

*Full Length Research Paper*

# Assessing Extension Approaches for Bacterial Wilt Control with Potato Farmers in Ethiopia

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Accepted 26th January, 2019.

Potato production provides a source of both food and cash income in the densely populated highlands of Ethiopia, playing an important role in improving food security and cash income of smallholder potato growers. However, potato farmers in Ethiopia face many constraints, including: lack of access to improved high yielding quality seed, seed tubers and soil with a high incidence of bacterial diseases and lack of agricultural extension support services. This study explores three questions. How well do farmers understand bacterial wilt and the danger it poses for potato production? How willing are farmers to be become involved in collective/community action to prevent bacterial wilt? How can farmers take action to improve their response to the condition – should they rely on local knowledge or on science-based recommendations. The thesis is part of a larger research programme entitled *Developing sustainable seed potato production system for improved livelihoods* in 2015. The programme is supported by Vita and Teagasc and is located in Chencha Woreda in the SNNPR region of Ethiopia. The thesis employs mixed method research; including farmer surveys, key informant interviews, field observations and focus group discussions. The research activity was conducted in two selected kebeles. The research objectives were: (i) To investigate farmers understanding of bacterial wilt (BW), (ii) Measure farmers' willingness to engage in collective action and (iii) Devise best-fit technical information channels for acquiring and disseminating knowledge on bacterial wilt management. The study has shown that the communities are obviously cognizant regarding BW and BW ranks as the most important disease problem. Farmers concern with BW is understandable, considering that this disease indeed reduces potato yields and is a real threat to potato production, food security and farmers profit. However, a knowledge gap exists regarding the management of BW. In addition, there is insufficient information to permit pursuing the best management practices in potato production. Three groups are affected by those deficits: the overall community, the farming community and there is a particular issue between female and male farmers relating to their understanding of BW. The study found that lack of knowledge regarding cultural control practices that might limit the spread of BW, is a common feature. It also found that more than half of farmers studied have a weak knowledge. A most important finding is that almost all farmers are willing to engage in collective action to combat bacterial wilt. Survey results showed that female farmers and poorer farmers must be considered as a group that require special attention from extension services. Both male and female farmers need access to information, skills and tools to improve yields. However, the level of contact between farmers and extension agents was observed as being relatively low in general and especially low among female farmers. Results show that farmers' preferences for learning about BW were identified as: peer to peer learning from fellow farmers; on-farm demonstration and farm visits, to observe improved agronomic practice. It was also found that Private organizations / non-state actors are important sources of information on BW. Churches, chiefs, community meetings, private agricultural companies, local FM radio, and on farm advisory services constitute a significant information source in some areas. The study concludes that combining technical innovations with initiatives involving collective action, would be necessary to lead to substantial farmer benefits. It further recommends that government and non-governmental organizations work together to support farmers, especially women to implement strategies to limit the spread of BW.

**Keywords:** Potato, Bacterial wilt, community collective action, participatory, Extension, Innovation, Chencha-Ethiopia, Vita, Teagasc.

### Abbreviations

AKIS: Agricultural knowledge innovation system  
AIS: Agricultural innovation system  
BOARD: Bureaus of agriculture and rural development  
BW: Bacterial wilt  
Bop : Bass of pyramid  
CIP: International potato center  
DLSL Defuse light storage  
EPRDF : Ethiopian People's Revolutionary Democratic Front  
FGDL Focus group discussion  
NGO: Non-governmental organization  
ETS: Ethiopia technology system  
PADETES: Participatory Demonstration and Training Extension System  
PEA: Participatory Extension Approaches  
SMS: Subject matter specialist  
SNNPR: Southern Nations, Nationalities and Peoples' Region  
UCD: University college of Dublin

### INTRODUCTION

Potatoes are a source of both food and cash income in the densely populated highlands of sub-Saharan Africa. Through this double purpose, the potato crop plays an important role in the rural livelihood system because of high prospects for growth of the market for fresh potatoes (Scott et al. 2000). It could be a good starting point for rural development in sub-Saharan Africa, particularly under the current conditions of increased cereal prices in the international markets.

Fuglie (2007) recommend that broad fields of potato research and development that could be prioritized in different regions of the developing world is important. For effective targeting of research and development efforts, a more detailed country-or region specific analysis of the potato system and its potential opportunities and possible constraints is required. This analysis should not only identify important technological research areas, but should also identify challenges, opportunities and the weaknesses within the innovation system that have deterred and could continue to deter innovation of the potato sector taking place.

Kenya, Uganda and Ethiopia are among the ten African countries with the largest area cropped to potato (FAOSTAT 2006). These countries, however, differ substantially in terms of the integration of potato farmers in the market as well as the structure and functioning of the potato-related innovation system. Together the three countries are representative of a large portion of the potato sector in sub-Saharan Africa. However, despite this fact, the major problems for these countries are diseases (Late blight and bacterial wilt) of potato, unavailability or inadequate supply of healthy seed resources and poor public extension systems to permit potato producers maintain a functional system. Therefore, the potato crop is seriously threatened in the area. Substantial economic losses often result from diseased potato fields (FAO-CIP, 1995).

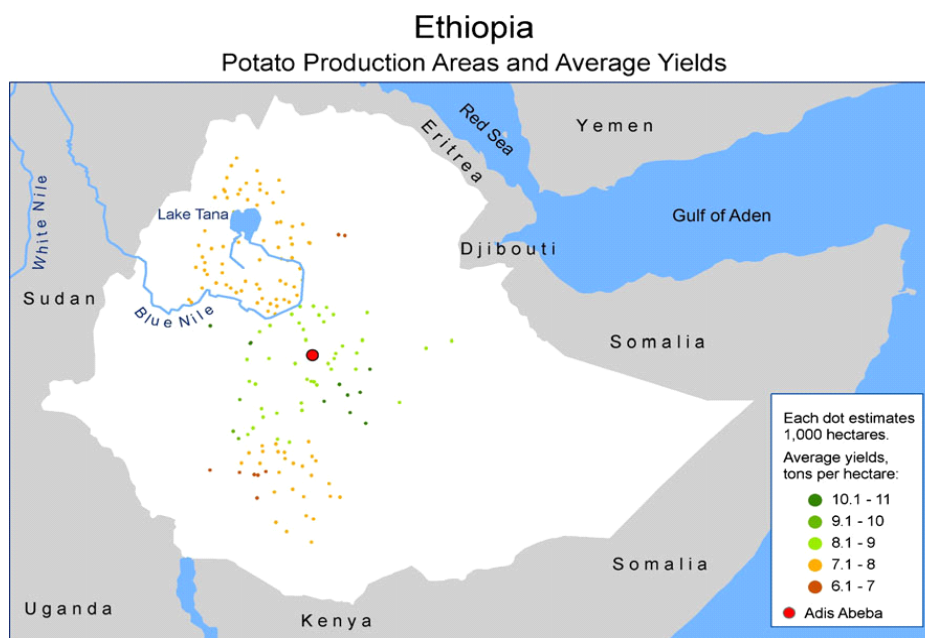
Despite the economic losses attributed to these diseases research and extension efforts have achieved limited achievements. When the rural poor are not involved in the decision making process there is an additional difficulty in transferring the new methodology and providing an essential extension service (Belay and Degenet, 2004; Davis et al 2010). Sewnet et al. (2016) also argued that research, extension and farmer linkages in these area are weak, plus both research and extension approaches are centralized and follow a top down approach, without due consideration of farmers' opinion. As a result, farmers lack adequate opportunity to influence research and extension priorities. They do not see the problems that affect them in their day to day lives being addressed in a meaningful manner. In view of the difficulties outlined above, a major objective of this study, therefore, is to assess the effectiveness of extension approaches towards assisting Ethiopian potato farmers to control the spread of bacterial wilt. The epidemiology of bacterial wilt is complex and is not responsive to simple solutions. If a field in the community becomes contaminated, it is a disaster for the individual farmer but is also a threat to the livelihood of all the neighbouring farmers due to the ease with which it can spread. Tackling the infection will require the community to understand the threat, also that they become fully involved in progressing and implementing control measures. This study will seek to measure the willingness of communities to participate in this activity and trigger community for collective action to tackle bacterial wilt. It further intends to understand the socio economic aspects of potato production, indigenous knowledge management, challenges and knowledge needed to support potato production for potato producers.

## 1.2 STATEMENT OF PROBLEM

In Ethiopia, potato (*Solanum tuberosum* L.) can play an important role in improving food security and cash income of smallholder potato growers. Potato production can be increased both through increases in acreage and productivity. The country has a very high potential for potato production as 70% of the 10 million hectare of arable land is located in the mid and high altitudes, which is suitable for potato production (FAO, 2008). The potential of this crop is increasingly being realized as witnessed by growing interest in the crop by private investors and policy makers. However, national average yields are still far below attainable yields and ample opportunities exist to realize this crops' potential for increased food security and income generation (Berga and Gebermedhin, 1994). Currently, only 2% of the potential area in Ethiopia is under potato production and the average productivity of potato is less than 10 tonnes per hectare. The low productivity is partly due to the use of poor quality seed potatoes of inferior varieties by most potato growers (Mulatu et al. 2005; Hirpa et al. 2010).

### 1.2.1. Major potato growing areas and type of seed system in Ethiopia

In Ethiopia, potato production is used to bridge the gap in food supply during the “hungry months” before the grain crops are collected. As a high land country located in the tropics, Ethiopia has very conducive land and climatic conditions for high quality seed potato. The crop can potentially be grown on area around 164,146 hectares producing an estimated total tuber yield of 940,087 tons (CSA, 2002). Potato is grown by approximately one million small holders. Approximately 83% of the potato farmers are located in four major areas viz. the central, the eastern, the north western and the southern high land of the country (CSA 2008/2009).



**Figure 1-1: potato production area**

**Source:** <http://research.cip.cgiar.org/confluence/display/wpa/Ethiopia>.

Nevertheless, the national average productivity of potato is only 8.03 tons' ha<sup>-1</sup> which is by far lower than the world average productivity of 16.02 tons' ha<sup>-1</sup>. (Fekaduet al, 2013). The major constraints faced by these small holder farmers include the lack of community agricultural extension support services including improved high yielding, disease-resistant and good quality seed potato varieties. Lack of production of clean seed is the crucial factor limiting the potential production of the country (Berga and Gebermedhin, 1994). Also there is no comprehensive extension system to enable healthy potato seed distribution in Ethiopia. Smallholder farmers access their seed potato from three important sources viz. informal (smallholder farmers), alternative (cooperative, and community based seed enterprises, NGO, ETS), and formal (licensed growers, cooperatives, or seed enterprise) seed potato systems. (Negussie et al., 2013). Hirpa et al. (2010) and Negussie et al (2013) found that most potato seed production in Ethiopia is informal,

and that most farmers recycle planting materials from the old harvested crop. About 98.7% of seed tubers used in the country is supplied by the informal seed potato system among small scale farmers (Hirpa et al,2010). Increasing the availability of high quality seed at affordable price and creating community awareness about high quality seed would be a priority as access to good quality and improved seed potato varieties is widely recognized as fundamental to ensure increased production and productivity. (Struik and Wiersema,1999;Kanguongo et al,2013).

The production of potato in Ethiopia is hindered by land shortage, land degradation and threatened by pest and bacterial disease problems. The country therefore needs to improve the technical performance of potato farming and support the community to use knowledge based intensive farming practices in order to increase productivity. However, this is the challenge for extension.

To understand the challenges in the adoption of potato technology and to improve knowledge based intensive farming practices, researchers have stated that some key technical areas need to be addressed to increase productivity both from production perspective as well as from socio agriculture perspective. These include the limited availability of healthy and high quality seed tubers (Gildemacher et al, 2009, Hirpa et al, 2010), management of diseases and soil fertility, poor communication and information sharing (Davis et al, 2010). Other areas identified for attention include gender and community based extension, indigenous knowledge, agro ecology and demand-driven extension (Besha and Park, 2014).

In fact, such studies are helpful to understand the existing perspective of extension constraints and inform subsequent actions. There has been limited investigation of the approaches for extending new knowledge to support farmers in adopting new systems. So far the challenge is to find the most effective extension approaches that will meet the needs of farmers and encourage wider community participation. Researchers also recognised the importance of farmers ownperspective and their reality underlying why technology adoption is not yet fully understood.

### 1.2.2 Research project on Potato Production in study area

Vita is an Irish non-government organisation (NGO), working in Ethiopia where one of its flagship programmes is the Irish Potato Coalition, which is currently supporting 10,000 farmers in Ethiopia to substantially increase their yield (Vita 2015). Within this programme, it is involved in a collaborative research programme in Chencha woreda in the SNNPR region of Ethiopia entitled 'Developing sustainable seed potato production system for improved livelihoods'. The project funded and trained three Ethiopian PhD students. The main aim of the project is to maximize the benefits that potatoes can provide to rural communities, through various means, including enhanced seed quality, better farm practices, improved storage, development of commercial sustainability, and community cooperation. The three PhD studies focused on the technical aspects of potato production, the farming system in which the potato grown and the social community approach to the cultivation and trading of potato.

The core value of Vita is community empowerment and partnership. Teagasc (the Irish Agriculture and Food Development Authority) is a partner on the project with Vita, Wageningen University and the Ethiopia Institute of Agricultural Research, the International Potato Centre (CIP), Arbaminch University (where the Author is from) and the Irish Potato Federation.

One PhD (funded by Wageningen University) aimed at improving seed potato quality through technology and systems, optimising the physiological age of potatoes and improving seed tuber health. The second PhD (funded by Vita) aimed at optimising the farming systems that the potato is part of. If potato production practices are changed then what impact does this have on the cultivation of other crops, labour requirements, nutrient management and house hold income. The third PhD (funded by Teagasc) focuses on programme delivery; the efficiency of knowledge transfer, research-farmers' interactions, transferability to other regions/scenarios. It assesses the social aspects of seed potato exchange, the effectiveness of interventions by state actors and NGOs and will develop an informal certification scheme for quality declared planting material. To supplement these three research projects, Teagasc also funded this Masters research on knowledge transfer as part of its collaborative Masters in Agricultural Innovation Support with University College Dublin (UCD).

The review of these studies showed that a number of factors constrain the system. These include, *inter alia*, lack of widespread adoption of improved potato varieties, unavailability of improved storage facilities, the high cost of widespread adoption of improved potato varieties, low price of produced tuber especially immediately during harvest. Based on the review information, it can be concluded that availing of improved potato varieties, improved storage facilities and creating better marketing opportunity are crucial to improve the seed potato system if there is opportunity for disease free land. However, the critical issue which is a recognized threat to potato production in the area emerging from these studies is the challenge of the diseases, Bacterial Wilt and Late Blight. Low soil fertility and rain fall fluctuation are also problematic.

The three PhD studies had focused on the socio-economic and farming systems of potato and technical aspect of potato production in Chencha and all recognised that the challenge of bacterial wilt was overwhelmingly affecting the potential production system of area. They prioritised the need to find the most effective approach for extension on this issue. At the beginning of this study and to help develop the title and focus of the study, a

conversation on how agricultural extension can help to tackle the problem of bacterial wilt through community participation was conducted between peer researchers included the researcher, UCD and Teagasc supervisors, staff of Vita and other researchers engaged from Teagasc.

The study on which this thesis is based sought to answer the following questions. How well do farmers understand bacterial wilt and the danger it poses for potato production? How willing are farmers to become involved in collective/community action to prevent bacterial wilt? How can farmers take action to improve their response to the condition (local knowledge and science-based recommendation)?

The research focused attention on understanding the local experience, on the socio economic value of potato to small scale producers, also on potato production management, practices and challenges. It also assessed farmers' knowledge about bacterial wilt, their management practices to combat bacterial wilt and stress or social exhaustion from bacterial wilt. It also asked how interested the community members are in potato production, how willing they are to produce potatoes and what knowledge or skill they need in potato production, how farmers prefer to learn and/or what information dissemination channels they prefer to use in acquiring new knowledge and information.

By providing empirical evidence at ground level, the thesis aimed to reveal social experience, constraints, interest and best-fit by exploring type and media channels for disseminating improved technology to manage potato production. This eventually would be supported by the development of integrated disease management training material for potato growing; thereby contributing toward better and more innovative extension approaches for farmers.

### **1.3. AIM AND OBJECTIVES OF STUDY**

The overall objective of this thesis was to develop community based approaches for potato production in the Chencha Woreda that help to effectively tackle bacterial wilt in potato production.

#### **1.3.1. Specific objectives of study**

The specific objectives which the study sought to address were:

- To investigate farmers understanding of bacterial wilt and the threat it poses for potato production
- To assess/evaluate the willingness of farmers to engage in collective action to prevent bacterial wilt
- To assess the best-fit technical information, and channels for learning and/or dissemination of new knowledge

#### **1.3.2. Expected Utility of the Study**

The study findings will be of interest to all stakeholders with an interest in maximizing the benefits that potatoes can provide to rural communities, especially for government and non-government organization in developing and refining their extension approach in potato production. Staff of Vita and of the Government woreda Agricultural Office who are currently supporting agricultural development and food security for small holder in Chencha and promoting potato. It also provides useful learning to Teagasc in developing its understanding of community extension approaches in further overseas development projects.

## LITERATURE REVIEW

This literature review comprises of the two parts. In the first part, the author discusses the history of government extension system in Ethiopia, and in the second section the author discusses the concept of extension approaches, community collective extension approach, participatory extension approaches, innovation-driven extension approaches, and the role of different actors in innovation approach.

### 2.1 EXTENSION AND ADVISORY SYSTEM IN ETHIOPIA

Extension in Ethiopia has been influenced through changes of policy in the past 50 years, from feudalism to Marxism to a free market system (Kassa, 2005). Over the past 20 years when many Africa governments have shown limited commitment to supporting smallholder agriculture and when they have neglected agricultural extension services in particular, the Government of Ethiopia has consistently invested in both (Fan et al., 2009). Extension becomes the centre piece of agricultural and rural development policy under the current government and through this, a new extension programme entitled the Participatory Demonstration and Training Extension System (PADETES), was introduced in 1995. The government announced that the objective of PADETES was to enhance the productivity, and production capacity of small-scale farmers through research-generate information and technologies; empowerment of small holders with a view to ensuring prospects for national food self-sufficiency, increasing the volume and variety of industrial raw materials and producing for the export market and ensuring the rehabilitation and conservation of natural resource base of country (Task Force on Agricultural Extension, 1994 Ethiopia Economic Association, 2004/5).

Currently, agricultural extension is provided primarily by the public sector, operating in a decentralized manner through which extension is implemented at the *woreda* (district) level. Davis et al (2010) argue that public sector is the single most important player, especially in terms of inputs, at the local level for smallholders. Limited extension is conducted by NGOs, usually working through the *woreda*-level Bureaus of Agriculture and Rural Development (BOARDS) (Davis et al, 2010). NGOs in particular have instituted many innovative and participatory approaches (FAO 2008a,2008b). on the other hand, the government PADETES system gives special consideration to the package approach to agricultural development. The packages have been diversified to address the needs of farmers who live in different agro-ecological zones of the country. PADETES promotes packages on cereals, livestock (dairy, fattening and poultry), high economic value crops (oil crops, pulses, vegetables and spices), improved post-harvest technologies (handling, transport and storage), agro-forestry, soil and water conservation and beekeeping developed for different agro-ecological zones (highland mixed farming system, highland-degraded and low moisture, lowland agro-pastoralist and lowland pastoralist zones (Belay and Degnet, 2004). Under this approach the major tasks of extension agents include organizing demonstration trials, assisting farmers in obtaining agricultural inputs and channeling farmers' problems to the relevant organization particularly to the district agricultural office (Belay and Degnet, 2004). As the result training or ups killing training has been provided for extension agents at national and at zonal level. Country achievement in rural development and extension as a result of this commitment and strategy has been increased (Davis et al, 2010). Farmers' use of inputs, use of improved seed varieties, credit service and other aspects of technology is on the rise.

Despite government interest to invest heavily in agriculture and the plan of accelerating sector development to end poverty, there have been great challenges in extension, and productivity remains low. Rohmato (2009) argues that the context in which extension workers operate is not politically neutral. In Ethiopia, the state and the ruling party structures are deeply intertwined. Therefore, in extending the control of the state across Ethiopia, the Ethiopian People's Revolutionary Democratic Front (EPRDF) has also been extending its own control. Berhanu and Poulton (2014) suggest that agricultural extension in Ethiopia is driven by the twin imperatives of economic growth and political control. Agricultural extension is largely the responsibility of the government through the Ministry of Agriculture. In the rural areas where (85%) of the population live, it is generally the better politically connected smallholder farmers who are recruited as "Model farmers" to become the engines of growth, notably with the support of public agriculture extension programs and they are usually also members of the ruling party (Lefort, 2012).

In every Kebele in the country there is an elected kebele council, a kebele cabinet and a part (EPRDF) kebele committee (Berhanu and Poulton, 2014). The cabinet is the state administrative body dealing with development planning, mobilisation, service provision and security. The cabinet consists of local government employees including the chief administrator and his/her deputy, the kebele manager (who is also the cabinet secretary), the speaker of the council, the school director, the health officer, and development agents (i.e. extension workers) (Berhanu and Poulton, 2014). There is usually some overlapping in personnel between the cabinet and EPRDF committee, with the chief administrator of the cabinet typically also being a member of the party committee. The speaker of the council and school director are appointed by the kebele council from amongst its members. They are formally accountable to the

kebele council as well as to the cabinet and council at woreda (district) level (Berhanu and Poulton, 2014). In practice, the council mainly hears reports from the cabinet but exercises little control over it. Control is chiefly from the woreda cabinet. Yilmaz and Venugopal (2008) claim that all “local government employers and local people beneficiaries, who are considered as model farmers are beholden to the party administration”.

The problems and challenges facing an effective extension system service in Ethiopia are exacerbated by political influence. Technology and inputs remain scarce and expensive. Delivery of inputs, weak seed system, transportation problems, monopolies on inputs markets, and poor communication and information sharing within the extension system and within line ministries from kebele to federal levels are also the major factors that indirectly affect extension approach (Davis et al. 2010).

Ethiopian extension programs also pay inadequate attention to gender, and fail to develop customized extension approaches to the various agro ecological zones or to adapt programmes to the social indigenous knowledge of communities (Davis et al. 2010). Davis et al (2010) also claimed that “in this dynamic environment national agricultural extension services should start to play new roles, based largely on principles of demand-driven planning, management, facilitation, and learning through interaction”. There is no “best practice” that can be taken from one country or region and implemented elsewhere without regard to the local conditions. They argue the need to go beyond “one size fits all” solutions. Every extension system, including the structure and approach, must be evaluated in terms of where it will be used and who will use it (Vanclay, 2004; Davis et al, 2010).

## 2.2 NEW CONCEPTS FOR EXTENSION SYSTEMS

Many definitions, philosophies, and approaches to agricultural extension and advisory services have been described, and the views of what extension is all about have changed through decades (Swanson, 2008). In the beginning the main purpose of agricultural extension was to disseminate information so as to raise the production and profitability of farmers (Swanson & Raiht, 2010). In most countries nearly all Agricultural Extension Systems were organized within the Ministry of Agriculture and focused primarily on technology transfer activities that would improve the production of basic food crops (Swanson & Raiht, 2010). Scarborough et al (1997) describe Agricultural Extension as an academic discipline and an educational practice to promote agricultural development and increase food production. There has been renewed interest in extension during the last few years, as conventional extension efforts have produced disappointing results, and have failed to adequately promote the adoption of agricultural innovation (Pamuket al., 2014). As result most country’s national governments as well as donor agencies have become increasingly concerned about the performance of national extension systems, and different models have been tried and tested (Swanson & Rajalahti, 2010). Rivera and Sulaiman (2010) also suggested that the diversity of extension service providers’ has increased over time and that the most important change in extension over recent years has been the shift from a mere linear technology transfer model towards a more holistic approach in understanding how and where farmers get their knowledge, and information.

Extension has been defined as a system that focused very much on increasing production, improving yields, training farmers, and transferring technology through community participation (Christoplos, 2010). However, it is also a social network in which the organized and formal process of actively communicating information about innovation can voluntarily change the behaviour of a society via communication (Roling, 1988). The challenge for extension is to determine how to convey information regarding a new innovation to a certain population (such as farmers) so that they will adopt it. The challenge then is to design appropriate communication channels. Extension is also a process that can bring together researchers, farmers, and other players in networks of knowledge exchange (Roling, 1988). Swanson and Rajalahti (2010) argued that extension, in effect, serves as a facilitator or knowledge broker between researcher, extension and farmer, often through the intermediation of innovative farmers. It is also the services that supports people engaged in agricultural production to help themselves, to solve their problems by themselves and enable them to obtain knowledge, information, skills and technologies to improve their livelihoods and wellbeing (Davis et al, 2010).

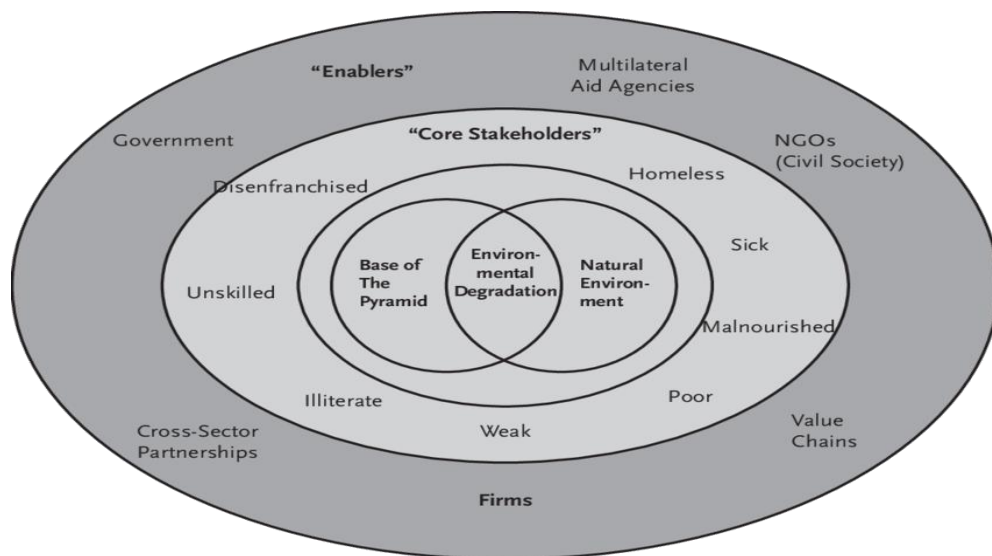
Therefore, then, today extension should no longer viewed as one agency but as a system that is integral and central to innovation systems and that focuses on facilitating interaction and learning, rather than solely on providing inputs to the farmers (Swanson and Rajalahti, 2010). Extension becomes “facilitating learning” instead of “teaching” (Lodenstein and Mur, 2010). Under extension as a learning paradigm, extension workers must learn from the farmers being served, as well as listen and link to research and extension priorities (Swanson and Rajalahti, 2010). Though ‘Traditional Extension’ models were widely accepted, they failed to adequately convey information and extend technology products required to fit the felt need of communities and in teaching new production practices (Pamuket al, 2014).

### 2.3 COMMUNITY COLLECTIVE ACTION EXTENSION APPROACHES

The most important change in new extension is the shift from a more linear technology transfer model towards a more holistic approach in understanding how and where farmers get their information and technology. Rivera and Sulaiman (2010) argued that extension is a better instrument, or engine, for the promotion of innovation, the dissemination of knowledge and the facilitation of development. Therefore, one of the key elements in the new extension approach is to work directly with and involve the farming community in understanding and supporting agricultural development services.

Mason and Beard(2008) observed that international strategies have moved beyond centralized, top-down approaches and have progressed to word decentralized community-based approaches that incorporate actors from the community. Bottom-up approaches, in contrast to historical top-down approaches, are designed to give increased control to communities(Dasgupata and Beard,2007). This approach has the potential to overcome barriers to participation, especially among female and poorer farmers. For poor farmers, instances of small-scale community collective action (either through indigenous institutions or external programs) provided renewed interest in involving local groups in many spheres of agricultural and rural development. These include watershed management programs, integrated pest management, farmer-managed irrigation systems, and a range of microfinance groups (Dick etal,2006). Community collective action approaches provide an opportunity for real participation and experience sharing with farmers by creating self-confidence with them and encouraging farmers to learn more by active participation. It encourages the involvement of the target group, shared interest within the group, and involvement in some kind of common action that works in pursuit of the shared interest(Marshall,1998). Community collective action helps develop more demand-driven approach in which community will have full opportunity to identify their own problems and it helps them in solving these problems, through their direct participation (Hagmann et al,1999; Koutsouris,2012).

The 'Base of the Pyramid' concept is often used in community collective action as an approach to ensure that the actors at the base i.e. those who are entirely dependent on the resources that are threatened, are directly involved in planning the required actions. Astrom(1990) explains how collective action by Base of Pyradmid residents gave them greater control in self managing the environmental commons and addressing the problems of environmental degradation. The base of pyramid in this context represents the community and the natural environment, as the central focus for engagement. Therefore, the actors at the bottom of pyramid are the whole socio economic classes of community and those whose livelihood source is entirely depending on the natural resource. The model proposes that any campacign of action must include the BoP community, the poor, weak, and illiterate irrespective of their gender, education, and physical capacities, as they can benefit most from the collective action model to address sustainability in the natural environment. Also facilitators or external agencies (Government, NGOs, and private firms) who should promote commons interest for collective action to contribute natural resource conservation must be included. The Figure 2.1 below illustrates the actors on the base of pyramid in search of environmental sustainability through collective action scheme.



**Figure2.1: In search of environmental sustainability: engaging human nature at its core ( from Heuer & Landrum,2016)**



Dick et al (2004) and Dick et al (2006) suggest that community collective action is voluntary actions, which include collective decision-making, setting rules of conduct of a group and designing management rules, implementing decisions and monitoring adherence to rules. Member can contribute in various ways to achieve the shared goal: money, labour, or in-kind contributions. Further the review of studies supports the view that collective action has the potential to be a successful path toward self-governance of environmental issues with Base of Pyramid communities (Dasgupta and Beard, 2007; Newell and Frynas,2007; Ostrom, 1990; Wijen,2008; Heuer and Landrum,2016)

### 2.3. PARTICIPATORY EXTENSION APPROACHES.

Participatory approaches to agricultural extension have developing since the 1980s. The Participatory Extension Approach (PEA) was developed in the late 1980s by the World Bank, as a response to continued failure of the conventional extension approach, where extension agents see themselves as teachers (Koutsouris,2012). It was realised that most technologies developed by researchers alone were inappropriate for smallholder farmers and that a more systematic perspective was needed enhancing the interaction between researchers and farmers (Koutsouris, 2012). Farmer participatory research became the approach to adapt technologies to farmers' conditions and, by the 1990s, to develop technologies together with farmers. It is defined as a process of involving, in decision making and implementation, stakeholders who will be affected by the decisions made (Hjortso,2004;Koutsouris,2012,). Farmers were by then seen as partners in research and extension, and the key players in the innovation process (Koutsouris, 2012). Therefore, PEA is a way of improving the effectiveness of rural extension efforts by government agencies, NGOs and other organisations engaged in rural development (Hagmann et al.,1999).

Hagmann et al (1999) describe the early days of the conventional extension system in rural development as the passive way, which consisted mainly of farmers and communities being told what to do, often by institutions that had not taken the time to understand their real needs. The results tended to be poor, because rural people did not have any sense of ownership of the ideas imposed on them (Hagmann et al.,1999). However, the change that swept through the development movement was encouraging rural communities to become the prime movers themselves in efforts to improve their economic and social well-being, sharing and synthesising their experience and thus creating new knowledge (Levinthal and March, 1993; Murray and Blackman, 2006). Government and non-governmental institutions increasingly recognised the need to move away from instructions and blueprint solutions, towards more participatory approaches which support communities in their capacity to set and fulfil their own development goals. It was expected that participatory approaches would build social and institutional capital and promote individual and organization learning among stakeholders (Saarikoski et al., 2010). At the heart of this change is the recognition that rural people themselves are the owners and shapers of their own development (Hagmann et al,1999). Paassen et al (2011) emphasise the critical role of social networks and solidarity, common values, social order and trust in enabling participatory learning and people working together.

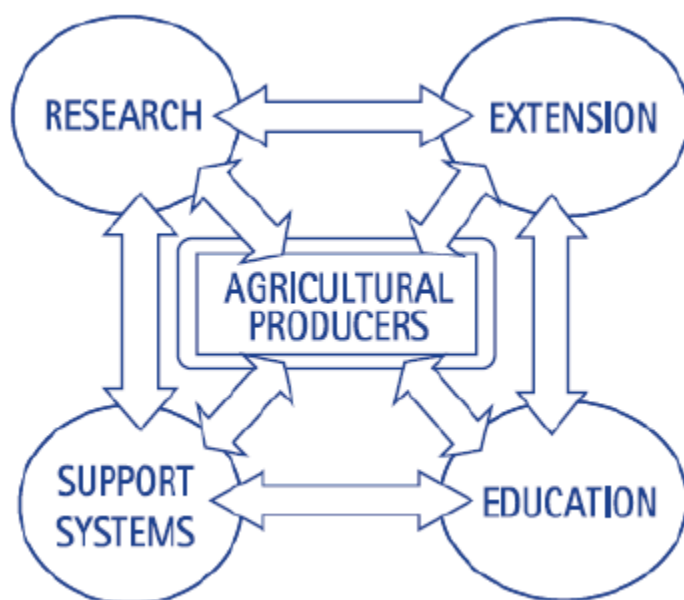
Koutsouris (2012) highlights that participatory extension and group learning require new roles for extension agents, namely that of facilitation. These changes bring with them major challenges, not only for the community themselves, but also for the institutions which advise and support them and for the agricultural extension agents in the way they work. Rather than simply being agents for technologies imposed from outside, they need instead to become catalysts, helping communities achieve goals they have defined for themselves. This means learning to interact closely with social groups and communities, becoming better listeners and facilitators, and developing a responsive, two-way communication process between the community and rural service institutions (Hagmann et al,1999,Koutsouris,2012)

Some of the key characteristics of participatory extension approaches have been elaborated by Chambers, (1993);Hagmann et al., (1999); and Koutsouris, (2012). They include, inter alia:

- Integration of community mobilisation for planning and action with rural development, agricultural extension and research;
- Equal partnerships between farmers, researchers and extension agents who can all learn from each other and contribute their knowledge and skills;
- Strengthening of rural people's problem-solving, planning and management abilities;
- Promotion of farmers' capacity to adapt and develop new and appropriate technologies/ innovations (usually agricultural technologies and practices, but also social institutions, health, water and sanitation, and other rural development domains);
- Encouraging farmers to learn through experimentation, building on their own knowledge and practices and blending them with new ideas. This takes place in a cycle of action and reflection which is called 'action learning';
- Recognition that communities are not homogenous but consist of various social groups with conflicts and differences in interests, power and capabilities. The goal is to achieve equitable and sustainable development through the negotiation of interests among these groups and by providing space for the poor and marginalised in collective decision-making.

### 2.3.1 THE ROLE OF DIFFERENT ACTORS IN PARTICIPATORY EXTENSION APPROACHES

A participatory approach system will include a number of critical stakeholders and players; the community themselves, the formal institutes through which people organize to act collectively and link with the production market-input access, a facilitating agent supporting the producers, researchers closely looking for solutions to the production problems and other service providers (Rivera et al, 2005, Koutsouris, 2012). Khanya (2007) highlights the importance of facilitation to build the linkages between these different stakeholders in order to coordinate efforts and get the maximum impact from the system. Figure 2.1 below illustrates the different actors in the agricultural knowledge and innovation system (AKIS).



**Figure 2-1:** An agricultural knowledge system model (from: Rivera et al., 2005)

Agricultural innovation systems for rural development are rapidly changing in terms of being demand-driven. The enhanced involvement of farmers, farmers' organisations, and farmers' advocates of innovation development planning, management and monitoring and evaluation has contributed to a more demand-driven agricultural research and extension agenda of public and private service deliverers (Hagmann et al., 1999). The introduction of new public management modes in the public sector (Heemskerk, et al, 2003) has led to opportunities for public-private partnerships, although involvement of the private sector for a co-innovation process in economic chain development is still in its infancy (Fujisaka, 1999). Public-private mixes are also important in addressing the needs of the different groups in society, varying from commercial farmers (private sector investment) to disadvantaged groups (public sector investment) (Merrill-Sands and Collion, 1994). Public project objectives can be shaped by local perceptions of what the project is able to yield to shape 'needs' (Quaghebeur et al, 2004). Private sector involvement in agricultural innovation has increased to the extent of privatization of innovation development programmes and organizations in major economic chains (e.g., coffee, tea and cotton) in some SSA countries and Latin-America (Heemskerk et al 2013). Agricultural innovation is expected to contribute to the further development of economic chains and rural income in the future. Therefore, the role of government and non-governmental extension agents is to facilitate this process.

Researchers also have a role – they assist farmers and extension agents in joint experimentation and learning processes and contribute their technical knowledge to find solutions to the problems identified by farmers (Hagmann et al, 1999). To bring about permanent change, Merrill-Sands and Collion (1994) recommend that farmer-responsive research methods be reinforced by changes in the balance of power between researchers and farmers and 'in the constellation of decision makers responsible for formulating research agendas'. Participatory planning methods applied at the level of research programs provide new opportunities for involving farmers in decision-making about program priorities and for systematically incorporating information about client's needs (Merrill-Sands and Collion, 1994 Hjordso, 2004,).

In addition to process facilitation, the extension worker documents farmer knowledge and experience and produces simple guidelines and fact sheets with and for farmers. These are very important for more effectively

spreading innovations and increasing the performance of agricultural extension through farmer experimentation and farmer-to-farmer extension (Hagmann et al,1999). Extension agents assist farmers in their search for solutions by providing background knowledge and options and encouraging farmers to experiment with the options and ideas as described above. Through the process described above, farmers and extension workers develop a research agenda together. The role of the agricultural researcher is to take up the questions identified by farmers and extension Agents and work from there (Merrill-Sands and Collion,1994, Hagmann et al,1999). With the exception of some basic research, most applied agricultural studies can be carried out on-farm in an interactive way in order to find appropriate solutions to farmers' problems. Researchers can also host farmers on 'look and learn' tours which serve the dual purpose of demonstrating new technical options and obtaining input and ideas from the farmers. As it would be virtually impossible for researchers to facilitate the whole social mobilisation process, extension workers have a vital complementary role. As mentioned before, research can provide technological options and serve as a back-up to the farmers' own experimentation process. Through the PEA process, farmers' problem analysis in terms of technological issues will reveal more clearly the need for research than conventional extension(Merrill-Sands and Collion,1994, Hagmann et al,1999). The research agenda resulting from PEA addresses farmers' problems more directly and the results should feedback directly into farmers' learning processes, as knowledge or as technical options. This feedback loop ensures that research is relevant and contributes to farmers' problem solving. For researchers, this process offers the benefit of linking their work effectively with farmers, without having to initiate separate community development processes Merrill-Sands and Collion,1994; Hagmann et al.,1999)

The key elements described here contrast with the basic principles underlying the technology-transfer model. Shifting the focus from teaching to learning, from hierarchical, top-down to participatory bottom up approaches, from centralised to decentralised decision-making does put institutions under pressure for change as well. Thus governmental and non-governmental organisations are important actors in the learning process.

#### **2.4. ROLE OF INNOVATION-DRIVEN EXTENSION APPROACH FOR SUSTAINABLE DEVELOPMENT**

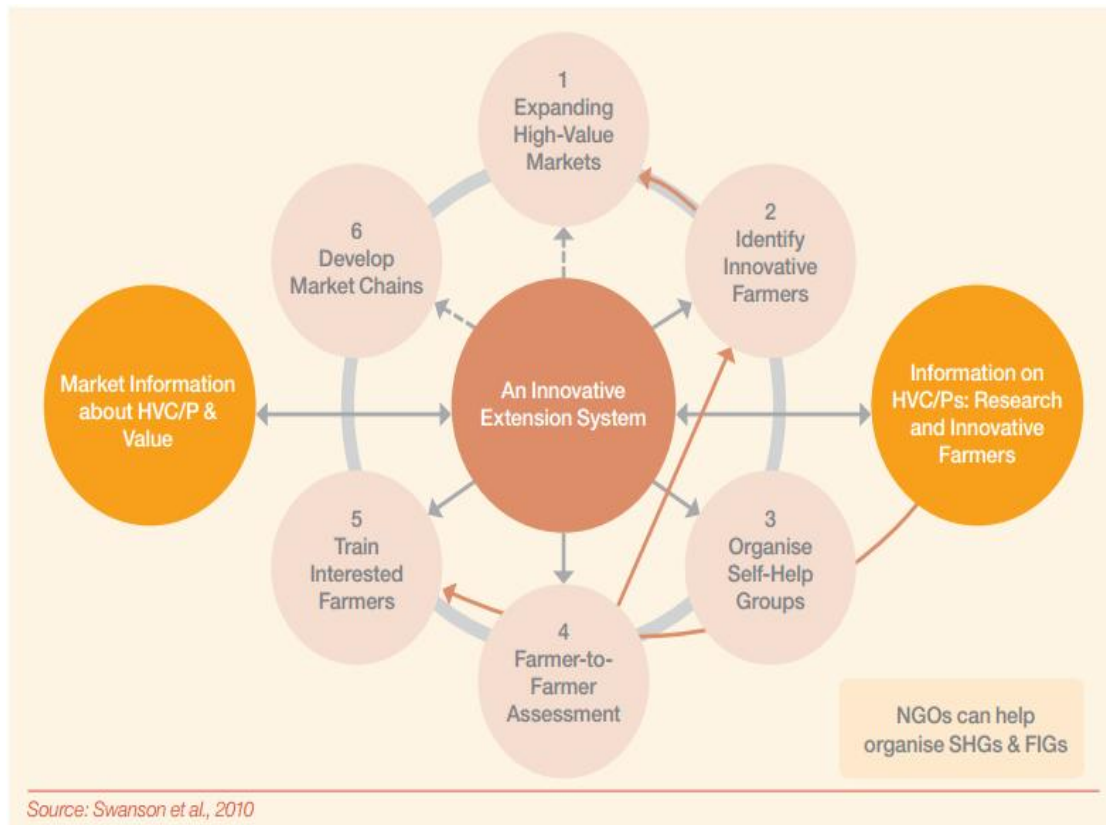
The concepts of sustained agricultural growth, natural resource management and poverty reduction require interactive approaches to agricultural development to recruit the relevant actors, organizations, and institutions, who all play a role in this process. Therefore, the innovative approach is one useful paradigm for these interactions (Chema et al., 2003; Marques et al,2010).

Innovations are essential for achieving changes in rural livelihoods. The incentive or pressure for change is a function of interwoven social, economic, cultural, political and ecological factors. Social and technical innovations are closely interlinked and cannot be dealt with in isolation. Neither technical nor social innovation on its own would make a substantial impact (Probst et al., 2003; Chema et al., 2003). Koutsouris (2012) argues that innovation approach is a network system that allows indigenous knowledge mixed with scientific knowledge to work in a manner that brings about a significant improvement in performance or product quality, market opportunity and in all socio economic processes, through community participation. The system includes the interaction between researchers, farmers, organizations, and the institution and policy makers that affect farmers' behaviour and performance through complex interaction extension and knowledge flow (Spileman et al 2009). One of the key elements of innovative learning approach is to work directly with community production in improving quality and responsiveness of services in collaboration with producers (Lodenstein and Mur, 2010).

Building on and scaling up community capacity for innovation is likely to have a greater impact on poverty than continuing to focus exclusively on expensive professional-based systems, with staff who are often remote and unable to access and reach local community (Khanya, 2007). Innovative-based service delivery systems create an opportunity to actively engage the community in meeting their own, locally specified needs and demands, and ensuring innovative farmers play a key role in innovating by demonstrating how to intensify and/or diversify current farming systems (Khanya, 2007).

Swanson (2009) and Davis et al (2010) consider innovative approaches in the development of opportunities for farmers with high value crops or products. They suggest that a basic element in the innovative paradigm is to provide two-way opportunities of production, input access and market opportunities for innovative small-scale farmers on a trial basis so that they can attempt to successfully produce and market these crops or product. If, and once successful, they begin to scale up their own production. Barrantes and Yague (2014) also argue that innovation has already become part of the management system of producers. It shows a difference in the areas where a new varieties were implemented by leading farmers in comparison to their producer. In some area, these innovative farmers are then considered for appointment to local "farmer professor" roles—where they share and disseminate their learning and promote the scale-up of the successful innovations across farming communities (Davis et al, 2010). Many small-scale farmers within these communities are aware that innovative farmers are trying something new, but few are willing to

learn more about these new enterprises or are able to handle the potential risk unless markets exist to absorb the different crops and products. As markets expand for these crops and products, many of these enterprises become scalable (Davis et al, 2010). Figure 2-2 below from Swanson (2009) illustrates the steps in this process.



**Figure 2-2:** An innovative extension strategy to help limited resource men and women farmers to diversify their farming systems and increase their farm income.

**Note:** HV=high-value; HVC/PS=high-value crops/products

Agricultural innovation then can be seen as a product of social negotiation among stakeholders. The spreading of innovation is only possible through effective social organisation and communication at community level (Hagmann et al., 1999; Padre et al., 2003). These stake holders need to be involved at all stages of innovation driven system for it to work effectively. The more and stronger the linkage of stakeholders with producers, the more likely a positive impact of the system. Apparently every stakeholder has a role of contribution for success in this approach. When the market opportunity expands for new innovative crops and product, many small farmers’ enterprises scale up. In most rural communities, small-scale and women farmers are generally unaware of these emerging markets and new products, but once they learn more, especially through farmer-to-farmer assessment, they are soon ready to learn how to produce and market these products on a small-scale basis to minimize household risk (Hagmann et al., 1999). Here is where an innovative extension system can first identify these innovative farmers and their respective enterprise and then begin the process of engaging other farmers in scaling up the enterprise among different groups of farmers, given land and labour availability, gender of the farmers, and farmers’ interest.

Davis et al (2010) consider that changing and increasingly more competitive markets have also provided new opportunities that require innovation in order to develop and strengthen economic chains. Here, innovative farmers and “farmer professors” can play a strategic role by helping extension workers to organize interested farmers into producer groups so they can begin working together to produce and market these crops and products. These start-up producer groups usually begin by supplying local markets, but as they gain experience and expand their production, they begin serving larger urban markets (meaning developing value chains) and, in some cases, global markets. While the field-level extension staff can facilitate this process, they need strong back-up support from research and the private sector

because in most cases even innovative farmers do not have the most up-to-date information and technology relating to these crops or products.

## 2.5. CONCLUSION TO THE LITERATURE REVIEW

The literature review started by examining some of the strengths and weaknesses of the Ethiopian agricultural extension system, noting that there has been considerable investment and commitment to supporting agricultural development. However, at the ground level, there remain challenges with the model farmer system and also with the support structure to field extension staff. The literature highlighted the shift in extension approaches to participatory models that centre on community mobilisation, partnerships, problem solving and adaptation. Attention was also given to the need to recognise that communities are not homogenous and some groups such as the poorest, the women and the youth are often not given adequate support. Literature on community collective action in natural resource management was reviewed showing the potential for involving especially the poor and marginalised social groups. Collective action was seen as an effective means of addressing problems that go beyond the individual farmer and require whole community responses. Innovation was also shown to be critical in solving problems and in allowing indigenous knowledge and knowledge from agricultural research to combine to find workable solutions for problems. For extension systems to really support innovation, there needs to be engagement of multiple stakeholders as it has been shown that innovation emerges from the interaction and sharing of knowledge between different groups. Community capacity for innovation and change needs to be a focus for extension efforts.

## 2.6 CONCEPTUAL FRAMEWORK

Agricultural extension services provide various institutionalized extension methods, such as extension contacts, meetings, mass media, demonstration, etc. (Aderson, 2007 and Ponniah et. al., 2008). The extension services however cannot teach all farmers on an individual basis, as they have a limited number of competent and well-experienced extension personnel and the ratio is low compared to the number of farmers demanding the service (Beay, 2002, Belay and Degnet, 2004). To address this problem, extension services widely emphasises new approaches, which depart from the traditional public services models. These approaches entails institutional innovations and reforms, community collective extension, and farmer to farmer contact, and many countries have pluralistic services encompassing government, private, non-governmental organisations, etc. (Rivera and Alex, 2004., FAO and UNDP, 2001; Hever and Londrum, 2016). One of the key elements of the new learning approach is to work directly with community leaders; then establish relationships such as farmers with facilitators, farmers with researchers and community workers (Swanson and Rajalahti, 2010).

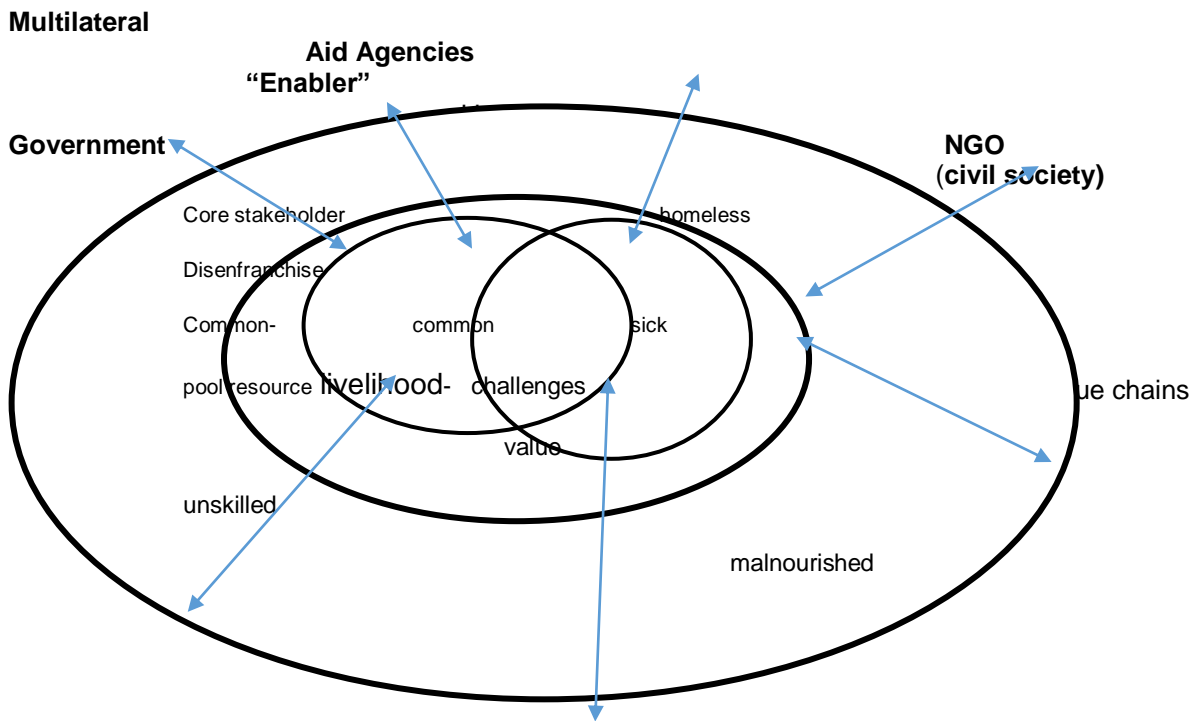
Feder and Savastano (2006) found that farmer to farmer extension is effective if the socioeconomic distance between opinion leaders and their followers is minimal. However, community collective extension can be more useful in sharing knowledge, setting priorities, experimenting with, and evaluating technology dissemination. This is achieved by providing full opportunity for the farmer to identify their own problems and then helping them resolve these problems by their direct participation (Hever and Londrum 2016).

Community collective action approach has been described as taking various forms, but they include, inter alia, the development institution, resource mobilization, coordination activities and information sharing. Therefore, the work force consists of three sets of actors: service providers, intermediaries, and farming community themselves. Ideally the community based workers should mainly come from the community, rather than being government employers. However, the facilitator/ trainer can be from either the community or an external agency. This confirms that the extension service, as an effective service needs to be a facilitator or knowledge broker between research, extension and farmers, often through intermediation of innovative farmers (Swanson and Rajalahti,2010).

The context and the purpose of community collective action has to be considered in any analysis of the phenomenon and the interconnections between the social units (individual group, community, inter-community,etc.) (Oarkesons 1992). It commonly combines the intention of whole community participation and is promoted as strategies that give local people more control over resources that are important for their livelihood. However, the experience from research findings suggests that this may be more difficult in practice than it appears in theory. Further the assumption of community homogeneity has been implicated as problems of common practices (Tsing et al,2005). Therefore, in practice, the collective action should be implemented in commons context where variegated values and interests cross-cut with other stratification to create complexities that need to be integrated in to a workable institution. Other stratifications may include age, gender, literate, illiterate, wealth and kinship status and personal history, among other. In this extremely uncertain and uneven conditions, project planners seek to find collaborative agreement among local actors on the right mix of incentives and sanctions to invoke “new” collective strategy institutional norms to direct

collective action towards common pool resource. Without understanding the specific and broader socio-economic setting or context (historical and spatially) in which actors are “embedded” it is unlikely that we can know the circumstance that affect individual decision-making over resource use (Agrawal,2003, Johnson 2004). This implies that we will not able to better promote collective action unless there is a better understanding of complex, and interrelated social phenomena, undertaken prior to project design and planning. As Dresser et al(2010) contends, it is also doubtful whether the local participants, many of whom are poor, are willing and/or can afford the extra “time” associated with rule design and main tenancy without considerable and ongoing external support or additional hardship.

Drawing on the literature, an appropriate conceptual model for this study was considered. Figure 2.3 below shows a large concentric circle including all the members of the community from the core stakeholders in potato production who are generally the better off farmers who can access improved seed and extension services. However, the circle also includes the poor farmers, those who are weak and marginalised, the women and the youth, the unskilled and the illiterate. In order for there to be successful collective action to tackle bacterial wilt, the commons have to be established and this involved both common pool resources and commonly shared challenges that are central to the livelihoods of all. These are the basis that can bring the heterogeneous community together. The model in Figure 2.3. also asks about the role of the external agencies (government, NGOs, private firms) in facilitating community learning, innovation and collective action. This model will be used to reflect on the findings of the study.



**Figure.2.3:** Model to illustrate community based extension approaches. (Drawing on Heuer and Landrum, 2016)

**Cross-sector partnership Firms**

This research project is structured in the following way. First of all, evidence from field observation, interviews, and focus group discussions are presented to establish the socio-economic farming practice of potato production, production value of potato, and common challenge and willingness of farmers in potato production. This is followed by the discussion that examines the farmer preferred channels for information and learning, solution forecast and extension method and the implication of this for commons project of problem solving.

### 3.0 METHODOLOGY

This short chapter describes the methodology used to gather data to address the research questions and explains the rationale for the choice of methods as well as the approach to sampling and data analysis. Social problems and issues typically have multiple causes and this means that *communications for social care* knowledge production will require a variety of methodology approaches (Marsh and Fisher, 2005). In-depth interviews, focus group discussion, and observation are used most frequently in qualitative approaches. However, in practice, of course, qualitative researchers often use combined approaches (Moriarty, 2011).

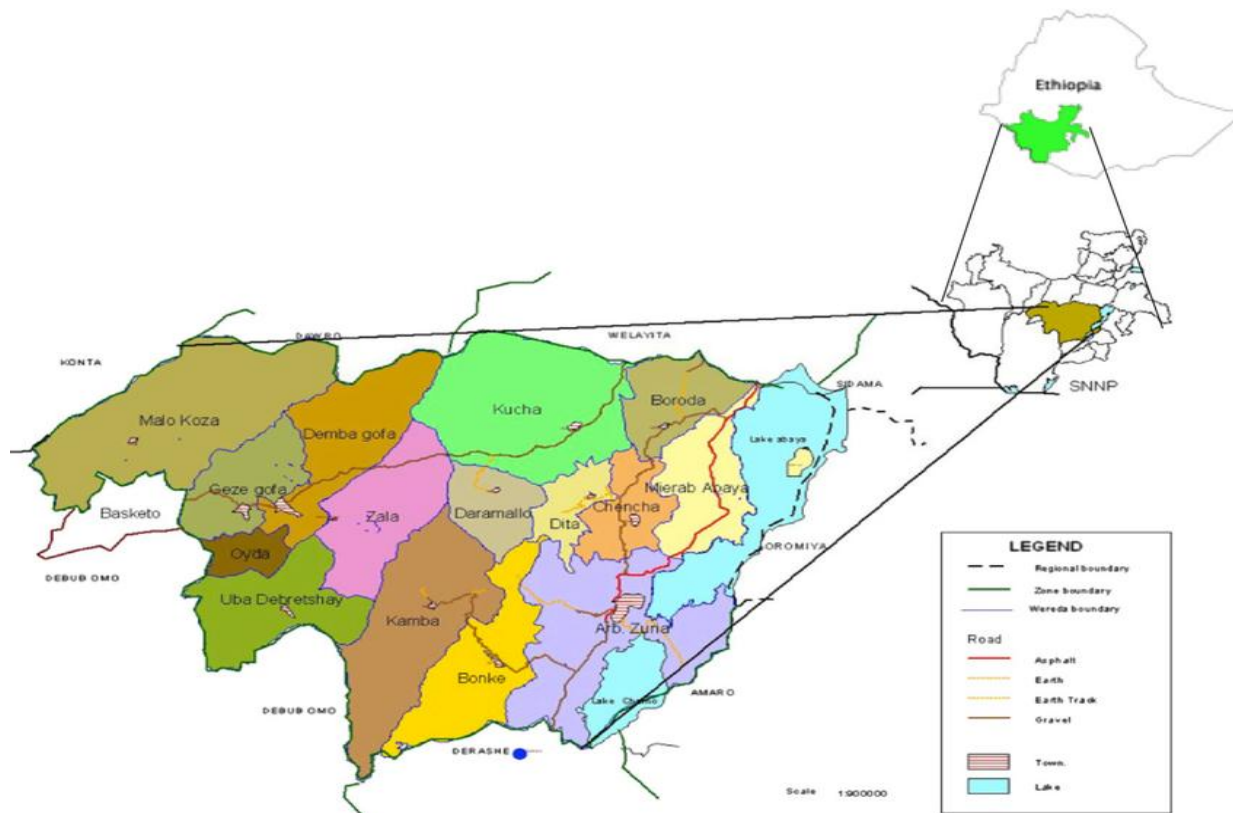
To achieve the objectives, this study adopted non-experimental research approach where quantitative and qualitative data were collected and analysed using SPSS statistics. Qualitative research methods were employed to provide an in-depth and interpreted understanding of the social phenomenon of research participants. This was achieved by learning about their social and material circumstance, their experiences, perspective, events, actions and history (Maxwell, 2005). The data collection methods involved close contact between the researcher and the research participants, which were interactive and developmental and allowed for emergent issues to be explored (Moriarty, 2011). The study design put attention on the local experience, on the socio economic value of potato to small scale producers, also on potato production management, practices and challenges. It also assessed farmer's knowledge about bacterial wilt, their management practice against bacterial wilt and social exhaustion or stresses experienced from bacterial wilt. It also asked how interested the communities are in potato production, how willing they are to produce potato and what knowledge/skill they need in potato production and to address bacterial wilt. By providing empirical evidence at ground level, the paper answered the questions of how well do farmers understand bacterial wilt and the degree of threat it poses for potato production in the Chenchā area, how willing are farmers to become involved in collective community action and what are farmers preferred extension methods to support their collective action and what is realistic in the institutional environment.

#### 3.1. RESEARCH DESIGN

Research design was tailored to the specific social context within which farmers live and within which extension, information and technology dissemination takes place. It tried to focus on how study participants have cooperated effectively to tackle bacterial wilt in their potato production and to improve their potato productivity. The researcher spent 10 months in the area getting to know the farmers and observing their practices and was able to adjust the design as the research progressed. The research methods tried to explore and understand what would be effective extension approaches for potato disease management, in particular community based approaches to effectively tackle bacterial diseases in potato production. A major component of the study was to assess the willingness of the community to engage in collective action on diseases management, what would be the best-fit technical information; and the channels that could work best to disseminate new knowledge. However, the most obvious limitation of this paper is time. The original intention was to develop a community based approach to tackle bacterial wilt, supported by action oriented farm-field experimentation. Ideally following the reflection and investigation stages, the researcher would have wished to establish and implement a pilot process of community collective action, which could then be evaluated. However, due to time limitation and financial requirement this stage was not reached but it is recommended as a follow on project requiring further study.

#### 3.2. STUDY SITE AND PARTICIPANTS

The study was conducted in Chenchā district or woreda, which is located in the GamoGofa administrative zone of the Southern Nations, Nationalities and Peoples' Regional State (SNNPR) of Ethiopia (Maps in Figure 3.1).



**Figure 3-1: Map of Ethiopia, SNNPR, Gama Gofa Zone and Chencha District**

The altitude of the district ranges from 1600-3200 masl. It has two agro-ecological zones, with 82% of the district classified as “dega” (2300-3200masl) and 18% as “woinadega” (1500-2300masl); within a total area of 37,650ha. From the review of secondary data, it was noted that the population of the district is 125,628(Female - 66,363 and male- 59,263). The number of households is 21,655of which2461 households are female headed (Fetena et al., 2014, p.8). It is one of the most populous districts in the zone. The major means of livelihood for the district is subsistence agriculture followed by traditional weaving and casual labor employment (Fetena et al., 2014, p.8).

Probability and non-probability sampling techniques were employed to delineate the study population and draw household respondents. Purposive sampling, simple random sampling and systematic random sampling with proportionate to house hold head techniques were applied to select the district, the sample kebeles, and draw household respondents respectively. The district encompasses 50kebeles. From the list of 50 potatoes producing kebeles in Chencha District two of them were selected for inclusion in this study, based on reports and advice from Vita in Ethiopia. Potato production is important in both kebeles while one kebele was experiencing a serious problem with bacterial wilt.

Households from these kebeles were categorized in two clusters depending on whether or not they were beneficiaries of the Vita potato development program. The purpose of this was to be able to compare the potato growing experience of farmers who were benefiting from agricultural extension and inputs with the experience of the average farmer in the area. The cluster comprised of beneficiary and non-beneficiary potato producers were 34 (48.6%) and 36 (51.4%) households respectively. The non-beneficiary households were drawn using systematic random sampling proportionate to household head techniques. The household head list in each kebeles was used as sampling frame to select sample households. Literature on research as well as the rule of thumb in statistics suggest that 10 percent of the accessible population for the sample is statistically significant to represent the target population. Thirty-four households (25 Males and 9 Female) were participants/beneficiaries of the Vita programme and they were selected purposively. Vita is an NGO working with the community to overcome some of their challenges particularly on potato production. Thus Vita programme beneficiaries are those farmers who are receiving Vita support of improved seed and access to extension and education on potato production; while 36 interviewees (28 Males and 8 Females) were not involved in the Vita program and were therefore assumed to have a lower level of access to agricultural extension and inputs. While conducting respondents’ interviews, Vita beneficiaries were selected by purposive



sampling technique from the respondent selection, whereas non-Vita beneficiary were selected by simple random sampling selection of respondents. This was to highlight and compare the farmers' experience, understanding of potato diseases and their management as well as the need for collective action to eliminate bacterial wilt.

Focus group discussions (FGD) were conducted to validate the survey findings and deepen the understanding of women (female) and men (male) farmers' experience, ideas and needs when learning new knowledge. A total of 4 FGDs (2 with women and 2 with men) were conducted in the local language in both study kebeles. Focus group participants averaged ten participants per group with a total of 40 farmers participating in the FGDs. The focus groups included almost equal cohorts of Vita beneficiary and non-beneficiary farmers. The four sex-disaggregated FGD between beneficiary and non-beneficiary were conducted in two focal centers: Gendo Gembela and Yeyiora centers. These centers were selected based on the mutual interest of the participants and their accessibility for all. In the beginning open public discussion were conducted in each center to select the representative of focus group discussion particularly for non-beneficiary. In each discussion centers, representatives of non-beneficiary of two kebeles were screened to participation in the discussion. The representative was equal to the male and female ratio. The group discussants were selected purposively from female household heads, model farmers and youth. However, for Vita beneficiaries, the group discussants were selected purposively from stake holder farmers, based on gender perspective. A total of 20 participants were involved in each center. The main criteria for focus group discussants selection was their versatile knowledge and experience on potato production.

In addition, 6 qualitative semi-structured interviews were conducted with Extension Officers and NGO staff (from Vita and World Vision, the other NGO active in the area) to explore the possibility and the limitation in terms of extension support to the farming community.

### 3.3. METHODS OF DATA COLLECTION

In April 2015, the researcher underwent an introduction orientation about the project among District/Woreda administration office and Woreda Agricultural Office to inform them about the project, gain their support and reduce risk in data collection. The field work (farmer interviews) of this study was carried out between April and June 2015 with help from extension staff who were nominated by Woreda Agricultural Office for data collection. Ahead of data collection, the researcher conducted orientation with the data collectors to ensure that they understood the questions and during this orientation period, the questionnaires were translated into the local language to ensure a common message for all study questionnaires. A series of focus group discussion, key informant in-depth interviews, and continuous field observations were held across the sample kebeles to extract qualitative data of study.

Moriarty (2011) suggests that Interviews are the most common data collection methods in qualitative research and are a familiar and flexible way of asking people about their opinions and experience. However, the researcher need to consider the impact of interview location, meeting people on their 'home' ground (whether this is their actual home or a place they have chosen) is thought to help participants to be more relaxed and all use the researcher to meet participant in a 'natural setting'. Where interview participant wants to maintain some distance between themselves and researcher, it may be more effective to use natural spaces. Therefore, for this study participants were interviewed in a place they preferred; mostly in their homes and farm land using in-depth interview to create a condition for understanding the meanings that emerge from the conversation. In-depth interviews using a questionnaire were used to understand (1) the socio economic value of potato, (2) potato production and management, (3) challenges to potato production, (4) knowledge about bacterial wilt and management practices to combat bacterial wilt, (5) social exhaustion (stress) from bacterial wilt, (6) community willingness to protect against bacterial wilt and (7) knowledge or skill they need both in potato production and addressing bacterial wilt. Also In-depth interviews with key informants including extension personnel and private sector stakeholders were used to explore the possibilities and the limitation in terms of extension support to the farming communities.

It has been argued that focus group discussions offer advantages to researcher in that they can encourage participation from people reluctant to be interviewed on their own or who feel worried that they have nothing to say (Kitzinger, 1995). They may generate discussion on a greater number of topics than an individual interview and the discussion may be more naturalistic than that in a one-to-one interview. However, skills are needed to encourage less confident participants to speak and to avoid one or two people dominating discussion. (Moriarty, 2011). In this study, adhering to the principle, group discussions were used to understand women's and men's experience of potato production and management, knowledge about bacterial wilt and management practices, ideal, and preferred channels for acquiring new knowledge.

Silverman (2006) argued that in contrast to interviews or focus groups, observation gathers naturally occurring data and first-hand information about social processes. Observation methods go some way towards addressing the issue that what people say is not necessarily what they do (Pope and Mays, 2006). Observation also offers opportunity for the analysis of non-verbal communication, furthermore, the additional time spent in observation offers insight that are

unlikely to have been gained from interview alone (Moriarty,2011). Field observation in this study was used to assess the actual potato production practices, from land preparation up to harvesting and storage. Secondary data were collected from published and unpublished Woreda Agricultural Office; cooperative and marketing, Non-governmental programmes of VITA and World Vision Ethiopia and central statistics.

### 3.4. DATA ANALYSIS PROCESS

The study used qualitative and quantitative research design. Qualitative data were collected and descriptively analysed using relevant techniques of qualitative content analysis

The data obtained from household survey through structured questionnaires was translated using rules of transcription (Padgett, 2008), before coding. The in-depth interviews were transcribed and translated into English from the local language by reading repeatedly with open mindedness to grasp the related issues and organizing the data into major themes or patterns that can describe and explain the phenomena being studied (Maxwell, 2005). The findings were further analysed using descriptive statistics including percentages, maximum scores and averages with the support of SPSS version 20.

Data collected from different sources such as focus group discussion, observation and secondary sources was triangulated and organized into thematic areas. The significant statements and themes, and composite descriptions which focus on the common attitude among the participants and/or something new emerged during group discussion and observation were written (Creswell and Tashakkori, 2007). To ensure quality transcription of data from focus group discussion, video recording was used. Macnaghten (2006) discussed video recording, which offers greater accuracy and produces more data (in terms for example, on participant gesture facial expression), but is more intrusive. The findings are discussed with reference to literature and objectives of the study in order to show how the findings are consistent or inconsistent with those literatures. Lessons learned during data analysis are also presented.

### 4.0.: ANALYSIS OF STUDY FINDINGS

This chapter begins with a profile of the study participants and then sets out the findings in response to the key research objectives and questions. The analysis comprised of evaluation of the potato production and management practices; farmers' experience of bacterial wilt, and management practices to combat it; farmers' willingness to engage in collective action to protect against bacterial wilt and the knowledge and skill needed by farmers for potato production and bacterial wilt protection.

#### 4.1. GENERAL SOCIO-ECONOMIC CHARACTERISTIC OF THE SURVEYED FARMERS

This first section describes the socio-economic characteristics of the surveyed farmers and compares them with the general population in Chenchu and nationally. Half of the respondents were selected randomly from the potato growers of the two kebeles, and half were purposively sampled because they are participants in the Vita programme. Those who participated in the Vita project have generally a higher educational background, and are more typical of farmers who access extension services. The Vita project is working with poor farmers to improve their livelihood, particularly with potato production, by supplying seed potato service and other extension support for potato production. By selecting half the respondents randomly and half from Vita programme participants, the study can compare the general potato growing population with those who are in receipt of some level of extension service support. However, on the ground the beneficiaries' socio-economic level and knowledge difference will not be considered as representative of the general population of the study area.

##### 4.1.1. Gender of respondents

Out of 70 respondents interviewed 53 (75.7%) of the respondents were male and the rest 17 (24.3%) were female, including both Vita project beneficiaries and non-project beneficiaries. Underlying gender norms and cultural norms mediate access to information (Mudege et al 2015). This was observed during home based interviews, when some men being interviewed regarded them-selves as the representative of their households, and needed to describe every activity as their own, even where it could be clearly observed that the women were the participants in the activity. However, honestly some male farmers handed over the chance of interview to women, because they saw their role as

artisanal activities while potato farming is practiced by their wives. During interviews, the author met three men such men who worked as artisans in Addis Abeba and have only occasional visit to their family in Chench. They gave the chance to be interviewed to their spouses who are the potato farmers but these were still recorded as male headed household. Many women involved in potato farming are engaged as part of male headed households. In spite of this potato is still an important crop for both men and women and while only a quarter of study respondents were women, in reality the author observed equal numbers of women and men as potato farmers.

#### 4.1.2 Age and family size of respondents

Table 4.1 below shows the age range of the respondents and the family sizes. It indicates that older farmers are involved in potato cultivation with almost 60% older than 41 and only 23% under 33. Twenty-four (34.3%) of the Vita beneficiary participants were aged above 40 while 17 (24.3%) of non-beneficiaries were older than 40. This might imply that Vita beneficiaries tend to be older farmers. It also implies uneven participation of different age groups in potato production. The family number of most respondents (52.9%) ranged from seven to nine while fewer respondents (7.1%) had more than 10 in family size (Table 4.1). The average family size of respondents was 5.7. This result is slightly higher for the Chench district than the report by CSA (2007) which found an average family size in the area of 4.7 (national average and 4.9. regional average). The involvement of such an age group and family size in potato production implies the presence of adequate productive labour to assign to intensive potato management activities as necessary. However, land scarcity limits the participation of different age groups of the community in potato production.

**Table 4.1: Age and family size of survey respondents (N=70)**

Age group (yrs.)	Frequency	Percent	Family size	Frequency	Percent
18-25	5	7.1	0-1	1	1.4
26-33	11	15.7	3-6	27	38.6
34-41	13	18.6	6-7	37	52.9
41-60	41	58.6	>=10	5	7.1

**Source:** own survey data, 2015.

Land shortage is one main problem in the area, while the average land holding is 0.5 acre per family. However, some farmers managed to gain land during the downfall of the Derg regime making for very uneven access to the land (interview with F70 on April 8, 2015). Most of these larger farmers with good land are considered as model farmers and also have political influence within the community (FG with F4 on April 24, 2015). The family distribution over the different number and sizes of the plots depends upon the age and the income variation. Younger farmers usually inherit a small portion of land after they marry and start a family. Those who did not inherit small plots from family are usually involved in small trading and artisanal activities either within the Woreda or migrating to urban centres. Those farmers who are skilled in artisanal activities often migrate to Addis Abeba. With many younger people involved in artisanal activities and trading, this might be a reason that the potato farmers are in the older age categories. Recently Government started to encourage young farmers to produce potato through organising them as cooperative on communal land. However, land shortages and the pull of urban migration is a constraint.

The author interviewed one young man (28 years old) and he underlined that young farmers are not involved in potato production due to land shortage, but not lack of interest. His family members are 6 in number together with his father and mother, but the land possessed by his family is 0.5 acres. Now he is involved in informal trading of local artisanal clothes along the street in Chench Woreda, selling these cultural clothes to tourists. He was interested to farm potato, but the land which his family possessed was inherited by his older brother. Now his father and mother are retired, their lives depend on same farm with his elder brother. If he wanted to stay in the area rather than migrate, petty was only chance to earn his livelihood. He also explained that sometimes wealthy farmers require labour during land preparation and planting so they hire young farmers who are landless by providing money and lunch for daily hire.



**Figure 4-1: young people informal trading with local artisanal clothes**

Source: own survey picture data, 2015

#### 4.1.3. Educational status of respondents

Table 4.2 shows the level of education of the study respondents. Almost half of the respondents (47.1%) were illiterate. During the Derg Regime there was program called “Meserats Tmehirte” which is like informal school for farmers to help them understand any extension teaching in Amharic language. In this study, participants who had only had this form of education were considered as ‘illiterate’ because although they can write their names they cannot read. Only 15.7% of participants had attended secondary school and 4.3% were above secondary school grade, but a significant portion of the respondents (34.3%) had never been to school at all. This finding differs from the findings obtained by Grimay et al. (2014) who found that over 57% of sampled households in Chencha District were illiterate. However regardless of whether it is 47% or 57% illiteracy, there is a clear implication that the low level of education might influence the adoption of modern agro-technology practices.

**Table 4.2: Level of education of Survey Respondents (N=70)**

	High School +	High School	Literate	Illiterate	Total
<b>Vita Beneficiaries</b>	2 (6%)	6 (18%)	14 (41%)	12 (35%)	34
<b>Non-Beneficiaries</b>	1 (2.8%)	5 (14%)	9 (25%)	21 (58%)	36
<b>Total</b>	3 (4.3%)	11 (15.7%)	23 (33%)	33 (47%)	70

Source: own survey data, 2015.

In order to test whether there was a statistical correlation between education levels and being a beneficiary of the Vita programme (and by implication other extension support programmes), the data was recoded to form two categories of Literate (incorporating all respondents with formal education from primary to post-secondary) and Illiterate and a cross tabulation carried out. Table 4.3. below shows the results which were statistically significant at the 1% level.

**Table 4.3:** Level of education between beneficiary and non-beneficiary

	Educational status		
	Literate	Illiterate	Total
Beneficiary(N=34)	22	12	34
	66%	34%	100%
Non beneficiary(N=36)	15	21	36
	42%	58%	100%

**Source;** own field survey, 2015

The majority of Vita project participant respondents could read and write. Twelve (34%) of Vita participant respondents had never attended school, while almost double that of the non-Vita study participants who had not acquired education. Only about 15(42%) of non-beneficiary had acquired education. It clearly indicates that the project either selects or attracts more educated farmers.

#### 4.1.4. Sources of Livelihood for Survey Respondents

Most participants in the study were small farmers with less than 1 acre of land. Most participating households derive the bulk of their income from agriculture and livestock management. However, some of informants also depend on off-farm activities to generate supplementary income, such as small business, temporary labour, and artisanal activities. As can be seen in Table 4.4 below, over half of the survey respondents (53%) were solely dependent on agriculture. This result is slightly higher than the result obtained by Grimay et al. (2014) who found over 40% of the sampled households in Chencha district earned their livelihood only in agriculture. However, 41.4% of the respondents depended on simultaneous economic activities of weaving and agriculture, trading and agriculture and sometimes agriculture, weaving and trading. More than half of the participating households generated their income from agriculture only while 47% were involved in on off farm activities to generate supplementary income, such as small business, temporary labour and artisanal activities.

**Table 4.4. Respondent's source of livelihood (N=70)**

Agriculture only	Agriculture + artisanal activities	Agriculture + trading	Agriculture + artisanal activity + trading
37 (53%)	13 (17%)	8 (12%)	12 (17%)

**Source;** own field survey, 2015

There were some differences between the Vita beneficiaries and non-beneficiaries as can be seen in Table 4.5 where 64% of beneficiaries compared with 42% of non-beneficiaries generated their income from agricultural activity only. Farmers not involved in the Vita programme are more likely to depend on other sources of income possibly because their farms are smaller or less productive.

**Table 4.5: Source of livelihood between beneficiary and non-beneficiary**

Client	Livelihood source		Total
	Agriculture only	Agriculture+1or more other activities	
Beneficiary (N=34)	22	12	34
	64%	36%	100%
Non beneficiary (N=36)	15	21	36
	42%	58%	100%

**Source;** own field survey, 2015

## 4.2. CROPPING PRACTICES OF RESPONDENTS

This section sets out to describe the main cropping practices in the area and to establish the importance of potato production to the livelihoods of farm households in Chencha Woreda. According to the researcher's observation the population of the district is fairly homogeneous in agro-ecology, socio-economic condition and they share common culture. Therefore, the study result of participants farming practice could represent the socio economic characteristics of study area.

### 4.2.1. Main Crops Grown in Chencha

The main food crops grown by the community are potato, enset (false banana), barley, wheat and apple. Among the listed crops, potato is the most important food crop of the area; it is followed by wheat and barley in volume produced. It is really difficult to find a participant who grow up only one of these crops alone, but for this study to understand participant prefer crop among, the Author used the quantity of land on which participants farm each of above listed crops. Thus this imply that those who grow potato can grow other crops, however the proportion of land on which farmers use these crops make different.

**Table 4.6: Main crops Grown by respondents**

N=70				
Potatoes	Enset and apple	Wheat & barley	&	Total
30	9	31		70
42.9%	12.9%	44.3%		100.0%

**Source;** own field survey, 2015

Enset (false banana) and apple are the major tree crops which are grown across the woreda. Apples were first brought to Chencha by missionaries about 60 years ago (Grimay et al. 2014) and it is still viewed as valuable and its production has transformed the lives of many farmers in Chencha. The missionaries focused attention on poverty stricken rural communities and helped them find a product compatible with their environment that they could grow and sell as a source of livelihood. They taught the local community how to grow apples and demonstrated in their project site as well as freely offering the apple seedlings to the community. As yet in Ethiopia, apple production has been low and concentrated in the Chencha district, while there is a good market in most urban areas of Ethiopia.

Enset is a multipurpose crop and very popular local food. It can be stored for more than ten years. In densely populated mid and highland areas of Ethiopia potato is an important cash and food crop (Gebremedhin et al, 2013). In the study area, potato, particularly old local potato varieties, and Enset are grown by all the community as a cash and food crop and therefore play an important role in food security (Gebersilase, 2015).

Concerning common cropping practices, the community of the study area practice mono cropping. Intercropping is not common in Chencha and only 2 respondents reported that they practiced inter-cropping, where inter-cropping is defined as producing 2 or more different food crops for the farm family in one cropping season or purposeful cultivation of two or more crops simultaneously on the same piece of farm land. Perhaps these two farmers tried their kind of intercropping because of land limitation. During interview they were asked open ended question such "please tell me why you are using this practice?" They replied that they produce apple seedlings as well as wanting to grow potato and other crops particularly for home consumption but they have small area of land, so they purposively inter-plant apple, potato, and cabbage at the same time on the same farm land. The researcher understands that land shortage is a problem in study area and will be more serious problem in future. This may eventually lead the community to understand the importance of intercropping and persuade them to practice it. These two farmers could not be considered among the better off as they are generating more income from apple seedling and producing apple fruit which has high market value in the area, as well as producing potatoes between the apple

trees. They are innovative in trying new intercropping practice which might influence other farmers to consider intercropping in to their farming practice. Krishana and Patnam (2014) observed that adoption rates of fertilizer and improved seed is more likely among wealthier farmers, who also have more and slightly better land and are better educated.

**Table 4.7: Farming systems of Survey Respondents**

Farming system	Frequency(N=70)	Percent
Mono-cropping	68	97.1
Inter-cropping	2	2.9
Crop-rotation	69	98.55

**Source;** own field survey, 2015

A form of intercropping with “Amochi<sup>1</sup>” is commonly practiced in the Chench area with Gebersilase (2015) reporting that about 30% of farmers intercropping with “Amochi”. It minimises labour cost for the control of weeds and results in a potential increase of production and farm profitability, farmers let it grow on farm as supplementary food source. It is also has drought and heavy rain tolerance. During an extended a season of water shortage for main crop, “Amochi” used to bridge the gap in food supply during the “hungry months” until the harvest. During the heavy rainfall season, “Amochi” has the capacity to control humidity that is difficult for other common main crops. Therefore, community considered this crop as an opportunity crop for supplementary food within a flexible behaviour of climatic change.

Crop rotation is common farming practice in Chench woreda. Gebersilase (2015) in her study of understanding factors affecting potato production found that two seasons rotation was common among the wealthy and medium wealthy farmers, whereas poor farmers practice every other season rotation.

#### 4.2.2. Importance of the potato crop to respondents

As depicted in Table 4.8 below in the majority of households, potato is important for both cash income and food. Study participants were asked about the importance of potato relative to other crops and whether they produce potato for 1) just home consumption, 2) home consumption and ware for market, or 3) seed production and ware for market. The table below shows and compares the responses for beneficiary and non-beneficiary farmers and also for male and female farmers and shows significant differences with male farmers and Vita beneficiaries operating at the higher end of the market with seed and ware while non-beneficiaries and women are more heavily represented in those producing for consumption only.

**Table 4.8: Purpose of Potato Production among Respondents**

	Potato production systems		
	Seed & ware for Market	Consumption and ware for market	Consumption only
N=70	20 (29%)	27 (33%)	23 (33%)
Vita Beneficiaries (34)	15 (44%)	14 (41%)	5 (15%)
Non-beneficiaries (36)	5 (14%)	13 (36%)	18 (50%)
Male (53)	17 (32%)	17 (32%)	19 (36%)
Female (17)	1 (6%)	8 (47%)	8 (47%)

This is consistent with the findings of Gebersilase (2015), who observed that potatoes are grown by all the farmers in the district as both a cash and food crop and play an important role in food security. In the households with

<sup>1</sup>Amochi (*Arisaema schimperianum* Schott) is an off-season crop plant in southern Ethiopia, grown during the dry season on residual moisture, for its edible tubers. It has gained importance as a “security crop” especially during the years of moisture stress and food shortage

extension support through Vita, they were more likely to produce for the market or to produce seed potatoes which are the most profitable, having received training on good potato production and management systems.

It is reasonable to assume that the 5 non-beneficiaries who produce seed potato for cash also have received training on good potato production and management through government extension program and are considered as model farmers. For farmers producing potato for market, there is more profit compared with other crops. However, half of non-beneficiaries produced potato for home consumption only. They have no supports of seed and training on potato production and management system.

As the formal seed program from government extension remains unable to satisfy the demand for seed potatoes, the main source of high quality seed in the Woreda is the Vita project. The price of cooperative seed however, is very expensive i.e. the cost of seed for one acre is between 1500-2000ETB (approx. €65). This is considered too expensive for ordinary farmers even when the seed is available, hence most farmers use their own seed that they selected from the previous harvest based on small size. Otherwise, they buy seed from local market that has been multiplied a number of times. The absence of seed certification system couples with farmers traditional sharing of seed means there is no control of potential source of infection and diseases.

From observation and discussion with farmers in the area, the researcher concludes that the majority of non-Vita beneficiaries did not have access to quality seed, especially those too poor, and women. Despite community interest to produce potato for market, lack of access to quality seed is a constraint and limits most poor farmers to produce potato for consumption only. About half of non-vita beneficiaries produced potato for consumption only. Only one woman of the 17 women interviewed produced seed potato and she was in the Vita project.

The study findings show that potato is produced in the study area basically for cash with 67% selling in the market. The respondents who are Vita beneficiaries were in a better position to exploit the market opportunities for seed and ware potatoes. Accessibility and availability of knowledge for potato production, management and quality seed management appear to be key factors in profitability.

#### **4.2.3. Overall Issues regarding management of potato production by Respondents**

In most potato producing areas of Ethiopia, including Chench, two rainy seasons are distinguished; the main rainy season ("meher", June to September) and short rainy season ("Belg", February to March). The "Belg" season is usually associated with short and unreliable rainfall (Geldeemarcher, et al, 2009b). However, in highland regions the Belg and Meher seasons merge in to one extended growing period whereby long-cycle grains such as sorghums and corn and short cycle small grains such as wheat, barley, and teff, as well as potatoes can be grown (CIR, 2008).

Gebresilase (2015) highlighted a number of areas in potato crop management that are challenging in Chench. These included, soil fertility management with farmers using a combination of organic and chemical fertilizers, though none of the farmers know the optimum recommended rate. They also included inadequate tilling of the soil by poorer farmers because of labour competition. She found that secondary and tertiary tillage, which allows optimal decomposition of plant residues, destruction of weeds and insects pests through solarisation, are mainly carried out by wealthy and medium wealthy farmers and those who have received practical training or exposure visits via government and NGOs (Gebresilase, 2015). Also while most farmers recognised the importance of fertile soil for planting potato and would seek to use organic manure to enhance soil fertility, the understanding of the importance of crop rotation varied. Only farmers receiving extension support understand the importance of long term rotation to reduce soil diseases. Land shortage was a big constraint on extending rotation periods.

Gebresilase (2015) also commented on the size of seed potato used by poorer, medium and wealthier classes of farmer with poorer farmers planting the smallest because of the lower cost associated with small seed and because they prefer to eat or sell the medium and large sized tubers.

In both study kebeles some farmers practice separate production, management and storage of seed and ware potato. Some of post-harvest activities used by them are spreading, sorting out within two week intervals, and storing. Immediately after harvest farmers spread potato in the sun for a week, providing the skins time to harden, minor injuries to seal, and drop any soil clinging to the potatoes. In this respect, beneficiary and wealthy farmers in both study kebeles were found to have good understanding of the negative effect of using part of ware potato as planting material. It seems however that in non-beneficiary smallholder cropping system, seed is the by-product of ware potato, that is, farmers use the potatoes that cannot be used for sale or consumption as planting material. Seed potatoes are stored using traditional local storage method or DLS. Local seed potato storage methods include bed-like structure situated under a roof outside or inside a residential house, sacks, corner of a room, and underground storage. Gebresilase (2015) found that wealthy (71%) and medium wealthy (33%) farmers owned DLS, mainly with technical and financial support of NGOs. In this study, the researcher also observed that 17 (50%) of Vita beneficiaries and 1 (3%) of non-beneficiaries owned DLS. Farmers understand that local storage methods are simple and less cost, while DLS was assumed to be costly and require knowledge to construct. During field observation, it was noted that DLS, varied in



size from 5-25m<sup>2</sup> and economic life from 5-15 years. It was noted that wealthy farmers who have good capacity and knowledge of DLS will build expensive one, and some who have medium economic capacity will build medium DL storage, whereas for poor farmers and women building DLS is impossible because of economic and knowledge problem.

### 4.3. WHAT KNOWLEDGE AND EXPERIENCE DO CHENCHA FARMERS HAVE OF BACTERIAL WILT?

This section explores the knowledge, experience and understanding that the study respondents had of Bacterial Wilt. To understand the potential effect of bacterial wilt, in study are the participants were asked about the extent and effect of bacterial wilt on their potato farming. Also to assess farmers' knowledge and understanding of bacterial wilt, participants were asked a number of questions regarding potato production management and infection of bacterial wilt. During the interview, respondents were asked to differentiate the symptoms of bacterial wilt, causes and any management practices they know during the potato production management against bacterial wilt. The questions were supported by providing a pictorial diagram, which showed infected symptoms of bacterial wilt at different stage of potato plant. This was important to help participants by easily saying "yes I saw this kind of symptoms during my potato management experience" or "no I never seen this type of symptoms during my potato farming".

#### 4.3.1. Experience of Potato Yield Losses due to Bacterial Wilt

Table 4.6 demonstrates that nearly half of the farmers (48.6%) had recorded a severe loss of yield due to bacterial wilt; 29% of farmers observed a significant effect on their potato farming, whereas only 10% of farmers endured a minor effect from bacterial wilt.

**Table 4.9: Respondents Assessment of the Effect of Bacterial Wilt on Potato Yields in the Kebeles of Yeyiora and GendoGebla.**

Village	Problem with disease			Total
	Minor effect on yields	Significant effect on yield	Severe loss of yield	
Yeyiora (N=42)	5 12%	20 48%	17 40%	42 60%
GendoGebla(N=28)	2 7%	9 32%	17 61%	28 40%

**Source;** own field survey, 2015

These findings indicate that Gendo Gebla kebele is more seriously affected having 50% loss of yield, compared with only 24.3% loss of yield in Yeyiora kebele. As the study coincided with the vegetative growth stage of potato farming, the author observed that most potato farms across this kebele were seriously infected. This might be due to location of farming site of potato in this kebele. The land location of a kebele is more than 50% hill site in which the water that might be contaminated with bacterial wilt can flow across edge of one farm land to neighbour's farm land. Also the majority of Vita seed producers are from Yeyiora kebele and information gap between beneficiaries and non-beneficiaries might also be a factor. The extension expert who works with community indicated that there was more serious and frequent infection of bacterial wilt in Gendo Gembla kebele over that last two production year, while potato production in Yeyiora kebele is relatively important.

#### 4.3.2. Farmers Knowledge and Understanding of Bacterial Wilt

To assess farmers' knowledge and understanding of Bacterial Wilt, a number of questions were asked in the survey. From an initial test of fifty-three knowledge items, 14 knowledge items were included in measuring the knowledge level of participants. These included:

1. Overall awareness of bacterial wilt as a disease
2. Knowledge of timing of disease incidence
3. Knowledge of stage of potato growth when vulnerable to BW disease
4. Knowledge of correct management of environment surrounding infected potato plant

5. Knowledge and experience of non-chemical management of bacterial wilt
6. Knowledge of ideal size of seed potato
7. Knowledge of appropriate management at different stages of potato growth
8. Understanding of crop rotation importance in reducing bacterial wilt
9. Understanding of role of weed and plant residue in carry over of bacterial wilt
10. Practice of sanitary measures before storing and after storing of seed potato
11. Knowledge of importance of quality seed in disease prevention
12. Knows where to source disease free seed

Depending on their responses they were scored as 1) excellent (10+); 2) good (5-10); 3) fair (3-4); or 4) weak (0-2). Table 4.10 below shows and compares the results in terms of knowledge levels between beneficiaries and non-beneficiaries.

**Table 4.10: BW Knowledge Levels of Vita Beneficiary and Non- Beneficiary respondents**

	Beneficiary(N=34)	Non-beneficiary(N=36)	Total
Excellent/Good	12 (35%)	4 (11%)	16 (23%)
Fair/Weak	22 (65%)	32 (89%)	54 (77%)
Total	34 (100%)	36 (100%)	70 (100%)

**Source:** own survey 2015

Farmers understanding of BW damage were also observed during field evaluation. Farmers knew that damage increased during the potato growing season and coincided with rainy periods, where it caused more damage. Unlike insects, diseases are difficult to see and farmers do not usually know about the causal agents of plants disease (Bentley, 1990). This was confirmed in this study which showed that farmers lack knowledge of bacterial biology. During the field observations the researcher met a young farmer who was weeding and turning back the soil in potato plant on his potato farm. Because it was vegetative growth stage of potato farming, he was interviewed (see Figure 4-2 below). For this, see the interview narrative of the young farmers in the text box 2 below.



**Figure 4-2: Farmers weeding and management to infected potato**

**Source:** Own photo

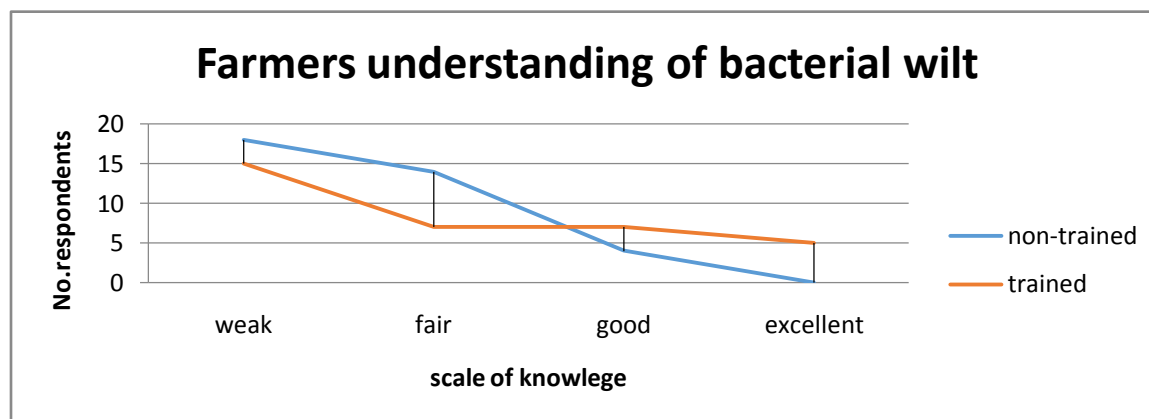
**Text box 1: Farmer understanding of bacterial wilt.**

A young farmer explained that he has been farming for 5 years since he inherited the land from his family. He was farming old local potato, wheat and barley. However, he switched to new potato variety due to relatively high level of return per hectare. It was his second time of farming with new potato. Last year he was farmed new potato on 0.5 acre, but because of disease he did not get good yield. This year he borrowed seed from his friend and sowed 0.5 acre again but on different farm land. He compared last years' experience with this year. Last year in the early stage of potato plantation, the crop looked good. When nearing vegetative growth stage, he found wilting of some youngest leaves at the end of the branches during the hottest time, while at night when the temperature was lower, the plants appeared to recover. After a few days all leaves wilted quickly and desiccated and died. Until this happened he thought that this may be due to rain fall shortage. When asked by the researcher did he not think about bacterial wilt, he honestly answered that he never heard about bacterial wilt and that he had never been trained in any aspect of potato production. The researcher asked him to pick out one wilted potato, then cut the diseased tuber revealing browning colour. When the young farmer saw the discoloration inside the tuber, vascular ring and surrounding tissue, he was really excited that he understands the disease is in the soil within tuber. He wanted to know the treatment.

The narrative above reflects the same understanding of BW disease for most farmers across the study area. Most farmers did not know that the real cause of bacterial wilt is a microorganism but they associated the disease with weather conditions that favour its occurrence, such as heavy rain fall, wet soil condition and cold weather. Very few farmers understand that bacterial wilt is introduced by lack of appropriate potato management, failure to select disease free farm land, lack of crop rotation practice, site of farm location and inadequate implementation of both pre harvest and post-harvest management. The existence of disease is a long term scenario in study area. The old local potatoes with low yields did have the capacity to resist the diseases. However, after the introduction of new potato variety which has realized high production potential, farmers shifted their production to the new potato variety. Farmers now find that the new varieties are more vulnerable to diseases than old local varieties. Despite this and because of the significantly higher yields and the high market value farmers are still interested in growing the new varieties.

Bacterial wilt disease has caused controversy in the area with arguments between different stakeholders about its introduction and spread with some accusations that Vita had introduced the disease with the new varieties. What was clear within the study was that not enough attention was paid to creating awareness among all farmers by government and NGOs about the disease and the fact that it can spread easily from one farm to another if best sanitary practices are not followed. The recent heavy losses of yield had focussed greater attention on the need to recognise and tackle the disease.

While Vita has started to create awareness among their beneficiaries about diseases, management and how quality control of potato seed will have to be maintained, the learning cycle has been very slow and community understanding of bacterial wilt is still not enough. Most of non-beneficiaries lack awareness about bacterial wilt and proper management. Those beneficiaries organised as cooperative to produce seed potato by the project have been trained on diseases, management and quality seed assurance of potato production. However, there is still lack of understanding between beneficiaries too, particularly for women farmers.



**Figure 4.3:** Farmer's knowledge of bacterial wilt.

Figure 4.2 above compares the knowledge of BW between farmers who have received some training in potato management and farmers who have not received any training. The graph shows that even farmers who have received some training are also weak in knowledge of BW. However, the graph shows that it is only trained farmers who had an excellent knowledge and this might be an indication that the diffusion rate of information is slow but that training is critical. Those who attended the training were extension beneficiaries. Non-trained farmers or ordinary farmers might be aware about bacterial wilt from neighbours who attended training, as information gets diffused. It might be argued that the information interaction between ordinary farmers and those who attended training would have a significant impact in diffusion of information. However, respondents suggested that most of trainings were focused on potato production management, quality control of seed, and type of diseases available, rather than on technical components of bacterial wilt management.

In summary, while 95% of farmers in the area face the problem of bacterial wilt, the study found a very low understanding of the disease. To date, training in potato production and management in the area has not focused specifically on bacterial wilt management, its symptoms and its ways of transmission. Therefore, there was no significant difference in the knowledge levels of those who had received training but there was an indication that training is the critical element to diffuse information about the disease.

#### 4.1.4.2. Gender-based understanding of bacterial wilt transmission and access to extension supports

As discussed earlier, women and poor farmers lack access to extension services and this was demonstrated in study analysis which found that the direct beneficiaries of Vita extension support and training on good potato production are those who already have higher level of education, and in the wealthy and medium wealth categories. Most have previously been considered as model farmers from the government extension point of view and who get special offers of inputs supply services such as fertiliser. Among the 15 (44%) of Vita respondents who produce seed potato, there was only one woman. Also only 4 (23%) of women farmer respondents had attended training on potato production, while 28 (53%) of men respondents received training. Lack of information and other resources increases the vulnerability of risk for both male and female farmers (Munyua, 2000). See the text box 2.

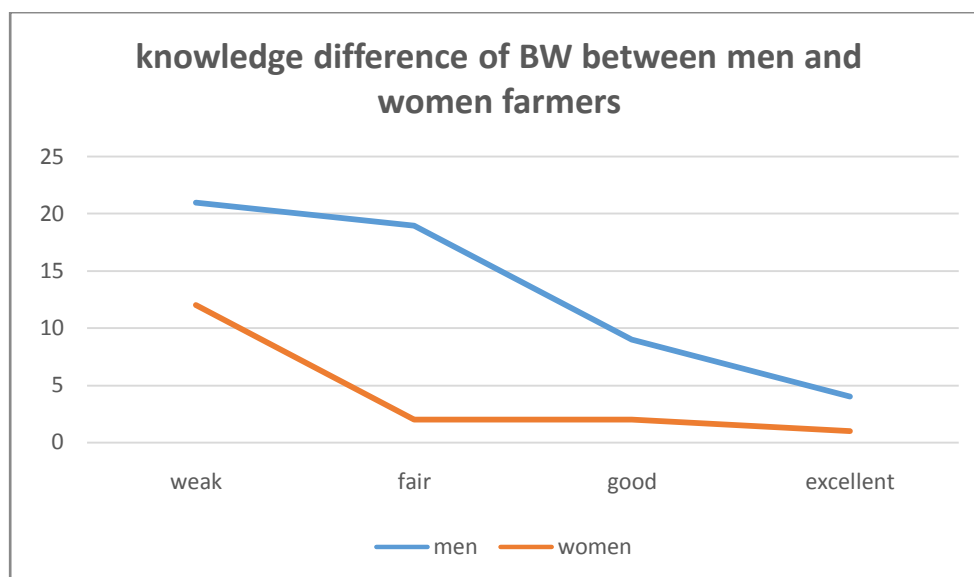
#### **Text box 2: Training access for women and poor farmers.**

A female farmer (widowed with 4 children) from Gendo Gembela explained that poor farmers are mostly limited for access to extension services even if they have interested, because of the model farmer approach system. She explained that she does not receive extension or input supports either from Vita or government. She farms 0.5 acres on which she grows old local potatoes, wheat and barley. Recently after Vita project invested in area, she observed that the farmers supported by the project are profitable in new potato production and the variety generate a larger return per hectare than the old one. She became interested to produce new potato production, however, she had no access. She tried to buy from the cooperative however, the price was very expensive. She tried to borrow from her neighbour who was Vita beneficiary but he was not willing to offer her. She bought seed in the market to grow on her farm, but she did not get yield as she observed from other Vita and model farmers. She explained that she was interested to get training and inputs accesses for new potato production, however, no one encouraged her. She believed herself that this is because of she has no political influence with in rural community as well she is not wealthy enough to be model farmer. She also claimed that model farmers are most of time not willing to share training information after they trained and also they sharing seed only for their best friends. She also claimed that to purchase new seed from cooperative is very expensive and very limited.

A comparison was made between women's and men's knowledge about bacterial wilt. Women scored lower than men on understanding bacterial wilt, the causal agents, symptoms and the way it can be transmitted. Whereas some male farmers had good understanding that bacterial wilt damage was evident in field, and damage increases during the potato season, female farmers believe that bacterial wilt is caused if black insects feed on potato causing it to wilt. In the women farmers focus group discussion, they said, "*the black insects might be the mother of bacterial wilt. It appears if heavy rain falls during the potato season*".

Potato researchers argue that volunteer potato plants are another means of survival of bacterial wilt and must be removed in the subsequent crops (potato or any other crops) soon after emergence (Priours et al,1999Muthani et al 2012). However, the female farmers in their focus group said they considered volunteer potatoes as a supplementary food before the main potato season arrives, so that they allow growers of voluntary potato.

Women lack of access to information was observed and very few women had attended training to improve potato production or management. Figure 4.3 below illustrates a different pattern of knowledge on bacterial wilt for women and men with proportionately more men moving towards fair and good knowledge and understanding.



**Figure 4.4: Different knowledge levels of women and men farmers of bacterial wilt**

Many women involved in potato farming are engaged as part of households headed by men. When farmers are nominated for training, the kebele administrator and the extension agents are the key actors information dissemination (Belay and Abebaw, 2004; Netsayi et al, 2015) and this often means that information is not given to everyone in the community but only to a selected few and, in most cases to men (Netsayi et al, 2015). Manfre et al. (2013) state that extension agencies should move towards integrating gender in all extension services and interventions in order to ensure that women become active agents in improving their livelihood and those of their households. If gender equality was really being addressed, women would also have the same chance as men to attend training (Netsayi et al, 2015). In group discussions, men did not always appreciate that women may need different approaches to access information.

While it could be concluded that men farmers have a better understanding of bacterial wilt than women, however, only a few men farmers understood that bacterial wilt is caused by the soil borne bacterial. The majority of male farmers believe that weeds and volunteer potato plants promote the survival of bacterial wilt. However, only a few farmers choose to remove weeds and volunteer potato plants as soon as the first potato crop is harvested and keep up the management regime until the second round of planting arrives. Many farmers do not adhere to the management of removing the host plant. When asked for a reason, they responded that they do not have adequate information, and because of land shortage, they use the post-harvest residue to graze livestock.

During sex-disaggregated Focus Group Discussions (FGDs), male farmers identified that bacterial wilt is transmitted by water movement from one farm to a neighbouring farm, and also by any means of contact with host material. During the discussion one Vita beneficiary explained that he had made a comparison demonstration on his two farm sites “uphill farm site and flat farm site”. He said, “*The hill farm site is relatively more vulnerable to disease than the flat farm site. That might be due to water flow across my farm from neighbouring farms. Even if I adjusted a canal for water to flow past my farm, the effect of disease was not reduced compared with a flat farm site. However, in the case of my flat farm site, with the same management, it was less vulnerable to disease than uphill farm site*”.

#### **4.3.3. Understanding of the mechanisms of carryover of bacterial wilt**

During FGDs only one participant said that practiced removing weeds and volunteer potato plants in addition to digging out the whole infected plant with its root system tubers, foliage and soil around it, from relatively clean seed potato plant, burned the two neighbouring plants, and mixing the soil in the hole with ash. He said that he had started this management after he had received training on bacterial wilt management through Vita and after he had worked with a researcher who is an expert on bacterial wilt.

The majority of Vita beneficiaries and some non-Vita beneficiaries do dig out only the infected potato plant with its roots system, tubers, and foliage, and dispose of it into the canal or street and/or feed to livestock. However, the majority of non-Vita beneficiaries and female farmers, in both participating kebeles, applied no further management except visual inspection to separate infected seed from non-infected seed during harvesting periods. Most farmers do not cut off the foliage and in most cases, after the crop reaches senescence, farmers do not harvest the entire field. They use the piecemeal approach of leaving the tubers in the field for extended periods of time then harvesting as

needed. The practice favours the pathogen remaining in the ground and serving as inoculum source for the next season (Guchi,(2015).

#### 4.3.4. Farmers understanding and use of crop rotation in limiting the spread of bacterial wilt

The common control measure employed by farmers includes the use of crop rotation with locally available non-host plants such as wheat, barley and pulses. Crop rotation of 5-7 year excluding host plants has been recommended to control bacterial wilt in the soil (Guchi,2015). However, crop rotation in the study area is much shorter because of the small farm sizes. A few farmers use continuous cultivation of potatoes on the same pieces of land. A majority of farmers use a very short rotation, which is inadequate to reduce the disease. During focus group discussion all the participants believed that crop rotation has most important role to reduce bacterial wilt. They also argue that their rotation practice is not long enough to reduce bacterial wilt, but due to land shortage it was impossible to keep to an appropriate rotation. This finding contrasts with the finding of Geberesilase (2015) that crop rotation is one of the strategies farmers commonly used to control disease. During FGD one Vita participant expressed his opinion that the ox-plough is not a useful tool in potato production management. He said, *“During ox-ploughing it is difficult to remove all weeds and volunteer plants. However, during hand tillage you get a good opportunity to remove all weeds and other material which sustains bacterial wilt”*

#### 4.4. THE ROLE OF COMMUNITY PARTICIPATION IN LIMITING THE SPREAD OF BACTERIAL WILT

Bacterial wilt disease has spread across the woreda and therefore the majority farmers are already aware of its existence. During focus group discussions almost all participants thought that whole community participation is the most important means to reduce infection by bacterial wilt through working together with other farmers in the area. While only a few people had received training on potato production, they are already considered as model farmers among the community but they also considered that their knowledge is meaningless if the majority of people possess inadequate knowledge of potato management. Table 4.11 below shows that the majority of survey respondents felt positively about a collective community response.

**Table 4.11: Willingness of Survey Respondents to engage in collective action to prevent bacterial wilt**

Respondent	Willingness to engage in community effort			
	Strong		Fair	
	Frequency	Percent	Frequency	Percent
Beneficiary(N=34)	33	97%	1	3%
Non-beneficiary(N=36)	33	91%	3	9%

In summary, the majority of people are aware of the threat from bacterial wilt. However, there is knowledge gap to manage bacterial wilt within the community and apparently between Vita beneficiaries and non-beneficiaries. Most importantly, carrying out the necessary management practices to prevent bacterial wilt is required by the entire community, since if only one farmer refused to stop planting potatoes in an affected area, this would create conditions for the pathogen to persist in the soil and spread in the community. As the bacterial wilt is caused by a pathogen that isn't easily managed, the incidence can be reduced only if various control components are combined and the entire potato producing community is involved in control components. Currently, the common control measures recommended by the researchers include cultural control, botanical control, biological control and rarely chemical control. For the small scale farmers, cultural control is most effective and could easily be adapted by all community. The most effective cultural controls include intercropping with cabbage and cereal crops, field crops, and material sanitation, resistant varieties, keeping the area free of weeds and volunteer plants, selection of disease free seed, and crop rotation with non-susceptible crops.

All the male farmers stressed the harmful impact of bacterial wilt on potato production, and felt strongly the need to get rid of bacterial wilt through community participation or working together with other farmers in the area. Almost all women farmers had similar interest in combating bacterial wilt through community participation. However, some women regarded themselves as having difficulty in participation due to the additional work burdens at home.

During sex-disaggregated focused group discussions (FGDS) farmers were asked open ended questions to describe how all members of the community could participate in collective action, whether there were groups that would pose a challenge for participation and how they could be supported to engage in participation. The FGD participants said that for the whole community, the potato is seen as a key crop, and an important diversification opportunity for both poor and rich farmers. They said that despite the potential, the farmers in their community are not benefitting as much as expected, due to lack of knowledge, high cost and access to quality seed. They also mentioned that in the study area there was a high rate of male out-migration to Addis Abeba for artisanal business activities. This means that women do a lot of the work in potato production, as well as housekeeping work and that this presents a barrier to accessing information and technology. Women regarded themselves as having difficulties in participation, due to the additional work burdens at home. During FGD farmers suggested how the whole community could participate in collective action and proposed that a cooperative farming/labour sharing system would be the best solution. They said, “*Cooperative farming for all farming activities seems to be the best way to share knowledge as well in learning together on farm for the new approach. Since we all do not have equally good experience in potato production, this would help us to exchange information and keep information transparent naturally throughout the community*”.

#### 4.5. THE LEARNING NEEDS OF FARMERS TO COMBAT BACTERIAL WILT AND THE CHALLENGE TO EXTENSION

This section looks at the expressed needs of farmers for knowledge and learning to support them in combating bacterial wilt and it also considers the different channels and methods that could be used to support farmer learning. All focus group participants discussed ways farmers prefer to learn and how specific situation or events lead the farmers to learn which in turn motivates the farmer to gather information over time from many sources. Table 4.12 below summarises the views of the survey respondents on their needs for knowledge and skills on potato production and disease management.

**Table 4.12: Expressed priority extension need of respondents**

<b>Extension / Training needs</b>	<b>Vita Beneficiaries N=34</b>	<b>Non-Beneficiaries N=36</b>	<b>Total N=70</b>
Potato production and management	9 (26%)	17 (47%)	26 (37%)
Technical aspects of disease management	8 (24%)	10 (28%)	18 (26%)
Access to disease treatment	17 (50%)	9 (25%)	26 (37%)

Of all the study respondents, 37% prioritised general potato production management and 37% prioritised access to disease treatment which they regarded as chemical control while 26% prioritised technical knowledge on disease management. There were interesting differences between Vita beneficiaries and non-beneficiaries with the beneficiaries most interested in the chemical control. One implication from this is that farmers are less than fully motivated about the complicated process of managing the disease through farm management practices and would like if there was an easy solution. The non-Vita beneficiaries were most interested in measures required for potato production management and the technical components of integrated disease management. It those farmers who are working with Vita have a little more knowledge of good potato production management and bacterial wilt management than non-beneficiaries, they also need to know how they should access information for disease treatment. Farmers concern with bacterial wilt is understandable, considering that, the disease indeed reduces potato yield and is a real threat to potato production, food security, and farm profit. However, the finding that a large section of the farming population prioritise access to disease treatment suggests that a lot of work needs to go into deepening the understanding that collective control through good management is the only feasible solution.

##### 4.5.1. The role of extension service in advising strategies to limit spread of bacterial wilt

Agricultural extension uses many methods, techniques and tools. People are influenced to make changes in behaviour in proportion to their contact with several different methods. Methods used with farmers often depend on

The context of the farmer's type of business, the extension agents approach and the nature of local social conditions. Methods which reach large numbers of people are called mass media methods. Somsala, (1963) assessed agricultural extension methods and their application to underdeveloped countries, especially in Asia. He recognised that mass media methods of agricultural extension, including radio, news print, magazines and circular letters would not be effective, since few farmers can read and still smaller number have radios. Now in the 21<sup>st</sup> century, the nature of extension work is changing, as all aspects of human life are changing. Chapman et al (2003) who assessed the impact of rural radio in agricultural extension, confirmed that rural radio can be used to improve the sharing of agricultural information by remote rural farming communities. Participatory communication can support agricultural extension efforts, especially using local languages and rural radio to communicate directly with farmers and listener groups (Chapman et al, 2003). Level of education of the house hold and the presence of a radio and/or television have a positive effect on adoption (Abebe et al, 2013). However, in fact this does not mean that radio broadcasting is the best extension method; there is no single best method in extension activity. Extension work and methods are changeable. Ideally, methods should be diversified and their combination for best results should vary with local conditions (Vanclay, 2004).

NGOs are very prominent in implementation of government programs towards sustainable rural development through third party involvement in agriculture, community development, youth empowerment and poverty alleviation (Enyioko, 2012). In the study area Vita, a private voluntary organization plays a major role in potato production and management by providing basic services to those who need them. It provides quality seed, advisory extension services and encourages the community in the practical knowledge of new potato production. Vita has created a good demonstrated environment, it is innovative, or in other ways it achieves things better than official agencies in its ability to reach poor people. However, the only limitation here is that Vita works with a specific number of selected communities, while the service demand is huge right across the community, particularly for poor and women farmers. It was found that it is impossible for this project to extend so further extension services for the whole community because of financial and staff limitation on the project.

Up to now, the Vita project has achieved much with its farmer beneficiaries in terms of basic knowledge difference on potato production between beneficiary and non-beneficiaries. However, combating bacterial wilt will remain a challenge if the project does not have a wider reach within the communities and find ways of engaging all farmers.

The government extension focuses on Model farmer approach system (PADETES). The terms "model" and "ordinary" farmers have been used in Ethiopia to identify locally influential farmers to promote new technologies. The Government identifies them as "kimbar kedem" to lead the other four ordinary farmers in the one to five development groups "limat budin". They are prioritized for opportunity of training, fertilizer, and improved seed. They are supposed to share their knowledge with the ordinary farmers in the development group. However, in many cases these model farmers are not fully accountable to their responsibility of teaching and sharing information with other farmers. While this approach seems sound, it is disappointing in implementation at grass root level farmers.

Vita also uses model farmers, however, they believe that their approach is little bit different from government. Their beneficiaries are continuously supported by extension services and there is close contact between project extension experts, model farmers and ordinary farmers of project. They have also cooperative members of model farmers, who are legally organised and trained by Vita to produce seed potato for the community. The model farmers who are organized as cooperative members have common land on which they farm potato to produce seed for community. They have extension support through different stages of potato production from land preparation up to harvesting stage. This approach is most important in encouraging the farmers in all activities of the potato farming management system. However, as the cooperative is limited to members those farmers who are not in the cooperative still feel inadequate to the extension support services and this leads to the knowledge gap between project beneficiaries. Most of time the project decides to give priority of the training to the cooperative committees. The work tasks of the cooperative committees are supposed to follow up the beneficiaries' potato farming and keep check for any illegal selling of seed potato. There are very few female headed households participating in cooperative committees as they are traditionally considered not as able as men to coordinate the members of cooperative. The ordinary participants also suggested that the system of cooperative to produce seed is very important in assuring of quality seed. However, many within the community complain that the seed produced is only offered to Vita beneficiaries and it is very expensive for ordinary community to get seed. They recommended that Vita provide the chance of seed and extension service to whole community rather than working only with the same farmers who are already selected once as project stakeholder. It is also important that those qualified with potato production management after training then encourage other ordinary poor farmers.

This study explores community understanding of the bacterial wilt situation and its contribution to empower the community in collective activity to prevent bacterial wilt. It sought a strategy for triggering community desire to combat bacterial wilt and lay the groundwork for an opportunity to develop leadership, which would spread natural



decision making and lesson learning. Therefore, during focus group discussions participants discussed ways in which farmers prefer to learn and how specific situations or events lead the farmer to learn. These in turn motivate the farmers to “gather information” over time from many sources.

Table 4.13 shows the survey results regarding how men and women farmers prefer to receive information that would help them combatting bacterial wilt. Respondents could give more than one response.

**Table 4.13:** Men and women prefer Information source channels

Medium	Male farmers (N=53)	Female Farmers (N=17)	Total (N=70)
Religious institutions	48 (91%)	16 (94%)	64 (91%)
Radio	42 (79%)	15 (88%)	57 (81%)
Farmer to farmer teaching	43 (81%)	13 (76%)	56 (80%)
Extension experts	23 (43%)	5 (29%)	28 (40%)

The major sources of knowledge for smallholders are local and informal (neighbours, family, market, and community based organisation). Only 43% of men and 17% of women respondents reported Government Extension as an important source of information. It indicates that the majority of women farmers are not satisfy with extension experts as information source. However relatively few 23(43.4%) men farmers were preferring extension experts as the information source. Though, both farmers and extension personnel themselves expressed dissatisfaction with the quality and frequency of the interaction. An agent said, *“We all know what is best for teaching farmers, but we do not always do what is best because of the constraint on our time”*. Agents also discussed that farmers be given a leading role in the search for appropriate solution to their agricultural problems, but 2 of 6 experts are believe that the key role should be allocated to extension agents. Given this reality, it seems that farmers’ empowerment, which is one of the basic objectives of PADETES, is far from being attained, in that extension agents decide who should participate in PADETES and have the firm belief that they have the right solutions to farmers’ problems (Belay and Abebaw, 2004).

A high percentage of men and women perceived local discussion as an important source of information while a very high number of respondents perceived that religious institutions are the most important source of information for campaign action, next to FM, local radio. It seemed to be unusual extension channel system for the experts to select religious institution. During discussion with an extension expert for what would be the best media channel, the expert referred to the Government article that “state and religion are separate” and “the state shall not interfere in religious matters and religion shall not interfere in state affairs”. This presents a challenge for utilising religious institutions as an extension channel. However, it was during male focus group discussion that, one participant quoted from the Bible citing, James 2; 14-17: *“Faith without work is nothing.” Potato is our life, therefore our local religious institution should be the best way to increase consciousness in our community for learning, if access information for disease treatment’*.

I laughed at the time, but after I got back home, and took down a copy of the Bible, I observed insightfully that the Bible states, *“What good is it, my brother and sister, if someone claims to have faith but has no deeds? Can such faith save them? Suppose a brother or a sister is without clothes and daily food, if one of you says to them? “Go in peace? Keep warm and well fed” but does nothing about their physical needs, what good is it? In the same way faith by itself, if it is not accompanied by action is dead”*.

This observation is consistent with David et al, (2000), who confirmed that non-governmental bodies are also important sources of information in those areas where they are active. Churches, chiefs brazes (community meeting and agricultural companies) are also a significant information source in some locations.

During FGDs, it was recorded that field days and demonstration were an important source of information for female farmers, whereas formal training, farm visit, and farmer to farmer teaching were an importance source of information for male farmers. For the male FGDs, formal training, demonstrations and field days were preferred as an important source of information. The observation is apparently consistent with Netsayi et al (2015) who states that he discretely hosted training on the positive and negative selection of potato management by categorising of participant as groups and non-groups. Groups “-were those who attended formal training when held out of the village, and non-groups, “were those who attended practically training sessions offered in the village, and these included observation and learning from the demonstration fields”. Eventually the study came up with evidence that female and those attended practical training; field days and demonstration were having an important information and training than those attended formal training by extension expert.

#### 4.5.2 Learning preferences ranked by focus group and extension expert

Franz et al (2010) point to the importance to give the opportunity for farmers to voice directly their learning preferences to influence and improve extension educational program development and delivery. One of the determinants of the success of extension work is the existence of a well-organized feedback system, to ensure that extension programs match the preference, resource and specific condition of the beneficiaries and the programs utilize local skill and knowledge (Belay and Abebaw, 2004, Kibwika et al 2009). In this study all focus group participants and extension agents discussed ways farmers prefer to learn and how specific situation or events lead the farmers learn more, and motivate farmers to gain information. It is observed that farmers learn more from fellow farmers, on-farm demonstration, and farm visit. The evidence from discussion shows that higher rates of technology adoption are achieved when extension agents possess adequate knowledge and work closely with farmers. Field demonstration days and farm visits are expected to enhance adoption of new technologies/practices through creation of awareness, exchange of ideas and skill acquisition. Extension experts also confirm that they understand the need to effectively engage farmers in learning processes and experiment options. However, application of farmer-best fit teaching, particularly on-farm demonstrations of technology is compounded by other constraints concerning for example, time, shortage and lack delivery of input, lack of extension material, transportation and workloads. This result is consistent with the finding of a previous study which underlined that extension agents in Ethiopia in general, face heavy workloads for at least two reason, first they are expected to serve a large number of farmers. Secondly, they are often required to be involved in various non-extension activities. (Belay, 2003; Belay and Abebaw, 2004)

In conclusion, the 40 participants in the sex-disaggregated focus groups discussed various extension methodologies and identified their top 7 preferences as 1) Demonstrations; 2) Farm visits; 3) Farmer to farmer teaching; 4) Field days; 5) Local radio; 6) Religious institutions; and 7) On farm advisory. The six agents/specialist who participated in a survey identified what they perceived to be the most effective extension methods in this woreda as 1) Farm visits; 2) Farmer-farmer teaching; 3) Demonstration 4) Field day and 5) On-farm test

## 5.0: DISCUSSION, CONCLUSION AND RECOMMENDATIONS

This section will briefly review and discuss the study findings in relation to the objectives before making recommendations for development of extension initiatives in Chencha as well as recommendations for further research.

This research thesis has been based on the approach so-called “triggering community collective action to control bacterial wilt” in Chencha woreda, where local farmers meet and seek to identify their problems, prioritize solution, consider the appropriateness of collective action and identify the kind of learning methods that would help them acquire new knowledge. The thesis also describes the current extension system providing by Vita (NGO) and Government extension service for the community.

### 5.1. FARMERS EXPERIENCE AND UNDERSTANDING OF BACTERIAL WILT AND THE THREAT IT POSES

Farmers in the study area are small farmers with less than 1ha of land. Most derive the bulk of their income from agriculture and livestock management, with less than one third also depending on off farm activities to generate supplementary income, such as small business, casual labour, and artisanal activities. They are all smallholders but they are not homogenous in economic well-being, in capacities and in resources. Potato is an important food crop in the area, followed by wheat and barley in volume produced. It is grown by all the community as a cash and food crop and therefore plays an important role in food security. According to farmers, the advantages of the potato over other crops are that it is easily marketed, has a potential for high productivity and good price. Mainly for some model farmers and extension beneficiaries, the potato has been extremely profitable compared with other crops. Despite its importance, the majority of small farmers are failing to achieve its full potential because of limitations that include: inadequate supply of certified seed, poor disease and pest control and inadequate management training.

The study focused on two different communities, one of which had a much greater problem with Bacterial Wilt. The community with the lesser problem was the one which had received greater support from the VITA project and was a centre for potato seed production. One can draw a conclusion that the use of improved seed with attendant training and extension is leading to overall better potato husbandry and better disease control.

The study assessed farmers' knowledge, experience and understanding of bacterial wilt through assessing 14 knowledge items. There was a high level of awareness about the disease and it ranked as the most critical disease in the study area. Farmers' concern with BW is understandable considering that this disease indeed reduces potato yields and is a real threat to potato production, food security and farmers profit. However, a knowledge gap exists on how to manage bacterial wilt, and this knowledge gap is influenced by gender as well as by whether or not the farmer participates in extension activities. Most farmers were unable to correctly diagnose the disease and most had weak knowledge about bacterial wilt management. While this differed between those who had attended training provided by extension services, even those farmers benefitting from extension programmes still had very limited knowledge on how to manage the disease. However, it was clear that training was making a difference and the challenge is to make this training available to the whole community to enhance farmers' knowledge, not just about disease management but about good potato management also.

Farmers knew that bacterial wilt increased during the potato growing season and coincided with rainy periods, when it tended to cause more damage. However, the farmers did not know that the real cause of bacterial wilt is a microorganism but they associated the disease with weather conditions that favour its occurrence, such as heavy rain fall, wet soil condition and cold weather. This shows that there is an opportunity to build on indigenous knowledge and that farmers are trying to make sense of what they see and interpret.

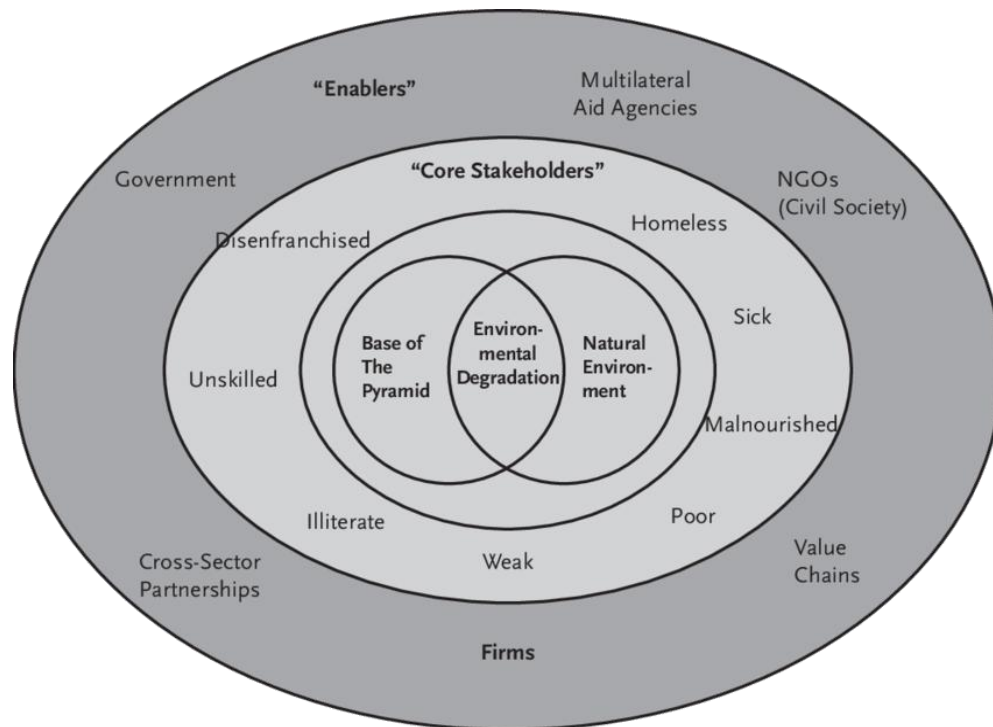
Farmers' knowledge about managing bacterial wilt was visual inspection to separate infected seed from non-infected during harvesting period. The only knowledge of management practice, which is the part of their indigenous knowledge is crop rotation with indigenous non-host plant such as wheat, barley and pulses. However, crop rotation is not effective because most farmers use continuous cultivation of potatoes on the same pieces of land or very short rotation because of land scarcity. Very few farmers used the proper cultural control practice of digging out the whole infected plant with its root system tubers, foliage and the soil around it, from a relatively clean seed potato plant, burning the two neighbouring plants, and mixing the soil in the hole with ash. Instead most farmers dig out only the infected potato plant with its root system, tubers, and foliage, take it to the canal or street site and/or feed to livestock. Most farmers do not cut off the foliage and in most cases, after the crop reaches senescence, farmers harvest in a piecemeal approach leaving the tubers in the field for extended period of time. This practice allows the pathogen remain in the ground, serving as inoculum source for the next season (Guchi, 2015).

## **5.2. INTEREST AND WILLINGNESS OF FARMERS TO USE COLLECTIVE COMMUNITY ACTION TO ADDRESS BACTERIAL WILT**

Almost all of the farmers interviewed in the study and those that took part in focus group discussions expressed an interest and willingness to engage in collective action as a disease control strategy. However, for this to succeed the study identified that lack of knowledge about BW control needs to be addressed. Women and poorer farmers were considered as a group needing special attention from extension services if they are to be part of an effective response.

From the literature, there are useful recommendations on how to incorporate collective action for different purpose and at different stage in the community extension processes. Hart and Sharma (2004) suggest that repeatedly accessing the same core stakeholders does not lead to break-through but that reaching out to the marginal will help identify radical solutions. Collective action can be useful in sharing knowledge, setting priorities, and experimenting with, evaluating and disseminating technology (Chesbrough et al, 2006; Dagupta and Beard, 2007; Hever and Londrum, 2016). The study found that these marginal stakeholders are not commonly participants in extension activities and indeed often feel excluded from knowledge networks.

This study recognizes that bacterial wilt is a fundamental challenge facing the farming system of area and must be addressed as urgent priority. The Base of the Pyramid Model (BoP) proposed by Hever and Londrum (2016) could be a useful framework for designing integrated community action. It underlines motivating participation, coordinating the actions of multiple resource users, spreading risks, managing environmental spill overs, and creating an environment conducive to joint experimentation and sharing of knowledge needed (Hever and Londrum, 2016). They propose that core stakeholders must include the BoP community, the poor, weak, and illiterate, as they can benefit most from the community collective action model giving them increased control over the bacterial wilt management.



**Figure 5.1:** In search of environmental sustainability: engaging human nature at its core

**Source:** Hever and Londrum community collection Model of environmental sustainability at the Base of the Pyramid (2016)

In the Chencha context, bacterial wilt is a fundamental challenge facing potato production and must be addressed collectively as an urgent priority. In BoP models, government, multilateral aid organization, and NGOs must serve as enablers of this bacterial wilt protection effort, while the primary actors or core stakeholders, must come from the community through collective action. The local community have motivation to provide a system of resources (improved seed, training and other production management facility without a governance system with the necessary scale and scope to address the need of a particular potato production system. Bacterial wilt management in this context involves protecting integrated management while also providing the necessary input services for produces. Since the community food security is linked through the dependency of community and their livelihood activities of the potato production. Therefore, bacterial wilt must be addressed as a priority and be recognized as normative and invaluable.

### 5.3. Best Fit Extension

NGOs are very prominent in effective implementation of government programs towards sustainable rural development in agriculture, community development, youth empowerment and poverty alleviation (Enyioko, 2012). In the study the basic extension service is provided by Vita, a private voluntary organization, working closely with the Government office of agricultural extension. Vita plays a major role in supporting potato production and management by providing basic services to those who need them. It provides quality seed, advisory extension services and encourages the community in the practical knowledge of new potato production. However, the survey result reveal that even though Vita project and government extension agents are expected to provide extension services to all farmers in their mandated areas, the Government extension agents are inclined to work very closely with those farmers who participated in PADETES (Model farmers), while Vita also selects specific farmers for its service. This concurs with the findings of Belay and Abebaw (2004), that extension agents tend to work very closely with middle income farmers and pay little attention to the resource-poor farmers. Extension agents are required to supervise the demonstration plots of all farmers participating in PADETES in their mandate areas, and this means that both Vita and Government extension agents find it impossible to provide the minimum required service to those farmers not involved in their programmes.

While PADETES and the Vita programme are largely sound in their approach, the study highlights the need for greater attention to poverty and gender proofing and greater investment in recruiting and training the more marginalised farmers. This would ensure fulfilment of the conditions necessary for the support of all members of the community, particularly the disadvantaged groups. Combining technical innovations with more collective action initiatives could lead to substantial farmer benefits.

The literature clearly identifies the need for farmers to voice directly their learning preferences to influence and improve extension educational program development and delivery (Piercy et al, 2009). In this study all focus group participants and extension agents discussed ways farmers prefer to learn and how specific situation or events lead the farmers learn more, and motivate farmers to gain information. It is concluding that farmers learn more from fellow farmers, on-farm demonstration, and farm visit.

Private organizations / non-state actors are also important sources of information in those areas where they are active (Davis et al, 2000). Churches, chiefs, community meetings and private agricultural companies, local FM radio, and on farm advisory are also a significant information source in some area.

#### **5.4. CONCLUSION**

This thesis describes farmers' knowledge of bacterial wilt and its impact on potato production practice. The extension approaches that could be used to tackle bacterial wilt has been explained. Farmers knowledge of and practical experience in dealing with bacterial wilt in potato production practice have been described and analysed.

Results show that limited access to useful training and practical participation is a fundamental issue behind high levels of adoption observed among the majority of potato producers' beneficiary and some of poor potato producers' – who are non-beneficiaries. Results further show that the progressive farmers, who are exposed to the new agronomic practices, and management, have got good knowledge regarding bacterial wilt. This was achieved through this group having the opportunity for instruction from the extension services, through experience sharing visits and by having intensive communication with extension workers. Such tactics allowed these farmers adopt workable practices, which would assist with bacterial wilt control.

The study showed that in the case of many low income farmers and a majority of women farmers, however, a poor understanding and even non-knowledge regarding bacterial wilt, was common. The findings show that the major obstacles to adoption of bacterial wilt control strategies seems to arise from lack of information, or being recently informed and not having access to training and to the opportunity to plant clean healthy seed. It is proposed that this may be due to the ineffective flow of information and also poor extension interaction and support between farmers having different socio economic status.

The research noted that, most importantly, farmers' lack of knowledge about the causative agent and general information related to bacterial wilt is not due to their lack of willingness to get information. It is caused by lack of adequate opportunity for them to access the essential extension service and the poor level of contacts between farmers and Extension Agents. The findings also suggest that men and women farmers need access to information, skills and tools to improve yields. The findings also show that the existing extension service, either from the Government and non-Government (Vita) is limited in its approach, with inadequate consideration of farmer's opinion at all levels and failure to allow them to decide on extension priority. Therefore, the strategy of the institutions involved in the delivery of the extension service must be to redesign the learning process and environment, so as to directly meet farmer needs by allowing the farmers to decide on the information channel they prefer.

The potato crop has common important production values and bacterial wilt poses risks for all farmers, irrespective of economic status or gender. The study shows that combining technical innovations with more initiatives on collective action will be necessary to result in substantial benefits for farmers. It also recommends that Government and non-Governmental organizations work together to support farmers, especially women. However, further study on action oriented farm-field experimentation is recommended to illustrate that community collective action is the best extension approach to tackle bacterial wilt. This finding is based on the result of reflection, analysis and investigation around farmers' experience and confirms their willingness to engage in community collective action to limit the spread of this serious disease.

#### **6.0. RECOMMENDATIONS**

Even though Vita project and government extension agents are expected to provide extension services to all farmers in their mandate areas, the Government extension agents are inclined to work very closely with those farmers who participated in PADETES (Model farmers), while Vita in the same way provides its service to selected farmers.

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Both Vita and Government extension agents find it very difficult to reach the poorest farmers and to reach women farmers. Both need to invest more in the selection and recruitment of the disadvantaged groups and ways of reaching the wider community.

Government and Vita need to also invest in innovative approaches to reach the wider community and engage them in improving their potato production and combatting the disease threat. This could include the production of popular education materials, radio programmes, film shows to support and supplement the activities of extension field staff. It could also include stronger engagement with religious and community organisations that influence community thinking.

Access and cost of good quality potato seed is another factor excluding resource poor farmers. Ways of improving the organisation of the seed supply system could help to engage the resource poor farmers.

NGOs and extension research institutions need to conduct action research with communities on how to adapt models of collective action such as the BoP model to engage multiple stakeholders and especially the most marginalised in addressing the problem of bacterial wilt.

## 7.0. Acknowledgements

First of all, I would like to thank the almighty God for his guidance and protecting me during research time in my home country. I thought that I would not finish my thesis on time, but now I realize God has power to make the impossible to be possible.

It is my pleasure to express my warm appreciation and special gratitude to my major advisors Dr. Monica Gorman of UCD and Michael Hennessy of Teagasc for their time to visit the study field and guide me how to collect the data. It seems to me impossible to have reached here without their support. Especially I would like to thank Dr. Monica for her particular support starting from before arrival to the Ireland and her guidance and encouragement on my thesis work and for her time sacrifices in the field to guide me how to collect the field data. Please Monica, receive my heart-full thanks and gratitude for what you did for me. I would also to express my gratitude to Ms. Henna Kinsella for her continuous support in sorting out my finances.

I am grateful to Teagasc, the Irish Agriculture and Food Authority for granting me a scholarship to pursue this study. I would like to extend my thanks and appreciation to Mr. Thomas Caffrey of Vita from Ireland and Mr. Tade Girma of Vita Arbaminch office in Ethiopia for facilitating my research work. I would also to express my gratitude to all field workers of Vita and the Checncha Woreda agricultural office at the center for their valuable assistance during field work.

Last but by no means least, the moral support, comment, encouragement I obtained from my friends John Burke, and Sean Mannion deserve a special place in my memories.

## 8.0. STATEMENT OF THE AUTHOR

First, I declare that this thesis is a result of my own genuine work that all sources of materials used for writing it have been duly acknowledged. This thesis has been submitted in partial fulfillment of the requirements of for the Degree of Master of Science at University Collage of Dublin, Ireland. The thesis is placed at the university's library to be made available to borrowers under the rules and regulations of the library, to Teagasc research institute, and to Vita project coordinator office, Dublin Ireland. I solemnly declare that this thesis has not been submitted to any other institution anywhere for the award of any academic degree, diploma, or certificate.

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