The effect of Farmers Field School on inputs investment through electronic voucher (e-Voucher) scheme.

-A case study in 4 provinces of Central Mozambique-

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Abstract

This paper provides the possible implication to improve the two on-going interventions by Food and Agriculture Organizations (FAO) of the United Nations Mozambique; Farmers Field School and electronic voucher (e-Voucher) scheme. In spite of the high dependence on farm income in Mozambican economy, farming by majority of smallholder farmers are still with little to no use of quality agricultural inputs such as certified seeds, insecticides, and fertilizers which is associated with the persistent high level of poverty concerning food security and livelihoods (Baxter et al. 2015). FAO Mozambique launched the first electronic voucher scheme to promote the distribution of quality inputs through the involvement of agro-dealers. With the focus placed on farmers' behavioral heterogeneity, the effect of Farmers Field School was examined based on the cross-sectional inputs transaction data obtained through e-Voucher scheme between 2016 and 2017. In parallel, complementary qualitative interviews were implemented to 70 beneficiaries. To substantiate the farmers' behaviors toward inputs investment, five different indicators were computed; Timing, Diversity, Frequency, Balance Amount, and No. of Deposits. Different regression models were applied among (multinomial) logit models, and linear regressions to capture the differences contributed by FFS membership. As a result, although there were variations across different input seeds (maize OPV, cowpea, and maize hybrid), significance was obtained on all of the behavioral indicators in such a way FFS 1) increases the early investment 2) increases the diversity, 3) increases the frequency, 4) maximizes the expenditure spent for inputs investment, and 5) increases the depositing behaviors. Moreover, by adding interactive term between FFS and e-Voucher, it revealed the behaviors of Timing and Diversity can be shaped more effectively among subsistence farmers while that of Deposits can be shaped more effectively among emerging farmers.

Keywords: Farmers Field School, Voucher scheme, Quality inputs, Investment behaviors, Mozambique, Multinomial logit model, Logit model, Linear OLS regression

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Takuya Nagasawa, 2017

List of abbreviations

ANOVA	Analysis of variance
DTP	Days To Planting
e-Voucher	electronic Voucher
FAO	Food and Agriculture Organizations
FFS	Farm Field School
IPM	Integrated Pest Management
JFFLS	Junior Farmer Field and Life Schools
MDG	Millennium Development Goals
OLS	Ordinary Least Squared
OPV	Open-Pollinated Variety
PAN	National Action Plan for Food Security
SI	Simpson Index
SSA	Sub-Saharan Africa
WFP	World Food Programme

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1. Introduction

1.1. Background

In Mozambique, alike most developing countries in Sub-Saharan Africa, the economy is dominated by the agricultural sector. As of 2014, 67% of Mozambique's population is concentrated in rural regions, of which 32 % of adult population are farmers (Maposa and Mutsonziwa 2014). By including dependents such as housewives and children, approximately 80% of total population depends on agriculture as the main source of income (FAO 2017). On top of that, agriculture in Mozambique is dominated by small-scale farming, with little to no use of tractors, plows, fertilizer, pesticides, irrigation, and other agro-inputs. In particular, little use of fertilizer on cereals is associated with low yields of the production, in which maize yields for example in 2014 was below 1 ton per hectare compared to up to 8 tons per hectare in the most productive developing countries (Carter et al. 2013). Likewise, adoption of inorganic fertilizer, irrigation, and improved seeds are quite low; 2.6%, 2.7%, and 8.8% respectively (World Bank 2017). In contrast, Mozambique has been enjoying stably high rate of economic growth averaged at 7.4% over a decade agricultural sector however contributed relatively less (25.2% in 2015; World Bank Database 2016).

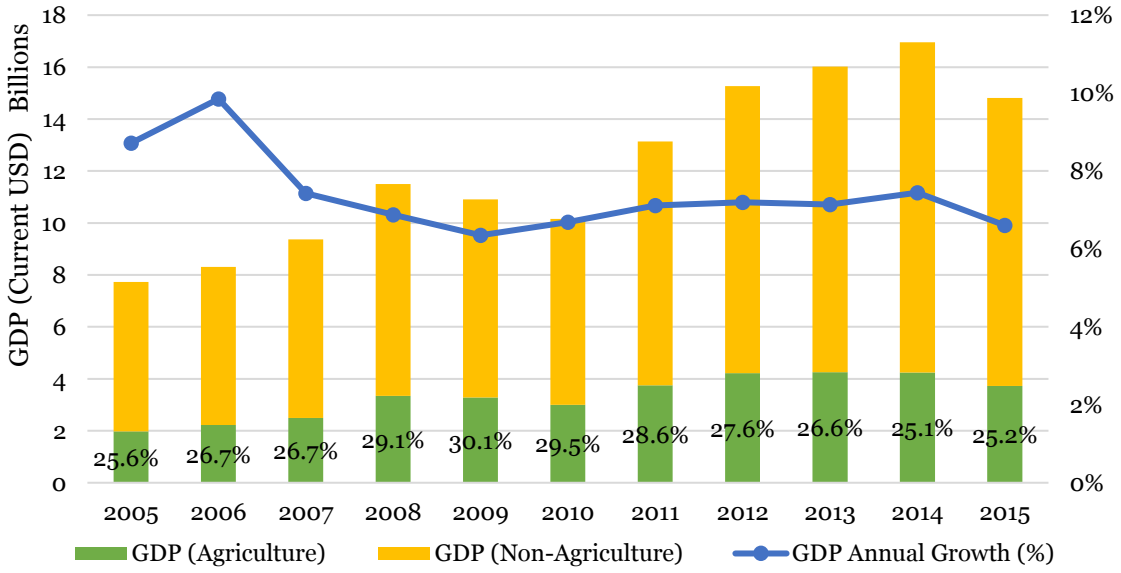


Figure 1 GDP and annual growth between 2005 and 2015 in Mozambique

Virtually, the benefits of economics growth have been monopolized by a small minority of Mozambicans such as resource boom enclaves and urban residents, leaving most of the rural population unaffected, making the country beset by poverty and a dualistic economy (Maposa and Mutsonziwa 2014, Baxter et al. 2015). Consequently, over half the population still lives in poverty, agricultural growth continues to be subdued due to low productivity caused by limited access to funding, farming inputs, technology and markets. (Baxter et al. 2015). Moreover, farmers in rural Mozambique are highly exposed to climate change and extreme weather events such as drought, floods and cyclones. It forms a proneness to seasonal instability and hampering not only farmer's well-being but also economic and social growth (FAO 2017).

As a tool of rural financial development, the use of electronic technology is gaining more international attention. Electronic money (e-money), mobile money, and smart cards (e-cards) are one of them. In particular, the adoption of mobile money technology is increasing in Sub-Saharan Africa. This is a significant trend in that listed 13 countries in which more than 10% of population holds a mobile money account, and surprisingly they are all in Sub-Saharan Africa. This is especially true of East African countries. Between 2011 and 2014, East Africa showed the highest growth by 24% (Maposa and Mutsonziwa 2014, Global Findex 2014). To be specific in Mozambique, the number of mobile money users in Mozambique did increase to triple in same period (Banco de Mocambique 2015), which indicates the huge potential of electronic monetary service in Mozambique.

In 2015, through the agreement with the government of Mozambique, Food and Agriculture Organizations (FAO) launched "smart subsidies" program using electronic vouchers (e-Vouchers) coupled with participatory agricultural extension approaches; Farm Field Schools (FFS). It aimed to be a powerful tool to facilitate access to seeds, fertilizers and other inputs needed to increase production and productivity. e-Voucher scheme aims at improving access and use of quality agricultural inputs and promoting the creation of a distribution chain of agricultural inputs through the involvement of various agro-dealers and input producers. This paper aims to analyze and evaluate the performance of the electronic voucher (e-Voucher) usage as a tool of input subsidy in Mozambique through the research collaboration with FAO.

1.2. Research Justification

Despite of the aforementioned potentials that electronic financial tool has, the application in the context of rural regions has been rarely examined. This is also due to that only 27% of population in Mozambique are currently gaining access to electricity (Maposa and Mutsonziwa 2014). Enabling environment with electricity coverage is even scarce in rural areas. Researching on the electronic technology as the financial tool within the rural context are thus quite new. Few research has been conducted in this discipline, even much less in electronic voucher scheme. Moreover, this research puts an extra focus on the effect of Farmers Field School (FFS). Although much of the previous research exploited the FFS from multiple points of view, even regarding the adoption of quality inputs, its interaction with farmers' investment behaviors is poorly investigated. Combined with the econometric analysis, this research aims to meet this knowledge gap and contribute to the research justification.

1.3. Research Objective

This research is intended to yield empirical data that could ultimately give additional insights to policy makers, stakeholders, and researchers on how to increase the number of smallholders farmers to reap the benefit out of the ongoing project and how to address the observable challenges that has been encountered throughout the project implementation. In particular, the FAO Mozambique is targeted as the main organization to which this research outcome is addressed. By considering that the e-Voucher scheme remains under implementation for the 2017/2018 agri-season. In line with the FAO voucher scheme, project implementation is based on a agri-season which is corresponding to 6 months from the middle of October to April. The provision of policy recommendation is expected to be informative. In addition, the research scope would have great potential to the body of knowledge in investigating the impact of FFS and voucher as a subsidy tool of governmental direct intervention. From the analytical point of view, this paper aims to reveal one of the way to exploit farmers' investment behaviors within the context of Sub-Saharan Arica, specifically in Mozambique.

1.3.1. Research Questions

Above mentioned research objective is pursued by following three main research questions. For each question, embedded purposes, and questioned elements are detailed as followed,

1) Does FFS-participation change the farmers' investment timing?

- The aim is analyzing the influence of FFS participation on one of the crucial investment behavior; purchase timing. Analysis is performed to examine to identify if FFS may change the timing of investment of farmers, and if so how it influences. In parallel, further comparison is made across different inpust particularly maize OPV (Open-Pollinated Variety), cowpea beans and maize hybrid, which are main crops targeted by FAO Mozambique.

2) Does FFS-participation change the farmers' investment behavioral indicators?

- The aim is analyzing further the influence of FFS participation on other different investment behavioral indicators; Diversity, Frequency, Balance Amount, and No. of Deposit. Analysis is performed to examine if the significant effect of FFS may be identified, and if so how it influences on those indicators. Ultimately, the determinants of those behaviors are exploited to understand the mechanism behind appearing variation. Moreover, in the same manner with the research question 1) above, the comparison is made over different inputs (seeds); maize OPV, cowpea and maize hybrid.

3) How does the interaction between FFS and the voucher package influence the farmers' investment behaviors?

- The aim is to analyze the possible conjoint effect given by the interaction between FFS and e-Voucher scheme. By creating the interaction variable, its influence and positivity/negativity are investigated on different investment behavioral indicators; Timing, Diversity, Frequency, Running balance, and No. of Deposit. In so doing, the specific effect of FFS contributed together by the voucher package are examined. In the same manner with the research question 1) and 2), the results are to be compared over three different inputs; maize OPV, cowpea and maize hybrid to check the consistency.

1.4. Structure of the paper

This paper is composed of 8 chapters, beginning with providing a background information in Chapter 1. Chapter 2 contains an essential description about the project intervention which is on-going in 4 provinces of Mozambique initiated by FAO Mozambique. Throughout Chapter 3, a review of relevant literature is demonstrated and is followed by the theoretical framework in Chapter 4. In Chapter 5 the used methodological strategies are elaborated by starting to present the descriptive statistics. results and discussion are given in chapter 6. Based on the results, some conclusions are raised within Chapter 7, where final recommendations toward policy and further research are made available in Chapter 8.

2. Context of Intervention

As described above, the scope of this paper is on full in line with the ongoing project implemented by FAO in Mozambique. In this vein, the majority of raw data is fully provided by FAO that include the beneficiary list, inputs transaction history. The beneficiary list contains e-card ID, residential area, gender, age, and FFS membership. The total number of beneficiaries who registered by the end of 2016/2017 agri-season is as much as 24,378, while some data (e.g. age, FFS) are unbalanced. The transaction history data show When, Which and How much of inputs each beneficiary purchased through the course of voucher scheme in time.

2.1. Description of the Study area

The target country is Republic of Mozambique, the southeast African country which holds 27.98 million of population in 801,590 km^2 of land (World Bank 2015). The main food staple is maize and cassava grown by 80 percent of all Mozambican smallholder. Agricultural value chain in Mozambique is still at an incipient stage due to production problems, lack of functional markets, and limited access to financial services (FAO 2017). In order to address these systematic problems, a close collaboration has been maintained between FAO and government of Mozambique in the pursuit of nutrition improvement and eradicating hunger. In this vein, The FAO Mozambique voucher project has been active in 12 districts in 4 provinces located in the central part of Mozambique, Manica, Sofala, Zambezia, and Nampula provinces. The first e-voucher scheme has been initiated in Manica province where the majority, more than half of total beneficiaries are living. In particular, Chimoio is the largest city of Manica Province located approximately 700 km away from Maputo, the capital city of Mozambique. Many of beneficiaries are living in the rural regions close to Chimoio, thus the field research has been performed within the proximity of this area.

Manica province (5 districts)

Barue, Gondola, Macate, Manica,

Sussundenga and Vanduzi

Sofala province (4 districts)

Buzi, Gorongosa

Maringue, and Nhamatanda

Zambezia province (2 districts)

Alto Molocue, and Gurue

Nampula province (1 district)

Ribaue

Figure 2: The map of Mozambique

Crop production in Mozambique is dominated by cereal and cassava. As shown in Table 1, the maize production occupies the most (Manica, and Sofala) or second most (Zambezia and Nampula) of the land across four provinces. By taking a closer look at the Food Consumption Categories, it shows the provincial variation associated with poor segmentation. The results of Figure 3 seem inconsistent, however one finding regarding Nigeria (Oni et al 2009) shows that farmers who grew sorghum, are more likely to be in poor segment. Also, the crop of Cowpea locally known as Nhemba beans plays a crucial role since its leaves are also edible.

Table 1: Crops grown by provinces (area) 000'ha (FAO 2010)

	Total	Manica	Sofala	Zambezia	Nampula
Maize	**1573**	**268**	**95**	**245**	**154**
Cassava	**1254**	3	20	**326**	**534**
Sorghum	**617**	**64**	**71**	**86**	**152**
Beans	517	6	24	66	87
Groundnuts	357	7	11	41	79
Rice	182	1	**35**	59	41
Millet	106	**17**	15	10	10

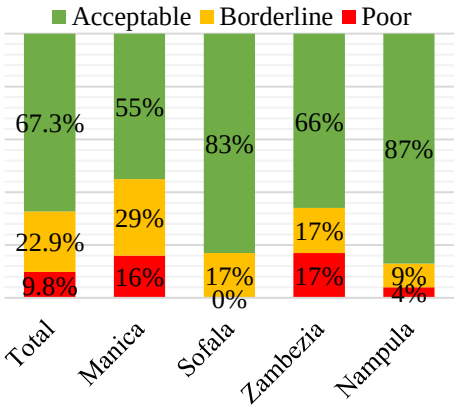


Figure 3: Food Consumption Category (WFP 2010)

2.2. Timeline

e-Voucher scheme

The e-Voucher scheme has been tested primarily in the Manica Province during the 2015/2016 agri-season and expanded to Sofala, Zambezia, and Nampula provinces. Prior to the launch of the e-Voucher scheme, the paper-Voucher has been active since 2013, which is now gradually replaced by the e-Voucher after the successful outcome of the pilot phase. By the end of the latest agri-season, 24,378 beneficiaries have registered the e-Voucher scheme, of which 18,706 beneficiaries activated the voucher and purchased quality inputs. The e-Voucher project remains under implementation at least until the end of 2017/2018 agri-season.

Farmers Field School (FFS)

In Mozambique, FFS is now adopted as the main extension methodology which originated from the National Action Plan for Food Security (PAN) implemented by the Ministry of Agriculture and Food Security with assistance from FAO (2004-2009). FFS is currently concentrated in Manica, Sofala and Maputo Provinces where more than 26,000 became members through 907 FFS by 2009. In the last 5 years since 2013, 434 FFS holding 10,650 members have been established in Manica and Sofala provinces. In line with the e-Voucher beneficiaries, approximately 15% of e-Voucher beneficiaries are also members of FFS.

2.3. Beneficiary Targeting and Voucher Package

In the following the selection criteria of beneficiaries are presented. The objective of establishing criteria is to avoid and minimize the inclusion of beneficiary with high level of income that do not need the support. Application of criteria is performed as a guideline used by Local Committees responsible for locally selecting beneficiaries. Local Committees are constituted by local authorities, representatives of farmer associations, extension service and other key local actors. At first, all of beneficiaries who are willing to register the e-Voucher program should be eligible by meeting the basic criteria (see Table 2).

Table 2: Vouche beneficiary criteria

Non-Negotiable	Negotiable	Additional
-Being a resident and farmer for at least 3 agri-seasons -Financial capacity to purchase the subsidized input -Willing to be trained for the correct input use -Possess identification documents	-Register in extension program -Willing to share the knowledge with others	-Families with children under 5 -Membership of a FFS or other extension service -Beneficiary of other MDG*[1] program.

Note; MDG= Millennium Development Goals

Secondly, another criterion is applied in order to classify those registered beneficiaries into two different packages namely package A and package B. The former targets "Subsistence Farmers" and the latter does "Emerging Farmers." All beneficiaries will be classified into package A or B as directed by the specific criteria (see Table 3). As shown in the Table 3, criteria is described in the context of for example land and family members. However, particularly in contact with beneficiaries living in remote rural regions, information asymmetry appears to be problematic. Due to that other external factors also may influence, it complicates the application of these criteria at the local level. It thus can be the case that freedom is given to beneficiaries to choose over two options, which is therefore an endogenous choice. This appearing endogeneity is to be in detail discussed through chapter 4.3.

Table 3: Voucher package criteria

Package	A	B
Target	Subsistence Farmers	Emerging Farmers
Landholding	More than 0.5 ha	More than 1.0 ha
Family labor	At least 1 economically active person	paying for labor and/or having at least 2 economically active persons.
Additional	Widowed women household heads	Access to market

As described above, beneficiaries are likely to have a freedom to choose package by their own. In this case, self-decision is to be made according to the package contents and condition. Table 4 shows the main components per each package, whereby value of subsidized inputs, subsidy coverage ratio, and selectable inputs differ across two packages. Major differences that may trigger the endogenous choice are for example 1) total payment (contribution) by beneficiaries are less in package A, and 2) maize hybrid and fertilizers (urea and NPK) are available only at package B. In this paper, the analysis focus is given to maize (OPV and hybrid), beans (cowpea, common bean and pigeon pea), insecticide (post-harvest insecticide and field-insecticide) and fertilizers (urea and NPK), while soybean, peanuts, sorghum, rice and inoculant are excluded due to high geographical specificity and inconsistent availability at different local stores.

Table 4: Description of voucher package

Package	A	B
Value of inputs	35 USD	130 USD
Beneficiaries' contribution	25% (=**8.75 USD**)	40% (=**52.00 USD**)
Voucher's coverage	75% (=26.25 USD)	60% (=78.00 USD)
Inputs	Maize OPV Cowpea Common Bean Pigeon pea Sorghum Soybean Peanut Rice Inoculant Insecticide (post-harvest) Field insecticide	Maize OPV Cowpea Common Bean Pigeon pea Sorghum Soybean Peanut Rice Inoculant Insecticide (post-harvest) Field insecticide **Maize Hybrid** **Urea** **NPK**

2.4. Performance of the e-Voucher

Upon the registration, all beneficiaries receive an individual electronic card (e-card). It contains the subsidy data, which card-holders can activate by contributing the co-payment by cash. It should be noted that the voucher can be activated only after enough co-payment is topped up, which is priced $ 8.75 for package A, and $ 52.00 for package B (see Table 4). In doing so, the e-Voucher functions as a discount coupon specified for the purchase of inputs at agro-dealer shops. Tablets and e-card readers are also distributed and made available at local agro-dealer shops that were chosen within the FAO project scheme. Provided the technical training, in total 25 agro-dealer shops were chosen and registered. The performance of e-Vouchers through co-payment procedure is detailed in Figure 4 below.

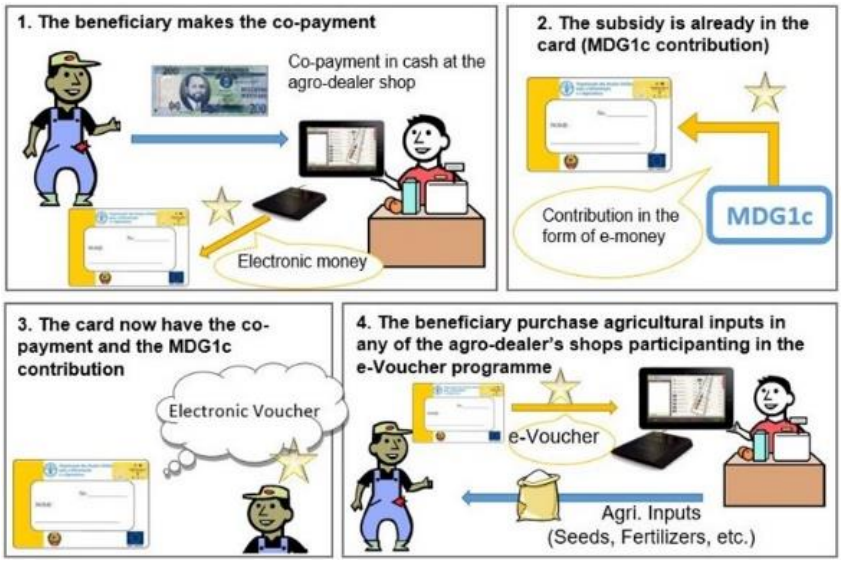


Figure 4: Performance of the e-Voucher by co-payment (FAO 2016)

3. Literature Review

3.1. Provision of agricultural input subsidy

According to Evenson and Gollin (2003), the use of improved seeds and fertilizer contributed to large productivity gains in many parts of the developing world over the last 50 years. One of the empirical results from Pakistan (Ali et al. 2015) reported that farmers who had access to certified seed were able to achieve higher crop yields, higher income, and lower poverty as compared to farmers without. This green revolution largely bypassed the African continent, which however registered the lowest yield increases in Sub-Saharan Africa (SSA). The problem in SSA is even exacerbated by rapid population growth and declining soil fertility (Howard et al. 1999). World Bank database (2014) showed that farmers in SSA used on average only 16 kg of fertilizer per hectare of arable land, while global average is 138 kg per hectare. To be specific in Mozambique, the use of fertilizer is performed only by 4% of smallholder farmers (FAO 2010). Carter et al. (2013) stated that the nascent input market in SSA remains small and its network unsubstantial due to little use of fertilizer. Being faced with these obstacles, series of public initiatives have been taken in SSA where Input Subsidy Programs (known as IPSs) plays the central to it. As of 2011, 10 African countries spent roughly US$1.05 billion on IPSs, amounting to 28.6% of their public expenditures on agriculture (Jayne and Rashid 2013). In general, ISPs provide a highly visible and demonstrative show of support, that explains popularity as the public intervention, while the context of cost and benefit is still being discussed over bulk of literatures.

3.2. Voucher scheme

A voucher is a method of providing some goods or services in which individuals have been given funds solely for the purchase of the specific goods or services (Edward 2013). By responding to underutilization of inputs, several African governments have introduced IPSs, of which implementation was carried out through voucher coupons. The input voucher scheme was addressed by Mangisoni et al. (2007) as the recommended most effective method at national or regional level, to small scale farmers without undermining the development of private sector-led marketing and distribution systems. Particularly in the context of agricultural financial service, the use of the voucher is carried out as the direct interventions. Direct public interventions are justified if they remove an identified market failure or social constraint (Jessop et al. 2012). In Mozambique, particularly in rural regions, due to lack of electronic connection and formal banking system, the access to quality inputs are rarely secured. It thus implies that monetary subsidies through the interest rate (e.g. market intervention) only benefit relatively wealthy farmers with access to credit, but exclude vast numbers of smallholder farmers and emerging farmers without. Intervention of a voucher is a way to ensure farmers (and not traders) reap the benefits, and use it for farm inputs.

As summarized by Ton et al. (2013), previous research in the context of African voucher project reported positive effects on income level, adoption of quality inputs, inputs market development, and on farmer organizational development. Another case-study conducted in Tanzania suggested that 99% of the respondents were reported to increase paddy production by 2.5 times resulting from the use of fertilizers (94%) and improved seeds (5%). This improvement was also associated with 88% of the farmers who increased farmers' assets, which indicated the better welfare of resource poor farmers in Tanzania (Edward 2013). According to the research findings through a two-year fertilizer subsidy program in Mozambique that launched in 2009, it benefited 15,000 maize farmers and 10,000 rice farmers (Carter et al. 2013). Results of the project showed that 73% of randomized samples were entitled to choose to use the voucher,

and the farmers who selected to receive the coupons used 15 kg more fertilizer and 3 kg more improved seeds than the control group (Carter et al. 2013).

3.3. Farmers Field School (FFS)

The Farmer Field School (FFS) is one of the agricultural extension method which was originally designed to educate rice farmers in terms with biological control, and to familiarize them with Integrated Pest Management (IPM) (Bijlmakers and Islam 2007). In keeping with the bulk of literature, FFS has been exploited for other subjects in agriculture (animal husbandry, vegetation, cottons etc.), and even non-agricultural subjects. Being faced with the issue concerning the lack of knowledge transmission in 1980s in Southeast Asia, FFS approach has been successfully implemented by the FAO, then introduced to other countries in Asia, Latin America and most recently Africa (Müller 2010). According to Kaosa-ard et al. (1998), FFS is one of the powerful inducement tools to rural farmers for encouraging technology diffusion with minimized financial, technical and managerial supports. It aims to teach agricultural knowledge and life skills to farmers together with an extension worker dealing with the hands-on agricultural know-how in a field donated by the local community (Mancini and Jiggins 2008, Müller 2010).

Another aspect that makes FFS crucial is the capacity building of rural farmers. FFS is functioning as a group-based and non-formal learning approach that brings desirable changes in the behavior of the farmers. By providing a first experience platform where a group of 25 or 30 farmers share their own experiences based on technically sound facilitator, farmers can improve their existing practices, that leads to sustainable agricultural production and powerful decision-making capacity (Tripp 2005). Ruttan (2003) stated that FFS enhances the decision-making capacity through discovery based learning in the field. This is also confirmed by Berg and Jiggins (2007) in that FFS promotes field observation and experimentation based on principles of adult education.

3.4. FFS role on input investment behaviors

As described above in 3.3, FFS is known to be a powerful tool to change the behavior of the farmers. Although FFS often works together with raising awareness in terms of the indigenous farming tactics, it is also expected to incentivize farmers to adopt new services and technologies such as quality inputs (e.g. insecticide, fertilizer, certified seeds) and financial products (e.g. microfinance). Muhammad et al. (2013) reported that FFS brought a positive effect on technology adoption improving their income, skills and knowledge that ultimately lead farmers towards empowerment. Much research has been made available by focusing on these behavioral changes for example on the adoption of the scientific knowledge, improved techniques and inputs (Gibson and Brown 2003, Rejesus et al. 2012). The specific role of FFS that promotes and shapes the investment behavior toward adopting quality inputs is crucial.

The importance of behavioral change is underscored not only by current little use of quality inputs by Mozambique farmers, but also by poor knowledge on the latest farming condition. This is especially true of the recent climate change associated with the unreliable rainfall. African agriculture is being threatened by climate change, where Mozambique is experiencing delayed and shortened rainfalls is no exception. In this specific context, the traditional farming can no longer be the alternative, meaning that lack of the latest knowledge may even cancel out the effect of quality inputs. Denning et al. (2009) reported that the returns on the fertilizer investment vary according to season-to-season variation in production since the majority of smallholder farmers are dependent on rainfall. It leads to a point that knowledge transfer through the extension service such as FFS needs to be deployed to lead farmers to adapt to those seasonal

variation, at least to avoid serious farm loss. FFS may play two different crucial roles where FFS may enhance the investment on quality inputs together with transferring up-to-date knowledge that promotes the proper use of those quality inputs.

Even though FFS is now adopted as the main extension service toward modernization of the agricultural production and improvement of the rural livelihood as recognized by the Ministry of Agriculture in Mozambique, not much research was demonstrated in Mozambique so far. As one of the latest research on the FFS specific in Mozambique, Müller (2010) reported the findings from a research project on junior farmer field and life schools (JFFLS), though the impact by FFS on other rural development projects is poorly investigated. In line with the primary objective of the National Action Plan for Food Security (PAN), it is still necessary to understand the mechanism to what extent FFS may influence on farmers' behaviors that include technology adoption, intensification and diversification, that altogether contributes to level of overall improvement in food security and livelihoods. This paper aims to fill the gap based on first-hand experience of the e-Voucher scheme in rural Mozambique.

3.5. Interactive effect by Voucher and FFS

As presented in research questions 3), this paper questions the interactive effect arising from the combination between Voucher scheme and FFS membership. Even though there is a bulk of literature on the single effect of respective intervention either voucher scheme and FFS, no research could be found in identifying those interactive effects. As a possible relevant study, Ton (2013) pointed out that voucher scheme is likely to facilitate innovation at the smallholder level. Vouchers may imply major changes at the local level in the socio-institutional and technical aspects of the agricultural system around smallholder farming. This triggers the development of institutions and institutional arrangements that facilitate the local innovation by farmers. On the other hand, by referring to the traditional farm tactics as the "endogenous innovation practices", voucher scheme possibly loses them due to the inflow of subsidized quality inputs. It implies that the voucher possibly affects the farmers through which a local external innovation is facilitated while losing internal innovation practices. Within this realm of trade-off relationship, the interactive effect between the voucher (external effect) and locally-driven innovation becomes the indicator of interest. By understanding the FFS as the method to enhance the farmers' capacity through bottom-up approaches, the interactive effect by the Voucher and FFS may represent the interested indicator.

Although Ton (2013) stated that the negative effects of voucher can be avoided by organizing in such a way that the vouchers offer farmers access to a broader menu of goods or services (e.g. seed fairs), the evidence based on the quantitative data could not be found neither from any other relevant researches.

3.6. New emerging electronic technologies

As stated by Jessop et al. (2012), a wave of new technologies has vastly increased access to financial services for rural clients over a decade. The use of electronic money (e-money) such as mobile money through mobile telephones, is by far the one of the most successful revolution in reaping the benefit of electronic technologies in African continent. In Sub-Saharan Africa, 12% of 64 million adults have mobile money accounts compared to just 2% worldwide (World Bank database 2014). With wider perspectives, mobile money is believed to fuel the huge potential and boost the financial inclusion particularly among women and the poor (Global Findex 2014). There has been some expectation that mobile money might improve the gender gap by providing more convenient and affordable services. It may thus expect to reach the traditionally excluded segments from the formal financial system such as women, poor, young people, and rural habitants.

As such that the financial inclusion database of World Bank (2014) did not cover Mozambique, little progress has been made in researching those new technology-driven services in Mozambique.

However, the potential in Mozambique is still recognizable. By taking a closer look on mobile money, Sub Saharan Africa is actually the only region with countries where more than 10% adults have a mobile money account, in which top 4 are all in East Africa (Global Findex 2014). Mozambique is the country left within East Africa to hold the room to grow the expansion in mobile money service. According to Maposa and Mutsonziwa (2014), only 3.3% of adults are now using mobile money in Mozambique, the major reasons behind of not-using was found to be "lack of awareness and information (90% of respondents)." It indicates that creating enabling environment that may include rising awareness campaign and provision of information could lead to the considerable growth.

3.7. Potential of e-money usage

Within the realm of e-money's rapid growth, it has improved efficiencies and reduced transactional costs which led to the usage of e-money now even evolving and diversifying (Jessop et al. 2012). Thousands of local beneficiaries now accept e-money as a mean of mobile banking service that includes transferring money (remittance), depositing, getting a loan, and simple payment at local stores. Its sphere of works may require local staff to use portable electronic devices that scan fingerprints as well as bank cards, and send the information back and forth to the head office (Jessop et al. 2012). It enables to comprehend real-time information of each service users. Exceedingly, it indicates the enormous potential attainment by strengthening the linkage of mobile operators with service providers (e.g. banks, MFIs, governments, private entities etc.). In general, the poor are more likely to depend on irregular income from occasional jobs, and farm produce and unable to get an access to formal financial services, which exposes them to financial risks and less secure transactions (Alampay and Bala 2009). However, this long-standing burdens might be solved provided emerging installation of electronic payment and banking platforms that vastly reduced the transaction cost and boosted rural outreach.

4. Theoretical framework

In recent years, various research has been conducted to evaluate the effect of project intervention, however, grasping a valid result requires a proper set of methods. Within this sub-section, main indicators and their theoretical background are presented as the result of the literature overview. It hereby will present the main indicators used in the theory: Timing, Diversity, Frequency, Balance amount, and No. of Deposits. Afterwards, the technical consideration is elaborated in line with the econometrics strategy.

4.1. Inputs investment and farm performance

In this research, the core interest is placed on the behavioral heterogeneity between farmers in relation to inputs investment. Olayide and Heady (1982) defined the agricultural production as the ratio of the value of total farm outputs to the value of total inputs used in farm production. To further investigate the farm performance, it is useful to mention two widely-used theoretical frameworks.

Neoclassical economists: The focus is on agency actors, such as the level of human capital (Mathijs and Vranken, 2000; Stone and Hughes 2000). It was attempted to understand variations in farm performance, particularly technical efficiency, through recourse to differences in the internal structure of farms (especially size and legal type). Within the realm of this framework, heterogeneity among agents is considered irrelevant for macroeconomic analysis.

Modern Perspective; Writings of institutional economists argue that human behavior is shaped by institutions. (Williamson, 1988). In this framework, the unit of analysis should not be the internal structure of farms but rather capture a farm's institutional embeddedness and inter-organizational relationships (transaction costs) (Pollak, 1985). As is obvious, heterogeneity is regarded as important determinant of aggregate economic activity (Galor 2009).

4.2. Factors influencing productivity

Farm production is a complex process involving multiple market and natural resource inputs, and often highly variable operating conditions. Bravo-Ureta et al. (2008) stated that a natural resource-dependent sector such as agriculture, is typically heterogeneous, and productivity differences are correlated with farm characteristics.

On the other hand, a typical problem for production analysis is that some variables are not observed. For example, a typical case in aggregate agricultural production is where temporal and spatial allocations of purchased variable inputs within growing seasons are not observed. In this research, we highlight particularly the farm efficiency underscored by the individual investment behaviors.

The following variables were used in this research: FFS membership, Package, Age, Gender, Input Price, Distance, Adoption behavior, Timing of investment, Diversity of investment, Frequency of investment, Balance Amount, and No. of Deposit. The following sub-chapters review the literature on factors identified to explain variations in farm efficiency.

4.2.1. FFS (Farmers Field School)

Oni et al. (2009) identified access to extension services as key to farm productivity. In keeping with the bulk of literature, there are mixed results on the influence of extension service. Seemingly a higher number of studies indicated a positive relationship; Obwona (2006) for tobacco farmers in Uganda, and Awotide (2004) all for Nigerian farmers as instance. On the other hand, BravoUreta and Rieger (1991) reported that extension services did not markedly affect productivity of farmers in New England. In this research, extension service is represented by the membership of FFS (Farmers Field School) and its influence is a core variable to be investigated. Main interest is to identify the behavioral change among farmers contributed by FFS membership.

4.2.2. Package

Package classification represents the internal farm structure as described in Table 4. By representing individual farm size, it is useful to test the widely-known 'inverse hypothesis' that smaller farms are more productive because land is used more intensively (Bharadwaj, 1974; Cornia, 1985). However, as Lund (1983) noted, there has been no generally accepted measure of farm. As one of the common methodology, Verma and Bromley (1987) empirically divided samples into two groups, of 'large' and 'small' farms. In the same manner, the classification of package A and B is assumed to relatively small and large farmers within the sample population.

4.2.3. Age

Age typically represents the level of experience in farming. As reported by Sumner and Leiby (1987), farmers with more experience have lower average marginal production costs. One study from Nigeria (Philip et al. 2009) also shows that age is also positively correlated with productivity, older farmers have also been observed to have higher productivity than younger farmers. In this research, the age is added to the interested variable upon the hypothesis that it is expected to yield positive factor that result in higher productivity.

4.2.4. Gender

The function of gender particularly the role of women is well discussed and documented through a bulk of literature. Odii (1992) for example reported the significant contribution to productivity by female farmers. In African context, results are shown to be similar, but for example Babalola (1988) found the opposite to be true to some extent. It was revealed that the lower productivity by women is associated with their weak bargaining position within the family and in the labor market. A recent study conducted in Nigeria by Phillip et al. (2009) showed higher productivity of the female farmers by fixing the agro-geographical factors through fixed effect model. In this research, being female is hypothetically expected to give certain positive influence. Concerns on the weakened bargaining power could be prudently offset through the electronic payment within the scheme where each transaction is being monitored, which ensures the consistency and fairness.

4.2.5. Price of the inputs

In general, price relationships have a significant influence on decisions relating to the type and volume of agricultural production activity (Chaudhri and Snowdon 1980). By no means, farmers' investment decisions are also influenced by investment prices in such a way that lower prices would encourage investment in an instant. In this research, input price is taken as the important factor which would give an effect to the purchase behaviors of each beneficiary. Because of price volatility due to inflation and other external shocks, the price of each input has been observed to vary over time. For example, the maize (OPV) varied from 120 to 250 with a rate of change of 208%. In the same manner, cowpea varied between 80 and 200.

4.2.6. Adoption of technology and quality inputs

As described in literature review in Chapter 3, much research have been done to prove the importance of quality inputs especially for the resource poor farmers in SSA. Alike that FFS or extension service plays important role in promoting the adoption by farmers, the determinants of adopting new

technologies are investigated from multiple point of views. One of the major finding is that being young is a strong indicator of new technology adoption. (Tiffin and Balcombe 2011; Mabaya 2015).

Speaking of gender toward technology adoption, several papers reported a lower rate of adoption played by female farmers. However, Mishara et al. (2015) pointed out an important finding that technology adoption in the first period is the primary determinant of adoption in the subsequent years. The primary (first period) technology adoption is the main driver for male farmers, while lagged technology adoption are main driver for female farmers.

Another common finding from literature is that larger farmers are more likely to adopt new technology. It was reported that larger farm size rise the possibility of adopting chemical fertilizers and improved seeds in Ethiopia (Abay et al. 2016) and that of new variety of seeds in Uganda (Mishara et al. 2015) respectively.

In regards of FFS membership, many reports have been published on the topic of effect of extension service given to technology adoption, but those findings are mixing. The report by Walisinghe et al. (2015) showed that extension service is recognized as the driving motive for rice technology adoption in Sri Lanka, while Pan et al. (2015) documented in Uganda that extension activities increase farmers' use of improved cultivation methods. On the other hand, Rejesus et al (2012) found that FFS did not result in significant impacts on insecticide use and yield by taking advantage of 2 years panel data in Vietnam. Instead, they found an "initial" knowledge impact by FFS, which provokes the possibility that FFS may have lagged impact as well. In this research, by identifying the e-Voucher as a representative of new technology, the determinants of adopting e-Voucher is to be investigated.

4.2.7. Distance

Ali et al. (2015) indicate that the distance to and from seed stores and markets influenced farmers' decisions to adopt certified seed. From the point of view of the supply side, the outreach of farm services is not likely to reach farmers in remote rural areas, due to high risks associated with agricultural input supply in rural areas and it further points out that agro-dealers still travel long distances to outsource agricultural inputs (Chianu et al. 2008). Applying this negative impact associated with the long distance, beneficiaries residing in proximity of agro dealer shops have a higher chance of purchasing inputs actively. Based on the field questionnaire, interviewee took on average 46.5 minutes to reach agro-dealer shop (min. 10 minutes, max. 200 minutes).

In this research, we assume a negative correlation between distance and purchase behaviors, which in turn leads to productivity. Furthermore, we should consider that not all the beneficiaries took advantage of on-truck sale. In certain areas, agro-dealers put extra efforts and arranged trucks where inputs are directly delivered and sold in the villages. In this case, behaviors of beneficiaries may significantly be influenced by this exogenous arrangement since the distance to the sale points becomes significantly less. Moreover, other purchase patterns may be influenced since on-truck sale typically offers the 'packaged set of inputs' in a way inputs can be sold efficiently within the limitation of inputs availability delivered by trucks. As indeed it should consider the substantial impact played by on-truck sale. The data showed that on-truck sales yield the large share of sale in comparison with any other agro-dealer shops. Due to this, dummy variables coded as 1 if purchased from on-truck sale, 0 otherwise are introduced in addition to the location (districts) dummy variables.

4.2.8. Timing of investment

Timely availability of inputs highly determines the agricultural productivity in rural Sub-Saharan Africa (SSA) (Takeshima and Nagarajan 2015). Maart (2011) stated that optimal timing of farmland investment represents fundamental decisions for agricultural entrepreneurs. However, it is also true in practice that the investment cannot be initiated optimally, which leads to the slow response to changes in the economic environment (Maart 2011). Not only farmers' self-decision making, but exogenous reasons are no exception that lead to purchase inputs too early or too late for example input availability, climatic condition and financial constraints (Hu and Schiantarelli 1998, Ison and Russell 2000). Takeshima and Nagarajan (2015) assumed that farmers' willingness to purchase seed may generally rise near the planting time because of the risk of seed loss during storage.

In this research, the timing of investment is to be identified as the farmers' strategical behavior that may influence the betterment of the farming. To quantify this variable, the seeding period within which the beneficiary is better to start farming are identified for each input. This is determined based on the questionnaire given to farmers, and consultation with local actors and FAO. Next to the identification of seeding weeks, beneficiaries were classified either [timely investor] [early investor] and [delayed investor] indicating the timing categories; during, before, and after the seeding periods respectively.

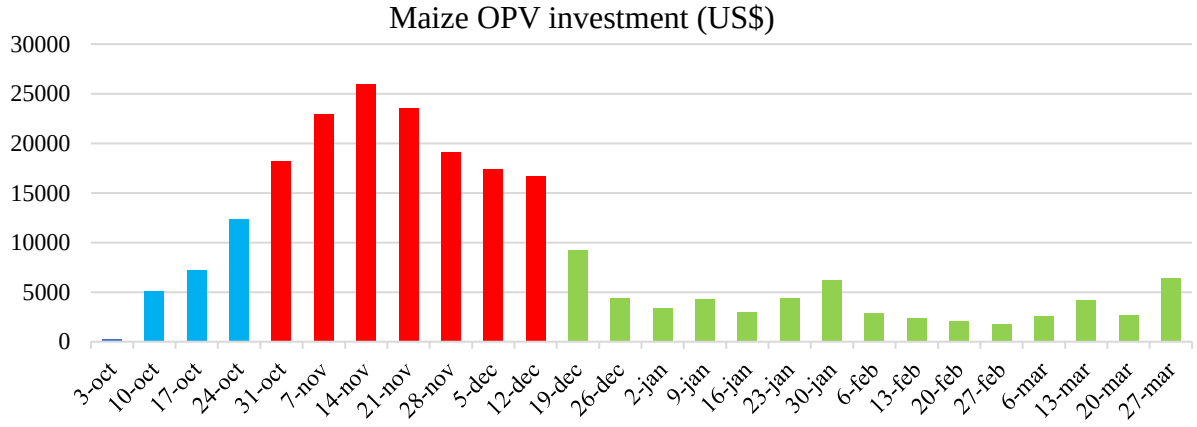


Figure 5: Timing classification for maize OPV

Blue = Early weeks, Red = Seeding weeks, Green = Delayed Weeks

For instance, of maize OPV which is one of the main crops in rural Mozambique, there are seeding weeks from the beginning of October to middle of December (red in figure above). In order to classify the beneficiaries and compute timing categorical variables, we categorize the beneficiaries into three; early investor, timely investor, and delayed investor. The classification was made in the same manner across different inputs based on each of seeding period. Seeding periods are determined through the hearing from beneficiaries during field survey and consultation with local actors and FAO, the classification was made available for those focused inputs; maize (OPV and hybrid), beans (cowpea, common beans. Pigeon pea), fertilizers (NPK and Urea), peanuts and sorghum. (see Table 5). Applying the seeding week(s), three major classification among beneficiaries emerge:

- Early investor who purchased inputs earlier to the seeding period,
- Timely investors who purchased during the seeding period,
- Delayed investors who purchased later than ideal period.

Table 5: eacg inputs seeding schedule

Inputs	Early Investment	Timely investment	Delayed investment
maize OPV	2016/10/03-10/30	2016/10/31-12/18	2016/12/19-2017/04/03
Cowpea*	2016/10/03-10/30 2016/12/19-2017/1/22	2016./10/31-11/20 2017/01/23-02/05	2016/11/21-12/18 2017/02/06-04/03
pigenon pea	2016/10/03-11/13	2016/11/14-12/11	2016/12/12-2017/04/03
common beans	2016/10/03-2017/01/22	2017/01/23-03/05	2017/03/06-04/03
maize Hybrid	2016/10/03-11/06	2016/11/07-12/04	2016/12/05-2017/04/03
NPK	2016/10/03-11/06	2016/11/07-12/04	2016/12/05-2017/04/03
urea	2016/10/03-11/06	2016/11/07-12/04	2016/12/05-2017/04/03
peanut*	2016/10/03-11/13 2017/01/09-1/22	2016/11/14-12/25 2017/01/23-02/05	2017/12/26-2017/01/08 2017/02/06-04/03
sorghum	2016/10/03-10/30	2016/10/31-12/04	2016/12/05-04/03

*Note; cowpea and peanut has two separate seeding periods. In particular cowpea is an important source of food in rural Mozambique since the leaves are also edible, mainly consumed by subsistence farmers.

4.2.9. Diversity of investment

Diversity is one of the farmers' strategy (Defoer, 1995). Through the variety of literature, diversity is still being discussed in variety of context such as business marketing, risk management, psychology etc. For instance, Theil and Finke (1983) reported that there is a significant positive relationship between the variety of items purchased and the level of income. According to Chang et al (2014), higher diversity in land use enhances the reasonable consumption of limited input resources in small farms. Those findings indicate that the identification of the diversity behind farmers' strategies allows us to evaluate their practices. The case study in Nigeria Idumah (2006), Mijindadi (1980), and Udoh (2000) indicated the diversified farming such as crop mixing, rotation, and diversification promoted productivity among crop farmers.

In this research, the diversity is calculated upon the concept of Simpson index. It enables to quantify how diverse each beneficiaries purchased inputs based on the expenditure shares. Maximum diversity occurs when expenditure shares are equally distributed among all inputs. The Simpson Index are one of the most common as useful measures of the distribution of expenditure shares, which is formulated as follows;

Simpson Index (SI)

$$\mathbf{SI} = \mathbf{1} - \sum_{\boldsymbol{i=1}}^{\boldsymbol{N}} \left(\frac{\boldsymbol{n}}{\boldsymbol{N}}\right)_{\boldsymbol{i}}^{\mathbf{2}}$$

Where: n = the total value of item of an input, **N** = the total value of all inputs. The $\frac{\boldsymbol{n}}{\boldsymbol{N}}$ indicates the budget share of input **i**. The Simpson Index measures concentration instead of diversity that varies from 0 (when the entire budget share is spent on one single input) to a maximum of $\mathbf{1} - \frac{\mathbf{1}}{\boldsymbol{N}}$ (when all budget shares are equal).

4.2.10. Frequency of purchase

Purchase frequency is one of the main product behaviors that represents how consumers perceive and use a product (Huang 2005). From the marketing point of view, the frequency is known to be one of the elements that constitute customer loyalty. The differences in purchase frequency can visualize different behaviors and perceptions among consumers with different habits. It was addressed within the case studies in floral market that the purchase frequency is also related to level of product knowledge and maturation of the market (Demby 1973, Behe and Wolnick 1991, Huang 2005). In this research, we assume that frequency represents two main attributes: loyalty and knowledge. The former is the straightforward concept that beneficiaries who purchased more frequently are more likely to trust the e-money left in the e-card, which leads to higher intensity of voucher use. Secondly, frequency is assumed to reflect the magnitude of knowledge toward the input usage. It is because each input has different seeding periods, with which knowledgeable farmers are to purchase different inputs at different ideal timing, which corresponds to higher purchase frequency.

4.2.11. Balance amount

As described in chapter 2.3, the voucher can be activated only after sufficient co-payment is topped up. Afterwards the voucher can be activated and beneficiaries can decide what to buy within the summed price: co-payment + voucher. At the end of the agri-season, not all the beneficiaries purchased as much as possible so it can be maximized up to exactly or nearly the total value. The majority of beneficiaries, nearly 70% purchased inputs without any balance amount left, while the remaining 30% left a certain amount of money in their e-cards at maximum US$103.3. This behavior may pertain to the beneficiaries' purchase strategy extent to which beneficiaries maximize the value spent for inputs, or save for next year (future investment). However, the latter case is seemingly the weak case since the value of voucher cannot be carries forward to the next year, meaning that beneficiaries lose the utility taken advantage through the voucher. By focusing especially on the aspect that lowering the balance amount represents the farmers' behavior where they maximize the expenditure on quality inputs, it also indicates the quantitative amount used for their farming. Reciting the Evenson and Gollin (2003), Ali et al. (2015), more use of improved seeds and fertilizer are supposed to achieve higher productivity, which made us assume the inverse relationship between balance amount and productivity.

4.2.12. No. of Deposits

As described above, all of the beneficiaries are required to top up and make copayment to activate the voucher. On top of that, different behaviors are observed regarding the number of times beneficiaries topped up until the completion of copayment. In this research, we recognized this behavior as 'depositing.' Although variations are not very large where 90.2% are did once, there was a one who did at maximum 9 times. The research on this behavior is rarely found, one study by Lishman and (2003) showed that higher risk farmers are more likely to accept deposit, while it is limited to commercial farmers. Considering the emerging trend that many financial inclusion schemes are being implemented lately where savings deposit from clients are getting popular, the deposit behavior by farmers is hereby examined.

4.3. Selection bias and Endogeneity

As noted in chapter 2.3 even though there are certain criteria, selection of package A or package B are not fully exogenous. In addition, the membership of FFS which is the core interest over this paper was

unknown regarding its endogeneity. In case that endogenous choice would be confirmed, the analysis is likely to suffer from endogeneity and selection bias that could adversely affect the accuracy of impact estimates. Although package selection is apart from the central variable interested to identify the causality on investment behaviours, FFS membership needs to be examined carefully.

To clarify this problem within this research, understanding the mechanism of package selection and being a member of FFS by beneficiaries are thus vital. A qualitative questionnaire in the field was implemented for this purpose. As presented in Appendix 5, crucial parts of the interview were spent in asking extent to which each beneficiary chose their packages, and became member of FFS.

5. Methodology

5.1. Data collection, Sampling Procedure and the Survey

In addition to beneficiary data and transaction data provided through e-card data, qualitative interview was conducted at the study area. The survey was conducted at the presence of the author to investigate the endo- and exogeneity of the variables that may be used for the regression analysis. The detail of the qualitative interview, together with the major findings are presented in following sub-chapters.

5.1.1. Qualitative interviews

The qualitative interview was implemented between 3rd - 8th July 2017 by taking advantage of the snowball sampling method. In each area, beneficiaries have been gathered initiated by a local facilitator who is working together with a local extension officer in the local government office. In 5 days of data collection a number of 70 sample beneficiaries was reached, which covered 7 sub-districts in different 4 districts in 2 provinces. (see Table 6). The interview was coordinated at the presence of the author, one FAO worker, one local extension officer and one local facilitator in order to overcome the language gap between English, Portuguese and local languages. The Questionnaire is composed of 4 pages of paper, taking approximately 20 minutes to answer. The contents are divided in 4 sections: 1) Participation of voucher scheme and package selection. 2) Timing of the input purchase 3) EMC membership 4) Overall and Conclusion. The full questionnaire is presented in the Appendix 5.

Table 6: Qualitative interview summary

Date	Province	District	Sub-district	Total	FFS member	package A	package B	Female
3-July	Manica	Gondola	Mudinea	10	5	9	2	8
4-July	Manica	Vanduzi	Chigodole	12	8	6	10	9
			Mtsinho	14	7	9	10	6
5-July	Manica	Gondola	Amatongas	7	3	7	0	6
	Sofala	Nhamatanda	Chirasicua	5	3	4	2	2
6-July	Sofala	Nhamatanda	Lamego	10	0	10	0	2
7-July	Sofala	Nhamatanda	Muoha	12	7	12	0	4
		Total		**70**	33	57	12	32

The main results of questionnaire revealed the endogeneity/exogeneity of the FFS membership and package choice. In the following, the main findings gained through the whole qualitative questionnaire are summarized.

FFS membership

FFS membership was shown to be **exogenous** where FFS membership was induced through certain exogenous intervention. 96.9% respondents answered that they became a member of FFS due to initiation/advice from others (facilitators and beneficiaries) in the community. The most frequently mentioned intervention was the ‘community meeting’ where FFS local facilitator who primarily gained trainings from FAO and local governments organized to initiate the FFS activities. Moreover, it was told that most of attendance of that community meeting became new members of FFS. By taking these into account, FFS membership variable is concluded to treat as an exogenous variable.

Package choice

The package selection was shown to be **endogenous** where beneficiaries chose a package over A and B through self-selection. 98.6% of respondents answered that they chose the package based on their own judgement, which proved the package variable as endogenous. The selection of package A is mostly price-driven (87.7% of farmers in package A). As previously described in 2.3., the copayment to be contributed by each beneficiary is relatively small (8.75 US$) in package A, which becomes as much as 4 times (52.00 US$) in package B. Most smallholder farmers thus simply could not afford package B, meaning that package selection is to some extent mirrored by the financial capability of farmers. Even though potential endogeneity persists, it is supposed not be the main drive of package selection. On the other hand, the choice of package B was revealed to be driven by the availability of specific inputs, especially fertilizers (NPK and urea). By considering that farmers afford to package B are more likely to grow not only cereals but also horticultural commodities (e.g. vegetables), the adoption of fertilizers becomes more important.

Timing of purchase

40.0% of respondents answered that they took on average 21 days between the registration and actual purchase of inputs. This was driven by following two reasons; 1) they needed to wait for the delivery of inputs (57.1% on average 21.9 days), and 2) they needed to collect money to fulfil the copayment (certain time (35.7% on average 19.3 days). Especially the delivery of inputs was awaited toward the On-truck sale, which apparently delayed the beneficiaries' investment.

Distance and On-Truck sale

On average respondents took 46.5 minutes (ranged from 10 to 200 minutes) to get to the agro-dealer shop. Particularly in remote rural areas, some agro-dealer shops organized a truck to sell in proximity to remote villages (on-truck sale). In this case, the investment behaviors (e,g, timing, frequency, Running balance) are likely to be influenced.

Others

In addition to that all (100%) of the respondents confirmed the ease of e-Voucher usage, several advantageous elements of e-Voucher were identified as follows: 1) It enabled the beneficiaries to use the voucher multiple times allowing them to purchase at right times, 2) It enabled beneficiaries to have more choice of inputs, 3) It created a sense of belonging to beneficiaries, and 4) It has stronger and more durable material compared to paper prone to mice bites. Above, it was also revealed that the launch of e-Voucher scheme stimulated the business of agro-dealer shops resulting in the increase not only in inputs purchase, but also in number of agro-dealer shops in rural regions.

5.2. Analytical Model

Here the analytical model and strategy are presented corresponding to each research question that was described in chapter 1.3.1. In order to answer those different research questions, different analytical strategies are applied among the logit model, multinomial logit model, and Ordinary Least Squared (OLS) model, In addition, the way to investigate the interaction effect corresponding to the research question 3) is also elaborated in 5.2.4. The total number of samples that is applied for those regressions differed. In order to take advantage of large samples available across 4 different provinces, cross-sectional data set with at maximum 15,006 samples has been imported. The basic descriptive overview on those 15,006 samples data and series of variables taken into account, are summarized in Table 7.

5.2.1. Logit Model

To apply the regression on Timing variables as corresponded to research question ***1) Does FFS-participation change the farmers' investment timing?***, it needs to deal with the models that have a dichotomous categorical dependent variable. As proposed by Verbeek (2011), the non-linear probability models (Probit or Logit model) should be applied for examining the non-continuous variable that may lead to inconsistent parameters otherwise. By taking into consideration that probit models follow the normal distribution while logit model follows the logistic distribution function, this study used Logistic model to analyze the dichotomous outcomes.

The equation below is expressed in terms of likelihood of $\boldsymbol{Z}$ representing on-time investment. The occurrence of on-time investment is coded as 1, while delayed investment is coded as 0. the logit model is applied to quantify the significant factors which influence this occurrence.

$$\boldsymbol{Z_i = \alpha + \beta_i FFS_i + \gamma_i Package_i + \delta_i X_i + \varepsilon i}$$

$$\boldsymbol{P_i = Prob\,(y_i = 1 \mid FFS, Package, X)}$$
$$\boldsymbol{= \lambda\,(\alpha_0 + \beta_0 FFS_0 + \gamma_0 Package + \delta_0 X_0 + \cdots + \beta_k FFS_k + \gamma_k Package_k + \delta_k X_k)}$$
$$\boldsymbol{= \frac{exp\,(Z_i)}{1 + exp\,(Z_i)}}$$

Where;

- $\boldsymbol{Z_i}$ represents the propensity to on-time investment (value 1).
- $\boldsymbol{P_i}$ represents a probability that beneficiary will invest on-time for given $\boldsymbol{FFS_i}$, $\boldsymbol{Package_i}$, $\boldsymbol{X_i}$.
- $\boldsymbol{y_i}$ represents the trends with the value 1 if beneficiary invested on-time, and 0 otherwise.
- $\boldsymbol{i}$ represents the beneficiaries associated with a given variable, and takes values *1,.., N* while $\boldsymbol{\varepsilon i}$ represents the unexplained (random) term in the sample.
- $\boldsymbol{FFS_i}$ represents a dummy with the value 1 if beneficiary is FFS member or 0 otherwise.
- $\boldsymbol{Package_i}$ represents a dummy with the value 1 if beneficiary chose package A or 0 if package B.
- $\boldsymbol{X_i}$ represents a vector of other explanatory variables related to investment condition, personal attributes and residential areas.
- $\boldsymbol{\alpha, \beta, \gamma, \delta}$ represent parameters of the model to be estimated whereby $\boldsymbol{\beta_i, \gamma_i, \delta_i}$ represent the coefficients associated with each explanatory variable $\boldsymbol{FFS_i}$, $\boldsymbol{Package_i}$, $\boldsymbol{X_i}$..

5.2.2. Multinomial model

In addition to the logit model described above, we deal with the polychotomous categorical dependent variables. Among three most commonly used models; conditional, multinomial, and mixed logit models, the multinomial model is chosen. Croissant (2011) described that multinomial model is applied with the inclusion of "individual specific variables" while the conditional logit model is applied with "alternative specific variables." The former refers to the variables which remain constant over time (e.g. age, gender, income), and the latter refers to the variables which have a different value for each choice question (e.g. the attribute levels). McFadden (1997) warned that the presence of alternative-specific variables in a multinomial logit model are evidence of failure to observe generic variables which are influencing behavior. Lastly, the models with both kind of variables can be analyzed with a mixed logit model. By taking into consideration that our model is composed solely by individual specific variables, the multinomial logit model is applied.

The equation below is expressed in terms of likelihood of $\boldsymbol{Uj}$ representing polychotomous timing variable. The occurrence of early investment, timely investment, and delayed investment are coded as 0, 1, and 2 respectively. By specifying in following model, the multinomial logit model is applied to quantify the significant factors which influence these occurrences.

$$\boldsymbol{U_{ij} = Z_i'\alpha_j + \varepsilon_{ij} = (\beta_{ij} FFS_{ij} + \gamma_{ij} Package_{ij} + \delta_{ij} X_{ij}) + \varepsilon_{ij}}$$

$$\boldsymbol{P_i = Prob\,(y_i = j \mid FFS, Package, X) = \frac{\exp\,(Z_i'\alpha_j)}{\sum_{k=1}^{J} \exp\,(Z_i'\alpha_j)}}$$

Where;

- $\boldsymbol{U_i}$ represents the utility level individual $\boldsymbol{i}$ attaches to each of the $\boldsymbol{j}$ alternatives
- $\boldsymbol{i}$ represents the beneficiaries associated with a given variable, and takes values *1*,., *N*, j represents alternatives 0, 1 and 2 (j=3), while ε_{ij} represents the unobservable error term.
- $\boldsymbol{X_i'}$ represents a K-dimensional vector containing the characteristics of individual $\boldsymbol{i}$
- $\boldsymbol{\alpha_j}$ represents a vector of individual-specific coefficients
- $\boldsymbol{\beta, \gamma, \delta}$ represent parameters of the model to be estimated whereby $\boldsymbol{\beta_i, \gamma_i, \delta_i}$ represent the coefficients associated with each explanatory variable $\boldsymbol{FFS_i}$, $\boldsymbol{Package_i}$, $\boldsymbol{X_i}$..
- $\boldsymbol{FFS_i}$ represents a dummy with the value 1 if beneficiary is FFS member or 0 otherwise.
- $\boldsymbol{Package_i}$ represents a dummy with the value 1 if beneficiary chose package A or 0 if package B.
- $\boldsymbol{X_i}$ represents a vector of other explanatory variables related to investment condition, personal attributes and residential areas.
- $\boldsymbol{P_i}$ represents a probability of outcome $\boldsymbol{j}$ occurring for given $\boldsymbol{V_i}$, $\boldsymbol{W_i}$, $\boldsymbol{X_i}$.
- $\boldsymbol{y_i}$ represents the occurrence of outcome $\boldsymbol{j}$ by individual $\boldsymbol{i}$

5.2.3. Ordinary Least Squared (OLS) Model

By corresponding to the research question ***2) Does FFS-participation change the farmers' investment behavioral indicators?*** other four investment behavioral indicators are taken into account. Since four of these indicators are continuous variables, OLS regression is acceptable. By taking advantage of as much as 15,006 samples available for both FFS membership and investment indicators across 4 different provinces, the regression is performed based on this cross-sectional data. In order to avoid the multinollinearity, the correlation between explanatory variables and the variance inflation factor (VIF) are checked. In following, the OLS regression model is specified and applied for analyzing continuous

investment indicators variables; Simpson Index, Frequency, Balance amount, and No. of Deposits. As referred in Appendix 3 and 4, the OLS regression is also applied in DTP (Days to Planting) concept which is being elaborated in chapter 6.1.1 and Appendix 3.

$$\boldsymbol{I_i = \alpha + \beta_i FFS_i + \gamma_i Package_i + \delta_i X_i + \varepsilon i}$$

Where;

- $\boldsymbol{I_i}$ represents the one of the Investment behavioral variables among Simpson Index, Frequency, Balance amount, and No. of Deposit.
- $\boldsymbol{i}$ represents the beneficiaries associated with a given variable, and takes values *1,.., N* while $\boldsymbol{\varepsilon i}$ represents the unexplained (random) term in the sample.
- $\boldsymbol{FFS_i}$ represents a dummy with the value 1 if beneficiary is FFS member or 0 otherwise.
- $\boldsymbol{Package_i}$ represents a dummy with the value 1 if beneficiary chose package A or 0 if package B.
- $\boldsymbol{X_i}$ represents a vector of other explanatory variables related to investment condition, personal attributes and residential areas.
- $\boldsymbol{\alpha, \beta, \gamma, \delta}$ represent parameters of the model to be estimated whereby $\boldsymbol{\beta_i, \gamma_i, \delta_i}$ represent the coefficients associated with each explanatory variable $\boldsymbol{FFS_i}$, $\boldsymbol{Package_i}$, $\boldsymbol{X_i}$..

5.2.4. Interactive Variables

Corresponding to the major analysis regarding Research Questions 2), the interaction effect needs to be analyzed over $\boldsymbol{FFS_i}$ and $\boldsymbol{Package_i}$ variables. To do this, interactive variables $(\boldsymbol{FFS * Package})_i$ are created and added to each regression model. By following example equation,

$$\boldsymbol{I_i = \alpha_1 + \alpha_2 FFS_i + \alpha_3 Package_i + \alpha_4 (FFS * Package)_i + \varepsilon i}$$

Where;

- $\boldsymbol{I_i}$ represents the Investment behavioral variables interested.
- $\boldsymbol{i}$ represents the beneficiaries associated with a given variable, and takes values *1,.., N* while $\boldsymbol{\varepsilon i}$ represents the unexplained (random) term in the sample.
- $\boldsymbol{FFS_i}$ represents a dummy with the value 1 if beneficiary is FFS member or 0 otherwise.
- $\boldsymbol{Package_i}$ represents a dummy with the value 1 if beneficiary chose package A or 0 if package B.
- $\boldsymbol{FFS * Package_i}$ represents the interactive variable between $\boldsymbol{FFS_i}$ and $\boldsymbol{Package_i}$ variables.
- $\boldsymbol{\alpha_1, \alpha_2, \alpha_3, \alpha_4}$ represent parameters of the model to be estimated whereby $\boldsymbol{\alpha_2, \alpha_3, \alpha_4}$ represent the coefficients associated with each explanatory variable $\boldsymbol{FFS_i}$, $\boldsymbol{Package_i}$ and $\boldsymbol{FFS * Package_i}$

Once the interactive term is added into the model, the interpretation of the coefficients is clearly changed. If the interactive variable $FFS * Package_i$ is shown to be significant, it means the effect of FFS_i on the dependent variables I_i is likely to be different for different values of $Package_i$, meaning that the unique effect of FFS is not limited to α_2, but also depends on the values of α_4. Since $Package_i$ is a dummy corresponding to package A if 1 and package B if 0, the coefficient α_2 is now interpreted as the unique effect of FFS_i when package value = 0 (Package B) while the unique effect of FFS_i when package value = 1 (Package A) can be taken as $\alpha_2 + \alpha_4$.

Table 7: Descriptive data used for regression analysis with cross-sectional data set

Variable	Variable Description	Mean	Std. Dev	Obs
Dependent variable				
Timing variables*[1]				
On-time Investors				
All	Dummy=1 if the beneficiary purchased before end of Seeding period	0.646	0.478	14532
Maize OPV	Dummy=1 if the beneficiary purchased before end of Seeding period	0.697	0.460	8688
Cowpea	Dummy=1 if the beneficiary purchased before end of Seeding period	0.531	0.499	5483
Maize Hybrid	Dummy=1 if the beneficiary purchased before end of Seeding period	0.570	0.495	5602
Other Investment Behavioral variables				
Simpson Index	Simpson Diversity Index	0.444	0.265	15006
Frequency	No of time(s) that the beneficiary made purchase	1.131	0.444	15006
No. of deposits	No of time(s) that the beneficiary deposited	1.009	0.108	15006
Balance amount	Amount of money left in e-card at the end of the agri-season	28.114	175.5	15006
Explanatory variables				
FFS membership	Membership of FFS by the beneficiary (1= member)	0.150	0.357	15006
Package	Package choice (1 = package A)	0.502	0.500	15006
Investment Condition				
On-Truck sale	Dummy=1 if the beneficiary purchased from on-truck sale	0.432	0.495	15006
Personal Attributes				
Year(s) of participation	Total year(s) of participating the voucher scheme	1.203	0.458	15006
Age	Age of the beneficiary	41.602	14.617	15006
Age-squared	Squared value of Age	1944.3	1365.9	15006
Gender	Gender of the beneficiary (1 = male)	0.570	0.495	15006
Residential Area				
Barue	Dummy=1 if the beneficiary lives in Barue (base)	0.137	0.344	15006
Gondola	Dummy=1 if the beneficiary lives in Gondola	0.039	0.193	15006
Macate	Dummy=1 if the beneficiary lives in Macate	0.026	0.158	15006
Manica	Dummy=1 if the beneficiary lives in Manica	0.100	0.300	15006
Sussundenga	Dummy=1 if the beneficiary lives in Sussundenga	0.059	0.235	15006
Vanduzi	Dummy=1 if the beneficiary lives in Vanduzi	0.022	0.147	15006
Ribaue	Dummy=1 if the beneficiary lives in Ribaue	0.052	0.223	15006
Buzi	Dummy=1 if the beneficiary lives in Buzi	0.028	0.164	15006
Gorogonsa	Dummy=1 if the beneficiary lives in Gorogonsa	0.236	0.424	15006
Maringue	Dummy=1 if the beneficiary lives in Maringue	0.044	0.206	15006
Nhamatanda	Dummy=1 if the beneficiary lives in Nhamatanda	0.189	0.392	15006
Alto Moe	Dummy=1 if the beneficiary lives in Alto Moe	0.031	0.172	15006
Gurue	Dummy=1 if the beneficiary lives in Gurue	0.039	0.192	15006

***[1]** Note on missing data on timing variables; timing variables are computed based on the inputs to which each beneficiary spent the highest share to. Due to this, in case the beneficiary spent the highest share to insecticides, rice, or inoculant, variable cannot be computed. Rice and inoculant are little to be purchased and excluded from the analysis, and insecticides does not specify the goodness in terms of purchase timing. (it can be ideally purchased at any time points before the cultivation, which correspond to whole period of agri-seasons.

5.3. Descriptive statistics

With this sub-chapter, descriptive statistics are used to verify the distinct elements characterized by the beneficiaries who participated in the e-Voucher scheme. In the first section, the determinants' analysis is discussed through the comparison between beneficiaries who activated e-cards and those who did not. Secondly, by focusing on the cycle of the investment, the variations over the project time, and heterogeneity across different inputs (seeds, insecticides, fertilizers) are visualized in diagrams. At the end of descriptive statistics, simple statistical tests are performed on 5 different investment behavioral indicators for different categories of beneficiaries such as FFS, gender and package.

5.3.1. Determinants of the Activators

As shown in Table 8, in total 24,415 registered the e-Voucher scheme until the end of the 2016/2017 agri-season, of which 22.8% did not activate the e-Voucher, meaning they did not purchase any inputs. At the first touch of descriptive analysis, the characteristics of each 'Activators' and 'Non-activators' are to be examined. This analysis is crucial, not only because it enables us to capture determinants of the 'e-Voucher acceptance' but also because further analysis on inputs investment can be made only within sub-sample population of Activators. In comparing the attributes between Activators and Non-activators, the simple t-test is carried out for continues variables by calculating mean and standard deviation, while the Pearson chi-square test is performed for categorical variables by calculating percentages. (See Table 9)

Table 8: Total number of beneficiaries by activation

Scheme	Beneficiaries				Total
	Activator		Non-activatior		
2016/2017	18,706	76.6%	5,709	23.4%	24,415

As a result, all of the variables were shown to be significant except for FFS. Apparently FFS membership is not likely to affect the activating behavior. From the analytical point of view, it also implies that the further analysis performed on investment behaviors only among Activators is not likely to suffer from heterogeneity over Non-activators, meaning that the appearing results related to FFS appears to be valid to all of the beneficiaries regardless to activation.

Age was shown to be significant with P-value at 0.01. It shows that beneficiaries who activated the e-Voucher are more likely to be younger. This is in line with the major finding that young age is a strong indicator of new technology adoption as described in 4.2.10. Older farmers are less likely to adopt new technologies, which is proven to be the case for e-Voucher.

Apart from the two variables presented above, all other categories are significantly different between Non-activator and Activators with p-values of 0.01. In terms of Package, and Gender, being "Package B" and "Female" are determinants of activators. It implies relatively wealthy (large scaled) and female farmers are more likely to adopt the e-Voucher and benefited from the voucher coupon. Both findings are validating the findings described in 4.2.10 to some extent. At first, on the assumption that package B represents relatively wealthy and bigger scaled farmers, the results validated that larger farmers are more likely to adopt new technology.

Secondly, the female lagged technology adoption reported by Khshubu (2015) is likely to be validated by checking the baseline data in 2015/2016 agri-season. By computing the gap in female ratio between activators and Non-activators, it turned out to be higher in the second year (2016/2017 agri-season).

For example, in 2016/2017 agri-season, the female ratio is 41.3% among activators while 31.6% among Non-activators, which computes the gap as 9.7%. This gap in 2015/2016 agri-season was only 2.2%, meaning that adoption rate by female farmers has been increased over time, which may represent the above mentioned lagged technology adoption.

Table 9: Descriptive statistive on Activators and Non-activators

Variables	Categories	Activator		Non-activator		statistics
FFS membership	Member	2,267	(15.0%)	592	(15.3%)	0.2622
	Non-member	12836	(85.0%)	3267	(84.7%)	
	SubTotal	15,103	(100%)	3,859	(100%)	
Package	A	9,176	(49.1%)	4,150	(72.7%)	**985.9*** **
	B	9,530	(50.9%)	1,559	(27.3%)	
	SubTotal	18,706	(100%)	5,709	(100%)	
Gender	Male	10,981	(58.7%)	3,905	(68.4%)	**172.87*** **
	Female	7,725	(41.3%)	1,804	(31.6%)	
	SubTotal	18,706	(100%)	5,709	(100%)	
Age		41.97	(14.51)	44.31	(14.11	**10.462*** **
	SubTotal	N=1,8256		N=5,459		
Year of Registration	2014*[1]	1,604	(8.6%)	641	(11.2%)	**1.0E+03*** **
	2015	5,886	(31.5%)	2,993	(52.4%)	
	2016	11,216	(60.0%)	2,075	(36.3%)	
	SubTotal	18,706	(100%)	5,709	(100%)	
Province	Manica	8,928	(47.7%)	3,990	(69.9%)	**1.3E+03*** **
	Nampula	965	(5.2%)	276	(4.8%)	
	Sofala	7,740	(41.4%)	888	(15.6%)	
	Zambezia	1,073	(5.7%)	555	(9.7%)	
	SubTotal	18,706	(100%)	5,709	(100%)	
District	Barue	3,165	(16.9%)	486	(8.5%)	**3.7E+03*** **
	Gondola	694	(3.7%)	721	(12.6%)	
	Macate	490	(2.6%)	623	(10.9%)	
	Manica	1,999	(10.7%)	891	(15.6%)	
	Sussundenga	1,537	(8.2%)	1,023	(17.9%)	
	Vanduzi	1,043	(5.6%)	246	(4.3%)	
	Ribaué	965	(5.2%)	276	(4.8%)	
	Buzi	420	(2.2%)	386	(6.8%)	
	Gorongosa	3,777	(20.2%)	107	(1.9%)	
	Maringue	669	(3.6%)	84	(1.5%)	
	Nhamatanda	2,874	(15.4%)	311	(5.4%)	
	Alto Molocué	473	(2.5%)	299	(5.2%)	
	Gurué	600	(3.2%)	256	(4.5%)	
	SubTotal	18,706	(100%)	5,709	(100%)	

Note: **Asterisks: *, **, *** indicates statistical significance at 10%, 5%, 1% respectively.** *[1] Registration in 2014 represents the paper-Voucher scheme participants. For further analysis on other variables; Year of Registration, Province, and District, the residual (post hoc) analysis is performed to identify the specific elements that determine significance. The results are presented and described in Appendix 1.

5.3.2. Investment cycle

This section focuses on the time cycle of investment. By aggregating the investment weekly, the cycle of investment is visualized and its seasonality is to be examined. Moreover, those cycles will be compared between some attributes such as input types, FFS membership, Gender and Package. The following figure shows aggregated weekly sale over the period of 2016/2017 agri-season. The aggregate sale was computed for different time points. Each time point is based on a week from Monday to Sunday ranging from 3rd October 2016 to 3rd April 2017, which totals to 26 weeks, corresponding to the whole agri-season of 2016/2017. Moreover, as shown in Figure 6, those time points can be clustered into 7 periods based on the 95% confidence interval with 5% significance. The main activities behind each clustered period were collected through the field visit and are summarized in Table 10 below. Concerning the figures for each investment cycle, X axis is corresponding to the weekly time points, while the Y axis is representing the aggregated sales. In case the US$ is depicted, the exchange rate; 1US$=61.07 Mozambican Metical (MTZ) (XE currency As of August 2017) is applied.

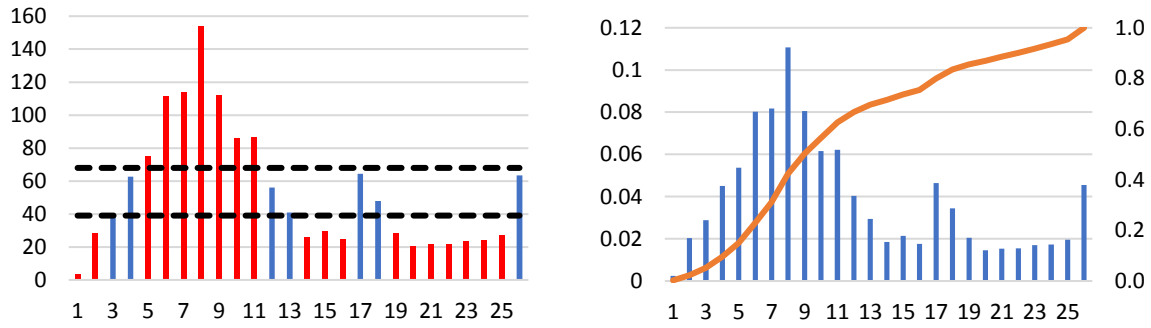


Figure 6: Total investment cycle in US$ (000') (left) and with proportional ratio (right)

Table 10: Farming Calendars in project sites

Date	Week	Main activities in the field
2016/10/03 - 17	1st - 2nd	-Preparation of land
2016/10/17 - 31	3rd - 4th	-Initial inconsistent rain (NOT enough for seed germination*[1])
2016/10/31 - 12/19	5th - 11th	-Consistent rain (enough for seeds germination) -Weeks for seeding; maize, 1st cowpea*[2], pigeon pea, 1st peanut, and sorghum -Weeks for fertilization to Maize hybrid (with NPK, Urea)
2016/12/19 - 2017/1/2	12th - 13th	-Taking care of soil (e.g. removing weeds)
2017/01/02 - 23	14th - 16th	-Harvest; 1st maize (fresh eat*[3])
2017/01/23 - 4/6	17th - 26th	-Weeks for seeding; 2nd Cowpea, 2nd Peanut, and Common beans -Harvest; 2nd maize (for processed powder), beans, sorghum

Notes; *1 Due to climate change, inconsistent rainfalls are likely to appear approximately at the end of October, which is misleading farmers to start seeding. *2 Cowpea is edible also for its leaves, which is why especially subsistence farmers are harvesting cowpea at two different periods. *3 Maize is cultivated in two different periods corresponding to the way to consume; as fresh vegetable and corn powder.

Each Input Investment

Now the closer look is given to each input. As discussed in chapter 2.3. we focused on maize (OPV and hybrid), beans (cowpea, common bean and pigeon pea), insecticide (post-harvest insecticide and field-insecticide) and fertilizers (urea and NPK). In the following figures, the investment cycle for those 9 inputs are prepared. At the same time, seeding periods (in red) and averaged price of inputs purchased at each week are also presented in the same figures. It should be noted that averaged price of inputs is calculated based on the price that was transacted. In following figures, X axis correspond to the weekly time points.

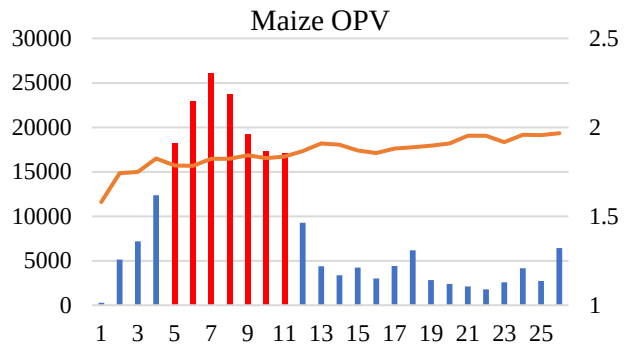


Figure 8: Inputs Investment of maize OPV (US$)

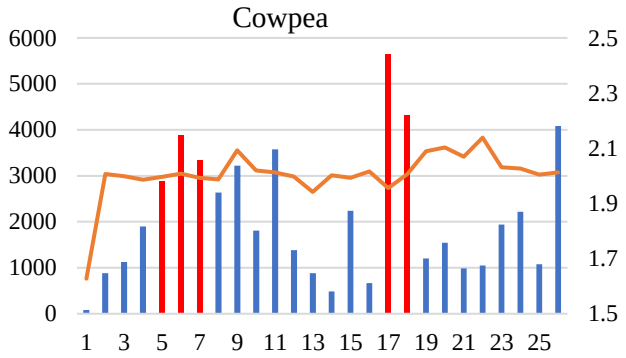


Figure 7: Inputs Investment of cowpea (US$)

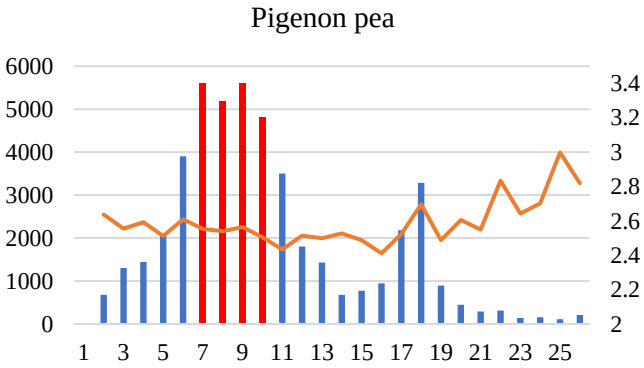


Figure 11: Inputs Investment of pigeon pea (US$)

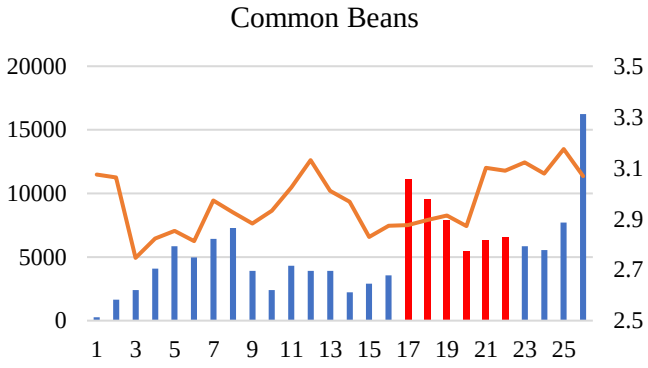


Figure 12: Inputs Investment of common beans (US$)

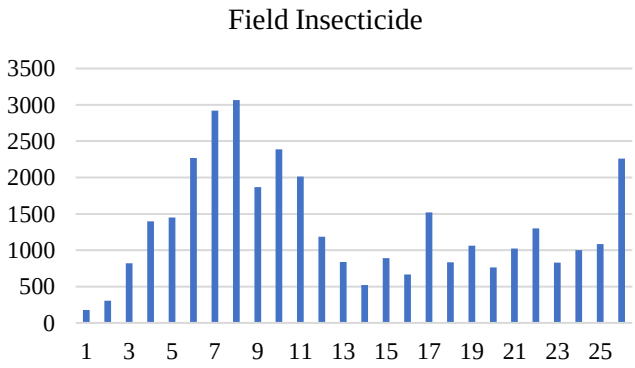


Figure 9: Inputs Investment of field insecticide (US$)

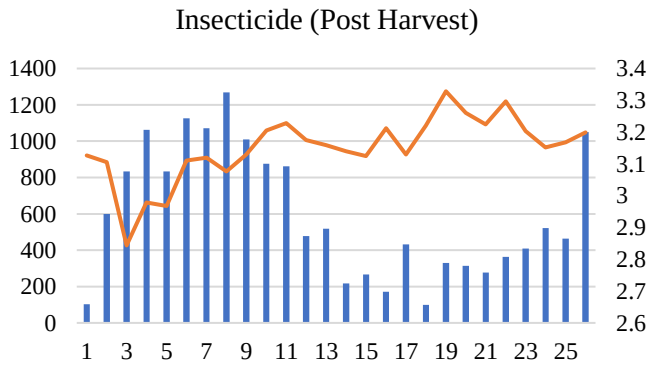


Figure 10: Inputs Investment of post-harvest insecticide (US$)

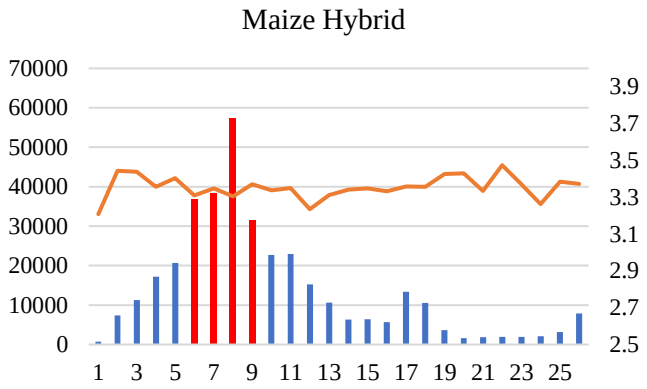


Figure 13: Inputs Investment of maize hybrid (US$)

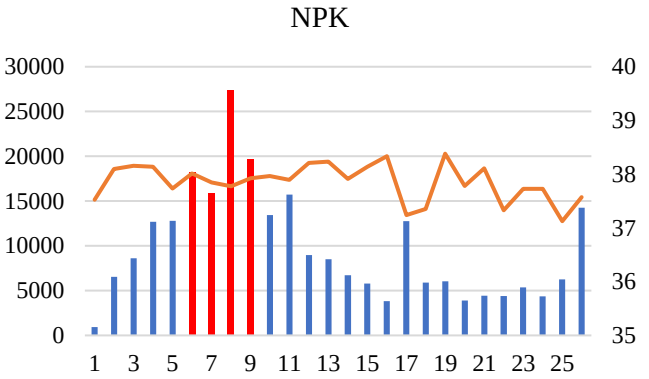


Figure 15: Inputs Investment of NPK (US$)

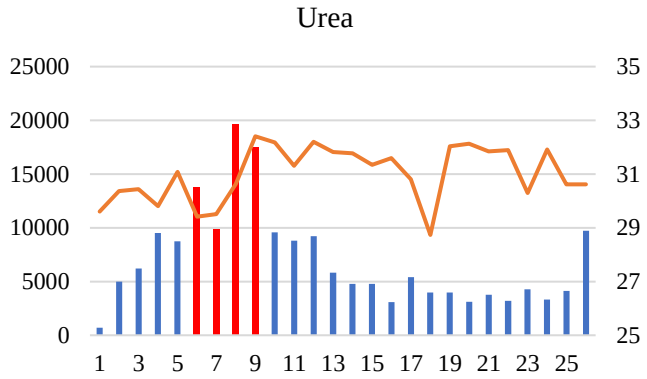


Figure 14: Inputs Investment of urea (US$)

It appears that there is no strong correlation between price vitality and investment, though it can be analyzed through the regression analysis after Chapter 6. It should be noted that insecticides (field insecticide and post-harvest) do not have ideal weeks since those two inputs are not timing-dependent. Also, the price is not depicted in the Figure 9 of field insecticides; this is because field insecticides are sold in three different volumes: 250mL, 500mL, and 1L. for the simplification of the analysis, those three are combined into one, which made averaging the transacted price meaningless. Two interesting insights can be gained from the Maize hybrid, NPK and Urea, which are all available limited to package B. In effect, fertilizers (NPK and Urea) are oriented for the Maize Hybrid through the recommendation by FAO. Due to this, apparent synthesis between Maize Hybrid and each fertilizer are all favorable signs. Moreover, another finding is that the demand of fertilizers became higher in the last week. Since Maize Hybrid is already being harvested, those purchased fertilizers were not supposed to be used for maize Hybrid anymore. There is a chance that fertilizers are used for different commodities, presumably horticultural commodities. To substantiate this hypothesis, further research in the field is to be pursued. Further investment cycle graphical analysis differed by categories (FFS, package, gender) are detailed in Appendix 2.

5.3.3. Investment behavioral Indicators

Since four of the investment behavioral indicators, Simpson Index, Frequency Balance amount, No. of Deposits are continuous variables, the simple descriptive heterogenous analysis was performed in

relation to FFS membership, package and gender respectively. Prior to the regression analysis from Chapter 6, it is expected to enable us to catch the first insight on the effect of FFS, together with package and gender.

Table 11: Simple t-test on investment behavioral indicators by FFS, package and gender.

	FFS			Voucher Package			Gender		
	Member	Non-member	t-value	A	B	t-value	Male	Female	t-value
Simpson Index	0.481 (0.005)	0.438 (0.002)	**-7.14*** **	0.356 (0.003)	0.550 (0.002)	**53.84*** **	0.457 (0.003)	0.451 (0.003)	-1.56
Balance amount	31.331 (4.261)	27.547 (1.508)	-0.943	30.038 (1.201)	24.716 (2.255)	**-2.06** **	31.080 (1.779)	22.030 (1.847)	**-3.45*** **
Frequency	1.179 (0.012)	1.122 (0.004)	**-5.58*** **	1.135 (0.005)	1.111 (0.004)	**-3.72*** **	1.136 (0.004)	1.104 (0.004)	**-5.01*** **
No. of Deposits	1.023 (0.004)	1.007 (0.001)	**-6.65*** **	1.007 (0.001)	1.014 (0.001)	**3.73*** **	1.013 (0.001)	1.007 (0.001)	**-3.34*** **
Obs	2,248	12,758		9314	8939		10674	7579	

Note; Standard Errors in parentheses. Asterisks: *, **, *** indicates statistical significance at 10%, 5%, 1% respectively

At first regarding the FFS membership, variables of Simson index, frequency, and deposit are significant at 1%. Thus, FFS members show higher purchase diversity, higher frequency, and higher deposit habits. It indicates that FFS members are more likely to diversify the inputs to purchase, and visit the agro-dealer shop multiple times.

The results of the Package comparison between A and B was very particular in the sense that all variables were shown to be significantly different. It shows that the farmers in package B are holding a higher diversity index, higher balance amount, and more depositing habits. On the other hand, package A displayed a higher frequency. The frequency variable indicates that smallholder (package A farmers) are more likely to visit agro-dealer shops multiple times to purchase inputs.

At last in terms of Gender, the variables Balance amount, Frequency, and Deposit showed statistical significance at different p-values. It indicates that 1) male farmers are more likely to remain more money in their own e-cards. 2) male farmers are more likely to purchase the inputs multiple times, which may indicate the attitude of purchasing inputs at the right time. Because different inputs have different ideal weeks to be purchased, farmers are recommended to purchase the inputs at the different ideal timing. 3) male farmers are more likely to have higher number of depositing until the full copayment. This behavior may indicate the general depositing habits of the individuals, which proved to be stronger in male farmers.

In addition to the two samples t-test above, an extra heterogenous analysis is performed in relation to the interaction between FFS membership and packages. Both being binary variables 2 times 2, namely 4 classifications were made, in which each investment indicators are again tested for overall differences through One-way ANOVA, and individual differences through post hoc Turkey analysis. (see Table 13). One-way ANOVA proved that there were significant differences (1%) for all of the indicators over 4 groups, and post hoc analysis identified possible strong interactive effect for Simpson Index and No. of deposits judging from the multiple significance. All of these findings gained through descriptive statistics could be further investigated by regression analysis from next Chapter 6.

Table 12: One-way ANOVA on investment behavioral indicators over FFS and packages

	Non-FFS × Package A	FFS × Package A	Non-FFS × Package B	FFS × Package B	chi-sqrd
Simpson Index	0.34 (0.25)	0.42 (0.25)	0.53 (0.25)	0.57 (0.23)	**16.33*** **
Frequency	1.13 (-0.45)	1.22 (-0.59)	1.11 (-0.39)	1.12 (-0.49)	**3.70E+03*** **
Balance amount	31.44 (-115.27)	34.69 (-136.54)	23.85 (-209.65)	26.6 (-268.4)	**2.80E+03*** **
No. of Deposit	1.00 (0.07)	1.02 (0.14)	1.01 (0.10)	1.03 (0.23)	**467.51*** **
Obs	6,214	1,314	6,544	934	

Note; Standard Deviation in parentheses. Asterisks: *, **, *** indicates statistical significance at 10%, 5%, 1% respectively

Table 13: Tukey post hoc analysis over FFS and package variables

comparison	Simpson Index	Frequency	Balance amount	No. of Deposit
Non-FFS × Package A vs FFS × Package A	**0.00755*** **	**-6.23*** **	5.327	**0.0032*** **
	(-9.820)	(0.013)	(-0.610)	(-4.440)
FFS × Package B vs FFS × Package A	**0.0106*** **	**-5.03*** **	7.509	0.005
	(14.580)	(0.019)	(-1.080)	(2.140)
Non-FFS × Package B vs FFS × Package A	**0.0075*** **	**-8.06*** **	5.304	**0.0036** **
	(14.890)	(0.013)	(-2.040)	(-3.120)
FFS × Package B vs Non-FFS × Package A	**0.0087*** **	-0.74	6.157	**0.0038*** **
	(26.280)	(0.016)	(-0.790)	(6.450)
Non-FFS × Package B vs Non-FFS × Package A	**0.0044*** **	**-3.09** **	**3.108*** **	0.002
	(42.260)	(0.008)	(-2.440)	(2.280)
Non-FFS × Package B vs FFS × Package B	**0.0087*** **	-0.82	6.137	**0.0038*** **
	(-4.970)	(-5.320)	(-0.450)	(0.015)

Note; Standard Errors in parentheses. Asterisks: *, **, *** indicates statistical significance at 10%, 5%, 1% respectively

6. Results and Discussion

6.1. Regression Analysis

To further examine the determinants of each investment behavioral indicators that were observed in chapter 5.3.3 based on descriptive statistics, series of regression analyses were performed. For the categorical variables including adoption and timing variables, the logit and/or multinomial regression are applied, while for continuous variables, Simpson index. Frequency, Balance amount and Deposit variables, OLS regression are performed. For each regression, the comparison was made for three different crops: maize OPV, cowpea, and maize hybrid. It should be noted that Maize hybrid is available only in package B, thus the estimates of the effect by package selection is not included for the regression on maize hybrid farmers.

6.1.1. Timing

As described in Chapter 4.2.7, the investment timing is determined based on the seeding period into either 0 = Early investment, 1 = Timely investment, or 2 = Delayed investment. At first, the logit model over dichotomous variable either 1 = On-time investment (combining early and timely investment) or 0 = Delayed investment is applied over three different main crops: maize OPV, cowpea, and maize hybrid. In parallel for the robustness check, Days-to-Planting (DTP) is computed by following in line with the similar concept of Months-to-Planting (MTP) as proposed by Takeshima & Nagarajan (2015). DTP enables to quantify the timing of investment into continuous variable, which can be re-checked through the OLS regression. DTP result is detailed in appendix 3 and 4. Afterwards, to further analyze the FFS effect targeted on On-time investors, the multinomial regression is performed by adding two more categories: Early investment and Timely investment.

Logit model

According to the results shown in the Table 14, the effect of FFS is not consistent over different seeds. A significant positive effect for cowpea can be observed, while the effect on maize OPV is negative. By considering that significance cannot be obtained for all (averaged) samples, FFS effect on on-time investment could be mixing. The results from Days-to-Planting (DTP) regression in appendix in comparison over 7 different inputs, FFS effect is likely yield a negative effect for maize hybrid, NPK and Urea, that are all inputs available only in package B.

Apart from FFS, some influential variables were identified such as: on-truck sale, package, price of deeds, year(s) of participation, and gender. Negative sign of on-truck sale coefficients indicates that the use of on-truck sale is likely to delay the input purchase by beneficiaries. By referring to the DTP regression, on-truck sale is delaying on average 11.06 days, which is longest with 20.62 days for cowpea farmers. Also, significant positive coefficients are gained from by package (A) variable, meaning that the farmers in package A are likely to invest on-time compared to package B. The Price of Seeds variables are also showing significance, which implies that beneficiaries are sensitive to the price volatility, where higher pricing delays the inputs purchase. Years of participation is positively increasing the probabilities of on-time investment, where an extra year of participation leads the beneficiary to invest 4.3 days earlier based on DTP. Gender turns out be significant for all the seeds, meaning female farmers are more likely to invest on-time (3.1 days earlier than male farmers).

Table 14: Marginal effect estimation after Logit regression on On-time investment

Variables	Dependent variable: Investment Timing (1 = On-time investment)			
	All	Maize OPV	Cowpea	Maize Hybrid
FFS member	-0.011	**-0.039*** **	**0.092*** **	0.008
	(0.012)	(0.015)	(0.019)	(0.021)
Package (A)	**0.215*** **	**0.075*** **	-0.010	
	(0.009)	(0.013)	(0.016)	
Investment Condition				
On-Truck sale	**-0.051*** **	**-0.083*** **	**-0.066*** **	**-0.084*** **
	(0.010)	(0.013)	(0.017)	(0.017)
Price of Seeds		**-0.010*** **	**-0.007*** **	**-0.004*** **
		(0.001)	(0.001)	(0.001)
Personal attributes				
Year(s) of Participation	**0.044*** **	0.005	**0.077*** **	**0.108*** **
	(0.011)	(0.013)	(0.018)	(0.017)
Gender (male)	**-0.026*** **	**-0.051*** **	**-0.028***	**-0.039*** **
	(0.009)	(0.011)	(0.015)	(0.015)
Age	0.000	0.002	0.001	0.005*
	(0.002)	(0.002)	(0.003)	(0.003)
Age squared	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Residential Area				
Gondola	**0.143*** **	**0.140*** **	**0.358*** **	**0.243*** **
	(0.022)	(0.020)	(0.031)	(0.055)
Macate	**-0.094*** **	-0.058*	-0.102**	0.047
	(0.029)	(0.030)	(0.051)	(0.089)
Manica	**-0.197*** **	-0.105***	-0.180***	-0.244***
	(0.018)	(0.028)	(0.039)	(0.024)
Sussundenga	**-0.199*** **	-0.075**	-0.085	-0.242***
	(0.022)	(0.030)	(0.055)	(0.033)
Vanduzi	**-0.106*** **	-0.094**	-0.165***	-0.109**
	(0.031)	(0.036)	(0.053)	(0.050)
Ribaue	**-0.053***	-0.159***	-0.360***	-0.267***
	(0.022)	(0.035)	(0.044)	(0.057)
Buzi	**-0.606*** **	-0.620***	-0.521***	-0.541***
	(0.014)	(0.020)	(0.016)	(0.045)
Gorogonsa	**0.183*** **	0.086***	0.165***	0.262***
	(0.012)	(0.018)	(0.038)	(0.020)
Maringue	0.026	0.192***	-0.141***	-0.335***
	(0.023)	(0.018)	(0.052)	(0.060)
Nhamatanda	**-0.139*** **	-0.168***	0.001	-0.209***
	(0.016)	(0.022)	(0.041)	(0.024)
AltoMoe	-0.002	-0.178***	-0.180***	-0.532***
	(0.028)	(0.036)	(0.056)	(0.034)
Gurue	**-0.062***	0.031	(dropped)	**-0.225*** **
	(0.027)	(0.035)		(0.048)
Freq.	0.666019	0.719471	0.522069	0.582515
p	0	0	0	0
Log-likelihood	-8389.8	-4621.76	-3354.75	-3362.16
Pseudo R2	0.1119	0.1332	0.1142	0.1218
Obs	14532	8688	5479	5602

Note; Standard Errors in parentheses. Asterisks: *, **, *** indicates statistical significance at 10%, 5%, 1% respectively

Multinomial logit model

The result from multinomial model shown in the Table 15 informs further insight on On-time investment. The significance in negative FFS effect on Timely Investment at the same time positive effect on Early Investment, indicates that FFS is likely to shift the investment timing to early. Likewise, Days-To-planting (DTP) OLS regression is again executed among on-time investors (who purchased inputs earlier to the end of seeding period), as detailed in Appendix 4. It proves that FFS member on overage invest 4.5 days earlier. Now the positive effect of FFS is recognized for all types of inputs.

It is again shown that On-truck sale is likely to delay the investment of beneficiaries. It is increasing the probability of delayed investment, and decreasing that of both the early and timely investment significantly. In terms of package variable, farmers in package A are showing to invest more on time rather than package B. As third point, more years of joining voucher scheme is also proven to shift the investment timing to early. This effect is quite similar to the effect of FFS. It should be noted that joining voucher in this variable means activation of voucher, not including for those registered and did not activate. Being consistent with the result of logit model above, it is again shown from the multinomial logit model that female farmers are more likely to invest on-time where they are less likely to be delayed, and more likely to timely invested. At last, age did not give any significance neither in the logit model above. Age is apparently not likely to affect the inputs investment timing, which is contradicting the hypothesis that age representing the level of experience is to be positively correlated with the favorable investment behaviors.

Discussion

Combining the results of those two logit models, important insight can be obtained. At first, FFS is though not significantly increasing the probability of on-time investment, is increasing that of early investment. This effect also varies across the different inputs. For example, FFS are already functioning positively on On-time investment for cowpea farmers while negatively for maize OPV. However, the effect that encourages the early investment within on-time investors is consistent across different inputs.

As notified by the DTP regression in Appendix 3, FFS members in package B particularly purchasing maize hybrid seeds are quite delayed in terms of investment timing, which is the case for fertilizers (urea and NPK) purchases as well. This finding informs of the problem that some maize hybrid is particularly the season-specific. maize hybrid in general requires seeding at the specific right period, so it can secure certain length of period (150 days) prior to cultivation. The delay of maize hybrid seeding may result in substantial loss considering the relatively higher price of seeds.

The results reported the consistent and strong effect of on-truck sale which was proven to delay the investment timing. It provokes the concern where time-scheduling of On-Truck sale seems inappropriate. Since the arrangement of truck is initiated by individual agro-dealer shops, not by farmers, the advisory toward to the agro-dealer shop or intervening the arrangement of on-truck sale may be useful. Also, positive effects were identified with year(s) of participation, meaning that the investment behaviors by farmers are have grown over time. In this vein, continuity of voucher schemes is to be promoted.

Table 15: Marginal effect estimation after multinomial logit regression

Variables	Dependent variable: Investment Timing		
	Early Investment	Timely Investment	Delayed Investment
FFS member	**0.038*** **	**-0.051*** **	0.013
	(0.010)	(0.013)	(0.012)
Package (A)	**0.055*** **	**0.162*** **	**-0.217*** **
	(0.007)	(0.009)	(0.009)
Investment Condition			
On-Truck sale	**-0.013***	**-0.038*** **	**0.052*** **
	(0.007)	(0.010)	(0.010)
Personal attributes			
Year(s) of Participation	**0.088*** **	**-0.049*** **	**-0.039*** **
	(0.008)	(0.011)	(0.011)
Gender (male)	-0.003	**-0.023** **	**0.026*** **
	(0.006)	(0.009)	(0.009)
Age	0.002	-0.001	-0.001
	(0.001)	(0.002)	(0.002)
Age squared	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Residential Area			
Gondola	-0.013	**0.158*** **	**-0.144*** **
	(0.017)	(0.025)	(0.022)
Macate	-0.031	**-0.063** **	**0.094*** **
	(0.019)	(0.029)	(0.029)
Manica	**-0.045*** **	**-0.151*** **	**0.196*** **
	(0.011)	(0.017)	(0.018)
Sussundenga	**-0.044*** **	**-0.155*** **	**0.199*** **
	(0.013)	(0.020)	(0.022)
Vanduzi	0.020	**-0.128*** **	**0.107*** **
	(0.023)	(0.029)	(0.031)
Ribaue	**0.059*** **	**-0.105*** **	**0.046** **
	(0.021)	(0.022)	(0.022)
Buzi	**-0.143*** **	**-0.460*** **	**0.603*** **
	(0.008)	(0.012)	(0.014)
Gorogonsa	**0.080*** **	**0.106*** **	**-0.185*** **
	(0.014)	(0.016)	(0.012)
Maringue	**0.141*** **	**-0.104*** **	-0.037
	(0.024)	(0.023)	(0.023)
Nhamatanda	**0.061*** **	**-0.193*** **	**0.132*** **
	(0.014)	(0.015)	(0.016)
AltoMoe	**0.081*** **	**-0.076*** **	-0.005
	(0.025)	(0.027)	(0.028)
Gurue	**-0.084*** **	0.009	**0.075*** **
	(0.016)	(0.027)	(0.028)
Freq.	0.1601795	0.50185562	0.33796488
p		0	
Log-likelihood		-13485.644	
Pseudo R2		0.0829	
Obs		14532	

Note; Standard Errors in parentheses. Asterisks: *, **, *** indicates statistical significance at 10%, 5%, 1% respectively

6.1.2. Simpson index

The results shown in Table 16. indicates that FFS are likely to increase the Simpson index, meaning that the pattern of purchasing inputs are diversified by FFS. It is also proven that the farmers in package B are likely to have higher index, and year(s) of participation also contributes to the higher index at 10%. On-Truck sale is decreasing the index, at least for the maize OPV and cowpea farmers. Other personal attributes variables such as Age and Gender did not show very strong results with consistency. Age is positively contributing to the higher index at 10% though the results are mixed over different inputs.

6.1.3. Frequency

The results shown in Table 17 present the strong positive effect of given by FFS on higher frequency. It implies that FFS members are more motivated to purchase the inputs multiple time at different time points. Although not many personal attributes variables are significant, one observation was that year(s) of participation are negatively affecting the frequency at 1% for across different inputs, contrary to the fact that Age is positively contributing to higher frequency significantly.

6.1.4. Balance

The results in Table 18 reveals that the FFS members are likely to have lower balance, meaning that they tried to maximize the benefit of vouchers rather than keeping for next year. Although its significance could be gained only for maize (OPV and hybrid), the negative sign attached to the FFS coefficients are at least consistent over different inputs. On-truck sale functions to decrease the balance at 10%. Other variables in particular the personal attributes were not very strong, which did yield any significance at more than 5%.

6.1.5. No. of Deposit

The results from Table 19 shows that the FFS are significantly increasing the No. of deposit. It implies that FFS members are more likely to have Depositing behaviors, which becomes even stronger in package B farmers as embedded by the negativity of package (A) variable. The results from personal attributes are neither strong, yet year(s) of participation are likely to increase the No. of deposit, it may imply that beneficiaries who are joining more years are understanding and trusting the e-card and increasing the intensity of use.

Discussions

Although the consistency cannot be fully gained, effect of FFS are is identified for all of the investment behaviors; positive effect on Simpson Index, Frequency and No. of Deposit, while negative effect on the balance amount. Results also inform that On-Truck sale is limiting the inputs choice and multiple investment. Since the seeding period differ across different types of inputs, this limitation hypothetically hampers the farmers' favorable investment behaviors. One interesting finding from Frequency determinants is that year(s) of participation and age has opposite sign with significance. A possible explanation can be that the single variable, year(s) of participation, does not deliver the information regarding the importance of higher frequency, which can only be grown by age-based experience, implying the importance of intervention and/or long-standing experiences and practices.

Table 16: OLS estimates on Simpson Index

Variables	All	Maize OPV	Cowpea	Maize Hybrid
FFS member	0.006	**0.013****	**0.024*****	0.002
	(-0.005)	(-0.006)	(-0.006)	(-0.008)
Package (A)	**-0.181*****	**-0.234*****	**-0.164*****	
	(-0.004)	(-0.005)	(-0.005)	
Investment Condition				
On-Truck sale	**-0.012*****	**-0.009***	**-0.041*****	-0.008
	(-0.004)	(-0.005)	(-0.006)	(-0.006)
Price of Seeds		**0.001*****	0.000	**0.001****
		(0.000)	(0.000)	(0.000)
Personal attributes				
Year(s) of Participation	**0.010****	**0.023*****	**0.011***	-0.002
	(-0.005)	(-0.005)	(-0.006)	(-0.006)
Gender (male)	-0.005	0.006	**0.015*****	**-0.026*****
	(-0.004)	(-0.004)	(-0.005)	(-0.005)
Age	**0.002****	0.001	**0.002***	0.000
	(-0.001)	(-0.001)	(-0.001)	(-0.001)
Age squared	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Residential Area				
Gondola	**-0.076*****	-0.016	**-0.216*****	**-0.156*****
	(-0.011)	(-0.011)	(-0.017)	(-0.028)
Macate	0.005	**0.034*****	**-0.055*****	0.046
	(-0.013)	(-0.012)	(-0.018)	(-0.034)
Manica	**0.225*****	**0.286*****	**0.087*****	**0.161*****
	(-0.008)	(-0.011)	(-0.013)	(-0.010)
Sussundenga	**0.120*****	**0.162*****	**0.047*****	**0.101*****
	(-0.009)	(-0.011)	(-0.017)	(-0.013)
Vanduzi	**0.143*****	**0.188*****	0.019	**0.129*****
	(-0.014)	(-0.013)	(-0.020)	(-0.019)
Ribaue	**0.078*****	**0.214*****	**-0.094*****	**0.091*****
	(-0.010)	(-0.012)	(-0.020)	(-0.024)
Buzi	**0.156*****	**0.258*****	**0.095*****	**0.127*****
	(-0.013)	(-0.013)	(-0.017)	(-0.039)
Gorogonsa	**-0.053*****	**0.129*****	**-0.065*****	**-0.135*****
	(-0.007)	(-0.008)	(-0.014)	(-0.009)
Maringue	**0.057*****	**0.267*****	**0.111*****	**-0.162*****
	(-0.011)	(-0.012)	(-0.019)	(-0.027)
Nhamatanda	**0.038*****	**0.140*****	-0.027*	0.000
	(-0.007)	(-0.008)	(-0.014)	(-0.009)
AltoMoe	**0.115*****	**0.240*****	**0.080*****	-0.005
	(-0.012)	(-0.012)	(-0.021)	(-0.048)
Gurue	**-0.231*****	**0.034****	0.033	**-0.387*****
	(-0.011)	(-0.015)	(-0.090)	(-0.020)
Constant	**0.455*****	**0.280*****	**0.592*****	**0.472*****
	(-0.016)	(-0.031)	(-0.041)	(-0.055)
Obs	15006	8688	5483	5602
R-sq	0.272	0.303	0.347	0.272
Adj R-sq	0.271	0.301	0.344	0.27

Note; Standard Errors in parenthese

Table 17: OLS estimates on frequency

Variables	All	Maize OPV	Cowpea	Maize Hybrid
FFS member	**0.021****	**0.059*****	**0.040*****	0.001
	(-0.010)	(-0.014)	(-0.015)	(-0.016)
Package (A)	0.009	-0.006	-0.015	
	(-0.007)	(-0.012)	(-0.012)	
Investment Condition				
On-Truck sale	-0.003	0.013	**0.028****	**-0.028****
	(-0.008)	(-0.012)	(-0.013)	(-0.012)
Price of Seeds		0.000	**-0.001*****	-0.001*
		(-0.001)	(0.000)	(0.000)
Personal attributes				
Year(s) of Participation	**-0.047*****	**-0.051*****	**-0.051*****	**-0.083*****
	(-0.009)	(-0.013)	(-0.014)	(-0.012)
Gender (male)	0	0.01	0.009	-0.003
	(-0.007)	(-0.010)	(-0.011)	(-0.011)
Age	**0.005*****	**0.006*****	**0.008*****	**0.003***
	(-0.001)	(-0.002)	(-0.002)	(-0.002)
Age squared	**-0.000*****	**-0.000****	**-0.000*****	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Residential Area				
Gondola	**-0.125*****	**-0.079*****	**-0.275*****	0.027
	(-0.020)	(-0.026)	(-0.038)	(-0.055)
Macate	**-0.125*****	**-0.085*****	**-0.265*****	-0.023
	(-0.023)	(-0.029)	(-0.040)	(-0.067)
Manica	**-0.171*****	**-0.154*****	**-0.293*****	**-0.196*****
	(-0.014)	(-0.025)	(-0.030)	(-0.019)
Sussundenga	**-0.090*****	0.016	**-0.172*****	**-0.133*****
	(-0.017)	(-0.027)	(-0.039)	(-0.026)
Vanduzi	**-0.222*****	**-0.170*****	**-0.303*****	**-0.297*****
	(-0.025)	(-0.031)	(-0.044)	(-0.037)
Ribaue	-0.02	**0.157*****	**0.081***	**-0.155*****
	(-0.018)	(-0.030)	(-0.046)	(-0.046)
Buzi	**-0.102*****	-0.03	**-0.309*****	**-0.245*****
	(-0.023)	(-0.031)	(-0.039)	(-0.076)
Gorogonsa	**-0.188*****	**-0.113*****	**-0.244*****	**-0.284*****
	(-0.012)	(-0.019)	(-0.031)	(-0.017)
Maringue	**-0.118*****	**-0.005**	**-0.149*****	**-0.295*****
	(-0.019)	(-0.028)	(-0.042)	(-0.053)
Nhamatanda	**-0.199*****	**-0.121*****	**-0.272*****	**-0.291*****
	(-0.013)	(-0.019)	(-0.031)	(-0.018)
AltoMoe	**0.701*****	**0.898*****	**1.027*****	**0.958*****
	(-0.022)	(-0.029)	(-0.048)	(-0.095)
Gurue	**-0.044****	**0.207*****	**0.931*****	**-0.174*****
	(-0.020)	(-0.037)	(-0.204)	(-0.038)
Constant	**1.150*****	**1.034*****	**1.360*****	**1.497*****
	(-0.030)	(-0.073)	(-0.092)	(-0.108)
Obs	15006	8688	5483	5602
R-sq	0.139	0.18	0.209	0.111
Adj R-sq	0.138	0.179	0.207	0.108

Note; Standard Errors in parentheses. Asterisks: *, **, *** indicates statistical significance at 10%, 5%, 1% respectively

Table 18: OLS estimates on Balance amount

Variables	All	Maize OPV	Cowpea	Maize Hybrid
FFS member	-1.425	**-8.696***	-6.000	**-10.795****
	(-4.144)	(-4.532)	(-4.053)	(-5.360)
Package (A)	-1.87	-0.346	-5.558	
	(-3.075)	(-3.996)	(-3.389)	
Investment Condition				
On-Truck sale	**-7.943****	**-7.209***	-4.108	-4.495
	(-3.361)	(-3.876)	(-3.556)	(-3.958)
Price of Seeds		0.265	**-0.379*****	**-0.625*****
		(-0.171)	(-0.139)	(-0.158)
Personal attributes				
Year(s) of Participation	-1.404	**-8.065***	-3.661	1.499
	(-3.762)	(-4.195)	(-3.829)	(-4.153)
Gender (male)	4.308	3.64	1.741	2.418
	(-2.961)	(-3.424)	(-3.093)	(-3.603)
Age	**0.912***	0.517	-0.409	0.562
	(-0.500)	(-0.580)	(-0.555)	(-0.650)
Age squared	-0.008	-0.003	0.006	-0.005
	(-0.005)	(-0.006)	(-0.006)	(-0.007)
Residential Area				
Gondola	**27.887*****	**23.629*****	**30.464*****	**52.869*****
	(-8.582)	(-8.358)	(-10.555)	(-18.890)
Macate	12.233	9.146	12.328	11.741
	(-9.773)	(-9.493)	(-11.123)	(-22.958)
Manica	-8.271	**-21.159*****	-7.663	**-11.487***
	(-6.093)	(-8.208)	(-8.378)	(-6.435)
Sussundenga	**25.490*****	14.185	6.828	**25.974*****
	(-7.149)	(-8.796)	(-10.943)	(-8.756)
Vanduzi	**-24.667****	**-23.440****	-15.689	**-25.826****
	(-10.415)	(-10.248)	(-12.308)	(-12.493)
Ribaue	10.107	**19.075****	**29.788****	**-47.244*****
	(-7.595)	(-9.640)	(-12.788)	(-15.837)
Buzi	-0.918	-7.027	0.353	-15.078
	(-9.762)	(-10.052)	(-10.888)	(-25.785)
Gorogonsa	**-17.277*****	**-21.107*****	-9.741	**-20.283*****
	(-5.189)	(-6.279)	(-8.665)	(-5.730)
Maringue	**19.351****	**30.272*****	**36.703*****	**43.377****
	(-8.173)	(-9.205)	(-11.648)	(-18.088)
Nhamatanda	3.865	1.426	5.223	-3.073
	(-5.465)	(-6.233)	(-8.747)	(-6.202)
AltoMoe	**115.946*****	**107.644*****	**131.368*****	**108.446*****
	(-9.388)	(-9.469)	(-13.363)	(-32.306)
Gurue	**27.953*****	**36.892*****	45.29	12.742
	(-8.486)	(-11.911)	(-56.610)	(-13.073)
Constant	4.737	-6.67	**78.026*****	**135.278*****
	(-12.522)	(-23.887)	(-25.549)	(-36.810)
Obs	15006	8688	5483	5602
R-sq	0.022	0.036	0.043	0.018
Adj R-sq	0.021	0.034	0.039	0.015

Note; Standard Errors in parentheses. Asterisks: *, **, *** indicates statistical significance at 10%, 5%, 1% respectively

Table 19: OLS estimates on No. of Deposit

Variables	All	Maize OPV	Cowpea	Maize Hybrid
FFS member	**0.017*** **	**0.019*** **	**0.011*** **	**0.007***
	(-0.003)	(-0.003)	(-0.004)	(-0.004)
Package (A)	**-0.006*** **	**-0.008*** **	**-0.011*** **	
	(-0.002)	(-0.003)	(-0.003)	
Investment Condition				
On-Truck sale	0.000	-0.003	0.001	0.002
	(-0.002)	(-0.003)	(-0.003)	(-0.003)
Price of Seeds		**0.000** **	**-0.000***	0.000
		(0.000)	(0.000)	(0.000)
Personal attributes				
Year(s) of Participation	**0.006*** **	0.004	**0.007** **	0.005
	(-0.002)	(-0.003)	(-0.004)	(-0.003)
Gender (male)	0.001	0.002	0.003	-0.002
	(-0.002)	(-0.003)	(-0.003)	(-0.003)
Age	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(-0.001)	(-0.001)
Age squared	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Residential Area				
Gondola	-0.001	-0.002	-0.009	0.013
	(-0.005)	(-0.006)	(-0.010)	(-0.015)
Macate	**0.015** **	**0.012***	**0.029*** **	-0.007
	(-0.006)	(-0.007)	(-0.010)	(-0.018)
Manica	**-0.009** **	**-0.016*** **	**-0.024*** **	0.000
	(-0.004)	(-0.006)	(-0.008)	(-0.005)
Sussundenga	0.007	0.003	-0.016	0.012*
	(-0.004)	(-0.006)	(-0.010)	(-0.007)
Vanduzi	-0.007	-0.008	**-0.023** **	0.001
	(-0.006)	(-0.008)	(-0.011)	(-0.010)
Ribaue	**0.028*** **	**0.032*** **	**0.027** **	**0.033*** **
	(-0.005)	(-0.007)	(-0.012)	(-0.012)
Buzi	-0.004	-0.004	-0.014	-0.007
	(-0.006)	(-0.007)	(-0.010)	(-0.020)
Gorogonsa	-0.001	0.000	**-0.015***	-0.002
	(-0.003)	(-0.005)	(-0.008)	(-0.004)
Maringue	-0.005	-0.007	**-0.018***	0.012
	(-0.005)	(-0.007)	(-0.011)	(-0.014)
Nhamatanda	-0.004	-0.005	**-0.018** **	-0.003
	(-0.003)	(-0.005)	(-0.008)	(-0.005)
AltoMoe	**0.046*** **	**0.046*** **	**0.082*** **	**0.212*** **
	(-0.006)	(-0.007)	(-0.012)	(-0.025)
Gurue	**0.013** **	**0.030*** **	-0.014	0.005
	(-0.005)	(-0.009)	(-0.052)	(-0.010)
Constant	**0.998*** **	**0.975*** **	**1.052*** **	**0.977*** **
	(-0.008)	(-0.018)	(-0.024)	(-0.028)
Obs	15006	8688	5483	5602
R-sq	0.015	0.02	0.033	0.02
Adj R-sq	0.014	0.018	0.03	0.016

Note; Standard Errors in parentheses. Asterisks: *, **, *** indicates statistical significance at 10%, 5%, 1% respectively

6.2. Interaction Effect

By responding to the research questions 3), the effect of interaction between FFS and voucher package is not investigated. To do this, new variable FFS*package(A) was computed and added to the previous regressions. As described in 5.2.4, Once the interactive term is added into the model, the interpretation of the coefficients is changed. The coefficient of FFS is now interpreted as the unique effect of FFS when package value = 0 (Package B) while the unique effect of FFS when package value = 1 (Package A) can be taken by summing the coefficients of FFS and interactive term. It should be noted that comparison between inputs is hereby limited to maize OPV and Cowpea only since maize hybrid is made available only in package B, which dropped out the inclusion of package selection variable.

6.2.1. Timing

Logit model

The coefficients of interaction variable are all shown to be significantly positive across different inputs, meaning that interaction between FFS membership and package (A) is increasing the probabilities that the farmers invest on-time. The strong positive effect gained from this interaction (0.055) overcome the unique negative effect by FFS membership (-0.039). Although the magnitude of the strength behind this interactive effect varies by inputs, the positivity of the interactive effect is confirmed for all of the inputs.

Multinomial logit model

The interactive variable turned out to be significant for the timely investment (positive at 1%), and delayed investment (negative at 1%). By checking the value of coefficients, it tells that effect through interactive variable are not overcoming, however are mitigating the unfavorable sign attached to the unique FFS variable (positive on timely investment and positive on delayed investment).

Discussion

The results above deliver the important insight and enable us to understand the detailed mechanism embedded by the two interventions; FFS and Voucher. At first, it proves the possible strong interactive effect by combining the FFS and voucher package (A), meaning also that the stronger impact is being created among subsistence farmers (package A farmers) rather than relatively wealthy farmers (package B farmers). As seen in the previous regression without interaction variable, FFS membership alone is likely to give negative effect on timely investment, and (insignificant but) positive effect on delayed investment. However, we now understand that those undesirable effects on on-time investment through FFS alone are likely to be mitigated by the interactive term. It clearly shows that the favorable investment behaviors are shaped even through the interactive context between FFS and voucher scheme among subsistence farmers.

Table 20: Marginal effect estimation after Logit regression on On-time investment with interaction variable

Variables	Dependent variable: Investment Timing (1 = On-time investment)		
	All	Maize OPV	Cowpea
FFS member	**-0.039****	**-0.107*****	0.029
	(0.017)	(0.029)	(0.030)
Package (A)	**0.206*****	**0.062*****	**-0.030***
	(0.009)	(0.014)	(0.017)
FFS × Package (A)	**0.055****	**0.082*****	**0.104*****
	(0.022)	(0.026)	(0.037)
Investment Condition			
On-Truck sale	**-0.052*****	**-0.084*****	**-0.066*****
	(0.010)	(0.013)	(0.017)
Price of Seeds		**-0.010*****	**-0.007*****
		(0.001)	(0.001)
Personal attributes			
Year(s) of Participation	**0.044*****	0.003	**0.077*****
	(0.011)	(0.013)	(0.018)
Gender (male)	**-0.026*****	**-0.050*****	**-0.028***
	(0.009)	(0.011)	(0.015)
Age	0.000	0.002	0.001
	(0.002)	(0.002)	(0.003)
Age squared	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Residential Area			
Gondola	**0.144*****	**0.140*****	**0.359*****
	(0.022)	(0.020)	(0.031)
Macate	**-0.094*****	**-0.060****	**-0.104****
	(0.029)	(0.030)	(0.051)
Manica	**-0.196*****	**-0.113*****	**-0.177*****
	(0.018)	(0.029)	(0.038)
Sussundenga	**-0.198*****	**-0.076****	-0.081
	(0.022)	(0.030)	(0.055)
Vanduzi	**-0.103*****	**-0.088****	**-0.166*****
	(0.031)	(0.036)	(0.053)
Ribaue	**-0.053****	**-0.163*****	**-0.358*****
	(0.022)	(0.035)	(0.045)
Buzi	**-0.606*****	**-0.621*****	**-0.522*****
	(0.014)	(0.020)	(0.016)
Gorogonsa	**0.183*****	**0.085*****	**0.166*****
	(0.012)	(0.018)	(0.038)
Maringue	0.027	**0.191*****	**-0.142*****
	(0.023)	(0.019)	(0.052)
Nhamatanda	**-0.137*****	**-0.167*****	0.005
	(0.016)	(0.022)	(0.041)
AltoMoe	-0.004	**-0.184*****	**-0.188*****
	(0.028)	(0.036)	(0.056)
Gurue	**-0.060****	0.031	
	(0.027)	(0.035)	
Freq.	0.66591185	0.71948823	0.52213413
p	0	0	0
Log-likelihood	-8386.8671	-4617.6302	-3350.9533
Pseudo R2	0.1122	0.134	0.1152
Obs	14532	8688	5479

Note; Standard Errors in parentheses. Asterisks: *, **, *** indicates statistical significance at 10%, 5%, 1% respectively

Table 21: Marginal effect estimation after Multinomial Logit regression with interaction variable

Variables	Dependent variable: Investment Timing		
	Early Investment	Timely investment	Delayed Investment
FFS membership	**0.057*** **	**-0.099*** **	**0.042** **
	(0.016)	(0.019)	(0.017)
Package (A)	**0.058*** **	**0.150*** **	**-0.208*** **
	(0.007)	(0.010)	(0.009)
FFS × Package (A)	-0.024	**0.085*** **	**-0.061*** **
	(0.015)	(0.025)	(0.022)
Investment Condition			
On-Truck sale	**-0.013***	**-0.038*** **	**0.052*** **
	(0.007)	(0.010)	(0.010)
Personal attributes			
Year(s) of Participation	**0.088*** **	**-0.050*** **	**-0.038*** **
	(0.008)	(0.012)	(0.011)
Gender (male)	-0.003	**-0.022** **	**0.026*** **
	(0.006)	(0.009)	(0.009)
Age	0.002	-0.001	-0.001
	(0.001)	(0.002)	(0.002)
Age squared	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Residential Area			
Gondola	-0.013	**0.158*** **	**-0.145*** **
	(0.017)	(0.025)	(0.022)
Macate	**-0.031***	**-0.062** **	**0.093*** **
	(0.019)	(0.028)	(0.029)
Manica	**-0.045*** **	**-0.150*** **	**0.195*** **
	(0.011)	(0.017)	(0.018)
Sussundenga	**-0.044*** **	**-0.154*** **	**0.199*** **
	(0.013)	(0.020)	(0.022)
Vanduzi	0.020	**-0.124*** **	**0.105*** **
	(0.023)	(0.030)	(0.032)
Ribaue	**0.059*** **	**-0.106*** **	**0.047** **
	(0.021)	(0.022)	(0.022)
Buzi	**-0.143*** **	**-0.460*** **	**0.603*** **
	(0.008)	(0.011)	(0.014)
Gorogonsa	**0.079*** **	**0.106*** **	**-0.185*** **
	(0.014)	(0.016)	(0.012)
Maringue	**0.140*** **	**-0.103*** **	-0.037
	(0.024)	(0.023)	(0.023)
Nhamatanda	**0.060*** **	**-0.191*** **	**0.131*** **
	(0.014)	(0.015)	(0.016)
AltoMoe	**0.082*** **	**-0.079*** **	-0.003
	(0.025)	(0.027)	(0.028)
Gurue	**-0.084*** **	0.012	**0.072*** **
	(0.016)	(0.027)	(0.028)
Freq.	0.16020567	0.50158459	0.33820974
p		0	
Log-likelihood		-13480.084	
Pseudo R2		0.0833	
Obs		14532	

Note; Standard Errors in parentheses. Asterisks: *, **, *** indicates statistical significance at 10%, 5%, 1% respectively

6.2.2. Simpson

Interaction effect on Simpson index yielded similar result with timing variable above (see table 24 below). Interactive variables are likely to offset the negative value attached to the unique FFS variable. In this case, it tells that FFS can be positively related to Simpson index among subsistence farmers in package A, while negatively related among relatively wealthy farmers in package B. Although the unique effect by package (A) remain negative, the interactive impact together with FFS are giving positive influence.

6.2.3. Frequency

The results shown in Table 23. are not very strong, meaning that frequency behavior is not likely to be determined by the interactive term over FFS and voucher package (A). The result where only FFS variable shows significant positivity, is consistent to the previous regression result without interaction term as well.

6.2.4. Balance Amount

Speaking of significance, the results concerning significance are quite similar to the previous results without interactive variable, which informs the insignificant effect created through interaction. However, by looking at the value of coefficients, the negative coefficient of FFS for Maize OPV for example, turned out to be decreased after adding the interactive term. The coefficient of FFS which was -8.686 (10% significance) were now decreased down to -14.754 (10% significance), while the interactive variable computes positive coefficient (although not significant).

6.2.5. No. of Deposits

The results (see Table 25) shows negative interactive effect except for cowpea farmers. Alike the previous results without interactive term, coefficients of the unique FFS variable remain positive with significance, meaning that FFS are giving positive effects on number of deposits among package B farmers to greater extent.

Discussion

The results through interaction analysis delivers some insights enabling us to understand the possible effect given to the specific category of farmers across FFS membership and package section. At first, it was revealed that the effect of FFS can be mixed according to the package; positive among package A farmers, and negative on package B farmers. Even though the total value and inputs choice are greater in package B, concerning the influence on Simpson index given to the farmers, package A farmers are more likely to change the behavior though the intervention. Secondly, Frequency behavior is shown not to be determined through interactive context but only through FFS membership regardless to the voucher packages. It possibly implies that the bottom-up mechanism such as FFS is required to increase the frequency behavior of farmers. Regarding the Balance amount, FFS membership with package B is proven to keep lower amount of balance in e-cards rather than FFS member in package A (maize OPV farmers). It implies the effect of FFS where relatively wealthy (package B) farmers are more likely to develop the behavior to maximize the benefit spent for inputs. At last, it was strongly proven that the effect of FFS in terms of increasing the No. of deposits, is stronger in package B. Regarding the development of deposit behaviors, it now proves that the farmers with access to extension service such as FFS, and relatively bigger and wealthy (package B) may be the most effect target group to be focused.

Table 22: OLS estimates on Simpson Index with interaction variable

Variables	All	Maize OPV	Cowpea
FFS member	-0.012	**-0.027****	0.011
	(-0.008)	(-0.011)	(-0.010)
Package (A)	**-0.186*****	**-0.242*****	**-0.168*****
	(-0.004)	(-0.005)	(-0.006)
FFS × Package (A)	**0.030*****	**0.053*****	0.020
	(-0.011)	(-0.013)	(-0.013)
Investment Condition			
On-Truck sale	**-0.012*****	**-0.010***	**-0.041*****
	(-0.004)	(-0.005)	(-0.006)
Price of Seeds	0.000	**0.001*****	0.000
	(0.000)	(0.000)	(0.000)
Personal attributes			
Year(s) of Participation	**0.010****	**0.022*****	**0.010***
	(-0.005)	(-0.005)	(-0.006)
Gender (male)	-0.005	0.006	**0.015*****
	(-0.004)	(-0.004)	(-0.005)
Age	**0.002****	0.001	**0.002***
	(-0.001)	(-0.001)	(-0.001)
Age squared	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Residential Area			
Gondola	**-0.076*****	-0.016	**-0.216*****
	(-0.011)	(-0.011)	(-0.017)
Macate	0.005	**0.033*****	**-0.055*****
	(-0.013)	(-0.012)	(-0.018)
Manica	**0.226*****	**0.283*****	**0.088*****
	(-0.008)	(-0.011)	(-0.013)
Sussundenga	**0.120*****	**0.162*****	**0.047*****
	(-0.009)	(-0.011)	(-0.017)
Vanduzi	**0.145*****	**0.192*****	0.019
	(-0.014)	(-0.013)	(-0.020)
Ribaue	**0.078*****	**0.213*****	**-0.093*****
	(-0.010)	(-0.012)	(-0.020)
Buzi	**0.155*****	**0.256*****	**0.094*****
	(-0.013)	(-0.013)	(-0.017)
Gorogonsa	**-0.052*****	**0.128*****	**-0.064*****
	(-0.007)	(-0.008)	(-0.014)
Maringue	**0.057*****	**0.266*****	**0.111*****
	(-0.011)	(-0.012)	(-0.019)
Nhamatanda	**0.039*****	**0.141*****	**-0.026***
	(-0.007)	(-0.008)	(-0.014)
AltoMoe	**0.114*****	**0.237*****	**0.079*****
	(-0.012)	(-0.012)	(-0.021)
Gurue	**-0.230*****	**0.034****	0.035
	(-0.011)	(-0.015)	(-0.090)
Constant	**0.457*****	**0.284*****	**0.593*****
	(-0.016)	(-0.031)	(-0.041)
Obs	15006	8688	5483
R-sq	0.272	0.304	0.347
Adj R-sq	0.271	0.303	0.344

Note; Standard Errors in parentheses. Asterisks: *, **, *** indicates statistical significance at 10%, 5%, 1% respectively

Table 23: OLS estimates on Frequency with interaction variable

Variables	All	Maize OPV	Cowpea
FFS member	0.012	**0.082*** **	**0.067*** **
	(-0.015)	(-0.027)	(-0.024)
Package (A)	0.007	-0.002	-0.008
	(-0.008)	(-0.013)	(-0.013)
FFS × Package (A)	0.017	-0.031	-0.043
	(-0.019)	(-0.031)	(-0.029)
Investment Condition			
On-Truck sale	-0.003	0.013	**0.028** **
	(-0.008)	(-0.012)	(-0.013)
Price of Seeds	0.000	0.000	**-0.001*** **
	(0.000)	(-0.001)	(0.000)
Personal attributes			
Year(s) of Participation	**-0.047*** **	**-0.050*** **	**-0.050*** **
	(-0.009)	(-0.013)	(-0.014)
Gender (male)	0.000	0.010	0.008
	(-0.007)	(-0.010)	(-0.011)
Age	**0.005*** **	**0.006*** **	**0.008*** **
	(-0.001)	(-0.002)	(-0.002)
Age squared	**-0.000*** **	**-0.000** **	**-0.000*** **
	(0.000)	(0.000)	(0.000)
Residential Area			
Gondola	**-0.125*** **	**-0.079*** **	**-0.275*** **
	(-0.020)	(-0.026)	(-0.038)
Macate	**-0.125*** **	**-0.084*** **	**-0.264*** **
	(-0.023)	(-0.029)	(-0.040)
Manica	**-0.171*** **	**-0.153*** **	**-0.295*** **
	(-0.014)	(-0.025)	(-0.030)
Sussundenga	**-0.089*** **	0.016	**-0.174*** **
	(-0.017)	(-0.027)	(-0.039)
Vanduzi	**-0.221*** **	**-0.172*** **	**-0.303*** **
	(-0.025)	(-0.031)	(-0.044)
Ribaue	-0.020	**0.158*** **	**0.080***
	(-0.018)	(-0.030)	(-0.046)
Buzi	**-0.102*** **	-0.029	-0.308***
	(-0.023)	(-0.031)	(-0.039)
Gorogonsa	**-0.188*** **	**-0.112*** **	**-0.245*** **
	(-0.012)	(-0.019)	(-0.031)
Maringue	**-0.117*** **	-0.004	**-0.149*** **
	(-0.019)	(-0.028)	(-0.042)
Nhamatanda	**-0.198*** **	**-0.121*** **	**-0.273*** **
	(-0.013)	(-0.019)	(-0.031)
AltoMoe	**0.700*** **	**0.899*** **	**1.030*** **
	(-0.022)	(-0.029)	(-0.048)
Gurue	**-0.043** **	**0.207*** **	**0.927*** **
	(-0.020)	(-0.037)	(-0.204)
Constant	**1.151*** **	**1.032*** **	**1.358*** **
	(-0.030)	(-0.073)	(-0.092)
Obs	15006	8688	5483
R-sq	0.139	0.181	0.21
Adj R-sq	0.138	0.179	0.207

Note; Standard Errors in parentheses. Asterisks: *, **, *** indicates statistical significance at 10%, 5%, 1% respectively

Table 24: OLS estimates on Balance amount with interaction variable

Variables	All	Maize OPV	Cowpea
FFS member	0.950	**-14.754***	-10.147
	(-6.195)	(-8.845)	(-6.603)
Package (A)	-1.264	-1.452	**-6.696***
	(-3.292)	(-4.229)	(-3.678)
FFS × Package (A)	-4.173	8.120	6.401
	(-8.089)	(-10.180)	(-8.047)
Investment Condition			
On-Truck sale	**-7.936****	**-7.348***	-4.116
	(-3.362)	(-3.880)	(-3.556)
Price of Seeds	0.000	0.269	-0.377***
	(0.000)	(-0.171)	(-0.139)
Personal attributes			
Year(s) of Participation	-1.370	**-8.220***	-3.712
	(-3.763)	(-4.200)	(-3.829)
Gender (male)	4.289	3.669	1.755
	(-2.962)	(-3.424)	(-3.093)
Age	**0.913***	0.513	-0.406
	(-0.500)	(-0.580)	(-0.555)
Age squared	-0.008	-0.003	0.006
	(-0.005)	(-0.006)	(-0.006)
Residential Area			
Gondola	**27.860*****	**23.631*****	**30.463*****
	(-8.582)	(-8.358)	(-10.555)
Macate	12.203	9.019	12.217
	(-9.773)	(-9.494)	(-11.125)
Manica	-8.411	**-21.620*****	-7.379
	(-6.099)	(-8.229)	(-8.386)
Sussundenga	**25.446*****	14.139	7.030
	(-7.150)	(-8.796)	(-10.946)
Vanduzi	**-24.883****	**-22.887****	-15.705
	(-10.424)	(-10.272)	(-12.308)
Ribaue	10.141	18.816*	29.932**
	(-7.596)	(-9.645)	(-12.790)
Buzi	-0.806	-7.284	0.233
	(-9.765)	(-10.057)	(-10.889)
Gorogonsa	**-17.313*****	**-21.221*****	-9.703
	(-5.190)	(-6.281)	(-8.666)
Maringue	**19.336****	**30.113*****	**36.687*****
	(-8.173)	(-9.207)	(-11.648)
Nhamatanda	3.728	1.491	5.452
	(-5.471)	(-6.233)	(-8.752)
AltoMoe	**116.085*****	**107.318*****	**130.951*****
	(-9.392)	(-9.478)	(-13.374)
Gurue	**27.765*****	**36.870*****	45.848
	(-8.494)	(-11.912)	(-56.617)
Constant	4.454	-6.049	**78.267*****
	(-12.535)	(-23.900)	(-25.551)
Obs	15006	8688	5483
R-sq	0.022	0.036	0.043
Adj R-sq	0.021	0.034	0.039

Note; Standard Errors in parentheses. Asterisks: *, **, *** indicates statistical significance at 10%, 5%, 1% respectively

Table 25: OLS estimates on No. of Deposit with interaction variable

Variables	All	Maize OPV	Cowpea
FFS member	**0.022*** **	**0.032*** **	**0.010***
	(-0.004)	(-0.006)	(-0.006)
Package (A)	**-0.004****	**-0.006***	**-0.011*** **
	(-0.002)	(-0.003)	(-0.003)
FFS × Package (A)	**-0.009***	**-0.017****	0.000
	(-0.005)	(-0.007)	(-0.007)
Investment Condition			
On-Truck sale	0.000	-0.002	0.001
	(-0.002)	(-0.003)	(-0.003)
Price of Seeds	0.000	**0.000****	**-0.000***
	(0.000)	(0.000)	(0.000)
Personal attributes			
Year(s) of Participation	**0.006*** **	0.004	**0.007****
	(-0.002)	(-0.003)	(-0.004)
Gender (male)	0.001	0.002	0.003
	(-0.002)	(-0.003)	(-0.003)
Age	0.000	0.000	0.000
	(0.000)	(0.000)	(-0.001)
Age squared	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Residential Area			
Gondola	-0.001	-0.002	-0.009
	(-0.005)	(-0.006)	(-0.010)
Macate	**0.015****	**0.012***	**0.029*** **
	(-0.006)	(-0.007)	(-0.010)
Manica	**-0.010****	**-0.015****	**-0.024*** **
	(-0.004)	(-0.006)	(-0.008)
Sussundenga	0.007	0.003	-0.016
	(-0.004)	(-0.006)	(-0.010)
Vanduzi	-0.007	-0.009	**-0.023****
	(-0.006)	(-0.008)	(-0.011)
Ribaue	**0.028*** **	**0.033*** **	**0.027****
	(-0.005)	(-0.007)	(-0.012)
Buzi	-0.004	-0.004	-0.014
	(-0.006)	(-0.007)	(-0.010)
Gorogonsa	-0.001	0.000	**-0.015***
	(-0.003)	(-0.005)	(-0.008)
Maringue	-0.005	-0.007	**-0.018***
	(-0.005)	(-0.007)	(-0.011)
Nhamatanda	-0.004	-0.005	**-0.018****
	(-0.003)	(-0.005)	(-0.008)
AltoMoe	**0.046*** **	**0.046*** **	**0.082*** **
	(-0.006)	(-0.007)	(-0.012)
Gurue	**0.013****	**0.030*** **	-0.014
	(-0.005)	(-0.009)	(-0.052)
Constant	**0.997*** **	**0.974*** **	**1.052*** **
	(-0.008)	(-0.018)	(-0.024)
Obs	15006	8688	5483
R-sq	0.015	0.021	0.033
Adj R-sq	0.014	0.019	0.029

Note; Standard Errors in parentheses. Asterisks: *, **, *** indicates statistical significance at 10%, 5%, 1% respectively

7. Conclusion and Recommendations

7.1. Conclusion

The effect of Farmers Field School (FFS)

It was revealed that the FFS leads to influential change in farmers' behaviors in multiple ways. At first, the effect of FFS given on on-time investment was not strongly proven, whether insignificant or even negative (maize OPV). However, by narrowing down to on-time investors sub-samples, it is increasing the probabilities that farmers invest earlier, on average 4.5 days than Non-members. This positive effect was observed as significant consistently over different seeds such as maize OPV, cowpea, and maize hybrid. Apart from investment timing, the effect of FFS is mixed on other investment behavioral variables. Positive effects are likely to be observed for the Simpson Index (maize OPV and cowpea farmers with significance), Frequency, and No. of Deposit, while negative effects on Balance amount (for maize farmers with significance). It is proven that FFS are functioning to the extent that farmers are changing their investment behaviors.

Interactive effects between FFS and Voucher Package

In addition, the discussion of interactive effects informs debates over the voucher impact given to specific segments, FFS member as subsistence farmers (package A), and FFS member as emerging farmers (package B). It is concluded that strong interactive effect was gained for the change in Timing, Simpson Index, and No. of Deposits. As for the Timing, stronger impact is created for FFS member in package A farmers. The favorable changes in timing investment (increase in on-time investment, and decrease in delayed investment) are shaped through the interactive between FFS membership and voucher scheme among subsistence farmers (package A). Regarding the Simpson index, it showed that the unique effect by FFS is negative, which is however overcome by the strong positive effect through interaction with voucher (package A). The other way around, the effect of interaction over No. of Deposits are negative, meaning that effect of FFS in terms of increasing the No. of deposits, is stronger in emerging farmers (package B).

Other influential factors

On-Truck sale

The use of On-truck sale is shown to determine the farmers' behaviors in particular for Timing, Simpson index, and Balance amount. By considering that On-Truck sale typically prepare the 'packaged set of inputs' to increase the outreach and sale efficiency, it is decreasing the diversity of choice by farmers, while maximizing the amount spent for inputs (which represents the low balance amount). In addition, On-Truck sale is delaying the inputs purchase by farmers on average 11.06 days, which may need to be improved. On the other hand, On-truck sale is also effective in decreasing the balance amount, which in turn increases the value spent for inputs.

Year(s) of participation

The year(s) of participation indicated the similar effect (sign and magnitude of change) with FFS in terms of all of the investment behavioral indicators except for Frequency. It implies that an extra year of joining voucher scheme is giving as much effect as being FFS membership. However, Frequency is an exception, where it cannot be shaped by participation but by FFS or by experiences by Age. It leads to the finding that there is variation in terms of determinants that change the farmers' behavior over investment. particularly, purchase frequency can be developed through the experience-based intervention such as FFS.

Gender

Gender variables are strongly significant in timing variables where female farmers are more likely to invest on-time. Especially, female farmers have higher probabilities of timely investment and and less probabilities of delayed investment.

7.2. Recommendation

Policy recommendation

Improvement of On-Truck sale

The most problematic fact behind On-Truck sale is that the investment timing is delayed, which potentially aggravate the farm productivity. Since the On-Truck sale is internally organized by the agro-dealer shop, it is recommended to intervene to improve the time-scheduling of On-Truck sale. Although On-Truck sale is also limiting certain behaviors such as purchase diversity, it is still an indispensable way to expand the outreach of inputs to remote rural areas. On the other hand, it is telling that the investment behavior by rural subsistence farmers are to some extent dependent on the On-Truck sale. In this vein, first and strong recommendation is raised to put the priority on it. It is expected give instant impact to lead a change in many farmers.

Farmers Field School (FFS)

It is hereby recommended that more expansion of FFS are favorable for the change in farmers' investment behaviors. Speaking of the efficacy of making a change, the combination between FFS and voucher is proven to be powerful mostly in subsistence farmers (except for deposit behaviors). Research also proposed one concern behind FFS that FFS members in package B are currently delayed in purchasing maize hybrid, and fertilizers (on the assumption that fertilizers should be purchased for maize hybrid). It is thus crucial to announce through FFS that farmers choosing maize hybrid to grow, should put extra attention on seeding period. This is also because that the seeding period of maize hybrid ends two weeks earlier to that of maize OPV, which should be re-announced to the package B farmers.

Gender impact

Gender

According to our results telling that female farmers are more likely to perform in favorable way in terms of investment timing, it also means that the announcement to incentivize farmers to invest on-time should be toward male farmers. Through the agro-dealers, or extension service including FFS, it is more efficient to direct the knowledge transfer to male farmers in the context of impact.

Credit provision

At last, the potential of microfinancing is to be mentioned in relation also to future studies. From the qualitative interview, it was revealed that lack of money is the major reason which delays the inputs investment and ultimately made the use of voucher (activation) impossible. In parallel, majority of the rural farmers in Mozambique have no access to any financial service, where financial inclusion becomes national assignment.

Together with the results showing that the deposit behavior is most effectively shaped by the beneficiaries who are FFS member in package B, the possibility to pilot the financial inclusion scheme is proposed with this specific group. The monitoring of the investment behavior is now enabled with the use of e-cards, where we can also screen out the untrustworthy beneficiaries. By considering that the purchase of fertilizers (Urea and NPK) are increased at the end of the agri-season, which is possibly indicating that some beneficiaries are using them for horticultural commodities, the given credit can also be unutilized for the purpose of expanding the farming business.

Recommendations on further research

To further investigate and gain a complete picture of the investment behaviors, and especially their causality, future follow up research is highly recommended. Since the scope of the research within this paper is based entirely on cross-sectional data, the panel data analysis by adding lagged values are recommended. Above, for more precise analysis on the package choice, an advantaged research strategy is required to overcome the endogenous problem behind package selection. At last, the research on relationship investment behaviors and farm productivities are to be fulfilled to understand the causality. It is highly recommended to collect the yield data from the same beneficiaries next year, which enabled the panel data analysis to control the time-invariant variables.

References

Abay, K. A., Berhane, G., Taffesse, A. S., Koru, B., & Abay, K. (2016). Understanding farmers' technology adoption decisions: Input complementarity and heterogeneity. Ethiopia *Strategy Support Program Working Paper*, 82.

Abay, K., & Hirvonen, K. (2016). Does market access mitigate the impact of seasonality on child growth? Panel data evidence from northern Ethiopia. The *Journal of Development Studies*, 1-16.

Alampay, E., & Bala, G. (2009). Mobile 2.0: M-money for the BoP in the Philippines.

Ali, A., Rahut, D. B., Behera, B., & Imtiaz, M. (2015). Farmers' Access to Certified Wheat Seed and its Effect on Poverty Reduction in Pakistan. Journal *of Crop Improvement*, 29(2), 247-265.

Awotide, D. O., Kehinde, A. L., & Adejobi, A. O. (2004). Determinants of fertilizer usage by upland rice farmers in Ogun State of Nigeria. Bowen *Journal of Agriculture*, 1(2), 108-116.

Babalola, A. S. (1988). Tobacco farming and women in rural community of Nigeria. African *Notes: Bulletin of the Institute of African Studies, University of Ibadan*, (3), 39-44.

Banco de Moçambique (2015) Estrategia Nacional de Incsao Financeira 2016-2022

Baxter, M., Allwright, L., & Lda, O. (2015). Opportunities to Improve Financial Inclusion in Mozambique: Building on Investments and Economic Activities Associated with the Extractives Sector. Report *by OzMozis for FSDMoç (Financial Sector Deepening–Mozambique)*.

Behe, B. K., & Wolnick, D. J. (1991). Type of floral product purchased and demographic characteristics and floral knowledge of consumers. HortScience, 26(4), 414-416.

Bharadwaj, K. (1974). Notes on farm size and productivity. Economic *and Political Weekly*, A11-A24.

Bijlmakers, H., & Islam, M. A. (2007). Changing the strategies of farmer field schools in Bangladesh. LEISA-LEUSDEN-, 23(4), 21.

Bravo-Ureta, B. E., Moreira, V. H., Arzubi, A. A., Schilder, E. D., Álvarez, J., & Molina, C. (2008). Technological change and technical efficiency for dairy farms in three countries of South America. Chilean *J. Agric. Res*, 68, 360-367.

Carter, M. R., Laajaj, R., & Yang, D. (2013). The impact of voucher coupons on the uptake of fertilizer and improved seeds: evidence from a randomized trial in Mozambique. American *Journal of Agricultural Economics*, 95(5), 1345-1351.

Carter, M. R., Laajaj, R., & Yang, D. (2016). Subsidies, Savings and Sustainable Technology Adoption: Field Experimental Evidence from Mozambique.

Chang, Y. C., & Ko, T. T. (2014). An interactive dynamic multi-objective programming model to support better land use planning. Land *Use Policy*, 36, 13-22.

Chaudhri, S. C., & Snowdon, E. L. (1980). Farm *and input prices: collection and compilation*.

Chianu, J. N., Mairura, F., Ekise, I., & Chianu, J. N. (2008). Farm input marketing in western Kenya: Challenges and opportunities. African *Journal of Agricultural Research*, 3(3), 167-173.

Cornia, G. A. (1985). Farm size, land yields and the agricultural production function: An analysis for fifteen developing countries. World *development*, 13(4), 513-534.

Croissant, Y., & Croissant, M. Y. (2011). Package 'mlogit'.

Defoer, T., Hilhorst, T., Kanté, S., & Diarra, S. (1995). Analysing the diversity of farmers' strategies. ILEIA *Newsletter*, 11(2), 9-11.

Demby, E. (1973). A psychographic study of the market for flowers. Amer Florists Mktg. Coucil, Alexandria,VA.

Denning, G., Kabambe, P., Sanchez, P., Malik, A., Flor, R., Harawa, R., ... & Keating, M. (2009). Input subsidies to improve smallholder maize productivity in Malawi: Toward an African Green Revolution. PLoS *biology*, 7(1), e1000023.

Edward, G. (2013). The *impact of national agricultural input voucher scheme on rice production at the Kiroka irrigation scheme, Morogoro district* (Doctoral dissertation, Sokoine University of Agriculture).

Evenson, R. E., & Gollin, D. (2003). Assessing the impact of the Green Revolution, 1960 to 2000. Science, 300(5620), 758-762.

Eymann, A., & Ronning, G. (1997). Microeconometric models of tourists' destination choice. Regional *Science and Urban Economics*, 27(6), 735-761.

FAO (2010) "FAO/WFP Crop and food security assessment mission to Mozambique" available at: http://www.fao.org/docrep/012/ak350e/ak350e00.htm

FAO (2016) Farmers Field School guidance document Planning for quality programmes

FAO (2017) Using technological solutions to improve smallholder farmer's access to agricultural inputs in Mozambique

FAO Mozambique country office website available at; http://www.fao.org/mozambique/en/

Femenia, F., Latruffe, L., & Chavas, J. P. (2016, December). Responsiveness of farm investment to price changes: An empirical study of the French crop sector. In 10th *annual French Conference of Rural Social Sciences ('Journées INRA-SFER-CIRAD'), Paris, France* (pp. 8-9).

Fernando. A., (2013) "Improved Fertilizers for Maize in Mozambique", IFDC Mozambique

Fisher, R. A. (1922). On the interpretation of χ 2 from contingency tables, and the calculation of P. Journal *of the Royal Statistical Society*, 85(1), 87-94.

Galor, O. (2009). Inequality *and economic development: An overview* (No. 2009-3). Working Paper, Brown University, Department of Economics.

Gibson, J. D., & Brown, A. S. (2003). Use of managerial proficiencies in agricultural and extension education: An assessment of Virginia Cooperative Extension. *Journal of international agricultural and extension education*, *10*(3), 19-24.

Global Findex database of the World Bank available at; http://datatopics.worldbank.org/financialinclusion/

Howard, J., Kelly, V., Maredia, M., Stepanek, J., & Crawford, E. W. (1999, August). Progress and *problems in promoting high external-input* technologies in Sub-Saharan Africa: the Sasakawa Global 2000 experience in Ethiopia and Mozambique. In Selected Paper for the Annual Meetings of the American Agricultural Economics Association, Nashville, Tennessee.

Hu, X., & Schiantarelli, F. (1998). Investment and capital market imperfections: A switching regression approach using US firm panel data. *The review of Economics and Statistics*, *80*(3), 466-479.

Huang, L. C. (2005). Floral product behaviors and their influence on consumer floral purchase frequency. HortTechnology, 15(4), 766-771.

Idumah, F. O., & Okunmadewa, F. Y. (2007). Relative efficiency of food farmers in the Niger delta area: application *of* profit function analysis. Bowen Journal *of Agriculture*, *4*(1), 63-75.

Jayne, T. S., & Rashid, S. (2013). Input subsidy programs in sub- Saharan Africa: a synthesis of recent evidence. *Agricultural economics*, *44*(6), 547-562.

Jekanowski, M. D., & Binkley, J. K. (2000). Food purchase diversity across US markets. Agribusiness, 16(4), 417-433.

Jessop, R., Diallo, B., Duursma, M., Mallek, A., Harms, J., & van Manen, B. (2012). Creating access to agricultural finance based on a horizontal *study of Cambodia, Mali, Senegal, Tanzania, Thailand and* Tunisia. *Paris, AFD, A savoir*.

Kaosa-ard, M., Rayanakorn, K., Cheong, G., White, S., Johnson, C. A., & Kongsiri, P. *(1998).* Towards public participation in Mekong river basin development. *Natural Resources and Environment Program, Thailand Development Research Institute, Bangkok*.

Lishman, J. L., & Nieuwoudt, W. L. (2003). An analysis of factors contributing to the use of an income equalisation deposit scheme by commercial farmers in South Africa. Agrekon, 42(4), 325-352.

Lund, P. J. (1983). The use of alternative measures of farm size in analysing the size *and efficiency relationship. Journal of Agricultural Economics, 34(2), 187-189.*

Maart, S. C., & Musshoff, O. (2011, January). Optimal Timing of Farmland Investment. In An Experimental Study on Farmers' Decision *Behavior. Agricultural & Applied Economics Association's 2011 AAEA & NAREA Joint Annual Meeting, July* (Vol. 24).

Mabaya, E., Kinuthia, B. K. (2015) The Impact of Agriculture Technology Adoption on Farmers. *Welfare in* Uganda and Tanzania

Mancini, F., & Jiggins, J. (2008). Appraisal of methods to evaluate farmer field schools. Development in Practice, 18(4-5), 539-550.

Mangisoni, J. H., Kachule, R., Kalinda, T., Chilongo, T., Simfukwe, M., & Tostao, E. (*2007). Input voucher study in Malawi, Mozambique and* Zambia. *FANRPAN Report*, *4*.

Mathijs, E., & Vranken, L. (2000, July). Farm restructuring and efficiency in transition: evidence from Bulgaria and Hungary. In *Selected Paper, American Agricultural Economics Association Annual Meeting, Tampa*.

McFadden, D. (1976, December). The theory and practice of disaggregate demand forecasting *for various modes of* urban transportation.

Mijindadi, N. B. (1980). Production efficiency on farms in northern Nigeria. Dissertation Abstracts International, A, 41(1).

Mishra, K., Abdoul, S. G., Miranda, M. J., & Diiro, G. M. (2015). Gender and Dynamics of Technology Adoption: Evidence from Uganda. In 2015 AAEA & *WAEA Joint Annual Meeting, July 26-28*, San Francisco, California (No. 206550). Agricultural and Applied Economics Association & Western Agricultural Economics Association.

Mishra, K., Abdoul, S. G., Miranda, M. J., & Diiro, G. M. (2015). Gender and Dynamics of Technology Adoption: Evidence *from Uganda. In 2015 AAEA* & WAEA Joint Annual Meeting, July 26-28, San Francisco, California (No. 206550). Agricultural and Applied Economics Association & Western Agricultural Economics Association.

Mishra, K., Abdoul, S. G., Miranda, M. J., & Diiro, G. M. (2015). Gender and Dynamics of Technology Adoption: Evidence from Uganda. In 2015 AAEA & WAEA Joint Annual Meeting, July 26-28, San Francisco, California (No. 206550). Agricultural and Applied Economics Association & Western Agricultural Economics Association.

Muhammad, S., Chaudhry, K. M., Khatam, A., & Ashraf, I. (2013). Impact of farmer field schools on social wellbeing of farming community in khyber pakhtunkhwa, Pakistan. *The Journal of Animal & Plant Sciences*, *23*(1), 319-323.

Müller, T. R. (2010). AIDS mitigation through agriculture- based interventions in rural contexts: junior farmer field and life schools and future livelihoods in *central Mozambique*. *Singapore Journal of Tropical Geography, 31(3), 330-342.*

Mutsonziwa, K., & Maposa, O. K. (2016). FinScope Consumer Survey Mozambique 2014

Obwona, M. (2006). Determinants of technical efficiency differentials amongst small-and medium-scale *farmers in Uganda:* A case of tobacco growers.

Odii, M. A. C. A. (1992). Gender consideration in resource allocation and food security behaviour of farming households in south eastern Nigeria. Unpublished PhD thesis in the Department *of Agricultural Economics, University of Ibadan.*

Odongo, J. A., & Muhua, G. O. (2015). MODELLING THE RELATIONSHIP BETWEEN FARMER'S ATTITUDE TOWARDS FARMING AND FARM PRACTICES: A CASE STUDY OF SMALLHOLDER FARMERS IN TANZANIA. European Scientific Journal, ESJ, 11(36).

Ọlayide, S. Ọ., & Heady, E. O. (1982). Introduction to agricultural *production economics. Ibadan University Press, University of Ibadan.*

Oni, O. A., Nkonya, E., Pender, J. L., Phillip, *D., & Kato, E. (2015). Trends and* drivers of agricultural productivity in Nigeria.

Owenya, M. Z., Mariki, W. L., Kienzle, J., Friedrich, T., & Kassam, *A. (2011). Conservation agriculture (CA)* in Tanzania: the case of the Mwangaza B CA farmer field school (FFS), Rhotia Village, Karatu District, Arusha. International Journal of Agricultural Sustainability, 9(1), 145-152.

Pan, Y., Smith, S. C., & Sulaiman, M. (2015). Agricultural *extension and technology* adoption for food security: *Evidence from Uganda* (No. 9206). IZA Discussion Papers.

Pan, Y., Smith, S. C., & Sulaiman, M. (2015). Agricultural extension and technology adoption for food security: Evidence from Uganda (No. 9206). IZA Discussion Papers.

Phillip, D., Nkonya, E., Pender, J., & Oni, O. A. (2009). Constraints to increasing agricultural productivity in *Nigeria: A review* (No. 6). International Food Policy Research Institute (IFPRI).

Pollak, R. A. (1985). A transaction cost approach to families and households. Journal of economic Literature, 23(2), 581-608.

Rejesus, R. M., Mutuc, M. *E. M., Yasar, M., Lapitan*, A. V., Palis, F. G., & Chi, T. T. N. (2012). Sending Vietnamese rice farmers back to school: Further evidence on the impacts of farmer field schools. Canadian Journal of Agricultural Economics/Revue canadienne d'agroeconomie, 60(3), 407-426.

Rulon D. P., Richard E. J. (2001) "Handbook of agricultural economics Chapter 12: the agricultural producer and statistical mesurement"

Russell, D. B., & Ison, R. L. (2000). The research-development relationship in rural communities: an opportunity for contextual science. Agricultural Extension *and Rural Development: Breaking out of Traditions. Cambridge University Press, Cambridge, UK, 10-31*.

Ruttan, V. W. (2003). Social science knowledge and economic development: An institutional design perspective. University of Michigan Press.

Solís, D., Bravo- Ureta, B. E., & Quiroga, R. E. (2009). Technical efficiency among peasant farmers participating in natural resource management programmes in *Central America. Journal of Agricultural Economics*, 60(1), 202-219.

Stone, W., & Hughes, J. (2000, July). What role for social capital in family policy and how does it measure up. In Family Futures: issues in research and policy, Australian Institute of Family studies conference Melbourne: Australian Institute of Family studies A.

Sumner, D. A., & Leiby, J. D. (1987). An econometric analysis of the effects of human capital on size and growth *among dairy farms. American Journal of Agricultural Economics*, 69(2), 465-470.

Suvedi, M., Ghimire, R., & Kaplowitz, M. (2017). Farmers' participation *in extension* programs and technology adoption in rural Nepal: a logistic regression analysis. *The Journal of Agricultural Education and Extension*, 1-21.

Takeshima, H., Nagarajan, L., Salau, S., & Oyekale, A. (2015). Farmers' preferences on seed purchase timing-rice, cowpea, and maize growers in Nigeria.

Tanellari, E., Kostandini, G., & Bonabana, J. (2013, February). Gender impacts on adoption *of new technologies: Evidence from Uganda.* In Southern Agricultural Economic *Association annual meeting, Orlando Florida*.

Theil, H., & Finke, R. (1983). The consumer's demand for diversity. European Economic Review, 23(3), 395-400.

Tiffin, R., & Balcombe, K. (2011). The determinants of technology adoption by UK farmers using Bayesian model averaging: the *cases of organic production and computer usage. Australian Journal* of *Agricultural and Resource Economics*, *55*(4), 579-598.

Ton, G. (2013). Financing innovation at the smallholder level: Voucher grant schemes to promote innovation. Capacity. org: a gateway for capacity development, 47, 8-9.

Ton, G., Klerkx, L., *de Grip*, K., & Rau, M. L. (2015). Innovation grants to smallholder farmers: Revisiting the key assumptions in the impact pathways. *Food Policy*, *51*, 9-23.

Tripp, R., Wijeratne, M., & Piyadasa, V. H. (2005). What should we expect from farmer field schools? A Sri *Lanka case study. World* Development, 33(10), 1705-1720.

Udoh, E. J., & Akintola, J. O. (2000). Land management and resource-use efficiency among farmers in southeastern Nigeria. Unpublished Ph. D. Thesis, *University of Ibadan, Nigeria*.

Van den Berg, H., & Jiggins, J. (2007). Investing in farmers—the impacts of farmer field schools in relation to integrated pest management. World Development, 35(4), 663-686.

Verbeek, M. (2008). A guide to modern econometrics. John Wiley & Sons.

Verma, B. N., & Bromley, D. W. (1987). *The political economy of farm size* in India: the elusive quest. *Economic development and cultural change*, *35*(4), 791-808.

Walisinghe, B. R., Ratnasiri, S., Rohde, N., & Guest, R. Does Agricultural Extension Promote Technology Adoption? Empirical Evidence from Sri Lanka.

WFP; World Food Programme (2010) Republic of Mozambique - Comprehensive Food Security and Vulnerability Analysis

Williamson, O. E. (1988). The logic of economic organization. Journal of Law, Economics, & Organization, 4(1), 65-93.

World Bank (2017) "Accelerating Poverty Reduction in Mozambique: Challenges and Opportunities' 'available at http://www.worldbank.org/en/country/mozambique/publication/accelerating-poverty-reduction-in-mozambique-challenges-and-opportunities

World Bank Database (2014) Fertilizer consumption (kilograms per hectare of arable land) available at: http://data.worldbank.org/indicator/AG.CON.FERT.ZS

World Bank Database (2016) Gross Domestic Product Growth available at: http://data.worldbank.org/indicator/NY.GDP.MKTP.CD?locations=MZ

Zottel S., Ortega C. R., and Xu S. Y. (2014) Enhancing Financial Capability and Inclusion in Mozambique A Demand-Side Assessment World Bank

Appendix 1. Descriptive statistics

Table-A 1: Descriptive statistics for categorical variables 2016/2017

Variables	Beneficiaries	Activator		Non-activator	
		N	r	N	r
Year of Registration	2014	1,604	**-6.074*** **	641	**6.074*** **
	2015	5,886	**-30.137*** **	2,993	**30.137*** **
	2016	11,216	**32.642*** **	2,075	**-32.642*** **
Province	Manica	8,928	**-30.104*** **	3,990	**30.104*** **
	Nampula	965	1.036	276	-1.036
	Sofala	7,740	**35.773*** **	888	**-35.773*** **
	Zambezia	1,073	**-9.225*** **	555	**9.225*** **
District	Barue	3,165	**15.885*** **	486	**-15.885*** **
	Gondola	694	**-25.881*** **	721	**25.881*** **
	Macate	490	**-26.640*** **	623	**26.640*** **
	Manica	1,999	**-10.491*** **	891	**10.491*** **
	Sussundenga	1,537	**-21.082*** **	1,023	**21.082*** **
	Vanduzi	1,043	**3.401*** **	246	**-3.401*** **
	Ribaué	965	1.036	276	-1.036
	Buzi	420	**-17.098*** **	386	**17.098*** **
	Gorongosa	3,777	**32.844*** **	107	**-32.844*** **
	Maringue	669	**8.265*** **	84	**-8.265*** **
	Nhamatanda	2,874	**19.934*** **	311	**-19.934*** **
	Alto Molocué	473	**-9.939*** **	299	**9.939*** **
	Gurué	600	**-3.057*** **	256	**3.057*** **

Note: **Asterisks: *, **, *** indicates statistical significance at 10%, 5%, 1% respectively.**

Looking at the result through residual analysis together with the previous chi-square test, activators are shown to be significantly determined by the higher ratio of 'registered in 2016' 'Sofala provinces' 'Districts from Barue, Vanduzi, Gorongosa, Maringue, and Nhamatanda' and the lower ratio of 'registered in 2014 and 2016', 'Manica and Zambezia Provinces', and 'Districts from Gondola, Macate, Manica, Sussundenga, Buzi, Alto Molocue, and Gurue.'

As for the year of registration, results indicate a higher ratio of activation acted by new comers, and a lower ratio by beneficiaries who have been previously involved in the voucher scheme. Possible explanation are 1) information asymmetry, where the participants who registered in 2016 are more like to have access to active information regarding the voucher scheme, which rose the activation rate, 2) area-specific exogenous factor, where the majority of participants from 2014 and 2015 are residing in the Manica province, which may have posed an area-specific limitation, and 3) low consecutive participation incentive, where the incentive to join the scheme through activation is degraded over time. Although understanding specific reasons for every identified province/district is difficult, several explanations that may have underscored the non-activation were collected through the field visit. Those are i) lack of money by beneficiaries, ii) unavailability of inputs at the agro-dealer shops, and iii) delay of voucher arrival. Especially ii) and iii) are exogenous limitations, which possibly formed area-specific reasons embedded by higher or lower ratio of activation.

Appendix 2. Investment cycle by categories

Each input cycle is visualized for three major categorical data; FFS membership, gender, and package. By so doing, the heterogeneity between those three variables are to be identified, and aimed to answer the Reseach Question 2. The Figures are compared horizontally over three categorical variables (cf. Figure-A 1,IIA 2, A 3,A 4, A 5, A 6, A 7, A 8 and A 9), but last three inputs; Maize Hybrid, NPK and Urea were compared by excluding package variable since they are not available to package A at all.

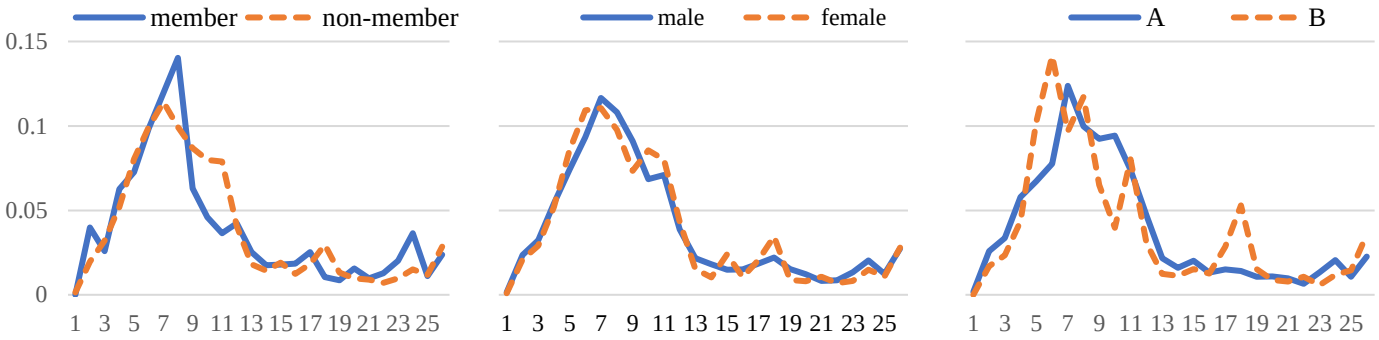


Figure-A 1: Maize investment classified by FFS (left), Gender (middle), and Package (right)

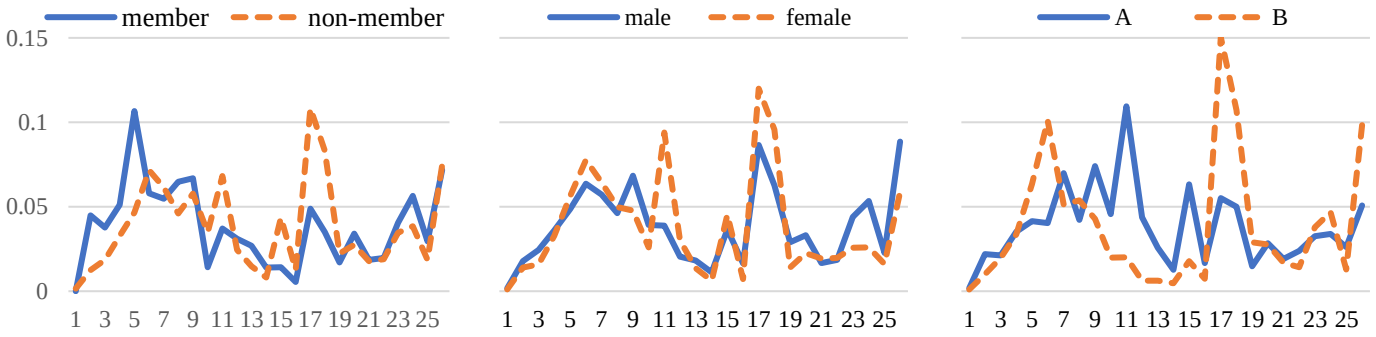


Figure-A 2: Cowpea investment classified by FFS (left), Gender (middle), and Package(right)

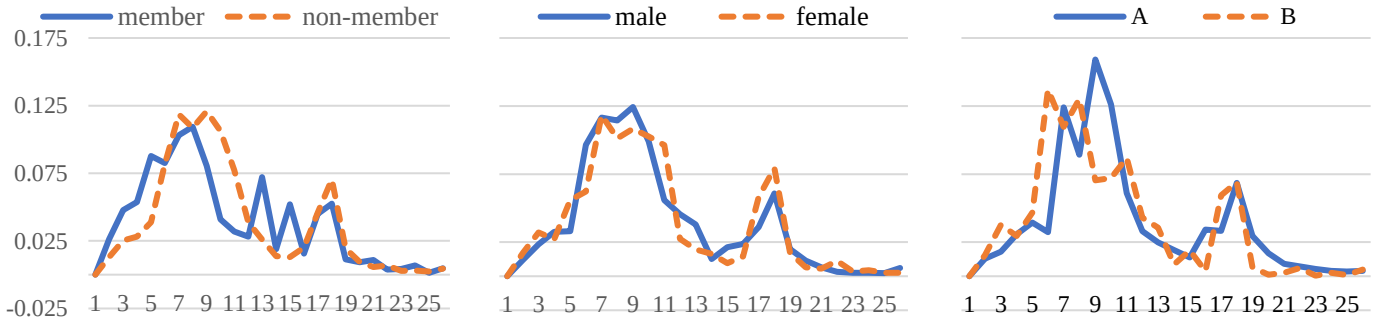


Figure-A 3: Pigenon pea investment classified by FFS (left), Gender (middle), and Package(right)

Figure-A 4: Common beans investment classified by FFS (left), Gender (middle), and Package(right)

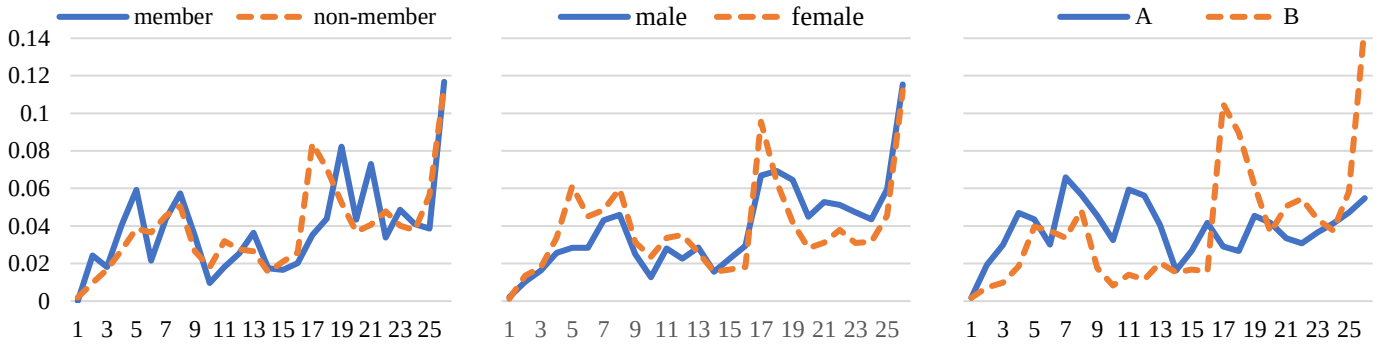


Figure-A 5: Field Insecticide investment classified by FFS (left), Gender (middle), and Package(right)

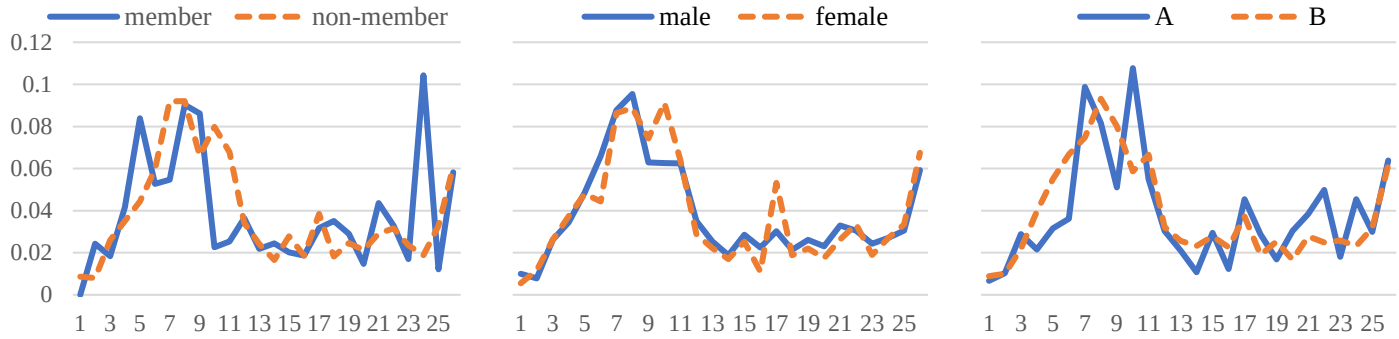


Figure-A 6: Insecticide (post-harvest) investment classified by FFS (left), Gender (middle), and Package(right)

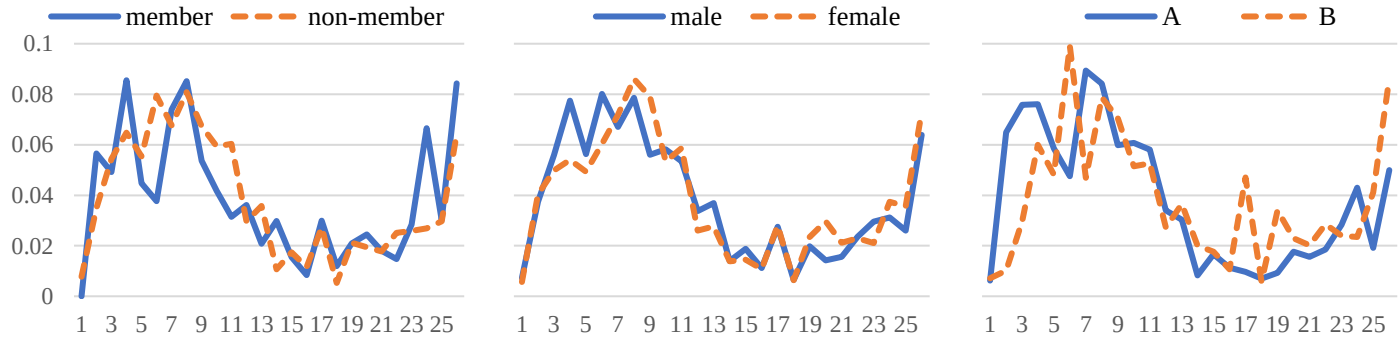


Figure-A 7: Maize Hybrid investment classified by FFS (left), Gender (right)

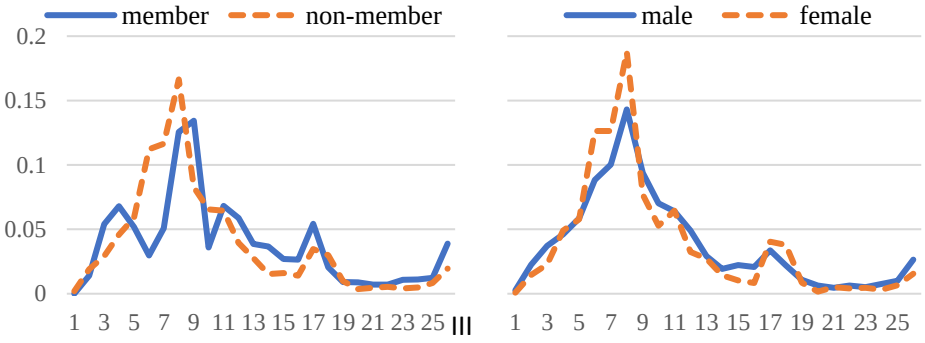


Figure-A 8: Urea investment classified by FFS (left), Gender (right)

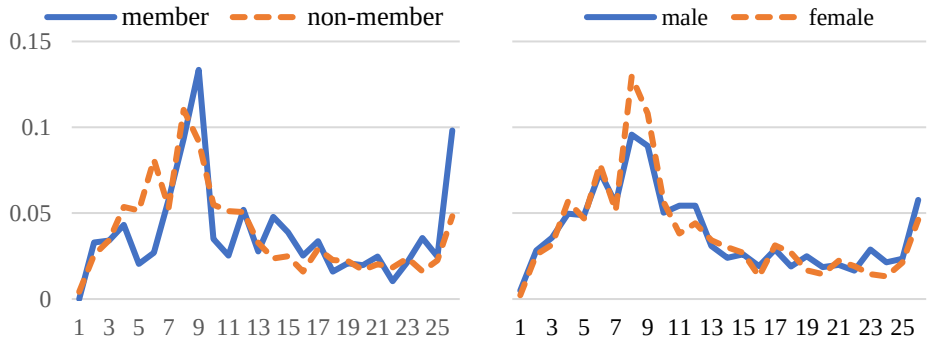
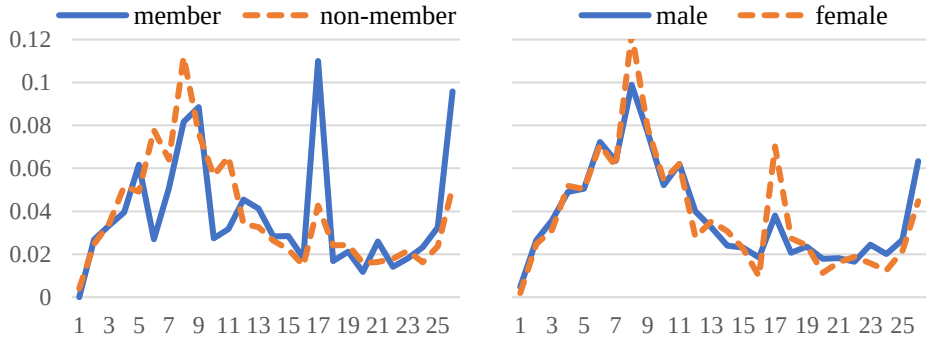


Figure-A 9:



It visualized the time-relevant behavioral differences between each category. For example, the investment cycle of Cowpea are distinctly differed. Apparently the second peak of cowpea investment were played by FFS non-member and/or package B (indicating larger scaled) farmers. Looking at the Pigeon pea and Sorghum cycle shows that FFS members tend to invest earlier than non-members. It implies that FFS plays certain mechanism to incentivize farmers to invest earlier. The cycle of Common beans is different between packages, which is likely due to Common beans being more cash crops, which are likely to be grown by emerging farmers (package B) rather than subsistence farmers (package A). Compared to FFS and package variables, the differences between the genders are not obvious; one possible explanation is that female farmers are investing highly concentratedly at a specific peak point.

Moreover, it is important note that the investment cycle of maize hybrid, and fertilizers (Urea and NPK) are quite similar except for that the NPK has a second peak around the 17th week. These three inputs are available only in package B, where purchasing maize hybrid together with fertilizer is recommended because hybrid seeds are supposed to require fertilization. The reason that NPK has a second peak may be because farmers are using NPK for other crops. The 17th week is dated approximately to end of January and beginning of February, and it is time start seeding several beans, for which NPK can potentially be used. Moreover, the peak at the end of the agricultural season around the 25th, might be used for horticultural crops such as vegetables.

Appendix 3. Days-To-planting (DTP) regression for all

Table-A 2: OLS on DTP (Days-To-Planting)

variables	DTP							
	All	Maize OPV	Cowpea	Maize Hybrid	Pigeon pea	Common Bean	NPK	Urea
FFS member	0.031	0.890	**4.721*** **	**-4.297*** **	**3.619** **	1.507	**-7.211*** **	**-6.407*** **
	(-1.035)	(-1.141)	(-1.573)	(-1.463)	(-1.609)	(-1.446)	(-1.887)	(-2.012)
Package (A)	**20.541*** **	**5.133*** **	**6.761*** **		-0.531	**15.119*** **		
	(-0.766)	(-1.006)	(-1.315)		(-1.248)	(-1.267)		
Investment Condition								
On-Truck sale	**-11.06*** **	**-9.824*** **	**-20.62*** **	**-11.05*** **	**-9.288*** **	**-11.433*** **	**-12.16*** **	**-6.757*** **
	(-0.837)	(-0.976)	(-1.380)	(-1.080)	(-1.257)	(-1.358)	(-1.655)	(-1.746)
Price of Seeds		**-1.122*** **	**-0.315*** **	**-0.073***	**-0.289*** **	**-0.744*** **	**-0.027***	**-0.017** **
		(-0.043)	(-0.054)	(-0.043)	(-0.032)	(-0.044)	(-0.014)	(-0.009)
Personal attributes								
Year(s) of Participation	**4.327*** **	**3.302*** **	**5.113*** **	**8.545*** **	**6.934*** **	**3.741*** **	**10.202*** **	**10.581*** **
	(-0.925)	(-1.056)	(-1.486)	(-1.134)	(-2.199)	(-1.390)	(-1.322)	(-1.337)
Gender (male)	**-3.121*** **	**-4.444*** **	**-6.159*** **	**-1.865***	0.513	**-4.993*** **	-1.135	-2.141
	(-0.737)	(-0.862)	(-1.200)	(-0.984)	(-1.120)	(-1.165)	(-1.365)	(-1.456)
Age	0.107	0.202	0.126	0.145	**0.716*** **	0.162	0.184	0.151
	(-0.124)	(-0.146)	(-0.215)	(-0.177)	(-0.176)	(-0.198)	(-0.239)	(-0.266)
Age squared	0.000	-0.001	0.000	0.000	**-0.006*** **	0.000	0.000	0.000
	(-0.001)	(-0.002)	(-0.002)	(-0.002)	(-0.002)	(-0.002)	(-0.003)	(-0.003)
Residential Area								
Gondola	**16.149*** **	**17.721*** **	**19.565*** **	**20.876*** **	1.575	**20.704*** **	-5.918	-11.398
	(-2.111)	(-2.105)	(-4.095)	(-5.156)	(-3.463)	(-4.451)	(-10.269)	(-13.100)
Macate	**-13.57*** **	-3.832	**-31.74*** **	-5.410	**-14.290** **	**20.685*** **	**-38.81*** **	**-15.598** **
	(-2.397)	(-2.391)	(-4.316)	(-6.267)	(-6.139)	(-4.385)	(-3.863)	(-6.498)
Manica	**-21.78*** **	**-4.76** **	**-23.07*** **	**-23.34*** **	-38.029**	**23.246*** **	**-23.21*** **	**-24.17*** **
	(-1.496)	(-2.067)	(-3.251)	(-1.756)	(-18.227)	(-2.537)	(-2.038)	(-3.114)
Sussundenga	**-22.65*** **	0.829	**-36.35*** **	**-33.63*** **	-35.19***	**7.861** **	**-52.06*** **	**-48.45*** **
	(-1.776)	(-2.215)	(-4.246)	(-2.390)	(-3.209)	(-3.208)	(-3.372)	(-3.074)
Vanduzi	-1.019	-2.087	**-24.48*** **	3.390	-3.104	**10.137** **	**-15.90*** **	**-19.86*** **
	(-2.554)	(-2.581)	(-4.776)	(-3.410)	(-15.839)	(-3.975)	(-3.736)	(-4.874)
Ribaue	**-7.098*** **	**-14.111*** **	**-27.49*** **	-0.371	**-16.20*** **	**-13.556*** **	0.505	-0.069
	(-1.874)	(-2.427)	(-4.962)	(-4.323)	(-3.451)	(-4.251)	(-3.625)	(-2.866)
Buzi	**-82.70*** **	**-69.171*** **	**-95.57*** **	**-83.15*** **	**-61.93*** **	**-47.011*** **	**-75.96*** **	**-83.53*** **
	(-2.635)	(-2.531)	(-4.225)	(-7.038)	(-6.501)	(-3.659)	(-8.574)	(-9.317)
Gorogonsa	**9.468*** **	**11.793*** **	5.150	**12.825*** **	0.804	**20.952*** **	**13.084*** **	**13.127** **
	(-1.276)	(-1.581)	(-3.362)	(-1.564)	(-2.574)	(-2.925)	(-2.606)	(-5.537)
Maringue	**15.242*** **	**17.306*** **	**11.252** **	**-32.66*** **	-4.900	4.264	**-51.24*** **	-54.154
	(-2.014)	(-2.318)	(-4.520)	(-4.937)	(-3.054)	(-3.421)	(-13.692)	(-42.819)
Nhamatanda	**-6.363*** **	**-7.132*** **	**-11.33*** **	**-4.766*** **	**-13.67*** **	**40.719*** **	**-4.641***	-5.974
	(-1.352)	(-1.570)	(-3.394)	(-1.693)	(-2.645)	(-2.900)	(-2.534)	(-4.105)
AltoMoe	**-6.647*** **	**-18.715*** **	**-17.78*** **	**-45.19*** **	**-30.78*** **	**-39.742*** **	**-35.571** **	**-64.98*** **
	(-2.321)	(-2.384)	(-5.185)	(-8.818)	(-3.418)	(-3.876)	(-13.865)	(-21.294)
Gurue	**-9.128*** **	-1.381	**-47.440** **	**-19.47*** **	**-20.06*** **	**-75.746*** **	**-15.487** **	-10.845
	(-2.253)	(-3.000)	(-21.966)	(-3.568)	(-4.057)	(-4.738)	(-7.526)	(-9.252)
Constant	**-6.780** **	**126.279*** **	16.103	0.933	**38.444*** **	**175.411*** **	41.046	8.882
	(-3.100)	(-6.015)	(-9.914)	(-10.048)	(-8.039)	(-9.703)	(-33.070)	(-19.031)
Obs	14532	8688	5483	5602	3418	5985	4359	3774
Adj R-sq	0.163	0.218	0.237	0.153	0.117	0.269	0.142	0.147

Note; Standard Errors in parentheses. Asterisks: *, **, *** indicates statistical significance at 10%, 5%, 1% respectively

Appendix 4. Days-To-Planting (DTP) regression for on-time investors

Table-A 3: OLS on DTP (Days-To-Planting) for On-time investors

variables	DTP							
	All	Maize OPV	Cowpea	Maize Hybrid	Pigeon pea	Common Bean	NPK	Urea
FFS member	**4.456*** **	**4.676*** **	**1.745*** **	**1.965*** **	**5.036*** **	2.410*	**2.031****	0.922
	(-0.746)	(-0.567)	(-0.596)	(-0.699)	(-0.783)	(-1.279)	(-0.881)	(-0.944)
Package (A)	**9.830*** **	**-5.269*** **	0.501		**-6.501*** **	**10.768*** **		
	(-0.548)	(-0.496)	(-0.523)		(-0.614)	(-1.115)		
Investment Condition								
On-Truck sale	0.620	**-1.043****	**1.714*** **	-0.075	**-2.445*** **	**-7.553*** **	**1.760****	**4.258*** **
	(-0.587)	(-0.472)	(-0.525)	(-0.484)	(-0.601)	(-1.209)	(-0.719)	(-0.751)
Input Price		**-0.298*** **	**-0.347*** **	0.010	**-0.061*** **	**-0.515*** **	-0.011	-0.010*
		(-0.025)	(-0.039)	(-0.022)	(-0.022)	(-0.042)	(-0.007)	(-0.005)
Personal attributes								
Year(s) of Participation	**4.248*** **	**3.325*** **	**2.950*** **	**6.016*** **	**5.613*** **	**3.874*** **	**6.274*** **	**7.509*** **
	(-0.672)	(-0.511)	(-0.574)	(-0.538)	(-1.113)	(-1.247)	(-0.599)	(-0.617)
Gender (male)	-0.500	-0.349	0.373	**0.828***	-0.036	-4.161***	0.651	1.033
	(-0.522)	(-0.417)	(-0.472)	(-0.452)	(-0.550)	(-1.019)	(-0.615)	(-0.646)
Age	0.082	**0.256*** **	**0.138***	**0.132***	**0.310*** **	0.189	0.096	0.112
	(-0.087)	(-0.070)	(-0.084)	(-0.079)	(-0.088)	(-0.177)	(-0.108)	(-0.113)
Age squared	0.000	**-0.001***	-0.001	-0.001	**-0.002****	-0.001	-0.001	-0.001
	(-0.001)	(-0.001)	(-0.001)	(-0.001)	(-0.001)	(-0.002)	(-0.001)	(-0.001)
Residential Area								
Gondola	**4.695*** **	**7.443*** **	**-17.377*** **	**10.049*** **	**-10.13*** **	**18.170*** **	**15.109*** **	**15.457****
	(-1.324)	(-0.940)	(-1.572)	(-1.994)	(-1.602)	(-4.066)	(-4.635)	(-6.006)
Macate	**2.973***	**5.253*** **	**-19.369*** **	0.481	**-8.610*** **	**13.876*** **	**-4.150****	**-9.698*** **
	(-1.730)	(-1.226)	(-1.900)	(-2.672)	(-3.251)	(-3.907)	(-2.006)	(-3.557)
Manica	0.043	**8.032*** **	**-10.908*** **	0.927	20.846	**22.215*** **	-0.284	-0.836
	(-1.121)	(-1.030)	(-1.626)	(-0.872)	(-12.803)	(-2.366)	(-0.915)	(-1.724)
Sussundenga	**5.716*** **	**7.861*** **	**-22.531*** **	0.752	-2.024	2.913	-0.111	**5.117*** **
	(-1.338)	(-1.091)	(-2.908)	(-1.301)	(-1.912)	(-2.945)	(-1.635)	(-1.743)
Vanduzi	2.579	0.500	**-11.756*** **	**7.665*** **	**-20.99*** **	**21.589*** **	**8.100*** **	**5.352****
	(-1.829)	(-1.230)	(-1.918)	(-1.529)	(-7.422)	(-3.780)	(-1.739)	(-2.481)
Ribaue	**3.902*** **	-1.691	**-18.065*** **	**3.783***	**-12.48*** **	**-24.267*** **	**12.878*** **	**14.726*** **
	(-1.385)	(-1.251)	(-3.442)	(-2.075)	(-1.706)	(-3.773)	(-1.802)	(-1.364)
Buzi	**11.974*** **	**-5.408****	dropped	-10.363	**-21.44*** **	-2.052		
	(-4.288)	(-2.307)		(-12.199)	(-4.741)	(-5.189)		
Gorogonsa	**6.482*** **	**5.739*** **	**-14.981*** **	**7.027*** **	**-3.731*** **	**12.358*** **	**8.702*** **	4.539
	(-0.879)	(-0.751)	(-1.553)	(-0.695)	(-1.214)	(-2.639)	(-1.034)	(-3.024)
Maringue	**20.393*** **	**2.473****	**-16.608*** **	-0.402	**-6.156*** **	1.835		
	(-1.344)	(-1.029)	(-2.026)	(-3.317)	(-1.432)	(-3.055)		
Nhamatanda	**6.626*** **	**-4.383*** **	-17.620***	**2.180****	**-5.951*** **	**24.615*** **	**4.696*** **	**5.702****
	(-1.010)	(-0.771)	(-1.634)	(-0.901)	(-1.285)	(-2.646)	(-1.214)	(-2.324)
AltoMoe	**3.554****	**-6.642*** **	-14.771***	-4.344	-12.55***	-29.198***	13.646	
	(-1.584)	(-1.127)	(-2.519)	(-7.326)	(-1.793)	(-3.633)	(-13.186)	
Gurue	**-3.249****	**-4.581*** **	dropped	-8.364***	-14.93***	-68.419***	-5.322	-1.032
	(-1.594)	(-1.406)		(-1.938)	(-2.017)	(-4.652)	(-3.577)	(-3.782)
Constant	**10.879*** **	**52.458*** **	**62.835*** **	1.613	**28.68*** **	**149.953*** **	29.882*	20.228*
	(-2.251)	(-3.308)	(-6.109)	(-4.894)	(-4.798)	(-8.987)	(-17.072)	(-10.824)
Obs	9053	6052	1841	3191	2355	5000	2023	1844
Adj R-sq	0.092	0.136	0.198	0.087	0.163	0.192	0.107	0.149

Note; Standard Errors in parentheses. Asterisks: *, **, *** indicates statistical significance at 10%, 5%, 1% respectively

Appendix 5. Qualitative interview sheet

Questionnaire Instruction

To interviewers and Translators

Thank you for your involvement in my research study. An important part of this research is the Questionnaire, designed to understand the mechanism of the e-Voucher scheme, implemented by FAO Mozambique, from the beneficiaries' perspective. Please be notified that simplicity and consistency is crucial to avoid the bias, which may be given to the beneficiaries. The results of this research are treated confidentially and used only for the research purpose, which will be made available for Wageningen University and Research (WUR) in the Netherlands, and Food and Agriculture Organization (FAO) Mozambique.

Before handing in the Questionnaire be reminded to:

1. Make sure that the form is completed.
2. Check that a response has been filled in for every line.

Takuya Nagasawa

Graduate student
Wageningen University and Research, Netherlands
Development Economics Group

SURVEY of the e-Voucher scheme

Name	**:**	
e-card ID	**:**	
Package	**:**	**A / B**
Age	**:**	
Gender	**:**	**Male / Female**

I. Participation of voucher scheme and package selection.

No.	Question 1-4
1.	In which agricultural campaign(s) have you participated the voucher scheme of FAO? **(multiple choices allowed)** a. 2013/2014 agricultural campaign (paper voucher) b. 2014/2015 agricultural campaign (paper voucher) c. 2015/2016 agricultural campaign (e-voucher) d. 2016/2017 agricultural campaign (e-voucher)
2.	How did you choose your package? a. By following the advice/criteria from Extension Service/FAO/ONG/Agro-Dealer/Outros. b. By myself. (Continue to Q4)
3.	What kind of advice/criteria did you receive? (Continue to Q5) _____
4.	What are the reasons for choosing your package? _____

II. Timing of the input purchase.

No.	Question 5-6
5.	Did you purchase the inputs soon after you received (registered) your e-card? a. Yes I did. (Continue to Q7) b. No I did not.
6.	What was the reason that you did not purchase inputs soon after the registration? REASON: _____

III. The membership of EMC.

No.	Question 7-12
7.	Are you a member of EMC (Escolas na Machamba do Campones)? a. Yes, I am b. No, I am not (Continue to Q13)
8.	Since when have you been the member of EMC? Since _____ (e.g. mm/yyyy)
9.	How did you decide to be a member of EMC? a. By following the advice/criteria from Extension Service/FAO/Others. b. By myself. (Continue to Q12) c. Others: _____ (Continue to Q13)
10.	What kind of advice/criteria did you receive? (Continue to Q13) _____
11.	What is the reasons to be the member of EMC? _____
12.	What kind of activities have you received through EMC? **(multiple choice allowed)** a. technical training b. workshop (knowledge sharing) c. financial support d. others _____

IV. Overall and Conclusion.

No.	Question 13-21
13.	Is the e-card easy to use? Are there any difficulties in using the e-card? _____
14.	During the voucher project, did you also purchase other inputs without the voucher? If yes, what and where did you purchase? a. Yes I purchased _____ from local market. b. Yes I purchased _____ from agro-dealer shop. c. No I didn't buy any other inputs.
15.	Before the voucher project, did you purchase any inputs? a. Yes I purchased _____ from local market. b. Yes I purchased _____ from agro-dealer shop. c. No I did not buy any inputs before.
17.	Do you have access to credit? Yes, I do. No, I don't. (Continue to Q19)
18.	From where do you have the credit from? **(multiple choice allowed)** a. banks b. local money lenders c. friends/siblings/relatives/neighbors d. others _____.
19.	Approximately how long does it take to visit agro-dealer shop from your home? _____ (e.g. min / hour , km)
21.	For the beneficiaries who **also joined paper voucher scheme** How do you compare e-Voucher with paper-voucher? Any advantage or disadvantage? _____

This is all of the questionnaire, thank you very much for your contribution.