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5. Improving seed potato quality in Ethiopia: a value chain perspective

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Abstract

In Ethiopia, use of low-quality seed potatoes by the majority of potato growers is associated with underdevelopment of the seed potato value chains. Three seed potato systems are present in Ethiopia: the informal seed system, the alternative seed system and the formal seed system. This chapter analyses the performance of seed potato value chains with respect to their ability to supply quality seed tubers to seed potato systems, by using the chain performance drivers enabling environment, technology, market structure, chain coordination, farm management, and inputs. Information obtained from literature review, secondary data and key informants' interviews were used for the analysis. In the informal seed system, seed potato value chains suffered from a poor enabling environment such as a low quality technical support and lack of a seed quality control system; use of sub-optimal storage and transportation technologies, sub-optimal farm management practices; and little use of inputs. In the alternative seed system, main constraints were the lack of a seed potato quality control system, poor farm management practices, little use of inputs by seed potato growers, and a distorted seed potato market that resulted from involvement of institutional buyers. Chains in the formal seed potato system were characterised by little involvement of the private and public sectors in the production and supply of seed potatoes. Based on the analysis, improvement options for the three seed systems were identified.

Keywords: seed quality, potato, value chain, Ethiopia

5.1 Introduction

In Ethiopia, agriculture is the main source of livelihood for more than 80% of the population. However, Ethiopian agriculture is characterised by smallholdings and low productivity. The average land holding is about 1 ha (IFAD, 2010; Spielman *et al.*, 2010, 2011; USAID, 2011) and the average productivity of crops and livestock is far

below its potential. As a result, food security and cash income are major constraints for smallholder farmers in Ethiopia. One way to improve the current food security and cash income situation is to change to growing crops and rearing livestock with higher productivity potential. Potato (*Solanum tuberosum* L.) is a crop that can be used to improve food security and cash income because of its high yielding ability in a short season, presence of suitable agro-ecological zones within the country, the availability of labour for its production on large areas of land, and the availability of a potential market with considerable added value for its produce (FAO, 2008).

In Ethiopia, farmers grow two types of potato varieties: local and improved. The majority of potato growers grow local potato varieties⁷ that are low yielding, infested with diseases and pests, and susceptible to most of the indigenous diseases and pests. Improved potato varieties are high yielding, relatively clean, and disease tolerant. However, seed of improved potato varieties is not available to the majority of the farmers. The majority of potato growers use poor quality seed saved from the previous harvest or obtained from the market. The use of poor quality seed by potato growers is associated with the underdevelopment of the entire potato value chain that results in low production and productivity of potato in Ethiopia. To suggest improvement options, knowledge on the performance of the seed potato value chains is important. However, currently there is a lack of knowledge on the performance of seed potato value chains. The objective of this chapter is to analyse the performance of seed potato value chains with respect to their ability to supply quality seed tubers to seed potato farmers. This chapter attempts to summarise knowledge that can be used to improve seed quality for all seed potato value chains. We characterise how chain activities are performed, we evaluate the performance of the chains against the most important drivers, and identify barriers and options for development.

5.2 Conceptual framework

Chain performance can be analysed by identifying its main drivers and assessing their impacts. In this study we adopted the chain performance drivers suggested by Da Silva and De Souza Filho (2007) and Moir (2010) to analyse the performance of the seed potato chain in Ethiopia. The chain performance drivers are the enabling environment, technology, market structure, chain coordination, managing business operations, and inputs.

⁷ To differentiate between local and improved potato varieties we used the definitions of Kaguongo *et al.* (2008). According to these authors, local potato varieties are potato varieties grown by farmers, whose origin is unknown, or varieties released by the national agricultural research system (NARS) but which have been out with the farmers for more than 35 years without being cleaned up for diseases. Improved potato varieties are those varieties that have been developed or cleaned up for diseases by CIP in collaboration with national research stations since 1970 and which are considered to be superior in qualities such as yield, resistance to diseases, dormancy period, maturity period or taste, compared with local varieties.

5.2.1 The enabling environment

The enabling environment comprises policies, institutions and support services that form the general setting under which enterprises are created and operate. Depending on the way it is arranged, the enabling environment can either support or harm the performance of an agri-commodity chain. The enabling environment components considered in this study are: provision of business development services such as training and extension to seed potato growers and the key providers of these business development services such as non-governmental organisations (NGOs), governmental organisations and private sector; research and development institutions supporting technology transfer and quality control; and laws and regulations regarding land tenure and access to land.

5.2.2 Technology

Technologies are essential determinants of value chain performance through their association with production, processing and distribution operations along the chains. Technologies include the methods, processes, facilities and equipment used in chain operations plus those applied in research and development. The components of technologies considered as chain performance drivers in this study are: availability and adoption of improved varieties, use of improved/diffused light store (DLS) storage methods by farmers, processing equipment, and transportation facilities.

5.2.3 Market structure

Evaluation of market structure shows the extent to which markets are competitive or whether they are characterised as oligopolistic or monopolistic markets. Market structure has impact on the performance of individual firms (business operations) at each stage of the value chain. The components of the market structure considered in this study include number and type of buyers.

5.2.4 Chain coordination

Chain coordination refers to the harmonisation of the physical, financial and information flows and of property right exchange along a chain (Moir, 2010; Da Silva and De Souza Filho, 2007). Well-functioning coordination facilitates planning and synchronising such flows and exchanges among the chain's different echelons, thus promoting organisational efficiencies (Moir, 2010; Da Silva and De Souza Filho, 2007). These, in turn, should translate into lower systemic costs, better consumer responsiveness and increased overall competitiveness. Coordination is affected by governments and/or organisations that can play a direct role in establishing or fostering public and private sector strategies and policies of interest to a particular chain. The evaluation of coordination should concentrate on the mechanisms that govern transactions among chain participants and on the effectiveness of such mechanisms in promoting the harmonisation of the physical, financial and

information flows and of property right exchange along a chain. Components of coordination considered in this study are degree of chain organisation measured by the presence of farmers' primary cooperatives and chambers of commerce that play a direct role in establishing or fostering public and private sector strategies and policies of interest to the development of the seed potato value chain.

5.2.5 Managing business operations or farm management

The ability of individual firms to efficiently allocate resources, respond to consumer needs and adapt to market changes is to a great extent a function of its managerial power. Components of managing business operations considered in this study are efficient allocation of resources, response to consumer needs, and adaptation to market changes.

5.2.6 Inputs

The availability and cost of the main inputs (land, labour and capital) in the different segments of a chain directly affect performance at every stage. Inputs considered in this study are availability and cost of land, labour, seed, fertilisers, and pesticides.

5.3 Methodology

The performance analysis first conducted a mapping of the seed potato value chains currently existing in Ethiopia followed by a description of the chain using the chain performance drivers. In order to map the seed potato value chain and to describe and analyse its performance and improvement options, a literature review has been carried out, secondary data has been collected (for instance from local seed business and Ethiopian Central Statistical Agency reports), and key informants have been interviewed over the course of 2008-2013, including experts from national and international agricultural research and development institutions such as the Ethiopian Institute of Agricultural Research, the International Potato Center (CIP) and Wageningen University. This study considers only components of the chain performance drivers relevant to the Ethiopian seed potato value chain. These components also vary depending on the actor group.

5.4 Results: performance analysis

5.4.1 Mapping and description of seed potato chain actors

The seed potato value chains in Ethiopia were mapped in such a way that they encompassed actors in three seed potato systems. The three seed potato systems operating within Ethiopia are informal, alternative and formal (Hirpa *et al.*, 2010). The informal seed potato system is the seed potato system in which tubers to be used

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for planting are produced and distributed by farmers without any regulation. The alternative seed potato system is the seed potato system that supplies seed tubers produced by local farmers under financial and technical support from NGOs and breeding centres. In Ethiopia there are community-based seed supply systems which are undertaken by the community with technical and financial assistance of NGOs and breeding centres. In the formal seed potato system seed tubers are produced by licensed private sector specialists and cooperatives. An integrated map of the three seed potato systems is presented in Figure 5.1. In the integrated map, seed potato flows among the main actor groups taking part in the three seed potato systems. In the *informal* seed system, the main actor groups of the seed potato value chain are ware growers saving seed for sale and own use, ware growers who occasionally buy seed tubers to renew their seed stock, ware growers who buy seed tubers every season, and ware/seed traders. The ware growers are smallholder farmers producing potato for home consumption and cash.

In the *alternative* seed system, the main actors are breeding centres, NGOs, governmental organisations, and organised seed potato growers. The activities of the breeding centres are to develop potato varieties and to supply basic seed of these varieties to smallholder farmers and commercial seed growers. Holetta Agricultural Research Centre (HARC) and Haramaya University (HU) are the most important actors in developing potato varieties and supplying basic seed of improved varieties

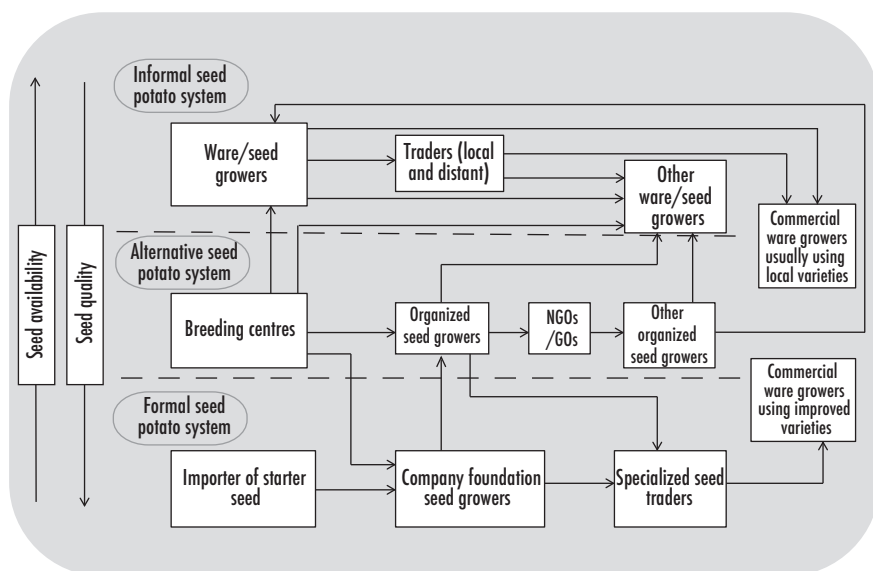


Figure 5.1. An integrated map of seed potato systems (delineated by dotted lines) in Ethiopia. NGO = non-governmental organisation; GO = governmental organisation.

in Ethiopia. Organised seed growers are smallholder farmers organised in farmers' research groups (FRGs) or farmers' field schools (FFSs), set up by research centres (especially Holetta Agricultural Research Centre). Currently, most of the FRGs and FFSs are transformed into seed producers' cooperatives. According to Hirpa (2013), there are more seed potato producers' cooperatives in the central and southern potato producing areas than in the eastern and north-western areas. The cooperatives in the central areas have more experience with producing seed than the cooperatives in the southern areas.

The actors in the *formal* seed system are modern commercial seed growers and ware/seed growers. Solagrow Private Limited Company (PLC) is the only modern commercial seed potato producer in the formal seed potato system. The PLC supplied seed potatoes to two seed potato grower cooperatives in the districts of Ambo and Doba. The cooperative in Ambo had 30 members (ISSD, 2011). These cooperatives out-grew seed potato for Solagrow PLC, which means that Solagrow PLC was the seed supplier and the seed buyer. The PLC plans to export seed potatoes to neighbouring countries. Ware/seed growers are domestic farmers or farmers in the importing countries.

Table 5.1. Main actors of the present seed potato value chain in the main potato growing areas of Ethiopia.¹

Actor groups	Different potato producing areas ²			
	Central	Eastern	Northern and north-western	Southern
Ware/seed growers	0.20 million	0.04 million	0.58 million	0.46 million
Breeding centres	HARC	HU	AARC, DARC	AwARC
Organised seed growers	16 SPGCs that comprised 744 members	One SPGC that comprised 40 members and 70 out-growers	One FRG that comprised 30 members and one SPGC that comprised 34 members	15 newly established SPGCs that comprised about 300 members
NGOs, projects and governmental organisations	DBARD	FAO, SHA, DBARD	CIP, World Vision, TDA, DBARD	CIP, GOAL Ethiopia, Vita, DBARD
Modern seed growers	Solagrow PLC	No	No	No

¹ AARC = Adet Agricultural Research Centre; AwARC = Awassa Agricultural Research Centre; CIP = International Potato Center; DARC = Debreberhan Agricultural Research Centre; DBARD = District Bureau of Agriculture and Rural Development; FRG = Farmers' Research Group; HARC = Holetta Agricultural Research Centre; HU = Haramaya University; SHA = Self-Help Africa; SPGC = Seed Potato Growers' Cooperative; TDA = Tigray Development Association.

² Central comprises east Shewa zone, north Shewa zone, west Shewa zone, south-west Shewa zone and Gurage zone; eastern comprises east Hararge zone, west Hararge zone, Harari regional state and Dire Dawa; northern and north-western comprises Tigray and Amhara regional states; southern comprises all potato growing zones in SNNPR except Gurage zone, Arsi zone and west Arsi zone.

The distribution of the actors across the major potato growing areas of Ethiopia is given in Table 5.1. The formal seed system is found only in the central potato growing area of Ethiopia.

5.4.2 Evaluation of actors against value chain performance drivers

In this section, we describe how each chain actor group is affected by the different chain performance drivers. As indicated above, the following chain performance drivers are used: enabling environment, technology, market structure, chain coordination, firm management and input.

5.4.2.1 Enabling environment

In the informal seed system, the District Bureau of Agriculture (DBARD) is the institution responsible for providing extension services for all crops including potato. Trained Development Agents (DAs) provide the extension service to farmers. According to Davis *et al.* (2010), there were 8,489 farmer training centres in Ethiopia in 2009, staffed with 45,812 DAs. The technical support that the farmers obtained from the agricultural DAs, however, is limited because (1) DAs were more involved in input supply, collecting tax and loan repayment than in providing technical support to farmers (Kassa, 2003) and (2) the DAs do not have sufficient technical knowledge (Kassa and Degnet, 2004; Davis *et al.*, 2010). In Ethiopia, less emphasis has been given to technical assistance on potato compared with technical assistance on major cereal crops like maize, teff, barley and sorghum. Potato is not among the priority crops for which an extension package is developed and implemented by the government of Ethiopia. CIP, the agricultural research centres and the NGOs have been undertaking the extension services on potato. The extension efforts by CIP and the agricultural research centres have focused on replacement of local potato varieties by improved potato varieties (Gebremedhin *et al.*, 2008). Little effort has been made to improve husbandry of local potato varieties despite their importance in total potato production. The local varieties comprise more than 90% of potato production (Gildemacher *et al.*, 2009; Hirpa *et al.*, 2010). In Ethiopia there is no institution responsible for the control of quality of seed potato. However, CIP in partnership with the Ministry of Agriculture and the agricultural research institutes has developed a quality declared seed system for potato and sweet potato. The quality declared system is at the stage of implementation by the Ministry of Agriculture but is threatened by the ubiquitous quarantine disease bacterial wilt (*Ralstonia solanacearum*).

The agricultural research centres, Haramaya University and Solagrow PLC are sources of seed potato for chains operating in the alternative and formal seed systems (Figure 5.1). Among the agricultural research centres, Holetta has been developing new potato varieties in collaboration with CIP. The role of Holetta is to test CIP potato clones for Ethiopian growing conditions. Other research centres such as Adet, Debre Berhan and Awassa demonstrate new potato varieties developed by Holetta Agricultural Research Centre. According to Haverkort *et al.* (2012), in 2012 all research centres

together had 15 researchers working on potato and an annual budget of Ethiopian Birr (ETB) 196,000 (about USD 10,000). Among the NGOs in the alternative seed system, CIP with its project entitled 'Better Potato for a Better Life' has been working to improve seed supply systems in Tigray and Southern Nations, Nationalities and Peoples Regions.

In the alternative seed system, breeding centres in collaboration with DBARD provide training on seed potato production to the organised seed growers. Some of the breeding centres are also involved in seed quality control and marketing. For example, potato researchers in Holetta Agricultural Research Centre have been supervising seed potato fields of members of cooperatives to examine the level of late blight and bacterial wilt infestations. Some cooperatives in the district of Welmera have committee members who supervise seed potato fields of member farmers for disease infestation (especially for bacterial wilt). In the alternative seed system, the role of NGOs is to distribute seed potatoes from the organised seed growers to other organised or individual farmers and provide technical assistance to farmers (for instance, assist farmers in constructing diffused light store).

Solagrow PLC, Holetta Agricultural Research Centre and DBARD are the institutions that provide support to the chain in the formal seed system. The PLC provides inputs and technical advice to the seed potato out-growers to ensure they produce seed of the required quality. Holetta Agricultural Research Centre has been providing seed potatoes in the formal seed system to smallholder farmers and commercial seed growers. For instance, Holetta Agricultural Research Centre has provided seed potatoes to Solagrow PLC. The land administration section of DBARD is responsible for providing land for seed potato production to produce seed potatoes.

5.4.2.2 Technology

In the informal seed potato system, the potato growers predominantly used local potato varieties to produce ware and seed potatoes. Seeds of improved potato varieties were unavailable to the majority of these potato growers. In this seed system, ware/seed potato growers used local storage methods, such as leaving in the soil (postponed harvesting), storing in a local granary, in jute sacks, or in a bed-like structure to store seed potatoes (Gildemacher *et al.*, 2009; Hirpa *et al.*, 2010). Local storage methods are largely sub-optimal because seed potatoes stored in local storage have fewer, longer and weaker sprouts that have low vigour at planting (i.e. are physiologically too old) (Gildemacher, 2012). In the alternative seed system, seed growers used the DLS method. According to Hirpa *et al.* (2012), use of DLS was perceived by seed growers in districts of Jeldu and Welmera to significantly improve seed yield compared with use of local storage methods.

With regard to transport, the means used in the informal and alternative seed systems are inappropriate. According to Hirpa *et al.* (2010), seed potatoes are usually transported by pack animals, tied by ropes on their backs, which could cause bruising.

In the formal seed system, seed potato is packed in boxes and transported by lorries. Seed damage during transportation is deemed to be very low. In the formal seed system, Solagrow PLC has two large seed storage facilities located at Hidi and Wonchi. It has its own plant and molecular laboratory (ELISA and qPCR) which is important to certify the phytosanitary quality of seed potatoes (Solagrow PLC, 2011). The company also has a seed tuber grading facility and modern ICT facilities to communicate with its customers.

5.4.2.3 Market structure

In the informal seed system, there are many ware/seed sellers and buyers. Price is the main determinant of transaction. In the alternative seed system, the major buyers of the seed produced by the organised seed growers are NGOs. Government organisations also buy small amounts of seed from organised seed growers. As a result of these inspirational buyers the seed potato market is highly distorted. Demand for seed of improved potato varieties from smallholder ware growers is very low because of the high price of the seed. Moreover, some ware potato growers are not aware of the benefits of using seed tubers of improved potato varieties. Abebe *et al.* (2013a) found that farmers in the Shashamene region preferred local potato varieties, such as Netch Abeba, above improved potato varieties such as Jalene and Gudene because of better agronomic characteristics and cooking quality of the former. The formal seed system is in an incipient stage. In this seed potato system, there is only one seed potato producer (i.e. Solagrow PLC). The PLC contracts smallholder farmers to produce seed potato and buy back the seed. The company grades and certifies seed, and sells it to ware growers.

5.4.2.4 Chain coordination

There is no formal institution that attempts to coordinate the informal seed system. In this seed potato system, ware/seed growers supply ware/seed to local markets and ware/seed buyers buy what is available in the market. Farmers obtain information on potato production and marketing from a variety of sources. According to Gildemacher *et al.* (2009), most potato growers in Ethiopia used their own experience to select seed potato (57.3%), to enrich their soils (63.7%), to undertake general crop husbandry (59.2%), post-harvest handling (62.9%), and marketing (70.4%). These authors also reported that farmers' own communities were the major sources of information about potato varieties (58.7%) and crop protection (33.7%).

In the alternative seed system, breeding centres are coordinated at national level. According to Haverkort *et al.* (2012), the existence of national coordination helped the breeding centres to use their research resources efficiently. Some NGOs formed a consortium which helps them to coordinate potato development activities in Ethiopia. These NGOs are Catholic Relief Services (CRS), FAO Ethiopia, Food for the Hungry (FH), GOAL Ethiopia, World Vision Ethiopia, ChildFund, Concern Worldwide and International Medical Corps (IMC). The consortium is organised and established by

FAO and aimed at implementing a project titled 'Disaster Risk Management – Root and Tuber Crops Response Intervention in SNNP Region' (G. Solomon, CIP-Addis Ababa, personal communication). The aim of the consortium is to achieve a wide geographic coverage and to coordinate and harmonise activities.

In the alternative seed system the market for seed potatoes produced by organised seed growers is a major problem because of unreliable demand. Buyers only buy seed when they have money. According to key informants, a decision on the area of land to be allotted for seed potato production by farmers in a certain season depends on the price of seed in the preceding season. A season with high prices usually leads to oversupply of seed potato in the subsequent season resulting in a very low price.

In the formal seed system, there is coordination among actors in the seed value chain. For instance, there is a contract between the growers and Solagrow PLC, which supplies the seeds to and buys the tubers from the growers (ISSD, 2011). Based on the contractual agreement, the PLC pays different prices for different grades of seed potatoes.

5.4.2.5 Seed potato farm management

In the informal seed system, ware/seed growers use suboptimal farm management practices (Hirpa *et al.*, 2012). Seed potato management practices that enhance the quality of potatoes are not practised by most of the growers. These practices are the following: use of appropriate seed tuber size; healthy seed; positive selection; rotation and allocation of a separate plot for seed production. According to Hirpa *et al.* (2010), in 2007 only 13% of the farmers in the district Degem, 15% of the farmers in the district Jeldu in the central area and 8% of the farmers in the district Banja in the north-western area produced seed potatoes by positive selection, whereas 1% of the farmers in district Degem, 14% of the farmers in the district Jeldu and 6% of the farmers in the district Banja produced seed potato on separate plots. In the southern area there is no practice of positive selection or use of separate plots for the production of seed tubers. According to Mulatu *et al.* (2005), farmers in the eastern part of Ethiopia usually do not produce seed tubers on separate plots. In this part of the country there is no positive selection either.

Solagrow PLC is the only modern and licensed seed potato growing PLC in Ethiopia. The PLC follows modern farm management practices to multiply seed potatoes. Its technical experts assist the out-growers to follow modern farm management practices.

5.4.2.6 Inputs

In the informal seed system, the majority of the farmers use seed tubers of local varieties to produce ware/seed. Ware/seed growers saving seed are the main suppliers of seed potatoes of local potato varieties. Self-supply and local markets are the major sources of seed potato of local varieties. Small amounts of seed potato of improved varieties

are supplied to this seed system by breeding centres and organised seed growers. According to Gildemacher *et al.* (2009), of the total seed potato used in Ethiopia, seed tubers of improved potato varieties comprised only 1.3%. Agrochemicals are supplied by the DBARD⁸ and traders in the vicinity, in order of importance. According to CSA (2011), of the total land allotted for potato cultivation in 2010, fertilisers (diammonium phosphate (DAP) and urea), fungicide and seed from improved potato varieties were used on 50%, 25% and 0.5% of the land, respectively. In 2010, on average 80 kg/ha of fertiliser was used for potato production.

In the alternative seed system, breeding centres supply basic seed of the improved potato varieties they developed to cooperatives of seed growers who produce seed potatoes from this basic seed. The members of these cooperatives produce seed potato on their individual plots. Governmental organisations and NGOs bought seed tubers from cooperatives and distributed them to farmers in distant areas. In this seed system, DBARD is the main supplier of agrochemicals to the organised seed growers. Private traders also supply agrochemicals. In the alternative seed system a high amount of fertiliser is used for seed potato production. According to Hirpa *et al.* (2012), in 2010 seed growers in Jeldu and Welmera used 245 kg/ha and 238 kg/ha of fertilisers (DAP and urea together) respectively, to produce seed tubers of improved potato varieties.

The only potato company in the formal system, Solagrow PLC, obtains basic seed from the Dutch seed potato company HZPC Holland BV. The company also obtains seed from Holetta Agricultural Research Centre. According to Haverkort *et al.* (2012), the seed potato obtained from Holetta Agricultural Research Centre comprises 20% of the total seed used by the PLC. The PLC sells seed, and other inputs to the organised seed growers (Abebe *et al.*, 2013b). These organised growers have access to irrigation water through irrigation systems constructed by the government.

5.5 Improvement options for the seed potato value chains

5.5.1 Enabling environment

Currently, the DAs that should provide extension services to farmers may have not enough technical knowledge on potato cultivation (cf. Davies *et al.*, 2010). They are also engaged in other activities such as input distribution, and collecting tax and loans. Provision of on-the-job-training could improve the technical knowledge of the DAs. Besides, they should be fully engaged in the provision of technical assistance to farmers.

Potato is an important food security crop, but is not among the crops being prioritised for expansion through formal agricultural extension programmes. Therefore, the

⁸ Fertilisers distributed to the farmers through the DBARD are imported by input supplying cooperatives.

government has to give more emphasis on rendering extension services to stimulate potato development.

There is also insufficient budget for potato research. As a result the number of staff engaged in research is low. For instance, only 15 researchers were engaged in potato research in Ethiopia in 2012 (Haverkort *et al.*, 2012), a number well below 1.5% of the total number of agricultural research staff in 2008. In 2008, the total number of agricultural staff was 1,318 (Flaherty *et al.*, 2010). Therefore, a larger budget has to be allotted to increase the number of staff in potato research.

In the informal and alternative seed systems, seed potato quality is a problem, whereas there is no quality control on the seed produced by the majority of seed growers during production and storage. However, seed producer cooperatives in South and Central Ethiopia have developed a quality control system. For instance, two seed growers' cooperatives in Welmera district have committees that supervise members' seed potato fields for diseases, such as bacterial wilt and late blight. These committee members obtained training from staff of Holetta Agricultural Research Centre. Building technical capacity of the quality control committee through training and encouraging other cooperatives to adopt this system will contribute to the enhancement of potato production. According to Hirpa *et al.* (2010), design of a quality control system is important to improve the alternative seed potato system in Ethiopia.

In Ethiopia, there is no formal institution responsible for seed potato quality control and certification. However, CIP and the Ministry of Agriculture (MoA) have developed a seed potato quality control system which is in the process of being institutionalised.

5.5.2 Technology

In the informal seed system, all ware/seed potato growers use local storage methods such as leaving in the soil (postponed harvesting), local granary, jute sacks, and bed-like structure to store seed potatoes. These methods are largely sub-optimal because seed potatoes stored in local storage have fewer, longer and weaker sprouts that have low vigour at planting and subsequently produce a low yield. The use of DLS, a good seed potato storage method, is limited to seed growers that produce seed potatoes of improved varieties. DLS can, however, also be used to store seed tubers of local varieties. To this end ware/seed growers of local varieties have to be informed about the importance of DLS. Seed quality loss also occurs during harvesting and transportation. Farmers have to be trained on the method that helps them to minimise seed tuber quality loss during harvesting and transportation. Farmers have to use farm or transport equipment that does not bruise, cut or pierce tubers during harvesting or transport.

5.5.3 Market structure

In the alternative seed system, the major buyers of the seed potatoes are NGOs. There is no involvement of the private sector in trade in seed potatoes of improved varieties. Involvement of private sector in seed potato trading is highly important. Therefore, linkage between traders and seed producers has to be created to change the existing monopsonistic seed potato market.

5.5.4 Chain coordination

In the informal seed potato system, there is no coordination within actor groups and among different chain actors in the ware/seed value chain. In the alternative seed system, there is some coordination among some actors. For example, the breeding centres are coordinated at national level; some NGOs operating in the southern part of Ethiopia have also formed a consortium that coordinates and harmonises their activities. There are also seed growers' cooperatives in central potato growing areas of Ethiopia that search markets for seed potatoes produced by cooperative members. However, these all operate at the level of the individual actors and little coordination exists across the chain actors within a particular seed system. Creating commodity associations and other forms of trader groups that can play a direct role in establishing or fostering public and private sector strategies and policies of interest to the seed potato chain could improve the supply of and demand for quality seed potatoes. Contracts can be one form of a chain coordination mechanism. The seed value chain in the formal system is coordinated through contracts. There is a good coordination between the chain actors in the formal system, as Solagrow PLC has a market, input and advisory service contract with its out-growers (ISSD, 2011).

5.5.5 Seed potato farm management

Good farm management can enhance yield and quality of seed potatoes produced by ware/seed growers. For example, a positive seed potato selection study undertaken in Kenya showed that positive seed potato selection increases the yield of potato by ware growers by about 34% (Gildemacher *et al.*, 2012). The current practice in the informal seed system is suboptimal and needs improvement. Advising farmers to follow good management practice can help to enhance the seed potato management practices by farmers and will result in better seed tuber health and better seed vigour.

5.5.6 Inputs

In the informal seed system, seed potato is traded as part of general ware/seed and other agricultural products. There is little differentiation between ware and seed and between different potato varieties. In this seed system, there is no label that indicates the variety name or origin of the potato. Tuber size is one criterion for potato tubers to be used for seed or ware: usually small-sized tubers are used for seed and large-sized tubers are used for ware (Endale *et al.*, 2008; Gildemacher *et al.*, 2007; Mulatu *et al.*,

2005). Small-sized tubers may have two problems. The first one is delayed emergence and low sprout vigour and number because of low food reserve (Lommen, 1994; Lommen and Struik, 1994) and consequently low yield and tuber number (Lommen and Struik 1994, 1995). The second is that they might be a progeny of an infected mother plant and thus infected by diseases, because infected mother plants usually give small tubers (Struik and Wiersema, 1999). In Ethiopia, the use of small potato tubers as seed might have contributed to the building up of a high level of disease infection especially in the local varieties. Therefore, potato growers have to be advised not to use small-sized tubers for seed. In this seed potato system, the use of agrochemicals is also very low; that needs to be improved as well.

In Ethiopia, the use of seed tubers of improved potato varieties by potato growers is very low. One cause is unavailability of seed tubers of improved potato varieties to the majority of the growers (Hirpa *et al.*, 2010; International Potato Center, 2011). Availability of seed tubers of improved varieties has to be increased. This can be achieved by encouraging the private sectors to participate in seed production and supply. A good supply of seed tubers of improved potato varieties also requires involvement of smallholder farmers in the seed potato production. According to Hirpa *et al.* (2012), high costs related to adoption of improved potato varieties plus their advised production methods could be one of the causes for the low uptake of improved varieties. This problem can be solved by availing to smallholder farmers, production methods that are affordable and at the same time can enable them to produce seed tubers with reasonable yield and quality.

5.6 Conclusions

This chapter analyses the performance of the seed potato value chains with respect to their ability to supply quality seed tubers to seed potato systems in Ethiopia using the following value chain performance drivers: enabling environment, technology, market structure, chain coordination, farm management, and inputs. All seed potato value chains experience problems with respect to supplying quality seed tubers and thus need improvements. Poor quality seed tubers supplied by the value chains in the informal seed system are related to a poor enabling environment such as a low quality technical support and lack of seed quality control system. Other causes of poor quality seed tuber in this seed system are the use of sub-optimal storage and transportation technologies, sub-optimal farm management practices, use of poor quality seed tubers and use of low level of inputs (fertilisers and crop protection chemicals). The results show that in order to improve the quality of tubers in the informal seed system, it is important to: (1) improve the technical knowledge of DAs; (2) use improved storage methods; (3) advise farmers and transporters how to minimise quality loss during harvesting and transportation; (4) advise farmers to follow improved farm management practices; (5) inform farmers to use seed tubers of the right physiological age; (6) advise farmers not to use small-sized tubers for seed; and (7) advise and facilitate farmers to improve the amount of fertilisers and crop protection chemicals.

The major problem of the chains in the alternative and formal seed potato systems is that they supply only a very small amount of seed tubers from improved varieties, mainly because of the negligible role of the private sector in producing and supplying seed tubers of improved varieties. Moreover, the seed tubers supplied by the chains in the alternative seed system are not of a standard quality mainly because of absence of quality control system. A major portion of the seed potato produced through alternative seed potato system is bought by institutions which created a distortion in the seed potato market. There is a need to establish or strengthen institutions that have a mandate to support and encourage private sector involvement and the establishment of quality control systems in the production and supply of seed tubers in the alternative and formal seed systems.

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