and interaction of relevant actors is limited or nil. There was no link between actors to create dynamic system of innovation development process. Absence of this link may hinder the generation of viable innovation in short period of time. As per my field experience; innovation, which is initiated and owned by individuals without the involvement of relevant actors have not been sustainable. In this connection Leeuwis (2004) stated innovation process is not likely to be successful if they are scientist owned and

/or initiated. It may also true for the innovation owned and initiated by individual farmer, since coherent innovation development requires the involvement of different actors in every stage of innovation generation process. As it was pointed out from the focus group discussion, ASE has overlooked coordinating stakeholders from the start of innovation generation to the scaling up of the generated beehive innovation. However, ASE has been providing the required support to the innovative farmer throughout the process.

In the course of innovation development, enhancing and strengthening collaboration across actors and sectors has an advantage of creating enabling environment for the generation and scaling up of the would be generated innovation (world bank, 2006). However, findings from the study indicated that there was no responsible body to bring those concerned actors in the development of the two innovations. For the generation of doable innovation, extension workers should have frequent contact and visit with the innovative farmer nevertheless the empirical study indicated that extension workers and experts from ministry of agriculture did not communicate and interact with the innovative farmer. The attitude of experts and extension workers to work with and learn from the innovative farmer was found low perceiving that farmers have no noble ideas that can be shared to 'experts'.

As it is indicated from focus group discussion, the proposed relevant actors for the generation of the two innovations are Ministry of Agriculture, ASE, innovative farmer, research institutes, CBI and beekeepers in the respective village. The interaction and participation in the process would have been indispensible for the generation of coherent innovation in short period of time. Nevertheless, none of them were participated except the innovator and some support of ASE. The innovative farmers involve their sons to assist them in providing necessary materials that are required for hive construction and queen replacement but their son have no skill and knowledge about their father innovation this may be due the innovator were using their son only for material provision or the son may not have an interest to learn from their father for various reasons. As it is indicated from the findings of the study, queen replacement innovation was generated 25 years ago but it has been kept as secrete in the hand of the innovative farmer. From these findings we can imagine how cultural barrier affected the disclosure of valuable innovations that would have been helpful for the benefit of the larger society. Most beekeepers and extension workers have no an idea and information about the existence of that innovation leave alone to participate in the process.

5.10 Networking

Networking is relation building between individuals, institutions and organizations. The most important aspect of networking is to have something to share for the relationship. As per the findings of the study, there was no functional network between the relevant actors that would have been established in the development process of the two innovations. The establishment of functional networks often results not only in new knowledge generation, but helps to stimulate and reinforce innovative attitudes within the network [http://www.casadofuturo.ua.pt/En/Papers/]. From this explanation it is apparent that networking allows you to share initiatives across your area of expertise and potentials. It also develops a group of resources that can refer to for advice, and knowledge. To the contrary findings of the study pointed out the traditional attitude and practice of actors in the study area hold back to network and interact for common goal and shared vision. The study also found out as there was no responsible body to facilitate the establishment of the networks between the identified actors.

A successful network in innovation development process requires a mutual understanding from the start that it is both about what you can contribute and what others contribute for the generation of coherent innovation. As it is pointed out from the focus group discussion, actors that could play vital role for the generation of the two innovations exist in the area but these actors are not involved and communicated from the start of the innovation

development process that have an impact on the scaling up of the two innovations and sharing the knowledge gained from the process. The only network functioned during the process is the link between ASE and innovative farmer but this network was limited between two actors that limit information and knowledge circulation among actors. Besides, it may have limitation on the generation of new knowledge that would have been generated through the interaction and reflection of different actors. ASE has networking strategy on promoting and scaling up local innovation but findings from this research indicated that the functionality and implementation of the strategy is not to the anticipated level. As per the discussion with ASE staff, willingness for networking from one party cannot be successful if not others is cooperating for the network. Findings from this research indicated that, ASE has been trying to create network with relevant actors for research and other development initiatives but other actors are not willing to maintain the network.

The dynamic global change circumstances forces to seek a network to interact with each others to bring changes and to survive with the changing circumstances but in individual path way is not longer feasible to gain knowledge and experiences from other sources [http://www.casadofuturo.ua.pt/En/Papers/]. The incompatibility of working modality, objective, values vision, mission, experience and knowledge of the relevant actors in the network of local innovation development have contributed for the poor network creation and malfunctioning of the existing network. Organizations or individuals rarely innovate alone, and when they do, the innovation process is usually inefficient and unsustainable [http://www.casadofuturo.ua.pt/En/Papers/]. More efficient solutions are based on interaction with other individuals and/or institutions in order to acquire, develop and share information, knowledge and other resources. As it is discussed with respondents, ASE has been identifying and facilitate networks based the potential of the organization or individual to the development of local innovation but the ASE may not consider whether the organizations have common strategic direction in encouraging local innovation specifically, common goal, shared vision, mission and competence in the identified innovation that ultimately affected the functionality of the network. Therefore, gathering full information about the organization, institution or individuals is vital and important aspect of networking to create effective and functional network among actors.

5.11. Social learning in the process of innovation development

In this section ‘learning’ in the context of knowledge sharing and innovation development refers to dealing with adult bee keepers who confront with interlocked problems and other actors that have stake in the generating and developing beehive and queen replacement innovation. As it is pointed out from the result of the study, learning among different actors was not carried out. The existence of poor linkage between different actors in the innovation development process affected the social learning process. If social learning has to be carried out, functional network of actors should exist in the area on the identified learning or researchable issues. Social learning can be facilitated if actors are willing to provide institutional and organizational support for the learning process. As it is indicated from the result, the learning between main actors at grass roots level that includes: an innovative farmer, beekeeper and extension worker was not successful.

It is general truth that farmers learn more from his fellow farmers than outsiders do but in the case of beehive and queen replacement innovation, this reality did not work out. This may arises from many reasons. However, the attractiveness of the learning topic/issue and lack of information access and clarity about the two innovations were identified for the failure of social learning process. Besides, the attitude of facilitator who provides backstopping for the learning process has also contributed for the hindrance of the learning process. In connection to facilitating or hindering factors about learning, Leeuwis (2004) stated that learning is a practice that affected by different factors like frame of reference social pressure and self efficacy. He also indicated that the interrelated factors and process that may influence people’s motivation to learn include the relative importance, seriousness of

experienced problem, urgency, self efficacy, environmental efficacy, complexity, observe-ability, and clarity about the problem.

As it is indicated in section 4.6, 25 % of beehive and 20% of queen replacement innovation interviewees accessed to information and learned from the innovative farmers but only one beehive innovation interviewee who has close link and pass through the innovation development process practiced beehive innovation in his garden. In this connection, (Dietrich Daar and Juregen Pretzsh, 2008) suggested that actors who have stronger links to the source are more likely to adopt the innovation which is strongly supported by the findings of one interviewees indicated above. This finding indicates the learning process might not effective either due to the complexity of the innovation or the learning process was not action oriented and participatory. On the other hand, interviewees indicated queen replacement is not complex to practice if someone are told or learn about the innovation yet no one has adopted the innovation. This may not be due to the complexity of the innovation but the learning process is hindered by low information access to beekeepers about the innovation. This is supported by the field findings that 50 % of beehive interviewees have seen the innovation for the first time during field day. As indicated in section 4.6 the deep-rooted cultural barrier to visit the garden of farmers has also constrained the practical learning process. In the study area, it is hardly to visit the beekeeping site of someone perceiving that the bees will abscond if visited by other farmers that ultimately affect the practical learning among beekeepers.

Field staffs who are acting as communication workers are responsible to facilitate learning and knowledge circulation between different actors. However, the empirical findings indicated as they are not motivated to facilitate the learning process and learn from farmers.The traditional attitude and practice of extension workers on farmers' knowledge hold back them to interact and facilitate learning among farmers and extension workers. Besides, the existing extension approach did not encourage and motivate extension workers to work with innovative farmer rather it promotes technologies that are generated outside the context of the farming community. Extension workers has also confirmed as they are not motivated to work with the innovative farmer since they are task oriented and assigned for promoting and transferring of technologies generated from the research centre. The approach may create an impact on the initiation of extension workers to work with and learn from the innovative farmers.

According to the information obtained from the focus group discussion with field staffs, the innovative farmer was not transparent to share his innovation explicitly. He did not consult field staffs and beekeepers to test the innovation jointly except requesting ASE to get protective and other bee keeping materials. Unwillingness of the innovative farmer to share his knowledge and experiences from the very beginning of the process might be the issue of getting intellectual property right and to be benefitted from his innovation. This finding indicates that social learning has been affected not only by lack of motivation of other actors to learn but also transparency of the innovative farmers to share.

According to the information obtained during focus group discussion with ASE staffs, ASE has played a role in circulating the knowledge and idea of beehive innovation to the local community and other relevant stakeholders after the innovation has generated by the innovative farmer using field days and other events. However, it is hardly to get beekeeper that practiced or adopted the innovation. This finding indicated that obtaining information only about specific innovation did not lead to the implementation but it needs close interaction and discussion to practice in the context of other localities. As indicated above on the Dorman's argument in the scaling up of local innovation up and adoption of local innovations in different context requires new elements of learning and negotiation to fit specific circumstances.

5.12. Facilitating and restraining factors for knowledge circulation

From the discussion presented in all section and result section 4.12, facilitating and restraining factors of the two innovations are clearly identified as summarised below.

Facilitating factors

Interest of farmers to learn from fellow farmer: The rural community have their means of information communication to their fellow farmers. Farmers of the study are not exceptional to share and learn each other. The well established traditional systems to share and exchange information may have vital role in circulating knowledge from one source to others. Interviewees explained as they prefer to learn from fellow farmers since they can interact freely and learning is practical from what fellow farmers did in their garden. In this connection, one interviewee explained that "I prefer to learn from my fellow farmers than extension workers who appear for a while and disappear for long''

Establishment of Community Based Institutions (CBI): In the study area, CBIs are established through the facilitation role of ASE and initiation of the community. CBI has been used as consultation forum where the community meet weekly to discuss on their development efforts and share experience among members. Organized farmers under different activities like farmers field schools have monthly meeting with CBI and report to share the performance and experience drawn during implementing the project activities. Findings from the meeting will be disclosed to the general assembly in every six months that has been serving as an appropriate means of learning and knowledge circulation among the community.

Establishment of community learning forum (CoLF) in each village: This is the learning forum introduced by ASE recently in its new innovation and communication strategy. The forum is an ideal development and learning forum where the community will raise discuss, and analysed social and economic issues (Assefa et al 2006). CoLF will give an opportunity to create strong social and economic bond between members and continue to learn over years.

Establishment of Farmers Training Centres (FTCs): Ministry of agriculture has designed new extension and training approach that focuses on building capacity of the farmers through training by organizing in group in different discipline. The training centres have demonstration site for practical training that are helpful to learn from practice be it farmers' or scientific knowledge. These centres can be considered as an opportunity to facilitate learning among group members.

Restraining factors

Attitude and perception towards local innovation: The traditional attitude and practice towards local innovation has restrained the knowledge circulation between farmers and extension workers. The long standing tradition about knowledge source was from scientist but farmers know more about their practice and environment than outsiders. These attitudes of extension workers restrain knowledge circulation between actors unless this institutional barrier is broken to facilitate learning from all sources.

Cultural barrier: though the community have practice of communicating and sharing information and knowledge, there are still cultural barrier that affect the learning and knowledge circulation among the community. As it is indicated from the result and discussion of this study, farmers are not freely move and visit the garden of their fellow farmer to draw or get practical lesson from the ground. Hence, the existing cultural barriers restrain knowledge circulation among the community.

Lack of transparency of the innovators: Existence of innovators in every village is an opportunity to facilitate learning but lack of transparency is a challenge. Innovative farmers

have an intention to use their innovation for their own and there is no system established to encourage those innovators to disclose their knowledge and circulate within the community. Innovations owned by few individuals and if those innovations kept for long with the same individuals, there is high likelihood to vanish when the knowledgeable old dies that will have an impact in circulation and transfer knowledge from generation to generation. To encourage innovativeness and facilitate knowledge circulation there should be a system that motivates farmers to disclose their innovation and motivate others to be innovative.

Unsupportive extension approach for local innovation: Learning between actors will be facilitated if the learning process has institutional and organizational support. The existing extension approach advocates for scientific knowledge and consider knowledge is concentrated from one source. The approach did not consider as local community is knowledgeable as scientist in specific matters and these knowledge are not yet utilized due to absence of supportive approach to facilitate two way learning.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATION

6.1 Conclusion

The study set out to explore facilitating and restraining factors for knowledge circulation in the scaling up of local innovation by taking beehive and queen replacement innovation as the case of the study. As it was discussed in the previous chapters, knowledge circulation and scaling up of local innovation has been facilitated and restrained by different factors. The interest of farmers to learn each other, existence of CBI, CoLF and FTCs could have been used as an opportunity to facilitate knowledge circulation among different actors; nevertheless there was no actor used these opportunities. On the other hand, attitude and perception of extension worker, the existing GO extension approach, cultural barrier, budget constraints for innovation, lack of transparency of innovators have restrained the knowledge circulation and scaling up of local innovation. As it is indicated in the previous chapters, ASE has not played a role in protecting intellectual property right of farmers and there is no rewarding system including allocating innovation fund for research that has also affected innovativeness and scaling up of local innovation. .

According empirical findings, the idea of beehive and queen replacement innovation was triggered by the problems that the two innovators have been experienced. Besides, exposure to others' knowledge and innovations has also contributed for the generation of beehive innovation.

Information communication between actors that are assumed to involve in the generation of those innovations was very limited. As it is discussed in the previous chapters, the relevant actors do not have functional network which enable them to circulate and access information about the development of those and other local innovations. The poor link and network with those relevant actors has affected negatively the knowledge circulation and scaling up of local innovation. Bringing different actors together and facilitate knowledge circulation was the prior task of ASE but the effort exerted in this regard was limited as reflected in the previous chapters.

The existing extension approach is not supportive to the enhancement of local innovation. The approach is designed in favour of scientific innovation and staffs working in the rural area assigned to promote and disseminate technologies that are generated by scientist from research institutes. ASE has supportive strategy that encourages innovativeness and promotes local innovation but only ASE's approach did not bring significant change in scaling up of local innovation and innovativeness. The extension strategy of ASE and government are not compatible yet these policies are implemented on the same farmer. There seems conflict of approach between government and ASE in encouraging local innovation and knowledge circulation.

Documentation of experiences and findings remains the major limitation of actors in the process of local innovation development. Both innovations have not documented by any actors that ultimately affected the knowledge circulation and scaling up of local innovation.

Despite networking is a powerful way of building relationship that actively foster contacts and disseminate information and share knowledge, it is found out there is no functional network for the generation and development of the two innovations. Major stakeholders identified in the innovation development process are not coordinated and motivated to scale up beehive and queen replacement innovation. There was not responsible body to coordinate and mobilise actors for the generation and development of local innovation. As per the empirical findings of the study, involvement of actors in resource mobilization, knowledge generation and circulation was very limited. It was limited to only between the two innovative farmers and ASE.

One of the most important issues in innovation development is the existence of social learning between actors for generation of viable innovation; nevertheless, the social learning process was limited except exchange of information between innovators and ASE. This has affected the circulation and generation of new knowledge during the interaction and reflection of actors. Cultural and institutional barrier highly affected the social learning process.

6.2 Recommendation

Based on the assessment of the empirical findings and discussions, the following recommendations are made.

- Considering the relative importance of the two innovations, ASE should play proactive role to involve research institutions, CBIs, beekeepers and extension workers for further improvement and development of the two innovations to scale up to the wider scale.
- ASE should facilitate and organize repeated workshop on the two innovations to lobby government officials for the recognition of local innovation and integrate farmers' knowledge with the public extension approach

- ASE should review its communication and innovation strategy to encourage innovativeness and scaling up local innovation in view of allocating fund for innovators, rewarding innovators, keeping the intellectual property right of the innovative farmers and establishing well organized documentation system from idea generation to development process of the innovation.

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8. ANNEX

8.1 Checklists for Agri Service Ethiopia program office staffs group discussion

1. What are the supports that ASE has provided to innovative farmers?
2. What are the strategies that are used by ASE to encourage innovativeness and facilitate knowledge circulation among actors?
3. What is the role of ASE in protecting the property right of innovative farmers?
4. What are the restraining and facilitating factors that ASE has faced so far?
   -Scaling-up of innovation
   -Encouraging innovativeness
   -knowledge circulation
5. How has ASE been working with stakeholders to circulate knowledge and experience of farmers in its operational villages?
6. How does ASE identify stakeholders for the process of innovation development?
7. What are the roles and responsibilities of stakeholders in the innovation development process?
8. How is the roles and responsibilities of actors defined?
9. How does ASE document the innovation development process and share the results to other actors?
   - procedures followed
   - actors involved
   - chosen format for documentation
   - sharing results
   - problems faced in documentation
10. What are the practical lessons drawn from the social learning process during the interaction and reflection of different actors in the network of innovation development process?
11. What efforts are made so far to integrate farmers' innovation with the government regular extension program and what are the challenges faced?
12. How does ASE facilitate knowledge circulation at local level?
13. What are the capacity building activities provided to innovative farmers and extension workers by ASE?
14. How is the integration of ASE with MoA and research institutions in knowledge circulation and scaling up of local innovation?
15. What do you suggest for the improvement of networking and social learning process between actors in the course of generating viable innovation?

8.2 Checklists for Ministry of Agriculture district staffs group discussion

1. What is the extension system that MoA is exercising currently?
2. What are the underline principles of existing extension system in terms of encouraging innovativeness, recognition of local innovation, knowledge circulation and participation?
3. How is the process of technology generation and dissemination carried out?
4. How is the flexibility of the extension approach to incorporate local innovation in the regular extension program?
5. How MoA has been working with ASE and innovative farmers in the process of local innovation development and scaling up of the innovation?
6. How is the motivation and interest of field staffs and experts to scale up and circulate knowledge of innovative farmers?
7. How does your office record and document local innovation?
8. How does MoA facilitate knowledge generation and circulation at local level?
9. Does MoA have a network with other actors in the scaling up of local innovation and knowledge circulation? Who are those stakeholders? How the network established?
10. Does MoA participate in stakeholder identification for network building among actors?
11. What are the practical lessons drawn during social learning process through interaction and reflection of actors/stakeholders in the process of innovation development?
12. How were you communicated by ASE for the innovation development and scaling up of local innovation?
13. What is the contribution of your office for the knowledge circulation and scaling up of beehive and queen replacement innovation?
14. What is the restraining and facilitating factors for knowledge circulation and scaling up of beehive and queen replacement innovations?
15. What do you suggest for the improvement of networking and social learning process between actors in the course of generating viable innovation?
16. How does MoA motivate its field extension workers to recognize knowledge and innovations of the local people?

8.3 Checklists for extension workers group discussion

1. How is the idea of beehive and queen replacement innovation generated?
    - Who, when, why, when, how
2. What is your role in the process of innovation development?
    - Facilitation
    - Technical support
    - Material support
    - Circulating their knowledge
3. How do you participate in the documentation of these innovations?
    - Role, availability of recorded documents, the process followed
4. In the process of innovation development who contribute what resources?
    - Material, technical, finance etc…
5. How do you communicate other farmers/bee keepers to circulate the knowledge? and experience of the innovative farmers?
    - Visit, field day, workshop
6. How do you consider the significance of these innovations for the betterment of the bee keepers?
7. How often do you visit and interact with innovative farmers?
8. In your opinion what are the added value of these innovations?
9. How are the compatibility, complexity, affordability and sustainability of these innovations in the area?
10. How many bee keepers practised these innovations in their garden? If not why and if adopted, how?
11. What are the main actors involved in the innovation development process at grass root level?
12. How is the motivation and initiation of the local people to learn from fellow farmer?
13. How do you evaluate the motivation and interest of innovative farmers to share their knowledge to other farmers?
14. What do you feel about motivation and initiation of the stakeholders on discharging their roles and responsibilities in the innovation development process?
15. What are the challenges and opportunities to scale up and circulate knowledge of local innovation?
16. What do you suggest for the improvement of knowledge circulation among actors?

8.4 Checklist for the innovative farmer interview

Name.....sex .....age..... beehive owned.....

1. What triggers you to start this innovation? When, where, why, how
2. Who has been working with you in the innovation development process?
   -Within the household, in the village, other actors
3. What are practical lessons you gained from the social learning process during the interaction and reflection of different actors in the network of innovation development process?
4. What are the types of problems that you solved by this innovation?
5. Whom do you consult during the innovation development process?
6. Did you record and document your innovation? If yes, in what form?
7. Who participate in the documentation process?
8. What is the role of actors' in the innovation development process?
9. Have you share your innovation to other bee keepers? If yes how? If no, why?
10. How many of them practised your innovation? How did you obtain the information?
11. How is the interest and motivation of bee keepers, extension workers and researchers to learn from your innovation?
12. What are the added values of your innovation?
13. How are the compatibility, complexity, affordability and sustainability of your innovation?
14. What are the challenges you faced during innovation development and scaling up of your innovation?
15. What are the factors that facilitate knowledge circulation, encouraging innovativeness and scaling up of local innovation?
16. What do you suggest for the scaling up of local innovation and knowledge circulation among actors?

8.5 Checklist for bee keeping farmer interview

Name.....sex.....age..... beehive owned.....

1. What are the extension services provided by extension workers related to bee keeping activities
2. How is your need and problem considered in the introduction of bee keeping extension activities?
3. Do you know existence of innovative farmers in bee keeping in your village?
4. Do the innovative farmer or extension workers communicate you about the innovation?
5. How do the innovative farmers or extension workers communicate you about the bee keeping innovation?
6. How is the motivation of the innovative farmer to share his knowledge and experience on bee keeping?
7. Do you ever visit the garden of the innovative farmer? If no why and if yes what was t like? What did you learn?
8. Have you practice the innovation by your own after getting or visiting the innovative farmer?
9. How is your motivation to learn and share experience from/to innovative fellow farmer?
10. What are the challenges that affect learning and knowledge circulation among the bee keepers, extension workers and the innovative farmers?
11. What parts of the innovation development process restrain you to learn and test beehive innovation in your garden?
12. What do you recommend on the scaling up of local innovation and encouraging innovativeness?