MSc Thesis

The Role of Storage as a Resource in the Adoption Process of Improved Maize Seeds in Ethiopia.


Source: author's photos

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Abstract

This paper estimates the role of storage in the decision process towards improved maize seeds in Ethiopia. In 2014-2016 Ethiopia was the African country with the highest number of undernourished people and using improved maize seeds is seen as an effective counter action. Based on existing literature this work concludes a streamlined farm model. Combining this model with the concept of the 'Resources-Based View' give means to evaluate interviews with Ethiopian farmers which have been conducted in the course of this research. The analysis shows that only very few farmers consider storage in their adoption decision towards improved maize seeds. This finding can be better explained when accounting for different levels of market orientation of farmers. Especially commercial farmers value storage considerably high, whereas subsistence farmers expect only a small value from storage.

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LIST OF ABBREVIATIONS

Abbreviation	Meaning
CIMMYT	International Maize and Wheat Improvement Center
DCFM	Developing country farm model page 4
ECX	Ethiopia Commodity Exchange
FAO	Food and Agriculture Organization of the United Nations
FCU	Farmers' Cooperative Union
NGO	Non-governmental organization
Pics bag	Storage bag
RBV	Resource-Based View
USAID	United States Agency for International Development
WFP	World Food Program

1. Introduction

Ethiopia is a developing country that often faces hunger, despite strong agricultural efforts. The agriculture sector is one of the largest and most important economic sectors in Ethiopia. In 2014, the agricultural sector contributed 42% ($23,4 billion) to Ethiopian GDP ($55.6 billion) and 79.3% of the Ethiopian population earned their living in the agriculture sector (NATIONS, 2016). From to 2000 to 2014 the population grew from 66.4 million (share of rural population: 84.8 % (56.3 million people)) to 97.0 million (share of rural population: 81.8% (79.3 million people)). In the same time frame the agricultural area increased from 30.6 to 36.2 million hectare (FAO STAT, 2017). When comparing the according growth rates, it becomes clear that the growth of the agricultural area (1.31% per year) was slower and more unstable than the growth in population (2.74% per year) resulting in an decreasing ratio of agricultural area per population (FAO STAT, 2017). In total numbers, an agricultural area of one hectare was cultivated to feed 2.17 Ethiopian in 2000 In 2014, it was 0.5 (23%) persons more with 2.67 Ethiopian per hectare (FAO STAT, 2017). As the country already faced hunger in 2000 the challenge to fight hunger is becoming increasingly difficult with a rising population per agricultural area ratio (NATIONS, 2016). As a matter of fact, in 2014-2016, Ethiopia was the African country with the highest number of undernourished people, according to the Food and Agriculture Organization (FAO); 32% of the Ethiopian population were affected (NATIONS, 2016). Most likely this trend will continue, and the Ethiopian population will grow at a faster pace than the agricultural area. In order to tackle the challenge of hunger three key fields can be identified: Food import, increase in agricultural area and increase in agricultural productivity.

Historically, Ethiopia imports a low amount of food in relation to its population size (FAO, 2015). One reason could be that Ethiopia is one of the poorest countries in the world with a per capita income of $1336 (FAO, 2015; World Bank Group, 2015). Therefore, a sufficient increase in paid food imports to eliminate undernourishment doesn’t seem feasible in the near future.

As of now the agricultural area already accounts for 36% of the total area of Ethiopia. Further, in 2050 the population is estimated to peak 171.8 million (Bekele & Lakew, 2014). In a worst case scenario the growing civilization will take over agricultural areas, due to the large share of population that tends to settle in rural areas (Josephson et al., 2014). This forecast leaves only little potential to counter hunger with the increase of agricultural area.

Agricultural productivity – the agricultural output per area – seems more promising to fight hunger and is also one of the three priority areas of the FAO in Ethiopia (FAO, 2017). Agricultural extension services are already in place and experience in the collaboration with farmers gained (Ethiopian AGA, 2014). Moreover, improvements in one of the largest economic sectors, the agricultural sector, could benefit the Ethiopian GDP and per capita income (World Bank Group, 2015). Against the backdrop this research focalizes on agricultural productivity.

The farmers' manageable input factors that influence agricultural productiveness are: water, fertilizer, labor and the quality of the seed. Among those this study's focus is on the chosen seed quality, in particular the seed quality of maize. Maize is the agricultural good that is primarily grown and an '*important crop for overall food security*', because it is '*the cheapest source of caloric intake in Ethiopia, providing 16.7% of per capita calorie intake nationally.*' (Ethiopian Agricultural Growth Program, 2015; FAO STAT, 2017). The underlying assumption to establish the importance of maize seed choice is that 'improved' maize seed varieties realize on average a higher yield than 'normal' maize seed varieties (Howard et al., 2003). Research that has yet investigated on the farmer's choice of maize seeds identified that increased seed quality leads to higher yield, but lacking infrastructure makes storing major problem (AGRA, 2014, AGRA, 2014; Demeke, 2012, 2012; IFPRI, 2010). Subsequently, post-harvest losses due to storage problems are high (AGRA, 2014; IFPRI, 2010). This problem is likely to diminish the benefits of higher yields and hence improved seeds. In other words, the additional costs for improved seeds might not be covered by the additional sales.

Typically, Ethiopian farms sell their yield right after harvest and thereby create excess supply of maize in the market resulting in low maize prices (Howard et al., 2003). Farmers could overcome those trading patterns by using storage that enables to flatten the maize supply curve and avoid such strong price drops after the harvest. Therefore, this thesis objective is to discover Ethiopian farmers' perception of storage availability with respect to their adoption of improved seeds. This leads to the following research question:

What is the role of storage as a resource in the adaption process of improved maize seeds in Ethiopia?

To provide a guideline for answering this question the following sub-questions have been formulated:

1. *What are farm and farmer characteristics influencing adoption of agricultural innovation in developing countries?*

2. *How can storage be examined through the theoretical lens of the Resource-Based View (RBV) in the context of farming in developing countries?*
3. *From a RBV perspective, should storage be a source of competitive advantage for Ethiopian farmers and thereby impact their maize seed choices?*
4. *What is the role of storage for Ethiopian farmers depending on their farm characteristics and, specifically, depending on their market orientation?*

In accordance with the above-stated research questions this research centers around three practical objectives; all in the context of Ethiopia: first, understanding farm and farmers characteristics that favor the adoption of agricultural innovation, in particular to grow improved maize seed varieties; second, pinpointing potential storage management strategies which create competitive advantages on the market; and third, this research combines findings from 1) and 2) in order to identify the role of storage in the Ethiopian farmers' adoption process towards improved maize seed varieties. Here, the Resource Based View serves as the theoretical foundation and is contributed by interviews with agricultural experts in Ethiopia.

The thesis will be structured as follows: Chapter 2 provides a literature overview and thereby explains farm and farmer characteristics that influence adoption of agricultural innovation in developing countries and outlines the concept of the RBV; Chapter 3 introduces the methodological foundation of the research as well as the data collection process in Ethiopia; Chapter 4 presents the findings of the field trip in accordance with the RBV; Chapter 5 discusses these results and the limitations of this study.

2. Literature Review

The following chapter provides an overview of literature investigating on farm and farmer characteristics related to adoption of agricultural innovation in developing countries, favorably in Africa and on concepts of strategic management, in specific the Resource Based View. The literature serves as the theoretical starting point to this work.

2.1 Farm characteristics related to adoption of agricultural technology in developing countries

To the author's knowledge there does currently not exist a holistic theoretical concept on adoption of agricultural innovation in developing countries. However, there exists a collection of different studies that highlight specific farm and/or farmer characteristics which affect adoption of agricultural innovation. In order to create a common viewpoint those characteristics are depicted and related to one another in a comprehensive farm model. The according developing country farm model (DCFM) is depicted below (figure 1: developing country farm model (DCFM)). Subsequently this chapter guides through existing literature always highlighting the according standpoint within the DCFM.

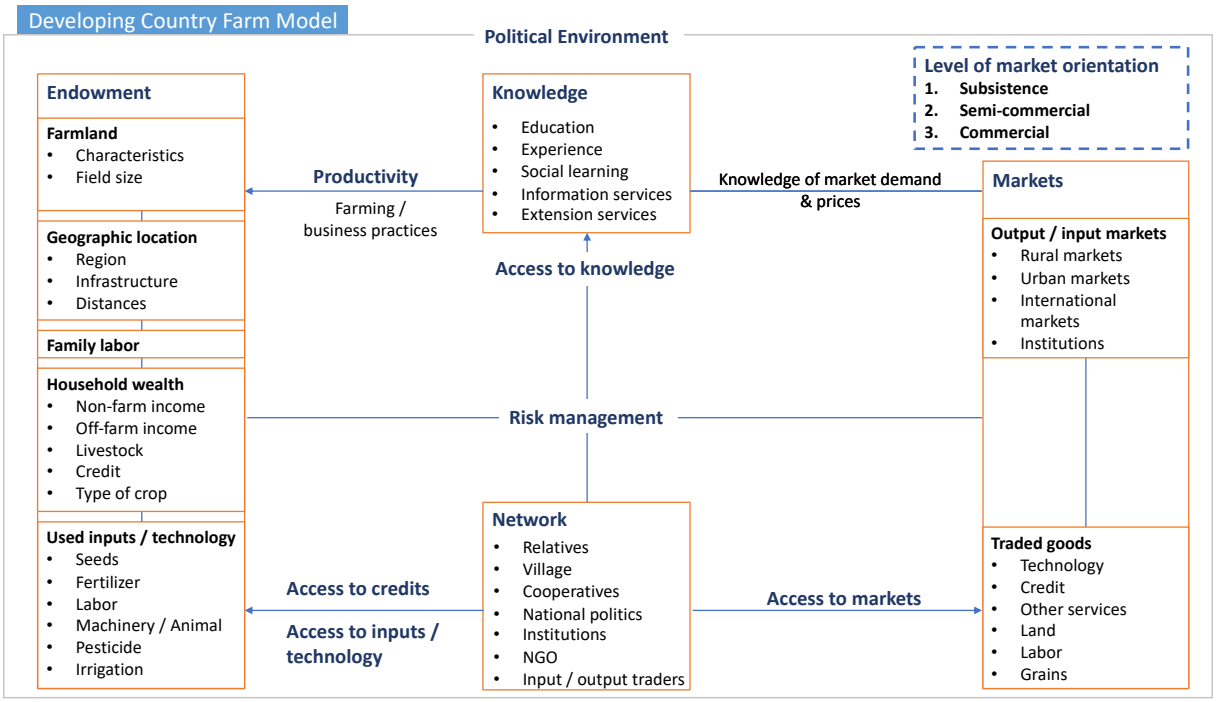

Figure 1: Developing country farm model (DCFM). Source: author's illustration

2.1.1 Farmland

Farmland characteristics

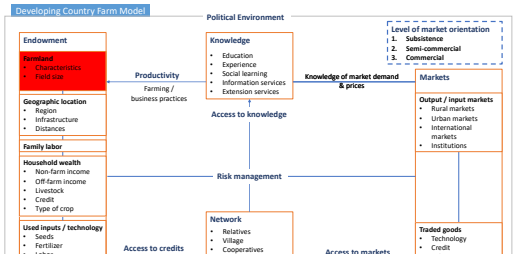

Figure 2: DCFM; Focus on farmland. Source: author's illustration

Farmland characteristics describe climate, soil and other physical factors that determine the potential productivity of a field depending on the type of crop (FAO, 1996).

Papers on soil fertility management emphasize the importance of soil fertility with respect to specific crops needs (Shiferaw et al., 2013; Rurinda et al., 2013; Smaling et al., 1992; Teklewold et al., 2013). Soil fertility requirements of one crop can be severe different from another crop's requirements. Papers on climate characteristics or climate change in Africa deal particularly with rainfall variability, monsoon timing and variability, risk of flooding and drought as well as increasing temperature (Crane et al. 2011; Deressa et al., 2009; Deressa, et al. 2009; Dinar & Somé, 2015; Tadross et al., 2009). The awareness of available technology for a particular crop increases with crop related farmland potential. In this respect Shiferaw et al. (2013) state '*the number of improved maize variety farmers know increases with increasing maize potential, i.e., compared to farmers in low maize potential districts, farmers in high and medium potential maize districts know more number of hybrid maize varieties*'. Moreover, productive farmland conditions can lead to an increase in a farmer's wealth, when sustainably exploited over the years. With increasing wealth resources, like cash reserves, input factors become affordable to a farmer, and he is more willing to try new technology (Feder et al., 1985). Nevertheless, also lower technology adoption can be a result of good farmland conditions. When crops appear healthy, and their yield stays constant farmers might not see a need for new technology (Nkonya et al., 1997).

Field size

According to (Nkonya et al., 1997) farm size positively affects farmers to adopt improved maize seeds*:* '*[…] larger farms had more land planted to improved seed simply because they had more land to allocate to this new technology'.* Other than that, larger farmers face less risk concerning their livelihood than smaller farmers. When two farmers dedicate the same field size to experiments, the larger farm has more field left to serve his livelihood (Feder et al., 1985; Feder and Slade, 1984; Lee, 2005). Additionally, larger farms tend to be better informed (Nkonya et al., 1997) and have better

access to credit (Feder et al., 1985; Heltberg, 1998). Both factors favor technology adoption as discussed below (sections: 2.1.6 knowledge; 2.1.8 markets).

2.1.2 Geographic location

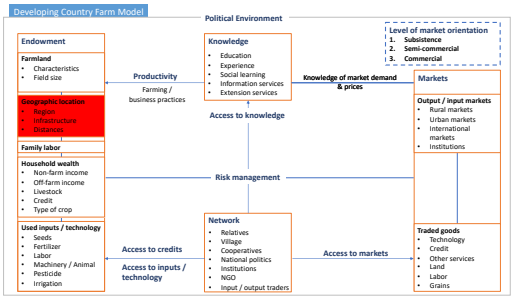

Figure 3: DCFM; Focus on geographic location. Source: author's illustration

The geographic location of a farm and the farmer's home determine the farmer's (walking) distance to input markets, output markets and villages or cities. These distances represent hurdles for farmers that can influence their profitability and input availability and thereby affect technology adoption. Generally, a farmer has one or two contact points, e.g. village centers, to handle his requirements and sales. In rural areas market imperfection is often a problem. As a result, output prices in rural markets can differ to the national market prices and certain inputs are not offered. Farmers barely know inputs that are not provided at their markets (Asfaw et al., 2011; Lee, 2005; Maddison, 2006; Teklewold et al., 2013). Even if farmers knew about market imperfection, they still face travel and opportunity costs when investing cash and time to visit different markets. With typically rather high-risk aversion it could be assumed that rural farmers are unlikely willing to make those investments (Feder et al., 1985) (For a detailed description on risk aversion see section: 2.1.10 Farm characteristics and related risk management). So, distance hurdles can be travel and opportunity costs representing costs of information and costs to access input and sales markets (Teklewold et al., 2013). Nevertheless, costs can be decreased by improving infrastructure and access to public information (Chen & Tang, 2015; Jayne et al., 2006). Concluding geographical factors can affect farmer's knowledge of technological inputs, access to them and profitability to afford them.

2.1.3 Family labor

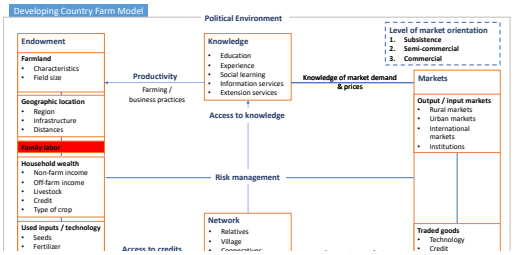

Figure 4: DCFM; Focus on family labor. Source: author's illustration

Several studies outline that household size and the resulting availability of family labor is positively related to the adoption of technology (Feder et al., 1985; Feleke & Zegeye, 2006; Samson P. Katengeza et al. 2012; Teklewold et al., 2013). Family labor is of high value for farmers as family members are typically trustworthy and

have the same dependency structure on the farm than the farmer. As the farm serves the living of those family members anyway, their labor is associated with low costs for a farmer (Feder et al., 1985). Instead, farmers benefit from their shared interest to prosper, resulting in higher productivity of family labor than hired labor. For the same reason, family members seem to be the better supervisors. Feder et al. (1985) showed that the number of family supervisors is one factor affecting the relation of farm size and productivity positively. The underlying assumption is that the more family members work as supervisors on the farm, the better is the control and performance of hired labor. Summarizing, family labor favors adoption of technology with enabling better control of technology implementation as well as it often increases wealth by higher productivity and lower costs.

2.1.4 Household wealth

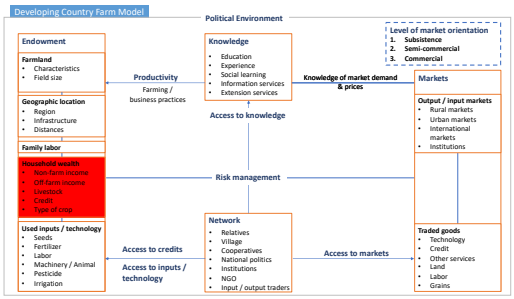

Figure 5: DCFM; Focus on household wealth. Source: author's illustration

A farmer's household wealth positively affects the adoption of technology as it enables farmers to afford technology and bear the risk of failure (Teklewold et al., 2013). Wealth can simply be expressed financially, but also livestock and land ownership represent a form of wealth (Asfaw et al. 2011; Feder et al., 1985; Samson P. Katengeza et al., 2012). Monetary sources are farm and off-farm income as well as non-farm income. Off-farm income is income of work at another farm, whereas non-farm income is income from other labor, e.g. taxi service in the city (Lee, 2005, Samson P. Katengeza et al., 2012). Typically, all household members contribute to a collective wealth pool e.g. children working in the city send a share of their salary home (Alene et al., 2000). Livestock can serve several functions, as mean to generate wealth with animal products, like meat or milk, as cash investment or as credit assurance (Asfaw et al., 2011). Land ownership is similar to livestock, as the land can be farmed, rented out, sold or used as collateral for credit (Deininger & Byerlee, 2012; Deininger & Jin, 2006). So, livestock and land ownership can be transferred to cash by selling, exploiting or enabling credits. Whereby access to credit trough livestock and land ownership is no matter of course, it further depends on the political system, local entities, and business practices.

Ultimately cash and credits (collaterals) facilitate farmers' probability to access, afford and adopt new technology (Feleke & Zegeye, 2006). Access and affordability through the financial ability to travel to several markets and buy technology; adoption through knowledge generation by traveling or paying

extension agents to assess technology requirements appropriately and thereby decrease implementation risks (Asfaw et al., 2011). Moreover, Afaw et al. (2011) discuss that political extension services might favor wealthier farmers and thus provide them better information about technology handling to reduce risk when implementing.

2.1.5 Used inputs and technology

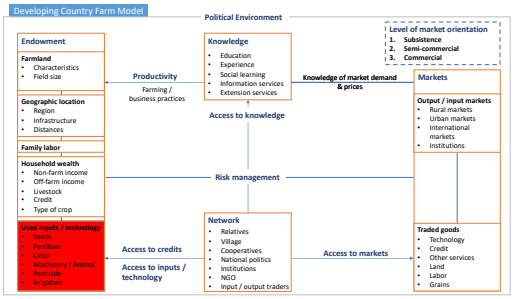

Figure 6: DCFM; Focus on used inputs and technology. Source: author's illustration

Prices of technologies are an essential decision criterion for farmers in the technology adoption process. High prices can stop farmers from adopting technology (Croppenstedt et al., 2003; Nkonya et al., 1997; Lee, 2005). On the one side, similar to wealth, prices determine the overall affordability. If costs are outside a farmer's budget he will not adopt. On the other side, the price is crucial in the cost-benefit estimation of a technology. The cost-benefit ratio determines whether a technology is worth adopting. The gained benefit needs to be higher than the adoption costs. When the additional benefit is smaller than the additional cost of a technology, the technology is most likely not adopted. Nevertheless, the cost-benefit ratio depends not only on the technology price itself but also on other required inputs for successful implementation, like labor wages (Lee, 2005*).* This suggests that technologies might be in competition for early adoption. When two technologies are accessible and appear to have a similar effect on performance, the low-cost technology is adopted earlier. Nkonya et al. (1997) found the following '*Producers are more likely to adopt the less expensive improved seed before they adopt the more expensive chemical fertilizer technology*'. The previously described dynamics assumes fixed output prices. However, output prices can change with market variability (see appendix 2). Thereby an increase in output prices can turn cost-benefit ratios of technology. Initially high cost-benefit ratios might turn low. In the case of seeds, Pitt and Sumodiningrat (1991) denote that profit-maximizing farmers choose their seeds on the basis of variety specific output prices.

2.1.6 Knowledge

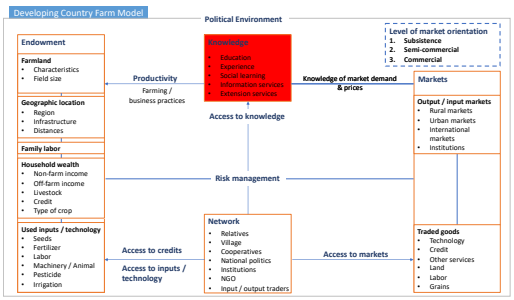

Figure 7: DCFM; Focus on knowledge. Source: author's illustration

Knowledge is often found to be positively related to adoption of technology. As stated before it helps to decrease implementation risks, but it also serves a more fundamental function; namely, creating awareness for existing and new technologies (Asfaw et al., 2011; Asfaw et al., 2012). Farmers in rural areas often lack information due to several reasons like poor infrastructure and opportunity costs of information. TV, radio or mobile phone can provide alternative access to information. Recent studies showed the presence of those devices positively affect adoption (Abebe et al., 2013; Asfaw et al., 2011; Teklewold et al., 2013). However, farmers seem to have less confidence in electronically transmitted knowledge advice on farming practices; mainly because the technology has not been proven particularly in their fields. A great number of studies outline a positive effect of extension services right at the farm on technology adoption rates (Alene et al., 2000; Kaliba et al., 2000; Nkonya et al., 1997, Samson P. Katengeza et al., 2012). Thereby it is especially emphasized that farmers are likely to be convinced by the practical in-field approach as it enables them to experience the technology added value in their fields. Independent of extension services, the level of formal education is found to be a good indicator for knowledge-driven adoption (Abebe et al., 2013; Aswaf et al., 2011; Nkonya et al., 1997). Educated farmer tend to be early adopters (Weir & Knight, 2004). Nevertheless, the effect of education blurs with experience and social learning. Social learning describes the ability of farm neighbors, village members or otherwise social connected farmers to copy technology from successful farmers and adopt it themselves. Observing successful implementation seems most convincing for all types of farmers (Weir & Knight, 2004). In particular when they are not confident with extension agents or other sources of information (Teklewold et al., 2013). Observations help them to assess risk practically. Knowledge on for example adequate field treatments or seed attributes adjusted to local conditions can be essential to implement technology efficient and achieve positive returns on investment *(Knowler & Bradshaw, 2007; Wyckhuys & O'Neil, 2007)*. Concluding, information helps the farmers '*to increase incomes and reduces uncertainty about the expected outcomes of the technology' (Amare et al., 2012).*

All of the affront mentioned assumes that information is existing, and problems are in the direction of technology distribution. However, also missing information on appropriate implementation, like

recommendations on types or rates of fertilizer for specific crops and local conditions, appear to be a problem and hinders adoption. Lee (2005) summarizes in his article that '*such recommendations have either not be transferred from research to extension departments or, more often, just do not exist.*`.

2.1.7 Network

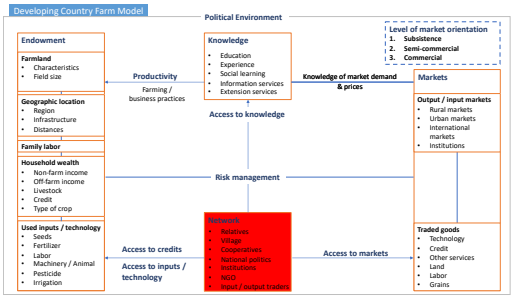

Figure 8: DCFM; Focus on network . Source: author's illustration

A farmer's network can be subdivided into the three fields. The first field includes his social relations (e.g. relatives); the second field represents official work (e.g. participation in cooperatives and political parties); and the third field considers business relations (e.g. traders) (Weir & Knight, 2004; Teklewold et al., 2013). Therewith, network increases farmers' knowledge of technologies (Moti et al., 2013). Reasonable explanations are that knowledge of agricultural practices increases with farmers' mutual contacts with other farmers. When farmers efficiently cooperate, whole communities can benefit from the knowledge of a few educated and informed farmers. Those social network dynamics can play a decisive role in spreading innovation (Weir & Knight, 2004). Also, cooperation with governmental distribution centers or contacts to traders enhance information exchange about available and existing inputs (Amare et al., 2012). Additionally, political and social connections can help to better access inputs and credits (Amare et al., 2012).

2.1.8 Markets

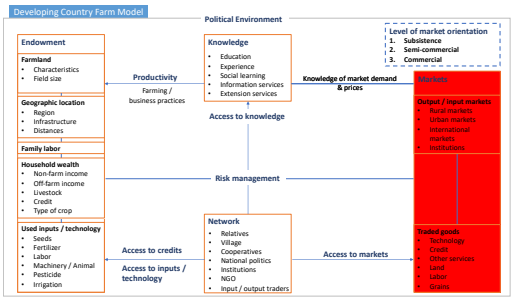

Figure 9: DCFM; Focus on markets. Source: author's illustration

Developing countries are often characterized by market imperfection (Lee 2005). Markets are constrained by '[…] *factors including small quantity of supplies, lack of grading and quality control systems, lack of well-coordinated supply chain, lack of efficient market information delivery mechanisms, underdeveloped infrastructure and high transaction costs'* (Shiferaw et al., 2007). Those factors hinder technology adoption in several ways as they limit access to knowledge and several markets (e.g. input, output, labor, etc.) (Asfaw et al., 2011).

Input markets are: access to credits, technology (e.g. seed, fertilizer), other services (extension); but also agricultural basics like land, work and water (Feleke & Zegeye, 2006; Knowler & Bradshaw, 2007; Moti et al., 2013; Rurinda et al., 2013; Shiferaw et al., 2008). Especially, access and availability of technology directly affects technology adoption. When the technology is not available, there is no adoption, even if a farmer is willing to adopt and has an appropriate farm endowment. Whereas input markets are more on a farm's production side and thereby indirectly influence profitability, sales markets directly affect income (Asfaw et al., 2011). Access to several sales markets enables (e.g. rural, urban, international) farmers to compare prices and sell for the best offer. Ideally, access to markets that differ in quality and pay premiums for higher quality can be an incentive to adopt quality improving technologies (Asfaw et al., 2011). Hence, farmers, integrated into input and output markets, favor most likely technology adoption. Local governmental or non-governmental institutions could also support linking farmers with markets (Amare et al., 2012; Bitzer & Bijman, 2015; Teklewold et al., 2013).

Besides agricultural markets, access to other entities like off-farm labor markets, credit markets or education institutions influence farmers' adoption decision (Samson P. Katengeza et al., 2012).

2.1.9 Political environment

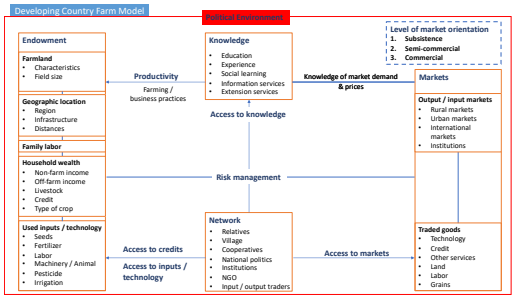

Figure 10: DCFM; Focus on political environment. Source: author's illustration

The political environment sets the legal framework to operate the farm and often supports or restricts farmers by several measures. In developing countries politics typically affect farmers' technology adoption by controlling input and output market access, property and land rights and providing insurance and extension services (Kassie 2010, Deininger 2006). Agricultural input and output markets are often strongly related to or controlled by the government. On the one hand, governments can raise taxes on inputs and outputs, to push market developments in certain directions or reallocate wealth (Kassie et al., 2010; Spielman et al., 2010). On the other hand, governments can support inputs (e.g. seeds) or stabilize output market prices (e.g. grain prices) to encourage investment in specific commodities (Howard et al., 2003; Feleke & Zegeye, 2006). Exchange rate policies that affect domestic input and output prices often aim at influencing technology adoption (Lee, 2005). Governments can also exert direct control over input markets by controlling institutions, like cooperatives, utilizing them as distributors to allocate

extension services, credits, and inputs. Confidence and trust are also crucial when governments provide insurance services in case of crop failure. Farmers are more likely to take the risk of new technologies when they trust the government to ensure their living in case of failure (Teklewold et al., 2013).

The farmers' future perspective when evaluating technology investments additionally includes the political stability and a reliable and trusted justice, especially regarding land rights. Assured land rights and long-term access to farmland, creates confidence for farmers to gain benefits from long-term investments (Pingali & Rosegrant, 1995). In particular, uncertainty regarding traditional spoken and written governmental laws strengthen caution with investments in technology (Clay et al., 2002; Deininger & Jin, 2006). Finally, the government can also direct the future of technology and its adoption with guiding national research and controlling access to international research and research collaboration (Lee, 2005).

2.1.10 Farm characteristics and related risk management

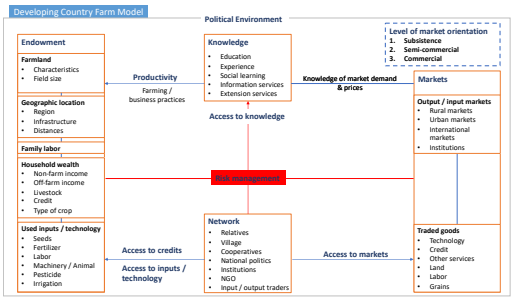

Figure 11: DCFM; Focus on farm characteristics and related risk management. Source: author's illustration

Literature largely emphasizes the positive effect of risk management regarding technology adoption (Amare et al., 2012; Asfaw et al., 2011; Dercon & Christiaensen, 2011; Teklewold et al., 2013). Risk management is in included in all of the affront-mentioned characteristics, either by single characteristics or combinations and their causal relations. Therefore, the following describes possible shapes of a farmer's risk management along with those characteristics.

Risk-averse farmers: farm's production risk determines the household's consumption risk

Generally, farmers in developing countries try to keep the farming risk as small as possible and act risk averse (Dercon & Christiaensen, 2011). One explanation is, that in cases where the whole household's livelihood depends on the farm, a farm's production risk often determines the household's consumption risk to a significant share (Shively, 2001). However, risk-averse behavior applies especially to older farmers (Lee, 2005). Younger farmers might also be risk-neutral or risk-loving, which could positively affect adoption.

Wealth and income diversification to compensate failures and spread risk

Independent of a farmer's risk attitude, historical wealth or other off-farm household income enable higher risk-taking. For example, income from children that work in cities or foreign countries. The farmer himself can establish several income or food generating farm activities to spread the risk over those. Thereby he keeps the average risk and risk deviation of the farm low (Amare et al., 2012; Asfaw et al., 2011). The underlying logic is, that if one activity fails, the other activities can compensate the losses either monetarily or in terms of food supply.

Sufficient field size to ensure living and create opportunities for experimenting

Here field size can play a decisive role. Once a sufficient field size is reached to ensure household living with traditional farming methods, additional land opens opportunities to try new technologies (Dercon & Christiaensen, 2011; Feder et al., 1985; Feder et al., 1993; Nkonya et al., 1997).

Diverse crop selection to account for weather and market risks

Also, cultivating different types of crops can help to spread the risk. Different crops account for volatile market prices and varying weather conditions (Feleke & Zegeye, 2006). In an ideal situation, the price of one crop increases when the price of another crop decreases. Similarly, weather conditions might favor one crop's growth to compensate another crop's poor harvest (Amare et al., 2012). Nevertheless, crop choices additionally depend on several factors like suitable soil and average weather conditions (rainfall) as well as crop-specific knowledge (Dercon & Christiaensen, 2011; Knowler & Bradshaw, 2007; Rurinda et al., 2013; Wyckhuys & O'Neil, 2007).

Livestock to assure crop failures

From a broader perspective, farm activities can be diversified in crop and livestock farming. Therewith livestock helps to compensate for general losses in crop cultivation (Asfaw et al. 2011, Samson P. Katengeza et al. 2012). As mentioned above in *household wealth*, farmers can use livestock to produce agricultural products like meat or milk, but they can also convert livestock into cash by selling or using it as collateral for credit. So, when improved seeds fail, the farmer might be able to ensure living through livestock. In this way, livestock bargain and other diverse farming activities represent an informal way of insurance.

Network as social (informal) insurance

Another way of informal insurance can be access to credit through social networks by borrowing money from other farmers or a farmer community. Those diverse mechanisms of informal insurance are often the result of missing information and access to formal insurance markets in developing countries (Dercon & Christiaensen, 2011; Teklewold et al., 2013).

Political support as official (formal) insurance

However, the government can provide a more formal way of insurance. Namely, a governmental statement that testifies to compensate farmers in cases of technology adoption failures. Those kinds of insurance promises can positively affect farmers' adoption decision, on condition that farmers are confident in the government (Teklewold et al. 2013). Indeed, confidence in the government and political stability can be critical when it comes to technology adoption and its risk assessment. These factors determine to a large share farmers' expectation about future access to land and inputs (Clay et al., 2002; Deininger & Jin, 2006; Lee, 2005). Thereby they are particularly relevant to assess risks of investments with rather long-term benefits.

Knowledge to enable efficient technology implementation

Apart from risk spreading, farmers can also try to minimize the risk of single activities, by efficient implementation of technology. Critical assets for efficient implementation are knowledge, knowledge transfer and supervision. With improved seeds, especially, local knowledge of crop specific field treatments and input requirements is essential to '*reduce[s] uncertainty about the expected outcomes of the technology*' (Asfaw et al., 2012). Farmers can acquire knowledge via extension agents, experience from other farmers or to some degree from mobile sources like TV (Abebe et al., 2013; Alene et al., 2000; Kaliba et al., 2000; Nkonya et al., 1997; Samson P. Katengeza et al., 2012)

Family labor to ensure correct application of knowledge

Application of the correct treatment is critical when several external employees work on the farm. Typically, they are paid on a daily basis and do not suffer nor benefit from a farm's performance. This leaves the incentive to perform, i.e. follow instructions accurately, rather low and hence represents a performance risk. Additionally, external workers change often, which makes it difficult for farmers to transfer and maintain their knowledge. Family labor provides one way to respond to the risk. Namely, family members that supervise external workers (Feder et al., 1985). As family members depend on

the farm, they have a strong incentive to maximize the farm's performance. Still then, knowledge transfer, especially among family members, is most likely key to keep a farm's quality standards high.

Recap: critical factors in risk management

Summarizing, the more diverse income sources, wealth, social capital, knowledge, and land a farmer has, the more he is willing to bear the risk of new technologies in one of his farm activities. Nevertheless, also farmers' risk attitudes might affect adoption decisions, the relation seems straightforward: the more risk-loving a farmer is, the more he is willing to adopt new technologies and bear its risks.

2.1.11 Categorizing distinct farm's characteristics by levels of market orientation

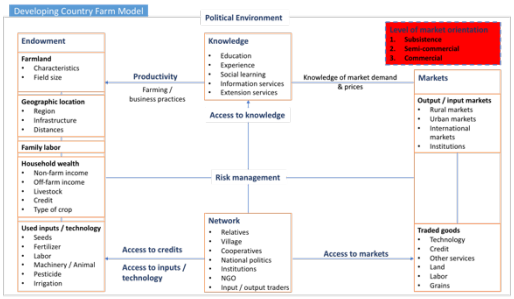

Figure 12: DCFM; Focus on levels of market orientation. Source: author's illustration

The previously described characteristics lead to the introduced DCFM. However, farms distinguish in specifications of the model and its characteristics . (Nkonya et al., 1997). To account for those differentiations among farms, it is helpful to consider the agricultural commercialization process. Pingali and Rosegrandt (1995) state: '*Agricultural commercialization means more than the marketing of agricultural output, it means the product choice and input use decisions are based on the principles of profit maximization'.* Among the definition they categorize developing country farms ('*food production systems*') in three levels of market orientation: subsistence, semi-commercial and commercial (table 1).

Subsistence farms serve mainly the purpose of food self-sufficiency and utilize household generated inputs. Farmers in semi-commercial farms are interested in surplus generation and substitute some of the self-generated inputs with traded inputs. Farmers in commercial farms act as profit-maximizers and mainly apply purchased inputs. Considering the source of inputs, particular farms in the categories semi-commercial and commercial seem to be of interest concerning the adoption of storage and improved seeds. Both, storage and improved seeds, are traded inputs.

Table 1: Characteristics of food production systems with increasing commercialization. Source: Pingali and Rosegrandt (1995)

Table 1 Characteristics of food production systems with increasing commercialization

Level of market orientation	Farmer's objective	Sources of inputs	Product mix	Household income sources
Subsistence systems	Food self-sufficiency	Household generated (non-traded)	Wide range	Predominantly agricultural
Semi-commercial systems	Surplus generation	Mix of traded and non-traded inputs	Moderately specialized	Agricultural and non-agricultural
Commercial systems	Profit maximization	Predominantly traded inputs	Highly specialized	Predominantly non-agricultural

2.2 Resource-Based View (RBV)

The concept of the resource-based view (RBV) is well-known and established in developed countries. The RBV is used to explain competitive advantages of organization within industries. In this thesis, the RBV is transferred to the developing country context to examine the importance of storage in regard to competitive advantages among farmers. In particular, competitive advantages which involve improved seeds are of interest to describe the potential role of storage in the adoption process of improved maize seeds. However, there is a gap in the literature when it comes to transferring the RBV to developing countries. To the author's knowledge only first attempts were being made. Therefore, the following summary of the RBV outlines its history and thereby identifies possible ways to transfer it to developing economies with a focus on farms.

Origin of the RBV - resources as source of competitive advantages

The RBV was first introduced by Wernerfelt (1984), but gained popularity through Barney, (1991) and bases on the assumption that heterogeneity among firms and economic sectors exists. As a consequence, company-specific resources can be the source of competitive advantages. Thereby a resource can be '*anything which could be thought of as a strength or weakness of a given firm. More formally, a firm's resources at a given time could be defined as those (tangible and intangible) assets which are tied semi-permanently to the firm*' (Wernerfelt, 1984).

Imprisoned resources

Wernerfelt (1995) himself claimed that specifically (Prahalad & Hamel, 1990, 2006)created attention for his theory in the managerial field with their approach to look at companies rather from a

competence than a business-unit perspective. In particular, Prahalad and Hamel (1990) investigate by means of several case-studies the relationship between corporation structure, incorporated processes and market success in their article *'The Core Competence of the Corporation'*. Their findings suggest that corporations which are merely divided into business-units can have internal organizational boundaries caused by competition between the business units. Therefore, organizations face the risk that relevant knowledge resources cannot flow across the boundaries of business-units. So-called imprisoned resources are only available to the respective business-unit, but not to the corporation as a whole. In the context of small-scale farmers in developing countries, the initial development of the RBV seems applicable from a geographic perspective. Considering a region as '*corporation',* single farmers in one region would represent the according '*business units'*. Different farmers can have different resources, which other farmers do not poses, like knowledge, infrastructure or access to markets. Mesquita and Lazzarini (2008) found that when those resources are pooled all farmers in the region could gain. Also, farmers that contribute more resources than the average would benefit. Examples are schooling effects for field workers or improved infrastructure. Moreover, they outline the reciprocal dependency in the supply chains; one's output can be the other one's input. In this sense, cooperation among the chain might lead to mutual competitive advantages; e.g. with innovation.

Resource identification - VRIO Framework

Barney specified the RBV further, by introducing the VRIN framework in 1991, which he improved to VRIO in 1995. The VRIO framework is an adequate method to assess resources regarding competitive advantages. Therefore, storage is evaluated on the basis of the VRIO framework to determine strategies that create competitive advantages among farmers. In particular, strategies which involve improved seeds are of interest to describe the potential role of storage in the adoption process of improved maize seeds. According to the framework, a resource must be valuable,

VRIO Framework

Valuable – A Resource is valuable, if it enables a firm to conceive of or implement strategies that improve the firm´s efficiency and effectiveness.

Rare – A Resource is rare, if it is not hold by a large number of firms simultaneously and consequently the value-creating strategy cannot be implemented by a large number of firms simultaneously.

Imperfectly mobile/imitable – A Resource is imperfectly mobile/imitable if it is very difficult to acquire the resource or only possible at disproportional high costs.

Organized to exploit – The full potential of resource's value can best be realized if the firm is organized in a manner to exploit the resource. When two firms have a similar resource, only the firm that is organized to make use of the resource is able to

rare, imperfectly mobile and the firm organized to exploit the resource's value in order to enable a strategy that leads to a sustained competitive advantage. A resource that is only valuable and rare will create a competitive advantage but can be acquired with little effort by other firms (farms). Therefore, those resources create a competitive advantage only at first sight. Similar to the concept of a first mover advantage, the resource advantage diminishes when other competitors follow in acquiring the resource and implementing a similar value-creating strategy. Adding the resource characteristic imperfectly mobile and a firm's suitable organization to exploit the resource turns a competitive advantage into a sustained competitive advantage. The advantage is then sustained, because competitors cannot implement a similar value-creating strategy, or can only do so at dis-proportionally high costs.

Complementary resources

In this process to sustain a competitive advantage additional complementary resources can be focal. Barney (1995) defines them as follows, '*[…] they [complementary resources] have limited ability to generate competitive advantage in isolation. However, in combination with other resources and capabilities, they can enable a firm to realize its full competitive advantage'*. Particularly, complementary resources can be decisive when it comes to a suitable organization of a farm to fully exploit storage as a resource.

From resource enabled strategies depend on firm characteristics

A similar logic was already introduced by Penrose in 1959 (cited version: 1995) when she described the resource environment as idiosyncratic to the characteristics and behaviors of firms. From this she derived that *'no firm ever perceives the complete range of services available from any resource'* and defined services as *'[…] the contributions these resources can make to the productive operations of the firm'.* So, depending on the individual firm (farm), different combinations of existing resources might enable new or more effective strategies for new or existing challenges. Baker and Nelson (2016) developed Penrose logic even further when stating '*[…] that the same resource may be worthless (even treated as waste products) to one firm but valuable to another […]'*. Thereby access and availability of

resources are crucial. A firm typically exploits the best suited available resource for its strategy. When two firms tackle a similar problem and firm B has a more suitable resource available than firm A, then the exploited resource of firm A might be worthless for firm B (figure 13). Hence, a resource's value creation for a firm depends on several factors like the individual firm organization, its environment and the firm's perception of that resource. This is of particular interest when examining storage as a resource and its role among interrelations with other (complementary) resources. Some competitive advantage creating strategies that involve storage might only be enabled in combination with other (complementary) resources of Ethiopian farmers.

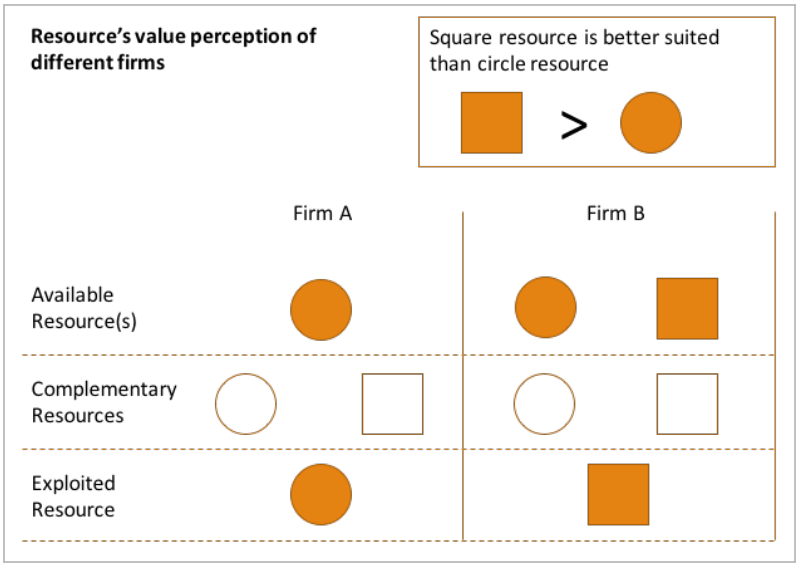

Figure 13: Resource's value perception of different firms. Source: author's illustration

Policies as additional source of competitive advantages

Lazzarini is one of the pioneers investigating on the RBV in the developing country context (Lazzarini, 2015; Mesquita & Lazzarini, 2008). He recently concluded that resources are not inevitably the sole source of competitive advantages. Also the industrial policy in place might affect a competitive advantage by generating country or region-specific resources; e.g. providing regional infrastructure, knowledge domains or access to international markets driving innovation with adopting international standards (Lazzarini, 2015).

3. Methods

The literature review has shown that several factors have an impact on farmers' adoption of improved maize seeds. However, the question how storage is connected with the seed choice of farmers could not be answered by the literature. This is an explorative and inductive study that looks into the relationship between storage and improved seeds in Ethiopia.

Thereby a qualitative approach was chosen to better understand the mechanisms which potentially drive farmers to adopt improved seeds. Expert interviews represent the centerpiece of the underlying empirical examination of this thesis. These were conducted during a three-week field trip to Ethiopia that took place between August 18th and September 19th in 2017. The consideration of both, primary (interviews) and secondary sources (literature review), allowed for a certain degree of triangulation. It ensured an internally and externally validity of this research: internally by the field trip; externally by embedding this research in literature. To evaluate the qualitative data in a structured manner the RBV was chosen as theoretical foundation. The underlying rationale is that storage might create competitive advantages, which in turn could promote the usage of improved seeds. The RBV is a well-established theory to explain competitive advantages in developed countries. Hence this research represents an attempt to transfer the RBV into the developing country context. The RBV is used to assess the potential of storage for creating competitive advantages. Subsequently, these competitive advantages are related back to the seed choice of farmers. Consequently, the chosen research approach is inductive as it starts with observations, builds arguments from interviews, compares the findings with theory and finally formulates implications for theory.

3.1 Research framework

Figure 14 illustrates the research framework that was followed to assess the impact of storage as a resource on farmers' maize seed choices in Ethiopia. Storage is assessed using the RBV and the DCFM that was derived from literature. The DCFM helps to account for other farm characteristics that could affect adoption of improved seeds. Those characteristics might also interrelate with storage.

As described in chapter 2.2, the VRIO framework is an appropriate method to assess the ability of resources to generate competitive advantages. Therefore, the VRIO framework is applied to storage on the basis of data derived from the field trip to Ethiopia. The underlying question is: from an RBV perspective, can storage generate competitive advantage(s) for Ethiopian maize farmers with respect to their farm models (indicated by '1' in figure 14). Subsequently, identified competitive advantage(s) of storage are assessed in regard to potential impacts on seed choices ('2'). Even though the analysis bases on data from the field trip, the outcome is strongly shaped by the theoretical lens of the RBV. This indicates that implications from the RBV perspective might be different than the actual interviewees' observations regarding the impact of storage on adoption of improved seeds in Ethiopia. To account for those differences, implications from the RBV are compared with the actual reported

impacts of storage. Differences between interviewee's observations and RBV implications are discussed against the background of DCFM characteristics in Ethiopia ('3'). For this purpose, storage is arranged within the DCFM. In specific the question is tackled whether and how farms' levels of market orientation influence the role of storage.

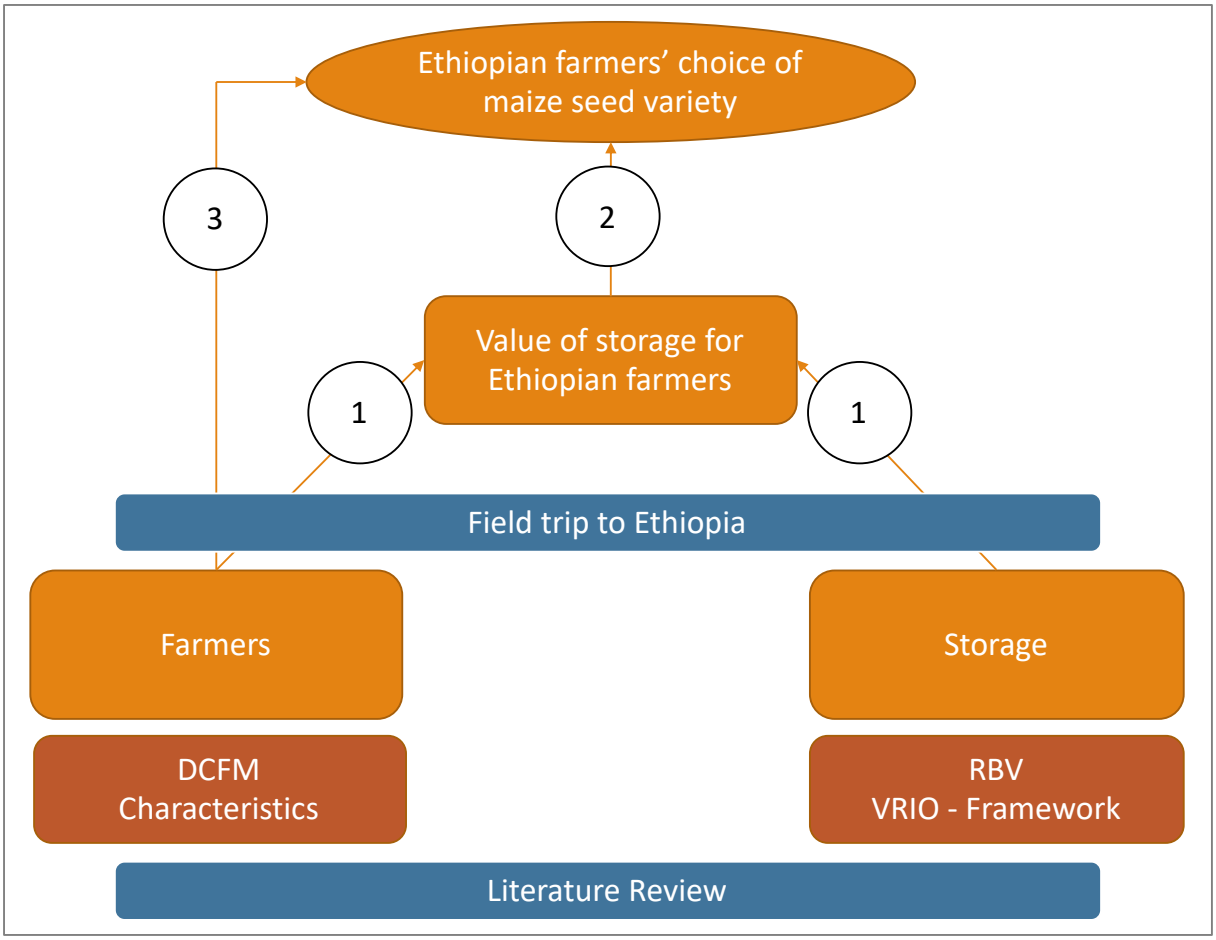

Figure 14: Research framework. Source: author's illustration

3.2 Qualitative and inductive approach: transferring the RBV to farmers in a developing country

The chosen research framework is different from approaches taken in most papers cited in the literature review that investigate the adoption of agricultural innovation. These approaches were mainly quantitative in nature (e.g. Alene et al., 2006; Deressa et al., 2009; Kaliba et al., 2010). In contrast, this research is a qualitative attempt to identify driving factors by investigating into their potential to create competitive advantages. The theoretical lens of the RBV allows to understand

farmers' adoption decisions from a new perspective. In specific, the VRIO framework helps to identify competitive strategies enabled through storage from the RBV's theoretical viewpoint. According to the RBV, competitive strategies generate competitive advantages. However, the suitability of the RBV for analyzing competitive advantages in Ethiopia is not self-evident as the theoretical construct has been established in the context of developed economies. Therefore, this research is an attempt to transfer the RBV to farms in a developing country. Monitoring whether farmers actually implement strategies that are identified through the RBV, provides first evidence about the RBV's validity in the context of farms in developing countries.

3.3 Data collection - Field trip and Interviews

Local situation during the field trip

The RBV and the DCFM, derived from the literature, serve as fundamental basis for the research. The qualitative data on Ethiopian farmers, which lies at the heart of this empirical examination, was collected during a field trip. The field trip took place between August 18th and September 19th in 2017. During that time, a general strike in the region of Oromia took place, making it difficult to leave the capital city Addis Ababa. The government asked foreign people to refrain from leaving Addis Ababa (ECADF Ethiopian News & Views). It was possible once, in the third week, to travel outside Addis Ababa and visit farmers as well as one of the largest agricultural research center. Besides, interview partners preferred to remain anonymous and to not be recorded.

Interviewee selection

In order to cope with the limitations and still obtain valuable insights about farmers, 15 interviews with agricultural experts in the area of Addis Ababa were conducted and anonymized. Addis Ababa is well suited for this research's interview selection as it is the capital city and in the center of the major maize production area in Ethiopia (see appendix 1). Therefore, Addis Ababa hosts a significant number of Ethiopian agricultural experts on Ethiopian maize farming. For the purpose of gaining holistic information about farming, farms and farmers in Ethiopia the interview selection centered around

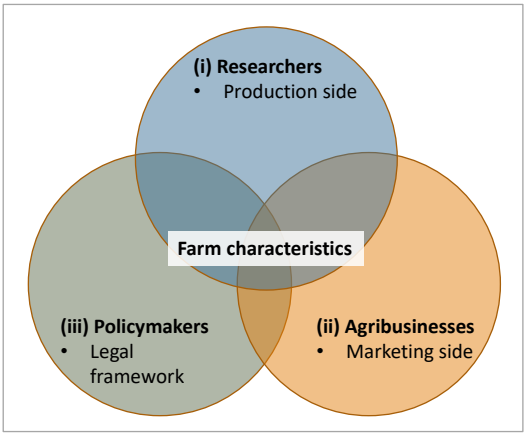

Figure 15: Interview groups. Source: author's illustration

three main groups: (i) researchers, (ii) participants in the agribusiness value chain and (iii) policymakers (figure 15). Considering the matter of interest from different perspectives and standpoints allowed for establishing a certain degree of triangulation. Each of the three groups has distinct knowledge about particular aspects. The interviewed researchers typically focused on the production side of farmers, e.g. farming practices. They often build long-term relationships with groups of farmers, which enables them to not only observe farmers' decisions but to comprehend their decision-making processes. Participants in the agribusiness value chain interact with farmers on the marketing side, either by selling inputs or buying outputs. Thereby, they are able to monitor farmers' demands for inputs, like various types of seeds, and describe sales practices as well as focal factors in trading with them. Policymakers shape the legal framework in the agricultural sector and can influence supply chain designs or infrastructure in place. For example, they decide on seed certification criteria or compulsory memberships of farmers in cooperatives. Moreover, the holistic stance that policymakers take on helped to assess the validity of the individual experiences of researchers or agribusiness participants. The interviewees comprised several of the main actors in the Ethiopian maize sector including representatives from a major development aid program, the largest official maize seed research program, the largest agricultural research center which is in charge of metal silos, the largest commercial seed producer, the largest storage bag manufacturer and the agriculture transformation agency. A detailed list of all interview partners and related interview notes can be found in the appendices. In the results chapter it is referred to 'interview no.' to indicate the corresponding interview of a finding. All of the interview partners have recently worked with farmers. For example, interviewees did agricultural field research, were business partners with farmers, were involved in development projects, made policies or provided farmers with extension services.

Most of the interviews were conducted individually, with the exception of two group discussions. One mixed group discussion[1] encouraged a direct exchange of arguments between representatives of all three interviewee groups.

Interview protocol development

To account for the various professions and positions of the interviewees, the author chose a semi-structured interview form (figure 16). Therefore, all interviews were conducted following a similar structure, yet adjusted to account for the interviewees' field of expertise. The primary purpose of the structure is to achieve preferably unbiased statements regarding farmers' adoption of innovation and the role of storage. Against this background, the interview guideline begins with general questions on which factors drive the adoption of innovations and becomes more specific towards the end by addressing the role of storage regarding the adoption of improved maize seeds.

Each interview starts with the same open questions, namely, what factors come to the interviewee's mind that facilitate farmers' adoption of innovation, like improved maize seeds. Without quoting any factors, this question aims at a first unbiased statement on farm and farmer characteristics regarding farmers' adoption of innovation. The subsequent question addresses storage explicitly and explores whether storage plays a role in the adoption process of improved maize seeds in the form of a closed question. The intention of this closed questions is to attain a direct intuitive answer, which reflects the interview partner's observation best. After gaining this ad-hoc answers, the purpose of the following questions is to reveal in-depth information and thoughts on the role of storage. If the answer to the role of storage is '*yes'*, the interviewee is asked what the role of storage is. If the answer is '*no'*, the interviewee is asked for reasons. At this point, the interviews become less structured and more adaptive to the circumstances. Additionally, it was avoided to raise the issue about what comes first: adoption of storage or of improved seeds. Finally, when the interviewee has not mentioned the adoption order up to this point of the interview, it was asked whether storage or improved maize seeds are adopted first. Afterwards, the interview addresses the personal and professional experience with

[1] Group discussion between 3 Diplomats of a foreign country, 2 Ethiopian civil servants, 1 international trader, 1 researcher and 1 government official all involved in development aid

farmers aiming at identifying various characteristics of the previous derived DCFM according to farmers' levels of market orientation. Also, critical constraints regarding innovation adoption are of interest.

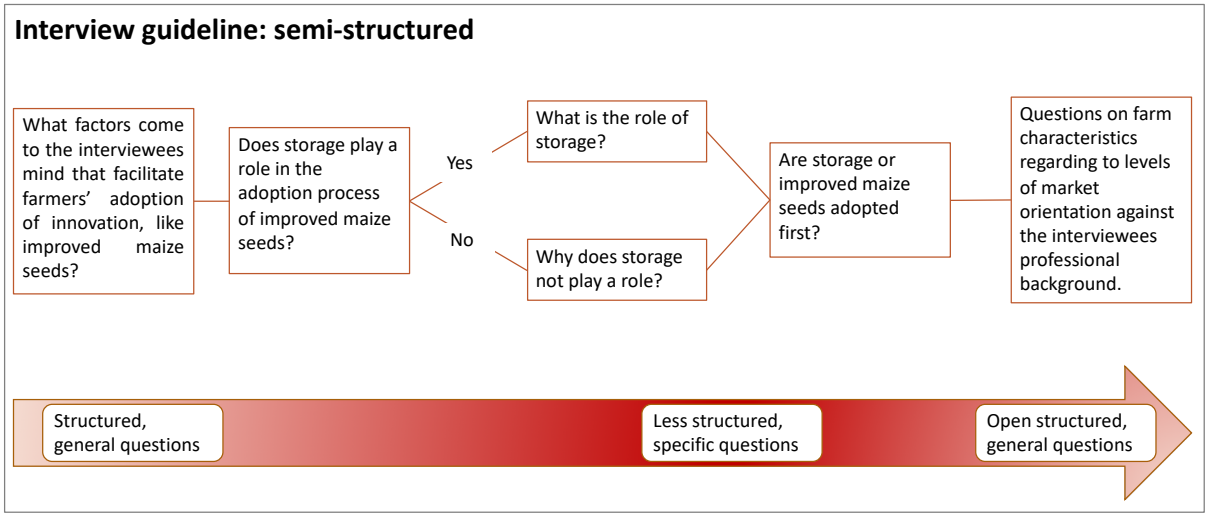

Figure 16: Semi-structured interview form. Source: author's illustration

4. Results

This section presents the results of the interviews and describes the resulting implications for the role of storage in the adoption process of improved maize seeds in Ethiopia. It was found that storage does not facilitate the adoption of improved maize seeds, although the RBV suggests so. To explain the contradiction, it proofed to be valuable to combine the DCFM from the literature with Ethiopian farms' levels of market orientation (Pingali & Rosegrant, 1995). Therefore, the results are subdivided as follows: The first section portrays the most widely used storage types in Ethiopia, as suggested by the interviewees. The differentiation is necessary to account for potentially different VRIO characteristics. The second section relates those storage types to strategies that enable competitive advantages in Ethiopia. This is done with the help of Barney's (1995) VRIO-framework derived from his work on the RBV. After the Ethiopian storage types are introduced (section 1) and evaluated through the RBV (section 2), the third section depicts the role of storage as a RBV resource in the adoption process of improved maize seeds. Against this backdrop, the fourth section describes the from interviewee's observed role of storage in the adoption process. It turned out that levels of market orientation vary greatly among Ethiopian farmers, having implications on their use of storage and improved seeds. Therefore, Ethiopian farms and farmers are described filling the DCFM according to levels of market

orientation on the basis of country-specific information. Finally, the empirical insights laid out in the three sections are combined to assess the role of storage in the adoption process of improved maize seeds against the backdrop of famers' characteristics corresponding levels of market orientation and the RBV.

4.1 Main storage types used in Ethiopia

Different storage types might differ in their capability to generate competitive advantages. Therefore, it is necessary to differentiate between the storage types that are used in the Ethiopian context. For that reason, the following section introduces the main storage types relevant for Ethiopian farmers, as suggested by the interviewees.

The interviews revealed that there are three main storage types: gotera (traditional storage), metal silo and pics bag (interview no. 8, 11, 13, 14). Even though there exist other storage types, like tents, interviews suggest that those are barely used. Also, storage space that is offered for rent is rarely common in Ethiopia. Interviewees could only tell of one storage space near to Addis Ababa.

Gotera	Metal silo	Pics bag
		

Figure 17: Storage types in Ethiopia. Sources: national parks safaris Ethiopia, author's picture, Purdue Extension (2013)

Gotera is a traditional, rural storage construction made of wood and mud. The constructions differ according to local available materials and traditions. Typically, goteras in one village are similar to each

other due to available materials and exchange between farmers. Metal silos are mainly facilitated by research and governmental projects. They are sourced in small batches from local artisans. Before being able to produce metal silos, artisans require training by qualified trainers, mainly facilitated through research institutes. Pics bags are promoted by private businesses and represent *chemical-free hermetic containers.* The following table lists key aspects of the different storage types.

Table 2: Storage types and characteristics. Source: Interview no. 13, 14 & Purdue Extension (2013)

Storage type	Capacity [kg]	Price [$]	Price [$] / kg	Durability
Gotera	<300	-	-	-
Metal Silo	300	77.00	0.25	15 years
	600	107.00	0.18	15 years
	1000	140.00	0.14	15 years
Pics Bag	50	1.80	0.036	1x reuse
	100	2.20	0.022	1x reuse

4.2 Main Ethiopian storage types assessed as RBV resource in Ethiopia (VRIO framework)

The RBV is an established theory to explain competitive advantages among industries in developed countries. In specific Barney's work on the RBV in 1995 – the VRIO-framework – is an adequate method to assess resources regarding competitive advantages. In this thesis, the RBV is transferred to the developing country context to examine the importance of storage concerning competitive advantages among farmers. Therefore, storage is evaluated on the basis of the VRIO framework to determine strategies that create competitive advantages. In particular, strategies which involve improved seeds are of interest in order to describe the potential role of storage in the adoption process of improved maize seeds.

4.2.1 Valuable

VRIO Framework
Valuable – A Resource is valuable, if it enables a firm to conceive of or implement strategies that improve the firm´s efficiency and effectiveness.

Adequate storages are storages with minimized post-harvest losses. Those storages are valuable as it enables two strategies for farms: 1) react to market dynamics 2) store for self-consumption to reduce food expenditures. Both strategies increase income, which creates opportunities to afford and take the risk of new technologies. Thereby pics bags and metal silos are similarly applicable.

Reacting to market dynamics: selling at higher market prices

According to all several partners, active market participation of farmers is key to raise their income and welfare (interview no. 4, 7, 8, 9, 11, 12). The head of a large domestic grain trader stated '*if farmers do not start selling in high price season their situation will never improve*' (interview no. 12). By means of adequate storage, farmers are can actively participate in the market. Namely, farmers can decide on the selling point of time and thus wait for periods with higher maize prices to sell (see appendix 2). Currently, most of the Ethiopian farmers sell their yield right after harvest. This is typically the period with the lowest maize grain price since all farmers harvest at the same time and thereby create a maize surplus in the market (Abate et al., 2015; Howard et al., 2003). One way to overcome low grain prices would be dynamic sales strategies. In 2003, Howard et al. emphasized, that if Ethiopian maize farmers reduced storage losses by 50% and sold in August instead of January, they could increase profits by 45-50%.

Storing for self-consumption: reducing food expenses

According to the researchers involved in development programs, food expenditures in the high price season are major expenses of farms (interview no. 12, 13, 14). Besides storing for selling, adequate storage also enables to store for self-consumption later in the year to reduce food expenses. The achieved savings on food expenses are disproportionately high due to the higher maize prices a farmer would have to pay.

Income effects enables to afford technologies and higher risk taking

The previous described strategies effect income positively and therewith increase a farm's wealth. This, in turn, enables further strategies. It generates the possibility for farms to take higher risks as well

as to test and afford different kinds of farm technologies. Hence the positive income effects can enable entrepreneurial acting.

Value limitation

The above-described dynamics assume several complementary resources. For example, that farmers have a maize surplus to store. This might not be guaranteed. Therefore, a detailed description of necessary complementary resources is depicted in the subsection *4.2.4 organized to exploit*.

4.2.2 Rare

VRIO Framework
Rare – A Resource is rare, if it is not hold by a large number of firms simultaneously and consequently the value-creating strategy cannot be implemented by a large number of firms simultaneously.

Currently, adequate storage in Ethiopia is rare. Interviewees unified observation was that most farmers store in traditional rural storages (gotera) with high post-harvest losses (interview no. 8, 9, 11, 12, 13, 14). Also, literature supports their observation (Abate et al., 2015; Howard et al., 2003; Mezgebe et al., 2016; Tefera et al., 2011).

Gotera, the common storage, has high post-harvest losses

Interview partners, in particular storage researchers, described gotera storages as vulnerable to pests and mold fungus (interview no. 1, 11, 13, 14). Weevil can easily access goteras through holes and climate conditions, like oxygen content, are not controlled. The result is high post-harvest losses with goteras, causing farmers to quickly sale after harvest (Howard et al., 2003; Mezgebe et al., 2016). Hence adequate storage with low post-harvest losses is rare. The most common types of adequate storage in Ethiopia are metal silos and pics bags.

Production capacity of metal silos is limited

Researchers working on metal silos are convinced that this is the best way to store grains. At the time of the interview, they were working on a study to evaluate the different types of storage. So far, they claimed to have the lowest post-harvest loss with metal silos. Metal silos can store maize grains for up to 12 month and pics bag for up to 6 months without any losses, given correct application. However, as metal silos require specific training for artisans, the current production capacity is rather low, making metal silos rare (Tefera et al., 2011).

Sales of pics bags have recently started

Even though the availability of pics bag is higher than of metal silos, sales are still at the beginning, and only a small share of farmers is using them according to distributors. Historical sales figures of a leading pics bag producer supported their opinion (Table 3). Further, the leading producer is continuously expanding its distribution network. For easy access, they offer a text message service to find the nearest dealer[2]. This leads to the conclusion, that pics bags are currently rare, but might lose its rareness in the future.

Table 3: Pics bag sales of a large pics bag produces. Source: interview no. 8

Year on market	Date	Sales
1st	2014	9,000
2nd	2015	75,000
3rd	2016	192,000
4th	2017	400,000

4.2.3 Imperfectly mobile/imitable

VRIO Framework
Imperfectly mobile/imitable – A Resource is imperfectly mobile/imitable, if it is very difficult to acquire the resource or only possible at disproportional high costs.

Depending on the type of storage, storage can be imperfectly mobile, especially as Ethiopia lacks rural infrastructure.

[2] Farmers can send a "region code" to a number. An automatic message is sent back naming villages with dealers and according phone numbers in the selected region. Example: "7" can be the "region code" for the region Jimma. If a farmer sends "7" to the number he receives an automatic message listing all village names and phone numbers of agricultural dealers in the Jimma region, that sell pics bags.

Metal silos' high hurdles for imitation: cost large share of farm's income, difficult to transport and require training

Storage researchers, convinced of metal silos, admitted difficulties regarding transportation (interview no 13, 14). Efforts to establish several local production centers support their statements, that metal silos are only available nearby to production. Moreover, metal silos are expensive and require instruction for correct functioning. Silos cost a large share of an average farm's income (table 2). The high price constitutes for farms a rather long-term investment linked with a late payoff. The point of payoff is further delayed when farmers miss correct handling (CIMMYT). Storage researchers raised the example of the 'candle test'[3] to control the oxygen content of the grains, which will be stored. When farmers do not apply the test, the oxygen content in the silo might be too high and mold fungus rots the stored grain before selling. Similar problems appear when the cover is not accurately sealed. In those cases, the payoff is shifted by one season. Although extension agents do educational work, researchers had the opinion, that only were few farmers knew about correct handling. Late pay-offs and uncertainty about correct application often disincentive farmers to acquire a silo. So, while imitation of metal silo production is facilitated with new local productions, imitation of silo adoption among farmers seems limited by price and training on correct application.

Pics bags' low hurdles for imitation: cost a fraction of farm's income, are mobile and require less training

Pics bags, as well, require knowledge on correct application, but to a lower degree (interview no. 9; Pics Network; Purdue Extension, 2013). Distributors emphasized mainly the 'glass bottle - salt test'[4] to control the moisture content of grains, which will be stored (the same test is also necessary for metal silos). When farmers do not apply the test, the grains' moisture content might be too high and mold

[3] A candle is lit and put inside the metal silo. The candle fire consumes the oxygen inside metal silo. When the candle fire is extinguished, most of the oxygen inside the metal silo is diminished and the silo is good for storing (interview no. 13, 14).

[4] Grains and salt are put in a dry bottle. The bottle is then shaken. When salt sticks at the walls of the bottles the grains are too wet for storing. (CIMMYT)

fungus rots the grains inside the pics bag. The head of a pics bag distributor seemed very much engaged in teaching pics bag handling to all kind of occasions like market or field days. Compared to researchers' statements about metal silo training, pics bag trainings seem to occur far more often. Reasons for more frequent pics bag training are mostly economical. Distributors have a considerable self-interest, that pics bags work for farmers. The more farmers are convinced of pics bags the more they buy, as a distributor said: '*When they [farmers] win, I win too. I sell more.*' (interview no. 8). Other than that, pics bags are lower priced, mobile and to a greater extent available (Pics Network). They can be folded to ease transportation and cost around 2.20$ per 100kg bag (Purdue Extension, 2013). The low price is affordable for most Ethiopian farmers. Summarizing, pics bags are mobile and imitation among farmers is conceivable. A farmer who observes another farmer using a pics bag can most likely imitate.

4.2.4 Organized to exploit

VRIO Framework

Organized to exploit – The full potential of resource's value can best be realized, if the firm is organized in a manner to exploit the resource. When two firms have a similar resource, only the firm that is organized to make use of the resource is able to create value out of it. In this exploitation process, complementary resources can help.

The organization of a farm determines the degree to which the potential of storage can be exploited. The potential of storage is represented by the enabled strategies, described in section 4.2.1 valuable. It is to benefit from sales during the high price season and reduced food expenditures. Three conditions are critical to do so: surplus to store, correct storing and market participation. In order to match the requirements and implement high price season strategies, a farmer requires complementary resources to storage. As stated in chapter 2.2, Barney (1995) describes complementary resources as follows: '*[…] they [complementary resources] have limited ability to generate competitive advantage in isolation. However, in combination with other resources and capabilities, they can enable a firm to realize its full competitive advantage.'*.

Single complementary resources are not enough

Different interview partners highlighted different complementary resources. Leading to the finding that, solely one complementary resource is not enough to exploit the full potential of storage. Exemplary statements are: '*If we don't provide them [farmers] market access to participate, storage is only worth half – only for self-consumption.*' (interview no. 12); '*What helps storage, if they [farmers] don't know how to use it and harvest is still wasted*.' (interview no. 13); '*Why are we talking about storage, when the biggest problem is that they [farmers] actually have to sell all grains after harvest to*

pay loans. There is nothing left to store in most cases.' (Interview no. 9); '*Our improved seeds require good nutrition and field practices.*' (Interview no. 4); '*If farmers have no access to improved seeds you can do whatever you want. They are sometimes not able to adopt even if they want.*' (interview no. 10).

Complementary resources and their support function

The most frequent mentioned complementary resources for storage concerning improved seeds were: wealth; knowledge on correct storing and market dynamics; network for market access and participation; as well as availability of improved seeds and fertilizer. The relation between the resources is straightforward. Wealth enables farmers to afford improved seeds and fertilizer as well as to keep grains after harvest, instead of selling it to pay loans. Availability of improved seeds ensures that farmers can actually grow improved seeds. Adequate field practices and fertilizer helps to achieve the best yield from improved seeds. Correct storing prevents post-harvest losses and is therefore crucial to value storage at all. Knowledge of market dynamics is necessary to understand high price season strategies and to identify potential selling points. Finally, the strategy execution requires market access and participation to sell, which is in Ethiopia typically provided through members or entities of a farmer's network, like governmental cooperatives, NGOs or WFP.

Having all complementary resources around storage in place enables a farmer to implement a competitive strategy to benefit from high price season. Or in case a farmer lacks market-related resources he can still save on food expenditures by self-consumption.

4.2.5 Recap

From the RBV-perspective adoption of storage will lead to a competitive advantage over other farms. Storage enables two income increasing strategies for farms, that farms without storage cannot implement: 1) react to market dynamics 2) store for self-consumption to reduce food expenditures. Whereby the shape of the competitive advantage depends on a farm's organization. The full potential of storage is exploited when a farm is organized to react to market dynamics and sell in the high-priced season. Without market access, storage can still represent a competitive advantage by reducing expenditures for food.

Competitive advantage might not be sustained since pics bags are imitable

According to Barney (1995), a competitive advantage from an RBV resource can only be sustained when the resource fulfills all four VRIO-criteria: valuable, rare, imperfectly mobile/imitable, organized to exploit. When a resource is only valuable and rare it creates a competitive advantage, but its sustainability is questionable. Over time, other firms might imitate the resource and implement similar strategies. This is the case with pics bags, as described pics bags are pics bags are mobile and imitable and therefore do not fulfill the I – criteria. A farmer who observes another farmer using a pics bag can also acquire a pics bag and therewith imitate the competitive advantage. When a significant number of farms utilizes storage, then storage is no longer a source of a competitive advantage, but a common practice.

Limitations

However, the above-described dynamics assume several complementary resources. For example, it is not guaranteed, that farmers have a maize surplus to store. According to several interview partners, cash demand (e.g. from credit obligations) might force several farmers to sell all their yield right after harvest (interview no 2, 3, 6, 7, 9). For those farmers, storage is not valuable in their current situation but might become valuable with changing credit conditions, like later payments.

Arranging storing in the developing country farm model

The previous VRIO analysis helps to arrange storage in the DCFM depicted in the literature review (figure 18). Each link of storage with other DCFM characteristics in figure 18 is derived in the previous analysis. Hereby it is important to emphasize the difference between RBV resources and other farm characteristics. From the RBV perspective, an RBV resource is defined as a source of competitive advantages for organizations. According to the previous VRIO analysis storage is a source of competitive advantages and therewith an RBV resource. Other farm characteristics might be complementary resources, but statements if they are RBV resource, sources of competitive advantages, cannot be made. In order to make such statements, each characteristic requires a VRIO analysis, as conducted with storage.

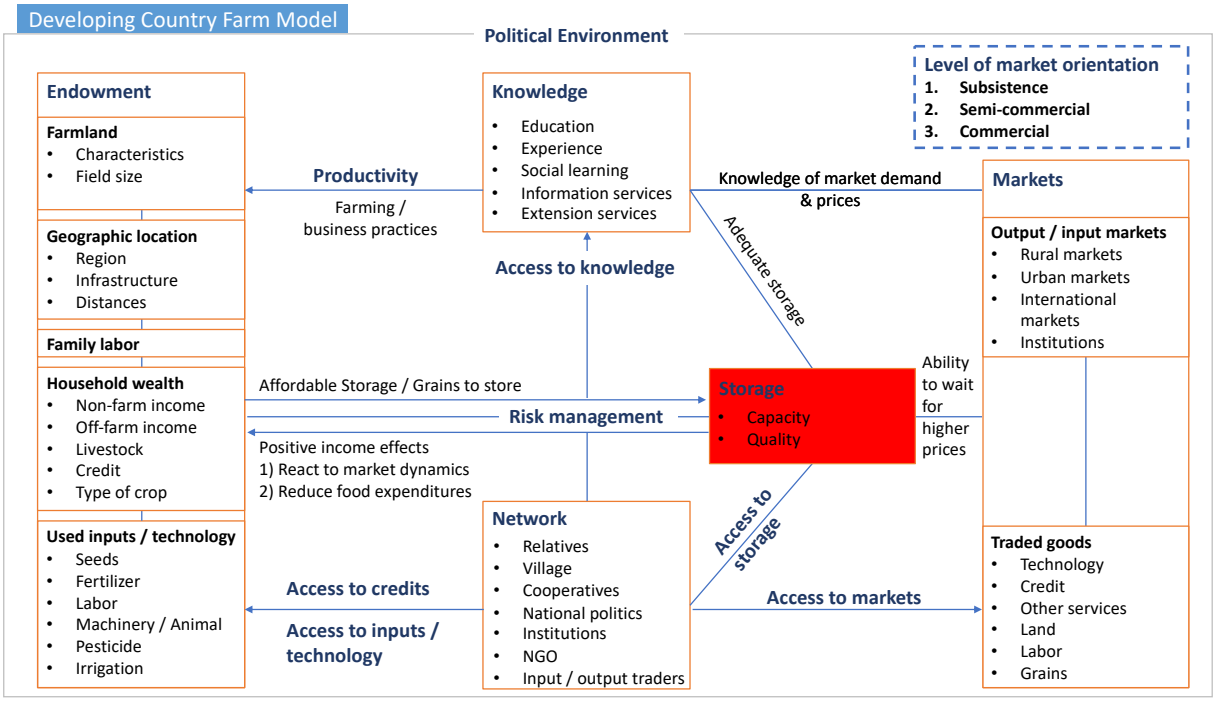

Figure 18: DCFM; Focus on storage. Source: author's illustration

4.3 The role of storage as a RBV resource in the adoption process of improved maize seeds in Ethiopia

From the RBV-perspective adoption of adequate storage (storage with minimized post-harvest losses) will lead to a competitive advantage over other farms. Thereby adequate storage enables two major strategies for farms: 1) react to market dynamics; selling in high price seasons 2) store for self-consumption to reduce food expenditures. Both strategies have a positive effect on income.

Increased income from storage-related strategies enables farmers to afford improved seeds and take related risks

Increased income creates opportunities to afford and test different kinds of farm technologies. Such a technology can be improved seeds. Implementing improved seeds is associated to a certain risk. They require specific treatments, regarding nutrition and field practices (Alene et al., 2006). The head of a large seed producer admitted '*Our seeds are very demanding [rich nutrition, fertilizer]. Additionally, they require correct treatment and sufficient water supply in order to achieve the promised yield.*' (interview no 4). Indeed, researchers working as extension agents reported of several cases where yields of improved seed varieties were lower than of traditional varieties (interview no. 7, 9, 11). In

those cases, farms have to bear the higher costs of improved seeds and compensate the lower yield. Against this background, both literature and interviews, underlined the importance of risk management when adopting new technologies (Amare et al., 2012; Asfaw et al., 2011; (Dercon & Christiaensen, 2011); Teklewold et al., 2013). A researcher reported: *'for farmers, a loss of income does not mean he drinks less beer [a lack of pleasure], it means their livelihood is at risk.'* (interview no. 7). Therefore, the income increase from storage does not only help to afford improved maize seed varieties but also to bear the risk of implementation.

Incentive to grow: Improved seeds can strengthen income effects of storage

Affordability by itself is no incentive for farms to adopt improved seeds. The incentive to grow improved seeds is their potential to enhance income effects of storage. Generally, interview partners agreed that income effects of storages can be enhanced by increasing yields (interview no. 2, 3, 4, 9, 11, 15). According to interviewed researchers, the seed manufacturer and literature, the most common ways to increase yields in Ethiopia are improved seeds and fertilizer (Alene et al., 2006) (interview no. 4, 7, 11). In this manner, storage can facilitate the adoption of improved seeds. The line of argumentation is straightforward: compared to traditional varieties, improved seeds varieties lead to higher yields, which in turn enable to sell more grains in the high price season or save more on food expenditures (figure 19).

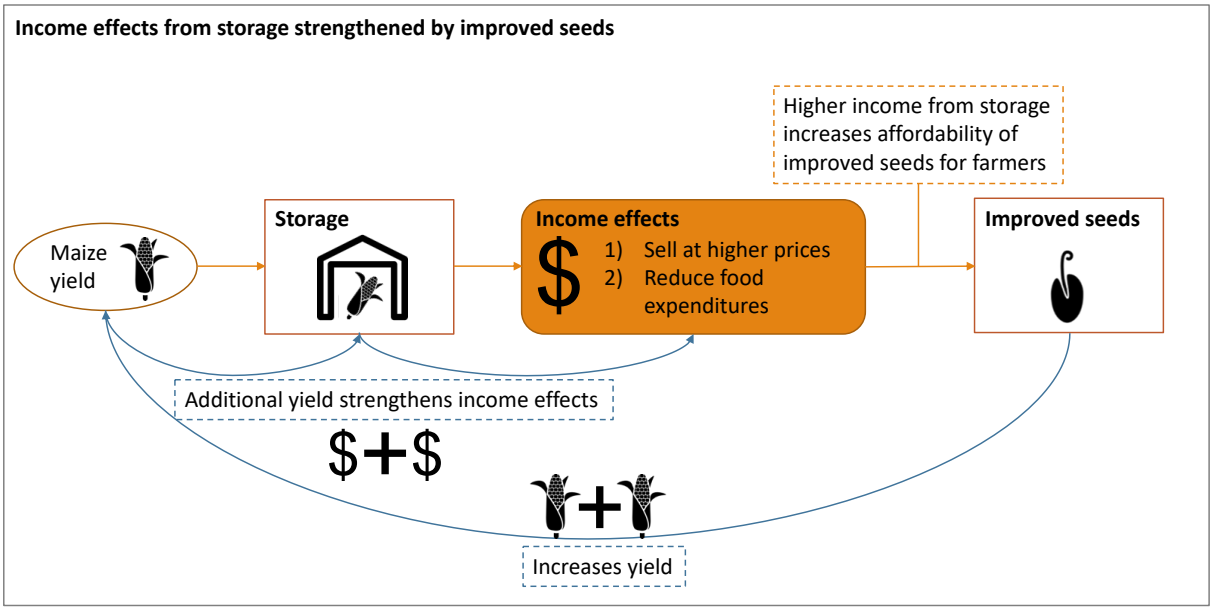

Figure 19: Income effects of storage strengthened by improved seeds. Source: author's illustration

Adopting storage first and then improved seeds is most beneficial for farmers

The previous paragraphs already indicate that the adoption order of storage and improved seeds is focal to realize income effects. In fact, adopting storage first and then improved seeds is most beneficial for farmers, due to the ability to attain higher grain prices.

Although interviewees agreed that storage is required to realize the full financial potential of improved seeds, they had contrary opinions on income effects of only improved seeds. Researchers involved in storage and extension services, as well as the head of a large pics bag producer, claimed that solely improved seeds are a zero-sum situation: the additional sales from increased grain quantities is eliminated by the higher costs of improved seeds, when sold right after harvest (interview no. 7, 8, 10, 11, 12). Contrary, the head of a large Ethiopian seed producer insisted that farmers still benefit from only improved seeds. However, he admitted that the income effect from improved seeds is significantly higher with storage in place, when he said: '*Farmers only come back to me when they notice a large income increase. Without storage, they will only feel very little income increase. So, I promote storage for a large income increase. It is a win-win situation. If their income increases my income increases too, because they want more improved seeds*' (interview no. 15). As described, the yield of improved seeds varies in accordance with several factors like field practices, nutrition, and water. Therefore, discrepancies among interviews might be reasoned in different expectations about yield increases from improved seeds. However, the statements suggest that income effects from storage[5] are larger than income effects from improved seeds[6]. Hence, adopting storage first and then improved seeds is most beneficial for farmers.

Limitations: fertilizer vs. improved seeds

As mentioned, improved seeds and fertilizer are both measures to increase yields. Therefore, it is conceivable, that from the RBV perspective, storage could in a similar manner facilitate the adoption of fertilizer. Previous statements about the complementarity of improved seeds and fertilizer support

[5] 1) selling at higher grain prices later in the season 2) reduced food expenditures

[6] selling more grains at lower grain prices right after harvest.

this assumption (seed producer: '*Our improved seeds are demanding. [rich nutrition/fertilizer]*' (interview no. 4); literature: Alene et al., 2006). Improved seeds require fertilizer for optimal growth. To include fertilizer in the analysis, more data is necessary, e.g. fertilizer prices, growth effects regarding traditional and improved seeds, etc.

Actual observation from interviewees in Ethiopia differ to RBV findings

The previous RBV analysis, which is based on interviews in Ethiopia, suggests that storage facilitates the adoption of improved maize seeds in Ethiopia. Storage is a source of competitive advantages and enables strategies to increase a farm's wealth. Improved seeds can strengthen those wealth increasing strategies; an incentive for farms to implement improved maize seeds when storage is in place. All interview partners agreed on the derived logic through the lens of the RBV. Nevertheless, none of the interviewees agreed, that storage currently facilitates the adoption of improved maize seeds in Ethiopia. Therefore, the next section depicts the actually reported dynamics.

4.4 The role of storage as observed by Ethiopian interview partners

None of the interview partners could report situations where the availability of storage facilitated the adoption of improved maize seeds in Ethiopia. Quite the contrary was observed: farmers adopted improved seeds first and then eventually storage (interview no. 4, 5, 6, 7, 9, 10 ,11, 13, 14, 15). To find an explanation for those observations, one mixed group discussion[7] revealed a key insight: an ongoing commercialization process of Ethiopian farms from subsistence to commercial levels of market orientation (interview no. 5). Farm and farmer characteristics vary in accordance with levels of market orientation and therewith the role of storage. The next subsection characterizes Ethiopian farms in levels of market orientation and highlights essential distinctions, also with respect to farmer characteristics and behaviors. Subsequently, the role of storage is evaluated against the background of different levels of market orientation.

[7] Group discussion between 3 Diplomats of a foreign country, 2 Ethiopian civil servants, 1 international trader, 1 researcher and 1 government official all involved in development aid

4.4.1 Ethiopian maize farmers' levels of market orientation

To assess levels of market orientation of small-scale Ethiopian farmers, the interviews revealed insights into different farm and farmer characteristics as well as farmer behaviors. At the beginning of the field trip, a group discussion[7 (p. 38)] gave the initial impulse to consider Ethiopian farms' commercialization process (interview no. 5). Diplomats and an international trader complained that Ethiopian farmers do often not stick to agreed arrangements. Thereupon, the Ethiopian civil servants, a government official and a researcher asked for the attendees understanding, that development projects are not progressing as planned by the foreign diplomats. In specific, the Ethiopian civil servants stated '*you [diplomats] have to understand that [Ethiopian] farmers are in a transformation process: from farming as a 'lifestyle' to farming as a 'business' '*. Within the transformation process, they described the following three levels: 1) lifestyle farm, 2) intermediate farm level, 3) business farm. A lifestyle farm serves mainly a farmer's household living and grows for self-consumption, whereas a business farm aims at monetary profit-maximizing. The intermediate level is in-between. Those farms are selling and aim for surplus generation, but still grow a large share for self-consumption. All other participants acknowledged and agreed to the commercialization process. In particular, diplomats and the international trader admitted that they underestimated the importance to account for different levels of market orientation. According to them they were mostly in contact with business farms and surprised when they noticed the significant differences in farm characteristics and farmers' behaviors with respect to lifestyle and business farms. From their contact with business farms, they presumed several business practices of Ethiopian farms, which lifestyle farms largely missed, e.g. profit calculations, etc. (further depicted in the next subsections).

The described transformation process appears similar to Pingali's and Rosegrandt's (1995) description of agricultural commercialization (chapter 2.1): '*Agricultural commercialization means more than the marketing of agricultural output, it means the product choice and input use decisions are based on the principles of profit maximization'.* Among the definition, they categorize developing country farms ('*food production systems*') in three levels of market orientation: subsistence, semi-commercial and commercial. These are similar to the levels derived from the group discussion: '*lifestyle*' corresponds to subsistence; '*business*' to commercial; '*intermediate'* to semi-commercial. To be consistent with literature Pingali's and Rosegrandt's (1995) wording is adopted in following sections. Moreover, interviews provided additional insights into farm characteristics and farmers' behaviors. Hence

following sections depict complementary descriptions to Pingali's and Rosegrandt's (1995) levels of market orientation in the case of Ethiopian small-scale farmers.

Ethiopian maize farms are mostly subsistence and semi-commercial

The majority of Ethiopian maize farmers were categorized as smallholder and subsistence farms throughout the interviews (interview no. 1-15). Literature supports this observation. According to Abate et al. (2015), about 88% of the total annual Ethiopian's maize output 2015 is consumed as food. Moreover, the authors find that smallholder farms are the primary producers of maize in Ethiopia: about 9 million smallholder households. So-called *lead farmers* came closest to the characterization of commercial farming (interview no. 2, 3, 5, 7, 8, 9). The head of a development organization described *lead farmers* as farmers '*who are advanced in at least one part of the farm model compared to other farmers in a region*' (interview no.9; DCFM, *figure 1* was in front of him). Within development projects lead farmers are typically chosen to demonstrate specific farming practices on the field. However, as lead farmers are determined on the basis of individual criteria, they cannot certainly be assigned to a commercial farming level. Several interviewees rather supported, that *lead farmers* are stepped ahead from a subsistence level to a semi-commercial level (interview no. 7, 8, 9). Indeed, the consistent opinion over all interviews was, that only very few farmers in Ethiopia are at a commercial stage (interview no. 4, 5, 7, 8, 9, 10, 11, 12, 15). Commercial farmers are mostly found with cash crops, like teff. For staple foods, like maize, the share of commercial farms appears very little. According to the head of a large Ethiopian seed producer, a maximum of 10% of Ethiopian farms are commercial profit-maximizer and those grow typically cash crops. Maize is mainly grown among the remaining 90% subsistence farms for self-consumption (interview no. 11, 15). Summarizing, the dominant share of Ethiopian maize farmers can be categorized into subsistence and semi-commercial levels of market orientation. Therefore, interviewees often unintentionally described subsistence or semi-commercial farms, when talking about Ethiopian maize farming, due to the fact that they knew very few or no commercial maize farms. Accordingly, the field-trip revealed most insights about subsistence and semi-commercial levels. This is also reflected in the varying level of detail in the subsequent sections, which characterize Ethiopian maize farmers with respect to levels of market orientation.

4.4.1.1 Ethiopian farm characteristics according to levels of market orientation

Farmland

As described in the previous paragraph, subsistence farms are the largest group in Ethiopian maize farming, with mostly smallholder farmers. Generally, commercial farmers have the largest farms followed by semi-commercial and subsistence farmers (interview no. 7, 9, 11, 12, 15). Subsistence farmers stick to their rather small farmland and show little interest to enlarge their cultivated land. It is passed from generations of ancestors and served for self-consumption through the years. On the contrary, semi-commercial and commercial farmers are eager to increase the size of their cultivated land. In their endeavor to generate surplus they see farmland as an important determinant (interview no. 9, 11, 12, 13, 15). As it appears to be difficult to buy farmland in Ethiopia, they often rent land from other farmers. Moreover, extension researchers emphasized, that it is often difficult to reach subsistence farmers due to poor infrastructure and far distances to main roads and cities. Semi-commercial and commercial farmers are typically better connected to infrastructure and transport systems (interview no. 5, 7, 8, 9, 10, 11, 12, 13).

Household wealth

With their profit-maximizing attitude, commercial farmers accumulate the greatest wealth from farming in comparison to semi-commercial and subsistence farmers. Thereby they can afford to pay for inputs, technology or school fees (interview 8, 9, 12, 15). Semi-commercial generated first income from farming. They cannot afford everything at once and have to prioritize concerning their planned expenses. Subsistence farmers earn very little. According to researchers, subsistence farmers earn just enough to pay loans for a few farming inputs. Therefore, their income is often exhausted with serving their livelihood without any further investments or savings (interview no. 2, 3, 6, 9, 11). However, the wealth situation can rapidly change when one of the relatives or children works abroad or at a governmental office. The change in household wealth is then independent of farming

Inputs and technology

A large seed producer and researchers in contact with farmers supported the description of Pingali and Rosegrandt (1995) with respect to inputs (interview no. 9, 10, 11, 15). Commercial farmers apply mainly purchased inputs, whereas subsistence farmers produce inputs themselves. Semi-commercial farmers are in-between. They partly buy and partly produce inputs. This hold especially for seeds and

fertilizer. When it comes to heavier machines or sophisticated irrigation system commercial farmers are the sole users.

Network

Almost all interviewees could report of several commercial farmers to whom they have a personal relationship (interview no. 1, 4, 7, 8, 9, 10, 11, 12, 13, 14, 15). With semi-commercial and subsistence farmers, the described relationships were less pronounced. Particularly, large agricultural input and output dealers emphasized the importance of exchange with commercial farmers opposed to other farmers (interview no. 4, 5, 8, 12, 15). For contact and transactions with semi-commercial or subsistence farmers, agricultural companies typically use intermediaries (interview 4, 8, 15). Those intermediaries can be small agro-dealers, cooperatives, politicians, NGOs or other institutions. Researchers and governmental workers supported those statements. National and international researchers organize extensions services to promote inputs and technology. Thereby researchers cooperate mostly with commercial and semi-commercial farms and intend to create spill-over effects on subsistence farmers (interview no. 9, 10, 11). Other than that, all types of farmers are typically members of cooperatives. Thereby cooperatives are closely connected to the government and often reliant on its support (interview no. 2, 3, 4, 5, 7, 9, 10, 11, 12). Moreover, farmers attach great importance to relatives as labor, knowledge or income source.

Markets and input sources

The choice of input sources or sales channels is strongly related to the previous-described networks and geographic locations of farmers. Selling patterns differ according to those characteristics. The relationship of large agricultural traders with commercial farmers provides evidence that commercial farmers sell their output directly to them, but also main (urban) markets are in their focus. Commercial farmers have the possibility to transport their harvest over large distances by transport services or (motorized) vehicles (interview no. 4, 12). Semi-commercial farmers sell to markets nearby which they reach via draft animals (interview no. 2, 3, 9, 12). Subsistence farmers sell directly at the farm (interview no. 7, 10, 11, 12). As they often lack transport opportunities, they rely on small rural traders with trucks or carriages. Additionally, international organizations show efforts to engage all types of farmers in contract farming. According to an international dealer, the success is marbled. Particularly, subsistence and semi-commercial farmers miss reliability (interview no. 5).

Similarly, procurement habits of inputs vary. Commercial farmers buy inputs at larger markets with a broader range of products or directly from large agricultural dealers. Agricultural dealers stated that they only trade with large commercial farmers directly. Trading with semi-commercial or subsistence farmers takes place through intermediaries which come by to the farms or sell at rural markets (interview no. 4, 8 ,15). Thereby the range of inputs is limited compared to commercial farmers. However, researchers stressed that for subsistence and partially semi-commercial farmers the most important sources of inputs are cooperatives (interview no. 7, 9, 10, 11, 12). According to governmental workers, the government distributes inputs (seeds, fertilizer, and credits) through cooperatives to farmers (interview no. 2, 3).

Consumption risk and risk mitigation

All interview partners agreed on consumption risk as the main driver when Ethiopian subsistence or semi-commercial farmers consider inputs or technology (interview no. 1 – 15). Those farmers know from family history, that they have just enough harvest to serve their household subsistence with traditional farming practices. For them allocating certain land to unknown inputs or farming practices, means to put their subsistence at unknown risk. One extension agent phrased it this way: '*From experience, they [farmers] know that current farming is sufficient for living. About other farming they know: maybe it is sufficient, maybe not. You have to understand, it is not that they put income [for idleness] at risk, it is that they put livelihood at risk!*' (interview no. 7). Although this might not always be the case for semi-commercial farmers, they still share risk perception with subsistence farmers to a large degree. Semi-commercial farmers typically just evolved from previous subsistence farming generations and therefore their consumption risk perception is historically marked. With considerably more wealth and mostly secured livelihoods commercial farmers percept consumption risk rather low (interview no. 7, 8, 15). Hence, subsistence farmers aim at strong risk mitigation, which is in a weaker form taken over by semi-commercial farmers. On the contrary, commercial farmers are able and willing to take risks for profit maximization.

Knowledge

Commercial farmers have a comprehensive understanding about the farming business. They know farming practices, and market dynamics regarding their focal crop(s) as well as they do profit- and cost / benefit-calculations. Thereby they decide on the basis of mostly rational criteria and expectations. Commercial farmers often went to school and eventually to university or at least their children go by

now (interview no. 9, 15). On the contrary, semi-commercial and subsistence farmers' lack of education was outlined as a key problem. They are often unable to evaluate investments through profit or cost-benefit calculations[8]. But knowledge was not only reported to be a problem regarding traditional school subjects, like math. Particularly, researchers complained about the absence of knowledge regarding farming practices, like soil treatments or sowing depth (interview no. 7, 11). Those farmers typically follow historically passed growing patterns and practices, that already served their ancestors. Adoption to exogenous factors, like changing rainfall or temperature pattern were barely observed. With respect to change management researchers and agricultural dealers reported similar dynamics when one farmer started to change farming practices and had success, nearby farmers asked for the same inputs to copy the farmers farming practices (interview 2, 3, 4, 9, 11). Researchers identified those dynamics as a form of informal education acquired via social learning (interview no. 9, 13, 14). They described social learning as a farmer's ability to observe his close environment in terms of farming practices and resulting yields to conclude on causal relations (see also chapter 2.2). In these dynamics, semi-commercial farmers were described to be early adopters or even first movers. Therefore, they show first signs of entrepreneurial acting.

Investment horizon

Subsistence farmers were described to live from '*day-to-day*' and typically face a constant cash demand (interview no. 10, 15). Statements like '*what farmers do not need to do today, they do tomorrow*', were no rarity among interview partners (interview no. 15). Subsistence farmers' business partners claimed, that reliability of farmers is weak (interview no. 5, 10). Since farms often require cash after harvest to pay loans, they sometimes ignore agreed long-term contracts and sell to the first trader who visits the farm. When a successful international trader was asked how those problems can be

[8] An Ethiopian trader illustrated it with an example; he visited farmers who bought fertilizer for 73$ per 7 quintals harvest when the market price of the commodity was 77$ per 7 quintals. The resulting profit was 4$ if no other costs are considered. He concluded, that farmers do not know other production costs than bought inputs, or putting it differently, do not value given farm endowments like family labor or manure. Ultimately, he questioned whether farmers did profit calculations at all when saying '*a calculating farmer would not buy fertilizer at all at this market conditions*'. (interview no. 12)

avoided, he answered, '*only trade vegetables which have no local market*' (interview no. 5). One trader even questioned if fast selling was only reasoned in paying debts or perhaps also in '[…] *being able to go to a bar and enjoy life*' (interview no. 12). The previous characterization leads to the conclusion that subsistence farmers seek for short-term effects and investments (interview 13, 15). According to the international trader semi-commercial farmers are in a learning process they are reliable most times and understand the principle of long-term investments (interview no. 5). However, as they act risk averse and are not completely confident in long-term payoffs, they still prefer short-term investments. Commercial farmers are one step further. Government agents and foreign diplomats highlighted their importance in Ethiopian agricultural growth programs (interview no. 2, 3, 5). Commercial farmers stick to contracts, sometimes are involved in contract farming and have experienced the benefits of long-term investment. Therefore, in contrary to semi-commercial farmers, commercial farmers have stronger confidence in long-term projects.

4.4.2 Differences in the role of storage according to Ethiopian farmers' levels of market orientation

As described at the beginning of this section, none of the interview partners could report situations where the availability of storage facilitated the adoption of improved maize seeds in Ethiopia, even though the RBV analysis (VRIO-framework) suggests so. An explanation for the contradiction between observation and theory revealed a group discussion. The discussants agreed, that Ethiopian farm characteristics and farmers' behaviors differ in levels of market orientation. Thereby also the role of storage in the adoption process of improved seeds varies with Ethiopian farms' levels of market orientation. The previous section already characterized Ethiopian farms and farmers according to their level of market orientation. Finally, on the basis of the depicted characteristics, the following describes the role of storage for each level of market orientation.

4.4.2.1 Subsistence farmer

As described in the prior section, subsistence farmers are constantly facing financial difficulties. They aim for risk mitigation, are sensitive towards short-term effects and characterized by a day-to-day attitude. In this context, the interviewed storage and seed distributors had a similar perspective on farmers. According to them, subsistence farmers' day-to-day attitude illustrates farmers' problem anticipation well: '*There is an awareness issue - farmers only see problem, when problem is there*', i.e. typically farmers only think about storage once they have a surplus to store. (interview no. 4) To

provide evidence for this adoption order, a researcher on metal silos showed pictures of maize farmers, which were surprised by increased yields from improved seeds and started storing maize in their bedrooms[9] (interview no. 13). In their constant demand for cash, subsistence farmers invest very little or nothing and are often reliant on external support from the government or NGOs. When they can choose between support measurements, extension researchers could tell from experiences, that subsistence farmers seek for short-term effects, which are easy to measure (interview no. 7, 10, 12, 13). In this respect, two frequently stated phrases about farmers were: 'seeing is believing' and 'touching is believing' (interview no. 4, 8, 13, 14). The common example was improved seeds against storage. Additional yield from improved seeds can physically be '*touched*' right after harvest, whereas lower post-harvest losses do not increase yields and require some time after harvest to be perceptible (interview no. 7, 10, 13, 14). Therefore, subsistence farmers preferred adoption of improved seeds over storage. They value a short-term increase in yield higher than a long-term decrease in post-harvest losses, even if cost-benefit calculations support a higher value for storage. These observations reinforce the prior described opinion, that subsistence farmers often lack basic business practices, like profit-calculations. Against this backdrop, interview partners denied capabilities of subsistence farmers to anticipate future events or pay-offs (interview no. 13, 15).

4.4.2.2 Semi-commercial farmer

Semi-commercial farmers, formerly subsistence farmers, expand their farm's purpose from food self-sufficiency to surplus generation (interview no. 5, 12). With their lower perception of consumption risk and their objective to generate a surplus, they show first signs of entrepreneurial acting. Thereby, semi-commercial achieved first improvements in their wealth situation (interview no. 10, 15). However, researchers emphasized that semi-commercial farmers just recently evolved from subsistence farming and still have similar behavior patterns (interview no. 7, 9, 10). They prefer tangible ('touchable') over intangible improvements and short-term over longer-term benefits. From this follows that semi-commercial still adopt improved seeds before storage. In this context the head of a large seed producer was satisfied with semi-commercial initial demand for improved seeds but

[9] The interviewee disagreed to share a digital copy until he released his final report.

struggled to build long-term business relations. He argued that they are not able to realize the full potential of improved seeds because they miss storage (interview no. 15). Therefore, he started to promote improved seeds with adequate storage (see also section 4.2). This indicates a learning process: semi-commercial farmers' objective to benefit from surplus generation creates awareness for storage issues (interview 9, 13). In this process they learn to consider long-term consequences from business decisions. Ultimately, it helps semi-commercial farmers acquiring the capability to assess resources on the basis of long-term benefits, intangible advantages and leads to first simple profit calculations.

4.4.2.3 Commercial farmer

Commercial farmers, were mostly described on the example of cash crop (e.g. teff) farmers in Ethiopia (interview no. 5, 11, 12, 15). They aim for profit maximization and have accumulated sufficient wealth with entrepreneurial acts. In this manner they secured livelihood and can further afford to bear investments. Commercial farmers act as entrepreneurs (interview no. 5, 8, 9, 12, 15). Researchers claimed that in recent history they went through the learning curve of semi-commercial farmers (described in previous paragraph 4.4.2.2). Hence, commercial farmers learned to consider long-term consequences of investments and decide on the basis of cost-benefit calculations. Thereby they are able to take intangible advantages into account and anticipate future expectations about pay-offs. Commercial farmers have the capability to assess resources on a logic similar to the RBV. One researcher on metal silos and the seed producer reported that commercial farmers try to ensure adequate storage capacities before they increase their production (e.g. by acquiring additional fields, growing improved seeds) (interview no 13, 15). Consequently, for commercial farmers availability of storage facilitates adoption of improved seeds. However, commercial farmers are mostly found in cash crops, therefore it is questionable if availability of storage also facilitates adoption of improved seeds of staple foods, like maize.

4.4.2.4 Conclusion and outlook: currently only commercial farmers follow RBV logic

Summarizing, the value criteria of Barney's VRIO-framework is only comprehensively followed by commercial farmers. Farmer categorized in subsistence or semi-commercial level of market orientation, have difficulties to anticipate and perceive value-creating strategies from storage that base on long-term or intangible advantages. Concluding, farmers' value perception of resources differs according to levels of market orientation.

5. Discussion

The results show that the RBV can only partly explain the role of storage in the adoption process of improved seeds. Although storage matches the Barney's (1995) RBV criteria to create a competitive advantage and appears to be superior over improved seeds, the dominant share of Ethiopian maize farmers does favor adoption of improved seeds before storage. It follows, that the majority of farmers do not or only partially apply a logic described by Barney's (1995) VRIO framework. It leads to the question what other determinants play a role when farmers evaluate storage. In this context, farms' levels of market orientation are identified as a significant factor. With different levels of market orientation, the value of storage, as a resource, seems to be perceived differently. Levels of market orientation are commercial, semi-commercial, and subsistence. In particular framers at a commercial level seem to follow strategies that match the RBV. Commercial farmers are most similar to developed farmers compared to semi-commercial and subsistence farmers. When it comes to examination of semi-commercial and subsistence farmers, the RBV requires adjustments. Or more generally speaking, the RBV cannot be transferred straightforward to developing countries. This appears reasonable since the RBV is rooted in developed industries.

The further discussion is structured as follows: section 5.1 contributes additional insights to Pingali's and Rosegrandt's (1995) description of farmers' levels of market orientation and relates levels of market orientation to the RBV. Section 5.2 discusses differences in farmers' perceived value of storage with findings from existing literature (Baker and Nelson, 2005; Penrose, 1959). Section 5.3 supports Lazzarini's (2008) findings with highlighting the importance of off-farm resources in a developing country context. Section 5.4 gives an outlook about the future role of storage in the Ethiopian adoption process of improved maize seeds.

5.1 Farmers' levels of market orientation and its relation to the RBV in developing countries (Pingali & Rosegrandt 1995)

The Ethiopian farmers' transformation process from lifestyle to commercial farming was transferred into levels of market orientation similar to Pingali and Rosegrandt (1995): subsistence (lifestyle), semi-commercial (intermediate) and commercial (business). But, whereas Pingali and Rosegrandt (1995) describe levels of market orientation by means of macro- and microeconomic dynamics, this research widens the view with insights into underlying dynamics regarding farm's characteristics and farmers'

behaviors. In this way, Pingali's and Rosegrandt's (1995) findings are extended by evidence from interviews in Ethiopia about maize farmers and their view on storage (table 4). One of the main outcomes is, that farmers with different levels of market orientation differ with respect to their capability to anticipate potential value and associated risk from resources. This seems to hold particularly for resources which create intangible advantages on a long-term basis.

Table 4: Levels of market orientation and corresponding characteristics. Source: author's findings

Level of market orientation	Farmer characteristic	Farmer's perception of consumption risk	Investments horizon	Investment aim at	Cost-benefit calculation	Crop
Subsistence	Risk avoidance	strong	Short term	Direct tangible effects	No	Staple (Eg. Maize)
Semi-commercial	Partly risk avoidance partly entrepreneurial	middle	Predominantly short-term	Predominantly tangible effects	Partly	Mix of staple and cash
Commercial	Entrepreneurial	low	Short- & Long-term	Tangible & Intangible effects	yes	Cash (E.g. teff)

5.1.1 Subsistence farmer

The majority of maize farmers were categorized as subsistence farmers throughout the interviews. For subsistence farmers, it appears to be difficult to assess resources on the basis of long-term benefits and intangible advantages – especially, when they have no historical experience with any strategies, which exploited intangible advantages. In the case of adequate storage, a long-term benefit is lower post-harvest losses leading to reduced expenditures for food or increased profit from selling in the high-priced season. Whereby enabling sales in the high-priced season represents an intangible advantage of storage. Subsistence farmers prefer physical improvements, like increased yields, even though monetary cost/benefit is questionable. Moreover, they associate less risk with investments in improved seeds than in storage. It is found, that those attitudes are rooted in ignorance of business practices, sensitivity for short-term effects and a high degree of risk avoidance. Against this background, missing education, a strong perception of consumption risk, and constantly scarce money ,as well as tight credit obligations, were identified as focal determinants for subsistence farmers'

characteristics. Additionally, interview partners claimed to overserve significantly missing entrepreneurial spirit, because of farmers' day-to-day attitude which lacks attempts to improve their situation (e.g. negotiating better credit conditions).

5.1.2 Semi-Commercial Farmer

Semi-commercial farmers, formerly subsistence farmers, expand their farm's purpose from food self-sufficiency to surplus generation. Interviewees described them by means of so-called lead farmers (section 4.4.1). They show first signs of entrepreneurial acting. Their perception of consumption risk is lower and with their objective to generate surplus, they appear willing to try different types of yield-improving technologies at first. Eventually, successful surplus generation confronts them with the issue of storing, especially when they face high post-harvest losses. This sequence - first surplus then storage - indicates a learning process, which makes them sensitive for consequences from business decisions. It helps semi-commercial farmers acquiring the capability to assess resources on the basis of long-term benefits and intangible advantages. Additionally, farm investments and an increase in traded inputs create awareness for expenditures, which can lead to first simple profit calculations. This might improve their management with credit obligations, which still appear to be a major challenge for semi-commercial farmers, similar to subsistence farmers.

5.1.3 Commercial farmer

Commercial farmers were mostly described on the example of cash crop (e.g. teff) farmers in Ethiopia. Whereas semi-commercial farmers still grow for self-consumption, commercial farmers are mainly interested in sales and profit maximizing. From selling, they have typically gained a sufficient liquidity level for a long-term secured livelihood and no instant obligation to sell after harvesting. With a considerably secured livelihood they percept a rather low consumption risk. Long-term investments, for example in storage, are no rarity among those farmers. Commercial farmers decide on the basis of cost-benefit calculations, in which they include expectations about future pay-offs. From this follows, that they are able to anticipate future events, issues as well as chances. Hence, they have the capability to evaluate resources more comprehensive than semi-commercial or subsistence farmers - especially regarding intangible assets or advantages. Those descriptions indicate distinct entrepreneurial acting, which was also attested by several interviewees.

5.1.4 Levels of market orientation in relation to the RBV

Summarizing, the value criteria of Barney's VRIO-framework is only comprehensively followed by commercial farmers. Farmer characterized by subsistence or semi-commercial levels of market orientation did barely anticipate and perceive benefits from resources that base on long-term or intangible advantages. Hence, farmers' value perception of resources differs according to levels of market orientation.

One possible explanation for these observations could be that the RBV was developed to address issues of market competition in developed countries and industries. Subsistence farms are not eager to engage in market competition. They endeavor to achieve sufficient harvest for a farm's household living. Thereby subsistence farmers do not aim for a competitive advantage over other farms. On the contrary, semi-commercial farms strive to participate in the market competitively. However, they are in a learning process and have not yet acquired distinct knowledge on long-term competitive advantages and resulting strategies. Their competitive thinking concentrates on yield-increasing measures at first. Therefore, semi-commercial farmers are mainly interested in improved seeds and fertilizer to achieve higher yields than other farms. Commercial farmers are eager to engage in competition and have acquired sufficient knowledge to assess resources from a competitive perspective like the RBV comprehensively. In the context of Ethiopia, commercial farmers were subsistence or semi-commercial farmers in previous generations. Therefore, commercial farmers just recently underwent learning processes, which seem necessary to acquire sufficient knowledge to consider competitive perspectives like the RBV. Hence the perceived value of storage differs according to levels of market orientation.

5.2 Differences in perceived values of a resource (Baker & Nelson 2005 / Penrose 1959)

Differences in perceived values from storage as a resource, is in the direction of Penrose (1959) statement, that '*no firm ever perceives the complete range of services available from any resource*'. Baker and Nelson (2005) support Penrose (1959) by introducing 'bricolage' to explore the full range of services – '*bricolage as making do by applying combinations of the resources at hand to new problems and opportunities*'. They further describe it as an actively initiated discovery process, which requires the willingness to experiment with different combination of resources at hand. Therewith, they

introduce a constructivist perspective on resources (= construct different resource combinations). Both, Penrose (1959) as well as Baker and Nelson (2005), concentrate on firms in developed countries.

Against the backdrop of farms in a developing country, experimenting appears to be focal as well. But contrary to Baker and Nelson (2005) this research highlights the mental construction of a new resource in an existing resource network. In other words, a farmer's mental capability to arrange storage within his farm model in order to anticipate potential benefits from storage. Anticipation is less expensive than actual experimenting and aims at risk reduction with predicting outcomes. This matches with the explored risk-averse characteristics of farmers. Farmers who are unable to anticipate value from storage, are not willing to try storage, mainly because they fear, that an investment in storage will put their livelihood at risk. In this sense, developed countries offer a more favorable environment for experimenting with rather secured livelihood and accessible venture capital.

In this line, this research gives indication, to introduce a comprehensive competence to the constructivist perspective. The comprehensive competence could be described as the ability to comprehend resources by anticipating potential benefits with respect to the single resource as well as to possible combinations with other resources.

5.3 Off-farm resources (Lazzarini 2008 / 2015)

Besides complementary resources within a farm model, researchers and agricultural dealers emphasized the importance of off-farm resources, like rural infrastructure or institutional efforts to create knowledge and awareness for technology. Therewith, they support Lazzarini (2015) when he concluded that resources of an entity are not inevitably the sole source of competitive advantages. Those resources can on one hand facilitate the transformation process from subsistence to commercial farmers and on the other hand create heterogeneity among regions. For example, from research promoted regions benefit from insurances and improved farming practices, which decreases farmers' consumption-risk and risk associated with entrepreneurial acting. Agricultural dealers also provide evidence for Lazzarini's and Mesquita's (2008) description of reciprocal dependencies in supply chains. Seed distributors highlight the importance to create a successful supply chain in order to enable farmers to pay improved seeds and thus achieve long-term profits with farmers. Since they recognized, that storage increases benefits from improved seeds, they promote storage (technology) through the chain.

5.4 Outlook

The results show, that the availability of storage does not facilitate the adoption of improved Maize seeds at the current stage. Nevertheless, it is conceivable, that storage will play a role in the future. Particularly, pics bag as it has a significant cost and mobility advantage over metal silos in short term. Already now, the popularity of pics bags increases as sales figures suggest (table 3). Farmers who took advice to use pics bags in the past and are benefiting from them in the meanwhile, might be interested in further technology in the future. In addition, social learning can occur when pics bags are promoted from farmer to farmer. In this process farmers might learn from previous experiences with 'bedroom storage' and transfer those to knowledge on favorable adoption orders. Hence, farmers who have not adopted improved seeds yet, would first want to adopt storage. In this manner storage could finally facilitate adoption of improved seeds.

6. Limitations & further research

This research represents an attempt to assess the role of storage in the adoption process of improved maize seeds, using the RBV as the theoretical foundation. As the RBV was originally designed to explain competitive advantages in developed industries and countries, it was not clear from the beginning, how well that theory would fit to explain economic behavior in a developing country such as Ethiopia. In fact, it was found that the RBV cannot be transferred one-to-one from the context of developed countries to that of developing countries (see chapter 4). A more practical limitation concerns the data collection. Within the three weeks during which the interviews were conducted in Ethiopia, farmers could not be interviewed due to ongoing strikes around the capital city Addis Ababa and associated safety concerns. To complement and validate the findings of this thesis, it would be beneficial to address this empirical gap, by conducting further interviews with farmers in the maize regions of Ethiopia. Those findings could be compared with the findings of this research and increase its validity. Lastly, it would be conceivable to quantify the schematic relationships that have been discovered in this research, for instance by assessing whether increases of pics bag sales are associated with an increased adoption of improved maize seeds.

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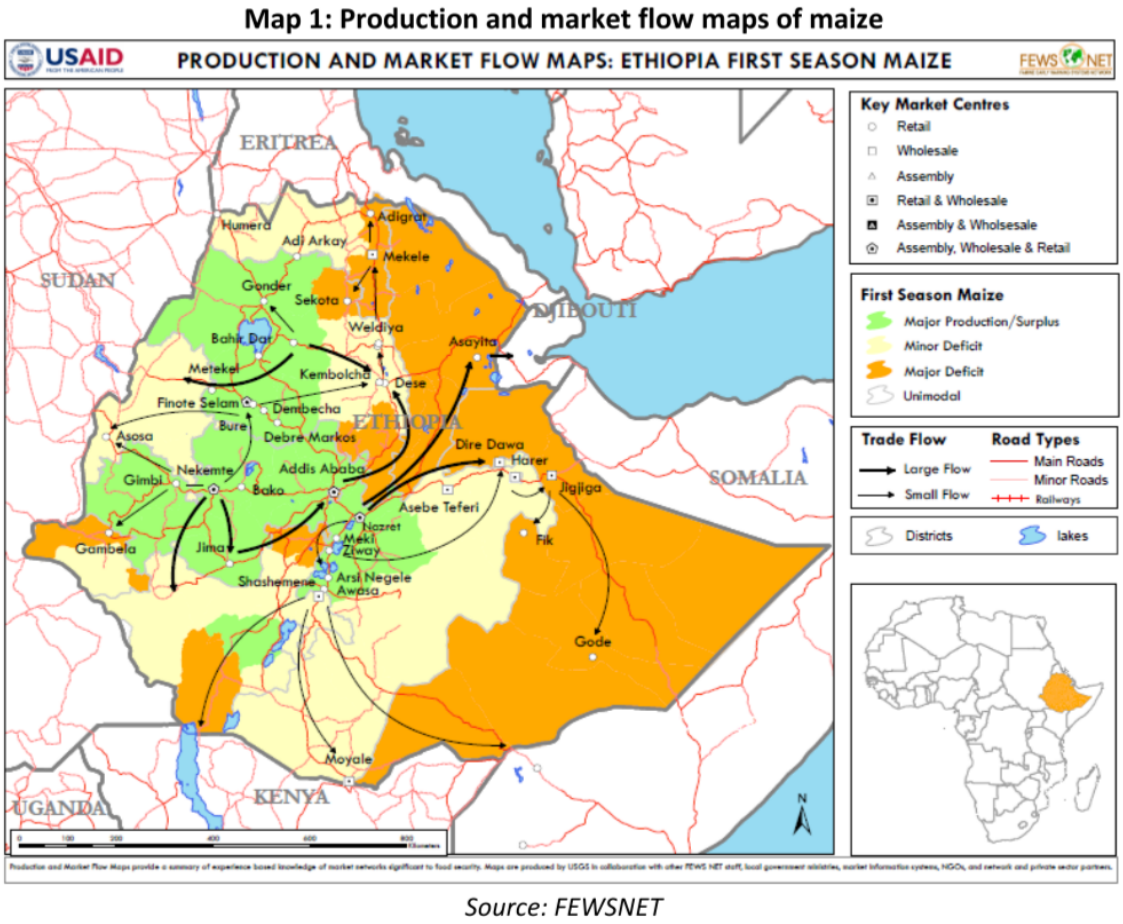
Appendices

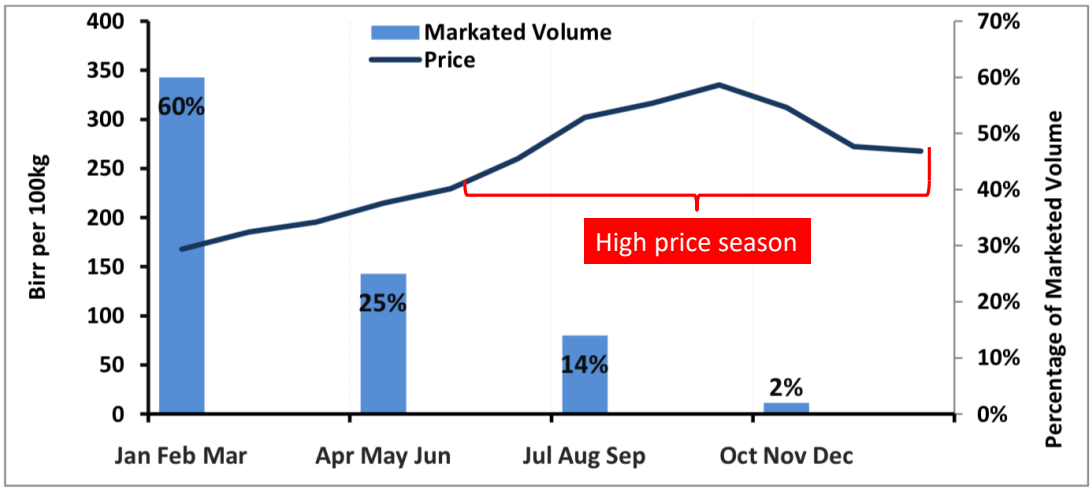
Appendix 1: Ethiopian maize production and market flow map



Source: FEWSNET

Figure 20: Ethiopian maize production and market flow map. Source: FAO (2012)

Appendix 2: Ethiopian maize market: price movement and timing of sales



Source: Price Source: EGTE, marketed volume data are based on Abebe and Hundie (2002) and participatory rapid assessment in January 2010.

Figure 21: Ethiopian maize market: price movement and timing of sales. Source: IFPRI (2010)

Appendix 3: Interview list

SI – Single interview

GD – Group discussion

PR – Private room

PU – Public room

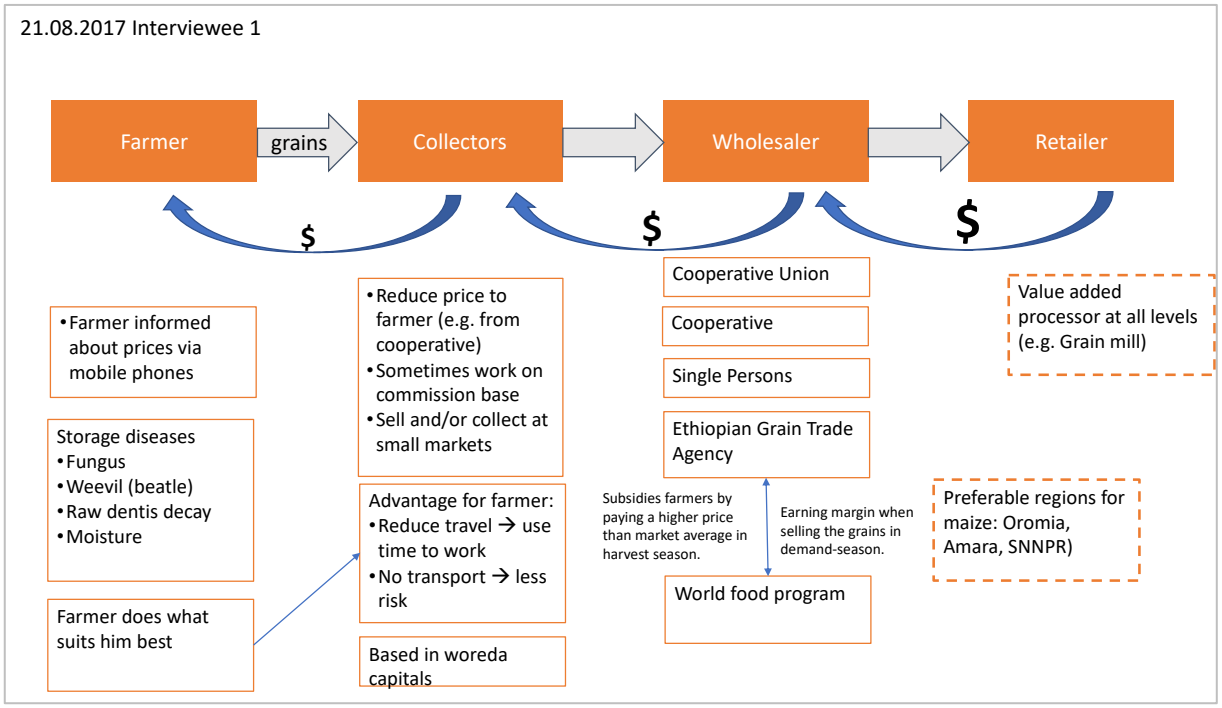
No.	Interview type	Participants / Job description	Field of expertise
1	SI, PR	Member of a seed research program	Maize seed supply chain
2	SI, PR	Employee of Ethiopian Agricultural Transformation Agency	Policies, cooperatives (water & grain), governmental input supply (fertilizer, seed, credit), seed certification, farmer characteristics
3	GD, PR	3 employees of Ethiopian Agricultural Transformation Agency	Policies, cooperatives (water & grain), governmental input supply (fertilizer, seed, credit), seed certification, farmer characteristics

4	SI, PR	Head of a large Ethiopian seed producer	Seeds: supply chain, types, availability, sales, farmers' preferences; farmer characteristics, extension services
5	GD, PR	3 Diplomats of a foreign country, 2 Ethiopian civil servants, 1 international trader, 1 researcher and 1 government official all involved in development aid	Farmers' characteristics and decision making, farmers' transformation process, supply chains of several crops, linkage between Ethiopian and international markets
6	SI, PR	Diplomat of a foreign country	Farmers' characteristics, aid programs
7	SI, PR	Researcher employed in a foreign embassy involved in extension services	Farmers' characteristics, seed decision criteria, extension services
8	SI, PU	Head of a large pics bags manufacturer and distributor	Pics bags, farmers' characteristics, extension services
9	SI, PR	Head of one of the largest development aids regarding farming in Ethiopia	Farmers' characteristics, Ethiopian maize data, seed types, extension services
10	SI, PU	Researcher, employed in a project which links different agricultural programs in Ethiopia (involved in extension services)	Farmer characteristics
11	SI, PR	Researcher, employed at a large international maize improvement center (involved in extension service)	Farmers' characteristics, seed decision criteria, maize market, crops (teff vs. maize)
12	SI, PR	Head of a large domestic grain trader in the north of Addis Ababa	Market development, policies, linking farmer to markets, trading chain
13	SI, PR	Technical director of one of the largest agricultural research-centers involved in storage and extension service	Storage, farmer characteristics
14	SI, PU	Technical deputy director of one of the largest agricultural research-centers involved in storage and extension service	Storage, farmer characteristics
15	SI, PR	Head of a large Ethiopian seed producer	Seeds: supply chain, types, availability, sales, farmers' preferences; farmer characteristics, extension services

Appendix 4: Interviews notes

No.	1
Stakeholder:	Member of a seed research program
Person	Interviewee 1
Date:	21.8.2017
Location:	Addis Ababa
Setting:	The meeting was set at 10:30hrs. Due to traffic I arrived at 10:45hrs. At this time interviewee 1 was still in a meeting and I waited 15min until we sat in his office to talk. In the end of our meeting interviewee 1 told me that he was in hurry and about to leave to Hawassa (city in the south of Addis Ababa). During the meeting he sometimes interrupted the discussion instantly when he had an idea on whom I could talk to and called the person. With this approach he organized me two more meetings the same day. Nevertheless, it turned out that one meeting he organized was with a person that was currently abroad (person a).

Interviewee connected me to several stakeholders and gave insights into the maize value chain (see below).



No.	2 & 3
Stakeholder:	Employees of Ethiopian agricultural transformation agency
Person	Interviewee 2
Date:	21.8.2017
Location:	Addis Ababa
Setting:	I arrived with the expectation to talk to person A. His secretary told me that he was currently abroad. Therefore, I asked if it is possible to talk to employees of him. I shortly introduced my topic and it seemed that 'storage' was the 'key word' for the secretary advising me to talk to interviewee 2. interviewee 2 is an expert in infrastructure and construction, namely of storages and transportation. After 20 minutes, when I asked about input distribution in general and in cooperatives in specific, he invited two more ATA employees: interviewee 3 and interviewee 4. From then on it was a group discussion. Before the other employees joined us I asked for a break, since I was not feeling very well. They assumed that it was because I was not acclimatized to the altitude. The talk with interviewee 2 was very friendly, but I had the feeling that he was carefully weighing his words, where interviewee 3 was speaking frankly.

Interviewee 2

Cooperative

- Manager is chosen among famer members. Incentive is 'respect' (leader gets commission by several sellers (Seed)).
- Profit is 'fairly shared' among members
- Input distribution
    - done on farmers' request
    - on loan basis
- age
    - Jung age: < 2 years
    - Middle: 2 < age < 30 years
    - Established age > 30 years

Group Discussion (Interviewee 2, 3, 4)

Seed certification

- GOVERNMENT decides on seed certification
    - Demonstration plot
    - Recommendation on field treatment and best suited area for type of seed

Cooperative

- Seed storages
    - Capacity and quality limits availability of seed
    - Current strategy: motivate suppliers to improve storages in order to sell more improved seeds
- Input distribution

- GOVERNMENT assessment of demand
    - Village: Cebele
    - District: Woreda
    - Zone
    - Region: Kilil

Farmers' drivers for seed

- Social (neighbor / community leader / lead farmers)
- Seed characteristics (input demand)
- Price
- Availability
- Some FCU are supported by GOVERNMENT
- Higher income

Seed availability

- When improved seed is delayed (2 weeks) farmers' grow old seed.

Long supply chain Farmer - Cooperative - FCU Seed - supplier [GOVERNMENT]

- Inefficient?
- Private sector?

Farmer in harvest season

- 'cash demand'
    - Children (school)
    - Families' only income`?
- Sales
    - Normal Farmer sell grain locally → 20% trough cooperatives
    - Only commercial farmers sell correctly and pay taxes

Buyer

- WFP and Ethiopian Grain Trade Agency have contract to prevent hunger

No.	4
Stakeholder:	Head of a large Ethiopian seed producers
Person	Interviewee 5
Date:	21.8.2017
Location:	Addis Ababa
Setting:	The appointment was set at 16:30, due traffic I arrived late. When I arrived interviewee 5 welcomed me warmly, although he was working on internet connection problem with his assistant. After I waited for ten minutes in which they talked to a service hotline, interviewee 5 asked me to sit down on a table in the same room. So while we talked the assistant was still working on the internet connection. After my introduction interviewee 5 stood up and got a folder with documents. It seemed that he was not looking for one particular document, but rather looked through all papers to see if he can find something interesting. He continued looking through the folder the whole meeting even when one of us was talking. His office was large compared to all other offices I have seen in Ethiopia.

Farmers' seed choice

- Service
- Price
- Availability
- Neighbor

Improved seeds

- Public research decides on best seed for area
- Producers
    - Public seed enterprises
    - Cooperatives that produce seeds
    - Private
- Sellers
    - Cooperatives
    - Individuals
    - Direct from seed warehouses
    - Neighbors
    - Local Agro dealers
- Improved seeds are very demanding
    - Only the seed doesn't help inputs and field treatment needs also to be correct in order to achieve high yields
    - Our improved seeds require good nutrition and field practices.
    - 'Our seeds are very demanding [rich nutrition, fertilizer]. Additionally, they require correct treatment and sufficient water supply in order to achieve the promised yield.'

Adoption of improved seed

- 'seeing is believing'
- Farmers always fear new inputs → they act risk averse / consumption risk

Region for DEVELOPMENT PROGRAM A

- Regions needs to fit to seed characteristics (Altitude / Farmer practice and so on) → Maize Belt

Farmers store all in one

- Seed
- Grain
- Fertilizer
- Pesticide

Yield:

- OPIS – open pollinated: 1.5 – 1.7 MT / ha
- Newer treatments 3.2 T/ha
- DEVELOPMENT PROGRAM A: 8 – 10 MT/ha

Development program A

- FCUs get seed on consignment
- Storage with large capacity to grains for farmers until prices raise again
    - When famer has high income he will more likely buy improved seeds
- Task share:

- Seed producer: Seed
- GOVERNMENT : Channels and extension network
- Development organization = extension training on the field

- Outlook
  - 'affect 1Million farmer' over exaggerating? → info document speaks of plans for 2015
    - 5,000 demonstration plots
    - Engage 32,000 farmers
    - Until 2018 impact 100,000 famers

Seed producer

- Outlets (work on commission)
  - Cooperatives
  - Individual dealers

Awareness of post-harvest losses

- Farmers are used to it ('There awareness issue - *farmers only see problem, when problem is there*'')
- 'Post-harvest loss is like money falling out of your (farmer) pocket'

Relation of storage and improved seeds

1. Productivity
2. Need for storage

No.	5
Stakeholder:	Development Initiative
Person	Interviewee 6, 7, 8, 9, 10, 11, 12, 13 3 Diplomats of a foreign country, 2 Ethiopian civil servants, 1 international trader, 1 researcher and 1 government official
Date:	22.8.2017
Location:	Addis Ababa
Setting:	I attended a presentation about contract farming regarding food crops like avocado. Although it was not about maize; insights about Ethiopian farmers in general were given. Most interestingly for this research was the group discussion after the presentation, where I could ask specific questions on maize farmers.

Cooperative

- Some farmer like it some don't
- 'Water distribution' – Farmer 'I get nothing, but have to be member'

Farmer Transformation process → from farming as a lifestyle to farming as a business. Currently in intermediate stage

- You have to understand that farmers are in a transformation process: from farming as a '*lifestyle*' to farming as a '*business*'
- Lifestyle: farm serves farmer's household living → self consumption
- Business: profit maximizer, surplus generation, take more risk
- Intermediate: surplus generation and self-consumption → lead farmers

- 1. Productivity 2. Storage

Infrastructure

- Only very few farmers have good access and / or a car or animals
- Rural subsistence farmers are very difficult to monitor

It should be an economic evolution process

- Rather a market pull by farmers for contract seeds etc than a push

Talk to farmers and not to NGOS

- See what farmers want one to one
- As long as habits work farmers tend to stick to their habits
- Farmer don't want to work on other farms to learn. Learn on their own fields
- Farmers don't push new things to the market – the market has to pull / demand
- Farmer are not homogenous what they want in one region might be totally different in another look at mentalities and sayings

How do you prevent that farmers don't sell locally?

- 'Make sure that there is no commodity for local market' – '*only trade vegetables which have no local market*'
- 'Other than that only trade with business farmers. They understand the long-term benefits. They also don't grow maize but cash crops like fruits and teff.'

Government :

- Interested in foreign investments

No.	6
Stakeholder:	Diplomat of a foreign country
Person	Interviewee 7 from group discussion before
Date:	22.8.2017
Location:	Addis Ababa
Setting:	Right after the presentation. Interviewee 7 and me sat down in his office. I introduced my topic and we discussed in an open-minded atmosphere.

Male and female farmers decide different.

When selling farmers' most important decision criteria is price then:

- Management
- Quality

Farmers storage decision

- Match seed
- Match grain
- Distance

Farmers' seed decision

- Taste

Farmers first increase productivity then look for storage

Right after harvest farmers have a cash demand for school cloth and so on

Seed adoption logic:

- first productivity then productivity handling storage

Discussed further research possibilities

- contacts
- emphasized that I need to go to farmers to learn

No.	7
Stakeholder:	Researcher employed in a foreign embassy involved in extension services
Person	Interviewee 14
Date:	23.8.2017
Location:	Addis Ababa
Setting:	Interviewee 14 welcomed me in a conference room. He was very interested in my research. He had graduated in abroad as well and followed a PhD program. With this background, he seemed to understand my questions and intention very well and was visibly motivated in the discussion.

I showed him farmer RBV → he said structure it more for econometric model

Open question: What do you think about the relation between improved seed and storages

- first productivity then storage
- 'I looked at your proposal headline and said no – the other way around'

Farmers sell according to price sometimes also look additional services from buyer

Farmers decide about seed on (also cash demand)

- Requirements
    - Farmer itself
        - Stock height for fire / prevent from monkeys / house construction
        - Leave as feed for animals
        - Self-consumption
        - Productivity
        - Marketability
        - Availability of seed (only after they decided for one seed type)
    - Local market
        - Taste
        - Demand (amount)
    - 'International Market' / ECX
        - Quality
        - Look
        - Not necessarily taste
    - Cooperative
        - Quality

        - Look
        - Taste
    - Government
        - Demand
    - FCU
        - Quality
        - Look
        - Taste
- Price
    - Also depending on market development and strength of the union

Farmer characteristics

- Small farmers. They grow for living
- Farmer says okay new suggestions (field treatment /seeds etc.) but does something different when not convinced
- 'for farmers a loss of income does not mean he drinks less beer, it means their livelihood is at risk' → consumption risk
- 'From experience they know that current farming is sufficient for living. About other farming they know: maybe it is sufficient, maybe not. You have to understand, it is not that they put income at risk, it is that they put livelihood at risk!'

Other

- It is hard to reach out to farmers. Most of them live in rural areas where off road vehicles are needed. Makes research difficult.
- Commercial famers are easy accessible. Government build roads for them

Traders

- Selling depends on price and Government enforcement
- Can be 50% ECX and 50% informal
    - Inefficient
- Farmers ask why they need traders and cannot sell directly to the market

Extension service by GOVERNMENT

- Lead farmers in which is invested → stepped up from subsistence farming
- Demonstration (farmer and extension agents explain)
    - 1st year learn about crop characteristics
        - Often improved seeds harvest in the first year is bad due to missing fertilizer and treatments
    - During seasons (sowing, field treatment, input …)
    - When harvesting to see crops
        - Crop characteristics
            - Stock height
            - Taste
            - Color
            - Size
            - Consistence
            - Productivity
    - 2nd year learn about marketability
    - After the first year to learn from lead farmer
        - Storage

- Market prices
- Markets he sold to
- Processing
- Post-harvest loss

Natural adoption

- Farmers travel and see other fields

Other thoughts

- Storage can enable to sell at higher prices but when many farmers adopt improved seeds and storage at the same time → price might drop
- Buying improved seeds is not beneficial for farmers – too expensive compared to additional sales
- Small group of risk takers (leaders and/or farmer with more cash) typically start trying innovation in one region others follows

Variables

- Household wealth: survey
- Input availability
- Geographical: dummy Woreda (number) / Kebele….
- Education: age…
- Risk: time preference, discount rates
- Community engagement: dummy (yes/no)
- Access to information: dummy and source
- Access to market: time and price

Questions:

- 'why do use that storage' Ask normal and improved seed farmer

Other questions

- Different relation for food and cash crop
- Effect of genders
- Introduction of improved seed is also introducing demand for better storage

No.	8
Stakeholder:	Head of a pics bags manufacturer and distributor
Person	Interviewee 15
Date:	24.8.2017
Location:	Addis Ababa
Setting:	Interviewee 15 welcomed me warmly in an open office. Three other people were working in this office during our discussion. Right at beginning he told me that he studied abroad. He took his time to answer all my questions properly, nevertheless he looked at his cell phone watch every 10 minutes. Most probably because office hours are until 17:00hrs. This made me feel to hurry that the meeting is finished before 16:55hrs.

I showed him farmer RBV

Look at maize price development!

Open question: What do you think about the relation between improved seed and storages

- Storing is a problem since improved seeds → we have the solution → explaining bag characteristics → benefit from higher prices
- Without storage farmers cannot benefit from improved seeds – too expensive

Statements:

- When they win, I win too. I sell more.
- Farmers are risk averse → consumption risk
- Farmers don't want to pay. They want our bags as gift. They are too much used to development help.

Company pics bags

- Hermetic bag with 8% Oxygen; 45 Birr
- Main intention: Prevent insects → keeps seed or grain but not any other living organism
- Sales
    - 1st year – 2014: 9,000
    - 2nd year – 2015: 75,000 (here demonstration started)
    - 3rd year – 2016: 192,000
    - 4th year – 2017: 400,000
- Future aim to store also seeds from seed companies → in touch with
    - Seed producer
    - Oromia trade organization
- Bag intention is to store and wait for higher prices

Marketing efforts

- Always adopted to local language
- Radio Commercials
    - Best way to reach smallholder farmers. Infrastructure is a big problem.
    - Sms service: To find nearest vendor send one of the region number below to a number XXXX
        - Regions: Jimma:
        - Finoteselam:
        - Bahir Dar:
        - Nelcemte:
- Demonstration
    - Done by 6,000 governmental extension agents
    - 6000areas * 50 farmers per area = 30,000 farmers affected
    - 1st phase tying the bag → sealing it and leaving it at the farmer's place
    - 2nd phase opening the bag
    - Videos
        - Documentary
        - Explanation
- Posters
- Local market (Marketing truck with loud speakers)
- Targeting areas are 'most productive' areas 'crop belts'

Famers

- 'touching is believing'
- Used a fertilizer bag that with 0% oxygen → maize rotted → pics bags looked similar → farmer didn't trust pics bag

- Lead farmer
  - Advanced farmer. More business
  - However, selection is not always 'the best farmer' sometimes it is political
- Maize is a multi purpose crop
  - Leave to animals
  - Fire wood
  - Construction wood
- Large differences in Regions : Jimma vs. Welaga
  - Jimma:
    - 500/600 bags per day
    - Farmer trust → could be because of cash crop area ; in cash crop areas farmers are willing to take more risk and are richer; relatively 45birr is less money for them
  - Welaga
    - Max 100 per day
    - Region is sensitive to Government and pics bag manufacturer extension agents are from the government
- Characteristics
  - Perception of innovation
  - NGO
  - GOVERNMENT
- Bag demand differs between
  - 10-15kg
  - 10MT
- 80% of the farmers that buy the bags are growing 'improved seed' hybrid seeds
  - For other crops it is the other way around → cash crops ?

NGO problem

- Farmer don't buy because they believe the NGOs will gift it them anyway at some point of time
- SNNPR → high sales were estimated, but too many active NGOs
- In remote areas of SNNPR where NGOs are not effective the bag is sold

No.	9
Stakeholder:	Head of one of the largest development aids regarding farming in Ethiopia
Person	Interviewee 16
Date:	28.8.2017
Location:	Addis Ababa
Setting:	Interviewee 16 told me on the phone that he welcomes me any time today (28.8). When I arrived I was welcomed by the secretary who guided me to Interviewee 16 office. Interviewee 16 welcomed me traditionally (hand shake and where right shoulders touch). He had a single office with a meeting table on which we sat down. During our discussion, he spoke slowly and accurate. He took his time to think of my questions and also waited for me to write my notes down. At end of the meeting Interviewee 16 explained me that people in Ethiopia help each other; especially when they see that

	foreigners need help they do their best to help. That matched with my impression that he answered my questions I thoroughly.

I showed him farmer RBV

Open question: What do you think about the relation between improved seed and storages

- Started explaining DEVELOPMENT PROGRAM A

Maize data Ethiopia

- 2,135,720 hectares = 17% of total agricultural area
- Mostly smallholder
- 27% of total agricultural production → more efficient than other crops
    - Maize 3.7 MT / ha
    - Wheat: 2.8 MT / ha
    - Rice: 2.7 MT /ha
- Grown Varieties
    - OPIS: 50%
    - Improved (hybrid): 50%
- Maize 2007: 2 MT / ha → productivity increase of 100-200kg / ha annually to actual 3.7 MT / ha due to:
    - Improved varieties
    - Chemicals (Pesticides / Fertilizer)
    - Improved technologies
        - Seed sowing
        - Harvesting
        - Post-harvest handling → shalling
    - Correct field treatment
- Maize is a multi-purpose crop
    - Leaves
    - Height
- Regions define height
    - Lot of rain → high crop
    - Less rain → lower crop

General Extension

- 3 governmental development agents per village (MoA = ministry of agriculture) each responsible for one topic
    - Crops (new varieties / fertilizer) – all types of crops e.g. maize, wheat, avocado but specialized in crop that is grow historically in that village
    - Animal Livestock
    - Land / soil – treatment

DEVELOPMENT PROGRAM A

- General
    - Several organizations and the government are involved
    - Common goal increase income and productivity of small scale farmer (0.5 – 2ha)

Development program A: 1Phase (2013 – 2015)

- General

- 2013
    - 16 Woredas (Regions: Oromia, Amhara, SNNPR in those regions are 85% of Ethiopian Maize producers) → infrastructure is weak. More woredas were not possible
    - 20 Demos per woreda = 320 Demos in total (1 Demo = 1 direct affected farmer)
    - Demo field is ¼ of a hectare
    - 3 Trained experts in each village of the 16 woredas
        - All activities from seed bed preparation to harvest
        - Trained experts selected lead farmers for demo
    - Seed is for free and DEVELOPMENT PROGRAM A ensures lead farmers to take the risk if anything goes wrong → farmers aim for risk mitigation / consumption risk is high
    - Average yield over all 16 Woredas = 6.2 MT / ha
- 2014
    - Same 16 Woredas
    - 20 x 10 = 200 Demos per woreda = 3200 Demos in total (1 Demo = 1 direct affected farmer)
    - Average yield over all 16 Woredas = 7.2 MT / ha
- 2015
    - From 2015 onwards 5000 Demos per year
    - Divided into districts (e.g. if 10 districts then 1000 Demos per district)
    - Average yield = 7.7 MT / ha

Development program A 2nd Phase (2016 – 2018)

- 2016
    - Region Tigray included
    - Total affected woredas by DEVELOPMENT PROGRAM A = 53
        - 29 graduated = those woredas took successful part in the program → seed varieties and treatment was shown and adopted by the farmers → farmers' productivity increased → farmers demanded seeds themselves and are able to pay them → no further need for support → seed supply through agro dealers, Cooperatives / FCU or other representatives; often in based woreda capitals
        - 24 active → demos and so on
- 2017
    - 24 Woredas
    - Per woreda 7 villages
    - 5000 demos / 24 / 7 = 30 Demos per village
    - Next year other 7 villages in the same 24 woredas

DEVELOPMENT PROGRAM A Methods

- Convincing farmers to participate is not easy but once they are convinced they stay
    - Some times they make up reason to not try
    - Risk averse → consumption risk
    - 'We bear the risk for you' Government statement they trust
- Field days → invite farmers to see the maize grown on the field once a year → lead farmers explains everything → 'from farmer to farmer'
- Other demos:
    - Sowing
    - Growing
    - Harvest
    - Post-harvest / Storage

- Farmers live in communities and support each other → family and friends→ spill-over effects → sister married to the next fields farmers…
- Harvest was out of farmers expectation → farmers asked for more seed
- Post-Harvest activities / Storage
    - Before improved seed no need for storage
        - From 600kg to 2-3 MT per ¼ hectare
        - Because of yield increase they started asking to wait for higher prices
    - Farmers surprised: With additional harvest farmers stored grains even in the bedrooms
    - Showed importance of storage and correct treatment (not with livestock or chemicals) → also price development and opportunities
    - Constructed 20MT model storage at farmers → Cost shared
        - 50% farmer – construction material from local markets
        - 50% DEVELOPMENT PROGRAM A
    - Maintaining Maize quality and reducing post-harvest loss is difficult for farmers
        - Pics bags
        - Chemical treatment (per
        - Machinery Shallers – not manual with manual shelling grains fly around on the ground
    - With storage farmers sell only so much grain to satisfy their immediate cash demand
- Credit / Loans from different institutions
    - Sometimes I think: Why are we talking about storage, when the biggest problem is that they actually have to sell all grains after harvest to pay loans. There is nothing left to store in most cases.
- Technology transfer differs from region to region
    - Remote areas more difficult but even there are 'lead farmers'

Lead farmers

- Excellent farmers → understood need for technology
- Leading in an area → showing others best technology
- Lead farmers are farmers who are advanced in at least one part of the farm model compared to other farmers in a region. (DCFM figure 1 was in front of him)
- Want their kids go to school
- Buy livestock to have different source of income
- Looking for business (entrepreneurial thinking)
    - New crops
- Lead farmers explain improved seed and so on their self to other farmers on field days
- Are able to travel larges distances and see /learn from other farms (animals / motorized vehicles

Value chain

- From FCU to cooperatives
- FCUs are supported to buy grains from farmers by e.g. WFP
- FCU only earns a small premium when selling grains for farmers
- 2 phases of payment to farmers
    - 1st phase fixed price (e.g. $10)
    - 2nd when grains is actually sold by cooperative for a higher price (e.g. $20) farmer get $10 additionally

ECX currently not working with my maize – only with cash crops

Gender issue

- GALS = Gender action learning system

- Train farmers with their wives together
- Who is doing what? Women often do most of the work from seed bed preparation to harvest but do not go to the market to trade
- → work together go to market together that both know prices
- Some FCUs are leaded by women now
- 25% of demo farmers are women (coming from 5%)

Correct nutrition with maize meal

- Prospect: recipes for a balanced nutrition with maize as basis
- Enough protein
- Healthy family → good work

Sale of Seed producer

- From 6000MT (2010) to 8000-9000MT (2017) ('very good growth' – really???)

No.	10
Stakeholder:	Researcher, employed in a project which links different agricultural programs in Ethiopia (involved in extension services)
Person	Interviewee 17
Date:	30.8.2017
Location:	Addis Ababa
Setting:	When I arrived at the office to talk to Amsalu; Amsalu was not there yet. Interviewee 14 had recommended me to talk to Interviewee 17. So I asked for Interviewee 17 at the reception. Interviewee 17 was having breakfast with two other people at the cafeteria. I asked him for an appointment later – He smiled and said 'please sit down'. After small talk I introduced my research and started with the open question. During the whole discussion Interviewee 17 appeared very relaxed and enjoyed talking. It seemed that he overcame frustration (because of research inefficiencies) with black humor.

I showed DCFM → he said structure it more for econometric model → gave concrete examples

See Paper Post Harvest Losses

Open question: What do you think about the relation between improved seed and storages

- Farmers don't know what they actually grow → also look at paper post-harvest loss
- They say they grow X but they actually grow Y
    - 9 out of 61 knew what they very growing
- Do they lie or don't know?
- Other:
    - it was difficult to get access to farmers. In rural areas infrastructure is not good.
    - 'Improved' inputs depend on cash → commercial farmers can afford more and buy more. Subsistence produce everything themselves and take seed they get randomly

Cooperative Sesam story

- FCU created market linkage to export directly to foreign importer
    - 1800 Birr / quintal farmer price
    - 2700 Birr / quintal price to the foreign importer
    - 900 Birr / quintal premium

- FCU collected sesam from cooperatives
- FCU could not sell on time – 2 months delay due to disagreement among board member (primary cooperatives):
    - No incentive since no premium for own pocket (There is a thesis that is not published from 2011)

Value chain

- Inefficient
- If farmers have no access to improved seed you can do whatever you want. They are sometimes not able to adopt even if they want.
- Also not clear whether improved seeds pay themselves
- Cooperatives and FCUs are enforced and not necessarily demanded
- When managers of FCU have a fixed salary and no share of premium from negotiations incentive to perform is low ('moral is only incentive')
- Farmers – primary cooperatives – FCU have a fixed agreement on shares of grains

Farmers

- Think storage when they have the problem
- Think of marketing when they have the grain

Contract farming – Barley Heineken Story

- Heineken has processing costs of 10% and a premium of 15% = 25%
- Trader has no costs of 0% and adds a premium 20% = 20% → is able to offer the farmer a 5% higher price (?)
- → farmers sell to trader
- → you loose with investments

Contract farming policy change

- Old – civil court based on 1960 law: farmer could say 'sorry I have no production' when he sold everything outside the contract
- New – legal issues if contract is violated hard consequences if contract is not followed

Annotations to model

Endowment

- Access to service
    - Credit
    - Market info
    - Market
    - Extension
- Social capital
    - Membership
    - Contacts
        - 'How many relatives do you have from whom you can get credit'
        - 'How many traders do call regularly'?
    - Network
        - No of traders: How many traders do you know in Woreda / Zone / Addis
        - No. of input suppliers
        - No of relatives w/ education

Social demographic

- Age

- Education
- Family

Resource ownership

- Land size
- Field size
- Land owned
- Machinery
- Transport (Car, etc.)

Access to service

- Extension
- Finance
- Markets
    - Output
        - Market
    - Input
        - Fertilizer
        - Seed
        - Distance to distributor

Livelihood options

- Farming
    - Type of commodity
    - Area
    - Fertilizer
    - Post-Harvest
- Off-farming (work at another farm)
- Non-farming

No.	11
Stakeholder:	Researcher, employed at a large international maize improvement center (involved in extension service)
Person	Interviewee 18
Date:	31.8.2017
Location:	Addis Ababa
Setting:	Interviewee 18 was welcoming me warmly in his single office. After small talk about Ethiopia and my stay so far, I introduced my research with the open question. During the whole meeting Interviewee 18 took time to answer my questions thoroughly. He was not afraid of telling any information because he said 'I am a scientist I have data to prove my statements'.

I showed him DCFM & econometric model→ he liked it

Open question: What do you think about the relation between improved seed and storages?

- Avoids to answer – Refers to interviewee 18

Farmers

1. Productivity & conditions for productivity (resistance / input consumption)
    a. Self-Consumption
    b. Selling
2. Crop characteristics
    a. Height etc.
3. Grain Characteristics
    a. Taste
    b. Color
    c. Consistence

- Farmers: 10% profit maximizer / 90% utility maximizer
    - 10% profit maximizer have rather more land and grow cash crops like teff (6x price of maize and easy to store, but productivity is lower) – maize only for self-consumption and often smallholder farmers
    - infrastructure is often only provided to profit maximizer. Government prefers them
- 'Productivity is gambling against nature'
    - Subsistence farmer gamble with their hands
        - Miss knowledge about correct treatment / e.g. sowing depth, water and nutrition demand
    - Commercial farmers gamble with chemicals
- Storages
    - Farmers think of storage when they have the problem
    - Temporary Storages
    - Bags
    - Chemical tablet against weevil in back
    - Cold place
    - Timehorizon: not storing longer than 6 month. Maximum is 8 month
    - After the Harvest farmers don't know what part of the harvest will be consumed and what part will be sold → distance to storage facilities is critical / do farmers have still access to storage
    - → farmer rather store at home in bags
- Farmer know market dynamics
    - Storage cost vs. market prices
- Micro finance by regional government to face constant cash demands of farmer
    - Debtor rating:
        - Wealth (max credit = 2-3x farmers savings)
    - Collaterals: Person is named by farmer that pays if famer cannot pay
- Growing
    - Crop rotation: not always maize not always the same field size for one crop
    - It helps against diseases and so… what do they do with improved seed → monoculture?
- Livestock
    - Not only off farm income, but also machinery
        - Oxen enable to start growing when the farmer wants it otherwise they rent it or ask friends / relative / neighbors
    - Transport animals and work animals

Seed

- 'farmers don't have a seed choice' → supply driven
- When they have a choice the look at grain prices and choose crop with highest grain price (when they know how to grow it)
- Input

- ‘for free’ through cooperatives
- When farmers buy it small aggro dealers
- ‘Improved seeds sometimes are so expensive I cannot believe they repay’

- Improved seeds are not always better in harvest. Need more fertilizer.

Market

- Maize price is the same for all qualities
  - How pure is the grain / is it damaged?
- Local traders buy maize from farmers and sell it to the wholesalers → so don’t want the risk of storing
- Wholesaler sells to processors → not farmers
- ‘I don’t know any cooperatives that buy maize grains’ → grains are too sensitive to diseases → risk vs. price achievement
- Teff is easier to store and more expensive

Crops: Maize vs. Teff → depending on farmers’ resource endowment

- Maize
  - First crop of the season
    - When it fails farmer can still grow another crop (opportunities) → good for risk averse
  - Hight productivity
  - Good for self-consumption
  - High post-harvest losses
- Teff
  - Last crop of the season → high risk – when it fails farmer has nothing
  - High price
  - Low productivity
  - Easy store
  - Farmer require more land to grow teff and a food crop (e.g. maize) for self-consumption → most farmers are smallholders

No.	12
Stakeholder:	Head of a large domestic grain trader in the north of Addis Ababa
Person	Interviewee 19
Date:	04.09.2017
Location:	Addis Ababa
Setting:	I communicated with Interviewee 19 via cell phone. The first planned meeting was dismissed due to connection problems. Additionally, I could not understand his English very well on the phone. The meeting took place in his office 20km west outside Addis in an rural area. The whole organization has an area of approximately 2sqkm where it has storages and parking-lots for trucks. The office building was converted from storage. Interviewee 19 welcomed me warmly. He is the head of this organization and was proud to show me around and introduce me to all departments (Marketing, H&R, etc.). The talk’s set up was his single office. Sometimes we had problems to understand each other due to language barriers. The phrase “Do you understand” was common during the talk. Nevertheless, we did several iterations around meaningful statements to make sure the correct meaning was grasped. I used simple English language. Unfortunately, it rained heavily at the end of our talk that I could only take few pictures.

See market price documents.

Statements:

- 'More talking then doing.'
- 'Economy depends on rain' 'Rain determines production'
- 'inefficient'
- 'if farmers do not start selling in high price season their situation will never improve'
- Political control
- Investors look at cash crops like flowers
- If we don't provide them market access to participate, storage is only worth half – only for self-consumption

Agricultural grain trader

- Objective: Facilitate direct market linkage between farmers and consumers → current value chain with farmer – trader – trader consumer is inefficient

Look up on the internet:

- Market consumer association

Farmers:

- Land distribution problem
  - Lot of small farmers
- Heterogeneity in farmers and regions
  - Infrastructure: Telephone, Road, Electricity, Water
  - Only business farmers have a vehicle. Some other farmers have draft animals
  - 'We see most farmers sell at their farm'
- Not all farmers have access to information (price / market dynamics)
- Broadcast TV as market / price information
  - Enterprise works together with TV
- Farmer need cash for kids, school, loan and inputs
  - 'sometimes I also ask myself if they just sell for *being able to go in a bar and enjoy life'*
- In high price season they require cash to buy expensive grains
- Farmer need to 'change' from only food for the family to a business
  - Only very few farmers act entrepreneurial
  - 15% of maize farmers have a storage to sell surplus → they acquired more land
  - Farmers don't know production costs only input cost
    - Labor cost
    - Land cost
  - Cost vs Price calculation
    - Eg.: Fertilizer costs per 7 Quintals = 2000Birr (fertilizer imported)
    - Market Price per 7 quintals = 7x300 = 2100Biir
    - → farmer that calculate tend to use no fertilizer
    - *'a calculating farmer would not buy fertilizer at all at this market conditions*'
- Productivity
  - With input use: 40-60 quintals (per hectares)
  - Without input use: 20-30 quintals (per hectares)
  - Political production with input: 80 Quintals (very few)
- Regions
  - West – maize
  - East – wheat

- Sell to regional trader → most likely consumed regional

Storage of organization

- 360 sheds at the place (check with area from setting)
    - per shed 10x40m 7m high (see photo)
    - 5-10 farmers share one shed
    - 2000 Quintals per storage
    - 1610 birr incl vat per month
    - Mostly used for maize / teff / lenthal

Government

- plans 11 more storages
- zone selected after production
- start in 2018

ECX

- does not trade maize
- they plan to

Cooperative

- only for agricultural input (seed, fertilizer) distribution – but no marketing
    - 100 cooperatives are in Oromia working as seed suplier
- plan: Farmer – cooperative – fcu
    - FCU markets and each stakeholder get a dividend (70%)
    - Oromia cooperative bank
        - Loans with no interest

Tomato example for chain inefficiency

- Farmer (5 Birr) – Trader (Woreda) – Broker (Addis) – market (Addis) – consumer (20Birr)

Illegal markets

- Masehmam Agricultural market
    - Est 2010
    - Show sample for quality → negotiate for quantity and price → product is delivered from the farm to buyer
    - No tax paid
    - → price advantage towards Oromia enterprise

Agricultural Production

- 60-65% of agricultural production is in Oromia
- Other regions mostly buy

Market dynamics

- Government sells imports cheaper than domestic produces
- Domestic price 900-1000Birr – Government sells at 600Birr

No.	13
Stakeholder:	Technical director of one of the largest agricultural research-centers involved in storage and extension service
Person	Interviewee 20

Date:	04.09.2017 11:00hrs – 12:30hrs
Location:	Ethiopian Institute of Agricultural Research
Setting:	Interviewee 14 recommended me to talk to Interviewee 20 as he manages a storage project at a large Agricultural Research Center. The project involves the engineering and testing of storages as well as trainings for farmers on how to use storages. Interviewee 20 himself is a MSc in engineering. We talked at his office in Addis. He welcomed me warmly and was visibly motivated to tell me about his work.

I showed him farmer RBV & econometric model→ he liked it

'work sometimes stuck because of Government '

Look at:

- facasi.act-africa.org
- South Africa 20 years ago
- MS cost varies between countries
- Maize export from Ethiopia to Kenia – indicator for productivity ?

Statements

- What helps storage, if they don't know how to use it and harvest is still wasted.
- Farmers always want it cheap
- Once the have a metal silo, they want more. But initially farmers always prefer improved seeds over storage. They still need to learn the long-term thinking.

Storage Projects

- 5-6years ago started first storage project → onions
- Currently also horticulture tries

Metal Silo (MS) project

- Target 14 woredas
- 4 types of storages
    - 300kg for grains
        - Total Cost: 2072 Birr = Material: 1381 + Labor: 345 + Margin: 345
    - 600kg for grains
        - Total Cost: 2903 Birr (What the average farmer income)
    - 1000kg for grains
        - Total Cost: 3830 Birr
        - Enough to feed 5-7 family members through the season
    - 20kg testing for seeds
- Start 2015
- 1st year
    - 75 Artisans were trained to manufacture MS at Melkassa
        - Artisans from 9 of 14 woredas
        - Certificate to be able to manufacture a hermetic Silo (0% oxygen)
    - 'Good farmers' were chosen all of them grew improved seeds of their commodity and had more land
    - Training for farmers on how to handle storage → how to put the grain inside

        - Candle test
        - Salt bottle test (put grains with salt in a glass bottle; shake it; if salt sticks to the bottle wall than moisture content is above > 14% → should be lower. Dry grain until salt sticks no longer to the wall and then put it in the storage)
- 2nd year
    - Test of Rural storage vs. Pics Bag vs. MS
        - 6 month storage
        - 4 grains
            - Maize
            - Sorghum
            - Wheat
            - Haricot bean
        - Chemical analysis at top – middle – bottom of the storage
            - Moisture content
            - Chemical count
            - Germination count
        - → MS and picks bag almost equal in keeping grain quality → but MS is long-term (15-20years)
        - → gotera high losses due to weevil and mold fungus
        -
- Plan
    - Train 5-15 manufacturers per year
        - Private
        - Big companies
- Learning outcomes
    - Farmers need initial kick up to get economy started (look South America)
        - Currently they cannot afford the storage
        - Once the have the storage and can make use of it the income should increase and they buy input and storage themselves
        - Possible measures
            - Subsidy
            - Loan
    - Farmers need to change from life-style to business to learn

Farmers

- Lack of promotion on how to use storage → skill is missing
- Farmers recognizes need for storage even if it is only for self-consumption because maize is a sensitive crop that is even after 3month wasted unlike e.g. teff
- Maize grains in high price season is a major expense for farmers
- Change from life-style to business
    - They lack education
    - Don't sell everything at once and go in a bar to drink
    - I have heard of coupon system that farmers cannot spend everything at once
    - Entrepreneurship skill is missing
    - Long-term thinking missing
        - MS is expensive but lasts for 15-20years = 138 Birr per year = 3-4 pick bags (45 Birr) per year

- Farmers need 'hard currency' → free inputs don't teach them (see pick bags & NGO)
- Infrastructure needs to be improved
- 'BUT we see that some farmers really learned our lesson. Before they acquired new land, they asked for more MS'

- Field days
  - 88 male
  - 52 female
- Productivity
  - Average: 30 Quintals / hectare
  - Melkassa maximum 55 Quintals / hectare (region is lower with higher moisture)
  - Difference to Government 100 Quintals / hectare
    - 'Research practice'
    - 'Farmer practice'
    - → Seeing is believing
  - Melkassa released 7 different moisture resistant seeds

Fight against Hunger

- 'Productivity could be sufficient when no harvest-losses'
- Maize export from Ethiopia to Kenia – indicator for productivity?

No.	14
Stakeholder:	Technical deputy director of one of the largest agricultural research-centers involved in storage and extension service
Person	Interviewee 21
Date:	06.09.2017
Location:	90km south east of Addis
Setting:	In the meeting with interviewee 20 I asked him if I can visit the Agricultural Research Center. He gave me the phone number of person b. Unfortunately, person b was not available on September 6th so he gave me the phone number of interviewee 21. After several calls we agreed that I could come by on Wednesday afternoon. Yonas welcomed me warmly and showed me everything (see pictures). Nevertheless, we had sometimes difficulties to understand each other due to language barriers.

Farmers

- Touching is believing
  - Farmers' adopt better when you improve technology that they have been using before
  - Plastic bottle sowing
- Farmers need more practical teaching → giving them a storage or machine is not enough. Teach them to do it right
  - Sowing
  - Storing
  - Machinery
- Most of them grow very traditional
  - Only men power
  - Sometimes oxen
- Farmer see storage need only when having surplus

    - With gotera weevil and mold fungus
- Farmers want everything for free
    - Cost is the biggest problem
    - They have to pay for their family
    - Also grain are expensive in high price season.

Innovations

- Trial and error
- Countries from which they had machineries
    - Scandinavia
    - Switzerland
    - Netherlands
    - China
- Machinery
    - Most of them are made for mechanical power like oxen or men
        - Cranks for pedaling with arms or legs
        - Belt / chain drive from driving wheels pulled by oxen or men
    - Examples
        - Plow
            - Pulled by oxen
            - One man can do work that 4 did before: Open the soil, sow the seed, apply fertilizer, close the soil
- Poor manufactured (due to available tools?)
    - Unregular welds
    - Friction
- Efficiency thoughts on
    - Sowing in rows
    - Distance between rows
    - Seed depth in soil
    - Soil condition: compact

Engineering hall

- No order system
- Simple materials
- Simple tools

University

- Teaches nothing new
    - Knowledge is the same since 20 years

No.	15
Stakeholder:	Head of a large Ethiopian seed producer
Person	Interviewee 5
Date:	07.09.2017
Location:	Addis Ababa

Setting:	I called interviewee 5 in the morning, because I had still some question about development programs and the seed producer work. He said I he doesn't like setting up meetings and I should come as soon as possible. When I arrived, he said that he has to leave at 12am. Nevertheless, he stayed until 12:15. He was very engaged in our talk.

I showed him farmer RBV & econometric model→ he liked it

- Taste weight of grains
- Floor content
- Water – irrigation
- Grain board – GOVERNMENT
- Exports

Important in Ethiopia

- Production (increasing – noticeable effects)
- Relation (Government)
- Trust (Helped before – trust building process)

Farmers

- Storage
    - DEVELOPMENT PROGRAM A provides no storage to the farmers
    - Demonstration of how to construct a warehouse
        - Rural / Local Materials and tent roof
        - Cement ground with iron construction and tent roof (grain pro)
    - Usability for seeds and grains
    - 'Farmers only come back to me when they notice a large income increase. Without storage, they will only feel very little income increase. So, I promote storage for a large income increase. It is a win-win situation. If their income increases my income increases too, because they want more improved seeds'.
- Transformation process
    - Farmers need to learn to think as business-men
    - *'what farmers do not need to do today, they do tomorrow*'
    - Only 10% are profit maximizer and those grow teff
        - can afford improved seeds and corresponding fertilizer best
        - willing to take more risk
        - 'they see the future'
    - Most farmers are still smallholders with little land

Seed producer Seed dealers

- Local agro-dealers

Seed producer Seed production

- Big-scale out-growers → commercial farmers grow seed under supervision on large field sizes
    - Currently: 19 Farmers
    - Plan: 20 -25 Farmers
    - Production: 100,000 Quintals seed
    - Sales 2017: 8,000 MT clean seed
- Production plan -> Demand assessment
    - Last year demand
    - Trends
        - Grain price
        - Land price

        - Weather / water
- Seed development
    - Development centers in Africa
        - South Africa
        - Kenia
        - Zimbabwe
    - From those seed is tested in Ethiopia
        - If successful certified parental line is imported from South Africa
        - Parental line is employed to multiply seed