Dynamics of Participation in Utilization of Local Value Chain Services: Assessing drivers and barriers for inclusive food systems

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Abstract

Smallholders' integration into agri-food value chains emerged as a popular mechanism for transforming food systems and alleviating poverty in agrarian communities. However, value chain development initiatives are increasingly being challenged for their lack of inclusiveness – the gains scarcely accrue to marginalized communities of the population that need them most, but mostly benefit resource-richer farm-households, thereby widening social inequality. There is no clear consensus on what drives disparities in value chain participation and the level of value chain service utilization. We rely on field data from soybean smallholders in Uganda to (a) describe how participation in value chain service use evolves, (b) assess the drivers and barriers to participation in value chain service use, and (c) explain why participants use different value chain services. We find that value chain service providers safeguard themselves against risks and losses, and implement measures that eventually exclude resource-poor farm-households from participating in value chain service use. Further exclusion happens at value chain service utilization once participation has taken place. We discuss the implications of these results for achieving inclusive and resilient food systems.

Key words: inclusive food systems, value chains; contracts; participation, adoption.

1. Introduction

The integration of farmers into agri-food value chains (AVCs) has become a popular policy device for alleviating poverty and improving food security in many African countries, including Uganda. Value chain services are considered a sustainable way to improve farmers' access to business training, input- and output markets, and financial services, for stimulating the adoption of climate-smart agricultural innovations to enhance food systems' productivity, farmer's income and resilience to climate change. However, mixed results of value chain initiatives for reducing poverty and food insecurity have been recorded for global export-oriented AVCs (German et al., 2020; Martiniello & Azambuja, 2019; Van Dijk & Trienekens, 2012). Global value chain development initiatives have been particularly criticized for their lack of inclusiveness – the gains scarcely accrue to marginalized communities of the population

that need them most, but mostly benefit resource-richer farm-households, thereby widening social inequality. Efforts have therefore shifted to support the expansion of integration initiatives into local AVCs to achieve better linkages between agriculture and midstream food systems for enhanced productivity and resilience to climate change.[1]

The shift from 'aid to trade' has accelerated interest in inclusive and resilient food systems, achieved through better farmer-linkages to small- and medium-scale agribusiness enterprises (SMAEs) (Herrmann et al., 2018). These SMAEs are envisaged to play a key role in improving smallholders' access to markets, knowledge and technologies. However, while VC integration initiatives may improve food security, they do not necessarily bring benefits to poor and marginalized groups of the population (Devaux et al., 2018; Francesconi & Wouterse, 2015; Orr et al., 2018). Ros-Tonen et al. (2019) note that several assumptions regarding positive development impacts of market integration and SMAE-producer partnerships are highly contested. Specifically, VC integration initiatives may exacerbate existing inequalities and exclude farmers who have less productive resources or assets (Bassett et al., 2018; Crane et al., 2014). Farmers may also deliberately disengage from production (Ros-Tonen et al., 2019), considering that VC integration initiatives target a specific commodity (such as soybean in this study) that may not be a priority for many emerging farmers (Chamberlain & Anseeuw, 2017). Gender inequalities inscribed in informal institutions and rooted in social norms and attitudes (Ruben et al., 2006) could also limit women's participation in VCs. There can also be differences in access to services among VC participants. For instance, in situations where demand for certain services such as climate-resilient seed is constrained, value chain service providers may deliberately prioritize only their loyal farmers, leaving other farmers to rely on lower-quality inputs.

Differences in VC service uptake can become manifest in two ways. First, they are associated with timing: while some farmers immediately respond to VC integration initiatives, others wait and sometimes participate later, which is in line with technology adoption life cycle (Rogers, 1983). This is likely to be related to differences in farmers' wealth, knowledge, and risk attitudes (Dedehayir et al., 2017; Hickey; Sam et al., 2016; Ngepah, 2017; Orr et al., 2018; Vicol et al., 2018). Some farmers continue to participate in AVCs, while others may opt out and perhaps re-join later when there are changes in the conditions that originally hindered continued utilization of VC services. Second, there could be variations in service uptake due to the nature of service supply. While some services may be easily accessible to VC participants, others remain less accessible due to limited supply. In a similar vein, differences in VC service use can also be attributed to variation in demand. Farmers may not need all services every year, especially when they sow recycled seed from previous harvests or when the crop

[1] We follow the definition of the International Food Policy Research Institute (2020, p.8): "Food systems are the sum of actors and interactions along the food value chain—from input supply and production of crops, livestock, fish, and other agricultural commodities to transportation, processing, retailing, wholesaling, and preparation of foods to consumption and disposal. Food systems also include the enabling policy environments and cultural norms around food".

needed by VC service providers is not grown due to crop rotation to maintain soil fertility, control pests or past bad experience with output markets.

The nature of integration or the timing of farmers' participation in VC service use is likely to depend on the design and/or the implementation of VC promotion initiatives. For example, the bundling of several distinct services could be helpful for early and sustained service users (Vučković, 2014; Ward et al., 2018). Hence, an inquiry into the drivers of differences in VC services uptake could shape our understanding of why value chain integration initiatives may or may not reach those at the bottom of the pyramid (Prahalad & Hammond, 2002; Vellema, 2015). Earlier studies have focused mainly on analysing causal relationships between VC participation behaviour and outcomes, paying less attention to variability in VC service use. Consequently, current understanding on how differences in the uptake of VC services account for distinct observed performance outcomes (e.g., productivity and resilience) remains limited (Orr et al., 2018; Vellema, 2015).

Past studies have attributed low economic growth and poverty to limited access to markets. In effect, policy interventions aiming at mitigating supply-side barriers that hinder access to these markets are frequently recommended. However, improving access to VC services may not necessarily increase the utilization of those services unless demand-side constraints and structural barriers hampering VC service use are also resolved. Notably, a contract may fail to facilitate farmer's access to (input or output) market services if these services (such as climate-resilient seed or rhizobia inoculants) become unaffordable or when the contract induces uncertainties associated with payments. Uncertainty could also delay the utilization of VC services if farmers seek to learn from experiences of early participants (Chavas & Nauges, 2020; Takahashi et al., 2019). Alternatively, farmers could be reluctant to invest in a new crop if they believe that their negotiating position will be weakened by availability of just a few buyers in their area. Under such circumstances, smallholders' participation in VC service use will depend on their attitudes, such as risk preferences, trust and impatience in their decision making (Adekunle et al., 2016).

This paper determines the nature and extent of smallholders' participation in VC service use and examines the drivers and barriers for smallholders' participation in value chain service use. Specifically, the paper answers two main questions. First, what motivates or hinders the participation of farmers in value chain service use? Second, for participating households, what drives differences in value chain service use? To address these questions, we use panel data from a survey of 2,533 smallholder farmers in Uganda, conducted in 2020 and 2021.

The rest of the paper proceeds as follows. The next section provides the setting and background on the larger project of which this study is part. Section three describes the analytical framework with testable hypotheses. Section four details the methodology, while section five presents and discusses the empirical results, and section six concludes.

2. Background and Setting

This study took place within the SNV-led 'Climate Resilient Agribusiness for Tomorrow (CRAFT)' project implemented in East Africa within the context of inclusive food systems.[2] The project offered technical and financial support to SMAEs engaging organized smallholder farmers in the production of different crops such as soybean, sesame, sunflower and potatoes. Our study focuses on the soybean value chain that is supported and implemented through three Ugandan SMAEs: ACILA Enterprises, ALITO Joint, and OKEBA in eastern, northern, and central/western regions, respectively.[3]

Soybean is an important crop in Uganda as it is widely used in food and nutrition supplements to address nutritional deficiencies among children and adults, as well as in the formulation of animal feed. Soybean has also been identified as one of the key crops to be developed and supported by the government for export (The Government of Uganda, 2020) in response to the increasing demand for plant-based meat and dairy products (Geijer & Gammoudy, 2020; Tonheim et al., 2022). The objective of SNV's support to the SMAEs is to improve farmers' access to the SMAEs value chain and it's benefits.

To integrate smallholder farmers into the soybean value chain, the SMAEs relied on two types of services:

a) Farm-level training (FLT) was provided through two channels. First, training in climate-smart agricultural (CSA) practices and technologies is delivered by the SMAEs' extension officers through training workshops at centralized locations. Second, agricultural extension and advisory services are delivered by volunteer trainer of trainees through farmer field schools established within communities where farmers reside.[4]

b) Verbal or written production and marketing contract were offered to FLT participants to facilitate access to the SMAEs' input market services (IMS) and output market services (OMS). The IMS entails bio-fertilizer (rhizobia inoculants) and climate-resilient soybean seed; these inputs are collectively purchased by farmers and delivered by the SMAEs through village-agents. Similarly, OMS involves village-agents' aggregation and verification of quantities and quality of farmers' supplies before effecting payments.

The CRAFT project includes four types of incentives for using IMS and OMS. First, the foundation seed and seed supplied by the SMAEs to seed producers and grain producers, respectively, is of superior quality and can withstand harsh weather conditions, compared to other varieties or seed sold on other

[2] For more details about the project, see: https://snv.org/project/climate-resilient-agribusiness-tomorrow-craft

[3] These SMAEs fall within Uganda Investment Authority's definition of SMEs – small enterprises employ between 5 and 49 people and have total assets between UGX: 10 million but not exceeding 100 million, while medium enterprises employ between 50 and 100 people with total assets of more than 100 million but not exceeding 360 million (Government of Uganda, 2022).

[4] These demonstration sites or FFSs were established by the volunteer trainer of trainees (identified within the same communities where farmers reside) with technical support from the SMAEs' extension officers. The Each village or community had at least one FFS.

markets. Second, inputs are brought closer to farmers through village agents and can be accessed at no cost. Third, biofertilizers (rhizobia inoculants) whose access is marred by limited supplies is sourced by the SMAEs from the main producer (Makerere University) and supplied to farmers. Lastly, farmers collectively sell their produce through a village agent in their community at a guaranteed (premium) price, helping farmers to circumvent transaction costs and risks associated with marketing. Some SMAEs also offer farmers loyalty incentives, such as input or in-kind credit, which help the SMAEs to deal with ex-ante uncertainty over future supplies from farmers.

With financial and technical support to the SMAEs, the CRAFT program's target was to extend the SMAEs' VC services to a wider network of new and existing soybean producers, hoping that increased utilization of these services would stimulate smallholders' adoption of CSA practices and technologies for enhanced climate resilience, yields and food security. Hence, many new farmer groups were enrolled by the SMAEs, adding to a limited number of existing farmer groups that were already utilizing the SMAEs' VC services prior to the CRAFT.

While new agricultural extension officers were recruited to extend VC services to an increased network of farmers, the SMAEs' capacity to cover all farmer groups at once was still very limited. Consequently, the SMAEs implemented the project by rolling it out across farmer groups in phases over four cropping seasons until all the groups were covered by the end of two years. The SMAEs also started engaging numerous volunteer trainer of trainees to support the delivery of agricultural extension services at farmer field schools or demonstration gardens.

3. Analytical Framework

For understanding the drivers and barriers for value chain participation, our study builds on the theoretical framework described by Chamberlain and Anseeuw (2017), which relies on Resource Dependence Theory (Pfeffer & Salancik, 1979), Transaction Cost Economics (Williamson, 1979) and Agency Theory (Eisenhardt, 1989). Focusing on specific input/output market frictions and contractual constraints that define business relationships between farmers (users of the SMAEs inputs) and the SMAEs (buyers of farmers' produce), these theories intersect to unveil a chain of decisions that determine the inclusiveness of food systems following smallholders' integration into agri-food value chains.

Resource Dependence Theory implies that smallholders' integration into agri-food value chains is motivated by dependencies between the parties involved (Pfeffer & Salancik, 1979). A contract is one specific inclusion instrument used by the SMAEs to facilitate such dependencies (Chamberlain & Anseeuw, 2017). Most AVCs use relational contracts during farmer-firm linkages which raises smallholders' dependencies and sustained utilization of the SMAEs' services (Chamberlain & Anseeuw, 2017; Ménard & Vellema, 2019). The dependencies of the SMAEs on farmers' productive resources and farmers' dependencies on the SMAEs' input or output market channels ensure that relationships take place or the relationships are sustained – a key feature of relational contracting.

Hence, while VC services are targeted to all members within a farmer group, the SMAEs are likely to identify and offer services only to members with adequate land, limiting access for resource-poor farmers. This means that resource-richer households will be prioritized and are more likely to adopt these services earlier than everyone else. Resource-poor households excluded from service utilization may participate later, when the SMAEs expand operations, farmers' conditions change, or the SMAEs seek to replace farmers that opt out of VC service use. The SMAEs use a combination of strategies (such as volunteer trainer of trainees and village agents) to identify the characteristics of farmers such as landholding and capability. Likewise, farmers depend on the SMAEs for inputs such as improved soybean seed and bio-fertilizers to produce the crop needed by the SMAEs. However, VC service utilization may concentrate amongst farmers that are closer to the SMAEs, leaving farmers located further away out of reach to these services.

Transaction Cost Economics is concerned with employing specific strategies within a selected governance structure aimed at reducing the transaction costs between farmers and the SMAEs (Williamson, 1979). The SMAEs employ village agents to perform two specific roles: collecting financial resources from farmers placing orders for collective purchase of inputs, and receiving the produce delivered by farmers under the collective bulking and marketing arrangement. These arrangements rooted within a contract are aimed at reducing costs associated with sourcing of inputs by farmers as well as costs associated with marketing of soybean by the SMAEs. The latter also use volunteer trainers of trainees to deliver FLT services, thereby reducing costs. The agents and trainers also help the SMAEs to enforce the contract to minimize side-selling.

One of the major reasons the SMAEs engage agents and trainers is to better reach farmers, but also to help in contract enforcement. Farmers are identified based on three criteria: the amount of land that they are willing to allocate to a crop, the ability to invest in the SMAEs inputs, and the degree of trust that the SMAEs place on farmers. On the basis of trust, the agents and trainers determine ex-ante which farmers will likely default in the form of side-selling and exclude them from contract farming. VC services are sustained among loyal farmers, with SMAEs likely targeting service users that they trust.

Agency Theory considers contracts between a principal and agent (Eisenhardt, 1989). In the context of our study, the contract enables the SMAEs (the delegating principal) to sell inputs to farmers (the implementing agent), while it enforces the latter to sell output to the former.

Chamberlain and Anseeuw (2017) argue that these theories are connected through uncertainty and power imbalance. Resource Dependency Theory argues that uncertainty arises from mutual dependency underpinning the SMAE-producer partnerships. Due to outcome uncertainty, the SMAEs normally set conditions to be met by farmers integrated into the VCs. For example, specifying farm size thresholds as a precondition for smallholders' integration into their VCs could inhibit participation among farmers seeking to utilize the SMAEs services for the first time. Land tenure insecurity could also be a barrier to VC participation.

For Transaction Cost Economics, uncertainty means increased dependencies especially with new farmers seeking to be integrated into the SMAEs AVCs; this could be a source of risk for the SMAEs, requiring use of some exclusionary measures as safeguards. Uncertainties could raise farmers scepticism about expected benefits, delaying participation among risk-averse farmers waiting to first learn from experiences of their peers. Similarly, opportunistic behaviour - such as late delivery of services by the SMAEs - hinders smallholders' participation in VC service use. For instance, the SMAEs may deliberately delay purchases or payments when market conditions become unfavourable, thereby deviating from contract commitments. This could lead to side-selling, affecting utilization of services.

Outcome uncertainty within the context of Agency Theory could arise due to differing goals which might be complicated by information asymmetry between transacting partners (the principal and the agent) (Chamberlain & Anseeuw, 2017). The offer of relational contracts to farmers by the SMAEs is thus motivated by outcome uncertainty, uncertain behaviour or risk aversion of the agents (Eisenhardt, 1989). Therefore, the principal offers a relational contract to circumvent outcome uncertainty. Ultimately, implementation of these safeguards could lead to exclusion of agents from using VC services. Noteworthy is that contracts offered by the SMAEs are conditional on FLT participation, which is the first form of exclusion for farmers who might be interested only in seed. Farmers lack safeguards against uncertainty emanating from the SMAEs' behaviours.

For this study, power imbalance in the context of Resource Dependency Theory means that less beneficial dependencies could hinder value chain integration triggering advantageous bargaining between farmers and the SMAEs. However, the bargaining power of smallholder farmers is generally weak, due to ignorance over their rights coupled with weak enforcement of those rights (Ménard & Vellema, 2019). Moreover, the more powerful SMAE would be unwilling to bargain but dictate contractual terms of engagement with ignorant smallholders. Therefore, households with higher level of education that are better equipped to gather information and negotiate terms of engagements, are more likely to utilize VC services. Other farmers may be compelled to consider alternatives or simply opt out if the cost of participation in AVCs is higher than the anticipated benefits. Hence, the powerful SMAEs with more information than farmers may exhibit opportunistic behaviours (Ruben et al., 2007).

Finally, regional and community characteristics also influence smallholder participation in VC service utilization. For VC services offered in locations further away from farmers, the state of roads or the distance to markets influence participation in VC service use. The SMAEs may also be unwilling to deliver services to remote rural communities with poor connectivity to road network. The establishment of farmer field schools in such communities by volunteer trainer of trainees may not be followed by input deliveries, circumventing high operational costs.

As these theories suggest, reactions to the SMAEs decisions and actions may vary depending on households' situation and constraints. Ultimately, inequalities in access to VC services could lead to differences in adoption of CSA innovations, affecting resilience, productivity and sustainability of food

systems. The outcomes of VC participation and the role of intra-household dynamics on adoption outcomes such as resilience and productivity are beyond the scope of this study.

4. Methodology

4.1. Data

We use panel data that includes a baseline survey conducted between June and September 2020, and a follow-up survey for the same period one year later.[5] The surveys were canvassed in the eastern, northern, and central/western regions of Uganda, where the SMAEs are active. At baseline, a total of 2,533 households from 318 farmer groups were covered, and we were able to revisit 2,398 households one year later, resulting in an attrition rate of 5.3 percent. The sample involves both growers and non-growers of soybean, where non-growers comprised mostly farmers that waited to be enrolled into CRAFT in the second year.

The surveys gathered detailed data on participation in the SMAE-organized training workshops and farmer field schools, the number of trainings attended and gender of participants, distance and time taken to learning sites, and time spent at learning sites. The questionnaire also included a detailed module for data on input/technology acquisition, and sale of soybean to the SMAEs. At endline, we elicited farmers' risk and time preferences through incentivized games.[6] Risk games were implemented using Holt-Laury lottery-choice experiment described in Ihli et al. (2016). In the time preference games, farmers were asked to choose between a lower amount that could be paid in two days and a higher amount that could be paid after 14 days, mimicking early and late purchases/payment, respectively (Casaburi & Willis, 2018). The questionnaire also included multiple questions used to measure trust for the SMAEs.[7]

We have three dependent variables of interest: participation in VC service use, bundles of services utilized, and the intensity of VC service use. We distinguish farm-households that used only FLT services, only IMS/OMS, and those that used both.[8] Figure 1 maps the use of VC services for our sample in both years, where we can classify the respondents into 4 groups: (i) *Non-participants* – farmers that never participated in use of any of the SMAEs services at baseline or follow up periods, (ii) *New participants* – households that didn't utilize any of the SMAEs services at baseline but did use at least one of these services one year later, (iii) *Regular participants* – farmers that utilized at least one of the SMAEs services at both the baseline and follow up periods, and (iv) *Irregular participants* – households that utilized at least one of the SMAEs services at only baseline.

The selection of the independent variables follows from the background and analytical framework described in sections 3. The variables are categorized into individual/household, behavioural,

[5] The baseline survey that had been planned to be conducted in from February was delayed by the lockdown measures against the COVID 19 and started June 2020.
[6] Elicitation of risk preferences, time preferences and trust was done at endline because these behaviours are not expected to change over time. See Appendices A1 and A2 for details.
[7] We used factor analysis to construct trust variable from the multiple questions (see Appendix A8).
[8] We combine IMS with OMS since less than 2% of households used OMS at follow-up. Combining IMS with OMS is plausible since these are both situated within an input/output contract.

regional/community and value-chain characteristics. The definitions and measurement of these variables are presented in Appendix A3.

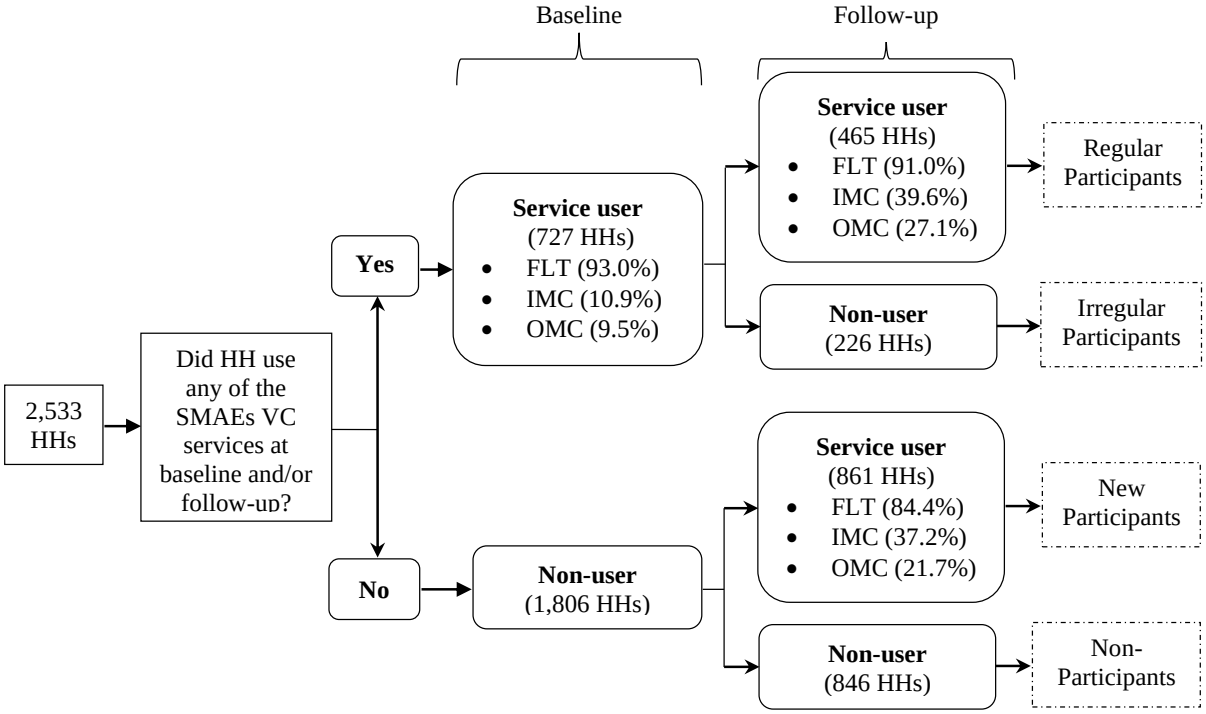


Figure 1. Categorization of participation in VC service use.

4.2 Empirical strategy

4.2.1. Participation in VC service use

We use a multinomial logit model (MNLM) to assess the factors that motivate or hinder smallholders' participation in VCs and use of different services, since both these dependent variables have multiple discrete and unordered outcomes:

$$\Pr(y_i = j) = \frac{exp(x_i'\beta_j)}{\sum_{m=0}^{M} exp(x_i'\beta_m)} \qquad \text{for } j = 0, 1, \dots, M \qquad (1)$$

where y_i reflects the two unordered categorical outcome variables, x_i' is a set of explanatory variables and β_j contains the parameters for choice j. For participation in VC service use, $M = 4$ (regular, new, irregular or non-participants), while for the use of different VC services $M = 3$ (FLT+IMS/OMS, only IMS/OMS or only FLT).

4.2.2. Participation intensity in VC service utilization

Participation intensity is defined as the number of VC services used by the household at either the baseline or follow-up survey, taking discrete values between 0 and 3 since there are three VC services. For our sample, about a third of households did not use any service, compared to 32, 19 and 16 percent that used one, two or three services. However, the decision not to participate may be driven by different

factors than those that determine intensity of use by participants. Imposing a linear specification could then lead to biased estimates. We therefore estimate participation intensity with a two-part model, to allow the determinants of these decisions to systematically differ (Farewell et al., 2017). The main advantage of the two-part model is that it does not rely on assumptions about the correlation between the errors of the binary and continuous equations, while the zeros are interpreted as true zeros.

The two-part model defines a likelihood function that includes both the zero and non-zero decisions for each observation (Buntin & Zaslavsky, 2004; Leung & Yu', 1996; Liu et al., 2019). First, we define the binary decision by farm-households whether to use VC services as a logit:

$$\Pr(y_i > 0|x_i) = F(x_i'\omega) \quad (2)$$

where x_i is again a vector of explanatory variables for farm-household i, ω is a vector of parameters, and F is the cumulative distribution function. Second, the non-zero decisions are defined as the expected number of VC services used conditional on using at least one service:

$$E(y_i|y_i > 0, x_i) = g(x_i'\beta) \quad (3)$$

where g is a normal density function. Both decisions are then combined in the likelihood contribution for each observation:

$$L_i = [1 - F(x_i'\omega)]^{Z(y_i=0)} \times [F(x_i'\omega)g(x_i'\beta)]^{Z(y_i>0)} \quad (4)$$

where Z is an indicator function.

Because we pool all the baseline and follow-up data together, our estimation does not include utilization of FLT, IMS and OMS at baseline as covariates as well as other endogenous variables such as competition and expert visits (defined in Appendix A3).

5. Results and Discussion

5.1. Descriptive Results

Table 1 shows use rates of only FLT services, only IMS/OMS and combined FLT + IMS/OMS across participants. Of the 1,707 non-participators at baseline, we differentiate those that never participate (49.6 percent) from others that started participating at follow-up (50.4 percent, see row 1). New participation represents 36 percent of the entire sample, compared to 29 percent baseline participants. Participation in VC service use almost doubled at follow-up (55 percent), although participants utilized different services. About two thirds of baseline participants continued to utilize the SMAEs' services at follow-up. Finally, 35 percent did not use any VC services at either baseline or follow-up, and most of these waited for enrolment into the CRAFT project in the second year, during the final roll-out phase. Some

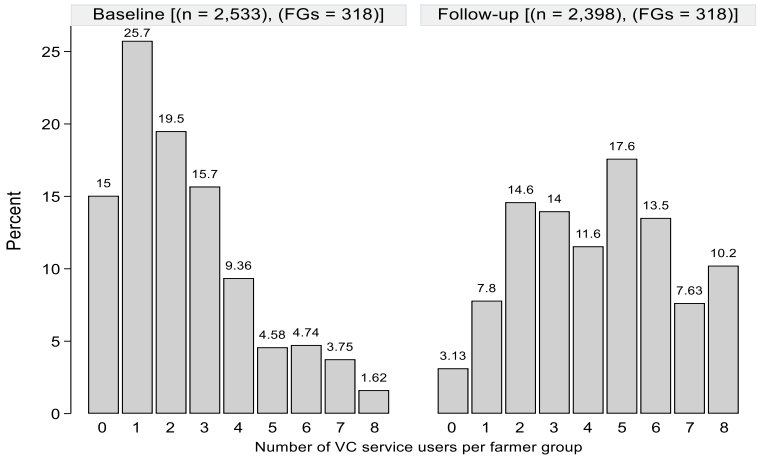
9.4 percent of the sample discontinued VC service use at follow-up, possibly signalling the presence of supply-side and/or demand-side constraints.

Table 1. Participation in utilization of single or a combination of VC services.

	Non-participant (n = 846)	New participant (n = 861)	Regular participant (n = 465)	Irregular participants (n = 226)	Total (n = 2,398)
Panel I. *Baseline*					
Non-user	0.496	0.504	0.000	0.000	1,707
FLT	0.000	0.000	0.674	0.326	576
IMS/OMS	0.000	0.000	0.569	0.431	51
FLT + IMS/OMS	0.000	0.000	0.750	0.250	64
Panel II. *Follow-up*					
Non-user	0.789	0.000	0.000	0.211	1,072
FLT	0.000	0.656	0.345	0.000	749
IMS/OMS	0.000	0.761	0.239	0.000	176
FLT + IMS/OMS	0.000	0.589	0.412	0.000	401

Figure 2 shows an increase in participation at farmer group level (Panel A) and intensity of participation in VC service (Panel B) from baseline to follow-up. In Panel A, each bar represents the share of farmer groups with the specific number of VC services users. About 26 percent of all farmer groups had only one VC service user at baseline; this reduced to 7.8 percent at follow-up. At baseline, the share of farmer groups reduced sharply with the increasing number of VC service users within each group. We observe the opposite trend at follow-up, signifying increased intensity of participation. We can see this trend also at the individual level. As shown in Panel B, at baseline 71 percent of households did not utilize any of the SMAEs services, which reduced to 45 percent at follow-up. The share of households using just one service increased from 26 to 37 percent, while using more than one service increased even stronger, from around 3 to 18 percent.

Panel A. *Intensity of participation in VC service use*



Panel B. *Intensity of VC service utilization*

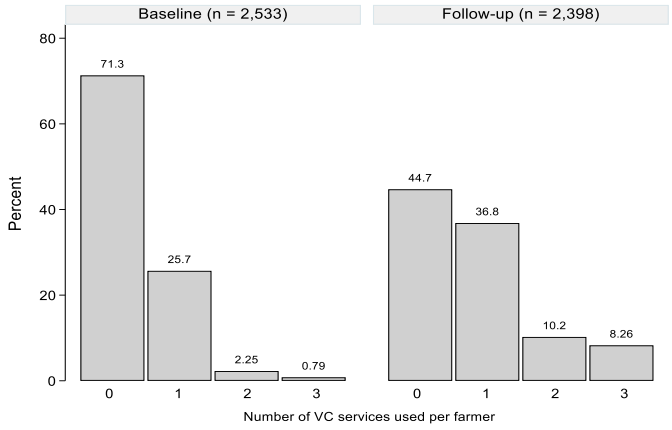


Figure 2. The intensity of participation and utilization of VC services

Note: FGs means farmer groups.

5.2. Estimation results

5.2.1. Participation in value chain service utilization

Table 2 presents the marginal effects of the covariates on the probability of being a regular, irregular, new or non-participant in VC service use, keeping all other variables at their means.[9] We categorize factors that determine participation into the individual/farm-household, behavioural, regional/community and value-chain characteristics in panels A, B, C and D, respectively.

The determinants of regular (or early) participation related with individual decision-makers or farm-households include: gender, education, landholding, land user rights and credit access. Female-headed households are 5 percentage points more likely to regularly participate in VC service use. One additional year of education or one extra hectare of land increases the likelihood of regular participation by 0.5 and 2 percent, respectively (Column 5). Access to credit from formal lenders such as banks or MTN and Airtel mobile phone operators increases the probability of early participation by about 8 percentage points; which is in line with findings by Fischer & Qaim (2012), while lower insecure land user rights raises the likelihood of regular participation by 6 percentage points.

With regards to value-chains, early participators are experienced service users (column 5, panel D). They are experienced soybean growers that received agricultural advisory services on their firms from agricultural experts prior to participation under the CRAFT project. The larger effects (by 28 percentage points) reflects prior expert visits by the SMAEs.

[9] The MNLM parameter estimates and associated standard errors for the covariate in each participation regime are presented in Appendix A6. In all estimations, we need to account for missing values for risk preferences, time preferences and trust variables – the missing values arose due to attrition and refusal to participate in risk and time preference elicitation games. We generate dummy variables that we assign a value of one for missing values and zero otherwise, and then replace the missing values for risk preference, time preference and trust variables with zero. These dummy variables are included in the regressions to maintain the full sample at follow-up.

Table 2. Probability of participation in value chain service (MNL marginal effects).

	Non-participation		New participation		Regular participation		Irregular participation	
	ME (dy/dx)	SE	ME (dy/dx)	SE	ME (dy/dx)	SE	ME (dy/dx)	SE
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A. *Individual and farm-household characteristics*								
Female head	-0.013	0.026	-0.041*	0.025	0.053**	0.023	0.000	0.018
Age	0.001	0.001	0.000	0.001	-0.001	0.001	-0.001	0.001
Education	-0.006*	0.003	0.000	0.003	0.005**	0.002	0.001	0.002
Household size	-0.005	0.004	-0.003	0.004	0.003	0.003	0.005*	0.003
Landholding	-0.014*	0.008	0.002	0.008	0.019***	0.006	-0.007	0.004
Extra land	0.006	0.019	-0.022	0.019	0.023	0.015	-0.007	0.010
Insecure land user rights	0.014	0.038	-0.031	0.036	-0.061**	0.031	0.078***	0.028
Phone ownership	-0.049*	0.026	0.052**	0.025	0.017	0.023	-0.020	0.019
Agric. Wage labour – base	-0.047*	0.028	0.048	0.031	0.003	0.025	-0.004	0.017
Off-farm employment – base	0.028	0.027	-0.029	0.026	-0.008	0.021	0.010	0.017
Enterprise ownership – base	-0.031	0.024	0.024	0.022	0.012	0.019	-0.005	0.015
Formal lender's credit – base	-0.040	0.043	-0.034	0.043	0.077**	0.038	-0.003	0.025
Panel B. *Behavioral characteristics*								
Risk lover	-0.016	0.033	0.037	0.035	-0.014	0.025	-0.007	0.019
Risk averse	-0.012	0.027	0.006	0.028	0.010	0.021	-0.004	0.017
Risk–missing values	-0.079	0.089	0.043	0.101	-0.017	0.078	0.054	0.068
Time preference	-0.045**	0.019	0.043**	0.019	-0.004	0.018	0.006	0.012
Distrust	0.037*	0.021	-0.068***	0.021	-0.011	0.017	0.042***	0.013
Trust – missing	0.077	0.099	-0.061	0.091	-0.014	0.081	-0.002	0.048
Panel C. *Regional and community characteristics*								
Urban location	-0.031	0.031	0.038	0.031	0.027	0.028	-0.034**	0.016
Distance to all-weather road	0.005	0.005	0.002	0.006	-0.010*	0.006	0.003	0.003
Distance to input market	-0.003	0.003	-0.001	0.003	-0.001	0.002	0.004***	0.001
Distance to output market	0.002	0.003	0.005**	0.003	-0.002	0.002	-0.004***	0.002
Distance to SC headquarters	0.003	0.003	-0.001	0.003	-0.000	0.003	-0.002	0.002
Distance to the SMAE office	0.002**	0.001	0.000	0.001	-0.001*	0.001	0.000	0.000
Seasonal drought at baseline	-0.007	0.022	-0.030	0.022	0.038**	0.017	0.000	0.013
Seasonal floods at baseline	-0.033	0.021	0.010	0.023	0.001	0.018	0.021	0.015
Panel D. *Value-chain characteristics*								
Soybean producer at baseline	-0.047*	0.028	-0.048*	0.029	0.075***	0.024	0.021	0.016
New soybean grower	-0.169***	0.022	0.146***	0.025	0.034*	0.019	-0.010	0.012
Expert visit at baseline	-0.196***	0.035	-0.174***	0.039	0.281***	0.044	0.090***	0.031
Enrolled in first season	-0.053*	0.027	0.049**	0.024	0.006	0.022	-0.002	0.013
ALITO	-0.161***	0.033	0.200***	0.035	0.003	0.032	-0.041**	0.016
OKEBA	-0.182***	0.032	0.213***	0.034	0.024	0.033	-0.055***	0.016
Pr(Participation)	0.353		0.359		0.194		0.094	
No. of observations	846		861		465		226	

*, **, *** denote significance at the 1%, 5% and 10% levels, respectively. In the parenthesis are robust standard errors. dy/dx for dummy variables is the discrete change against the base category (Non-participation = 0)

In relation to regional or community characteristics, early participants also reside closer to service points including all-weather road or the SMAEs office (column 5, panel C). A one Km reduction in the distance from the household to the nearest all-weather road or SMAEs office increases the probability of regular participation by 1 or 0.1 percent. Exposure to seasonal drought raises the probability of regular

participation by about 4 percentage points. This result reflects access to input credit by regular (or loyal) VC service users following exposure to climatic shocks.

Next, we examine factors that influence new participation in VC service use (Column 3). We find that new participants are less likely to be female-headed households but more likely to own mobile phone (Panel A).

Turning to behavioural characteristics, we observe a positive relation between intertemporal preference and new participation. A higher time preference coefficient suggests that late participants tend to be present-biased. Hence, their participation is driven by expectation of benefits in the short-term. Our results also show that trust for SMAEs is an important enabler of new participation. An increase in farmers' distrust for the SMAEs reduces the likelihood of new participation by about 7 percentage points (Column 3).

In relation to value chain characteristics, new participants are mostly households without prior experience in soybean production or value chain service utilization (panel D). They are thus new growers or households enrolled by the SMAEs to begin utilizing their VC services. For instance, new engagements in soybean production raise the probability of participation by 15 percentage points. New participators also tend to be located further away from output markets. Thus, their participation is likely driven by improved access to the SMAEs' output market channel.

The main drivers of non-participation (column 1) include lack of or lower level of education, limited landholding, lack of a mobile phone or lack of wage labour employment opportunities. The probability of non-participation increases by 0.6 percent for household heads with lower level of education, while a reduction in landholding by 1 hectare increases the likelihood of non-participation by 1.4 percent. The probability of non-participation is 5 percentage points higher for households without a mobile phone or wage labour employment opportunities.

We observe the opposite trend with regards to behavioural characteristics when compared to late participants. For instance, intertemporal preference is negatively correlated with non-participation, implying that households anticipating delays in benefits are 4 percent more likely to not participate in VC service use. Distrust for the SMAEs raises the probability of non-participation by about 4 percentage points.

Like new participants, non-participants are mostly households with no prior engagements in soybean production or prior exposure to VC services. Delayed enrolment of households into the CRAFT project increases the likelihood of non-participation by 5 percentage points (panel A). These results suggest that non-participation is largely driven by lack of prior experience in soybean production and limited access to VC services. Specifically, limited experience in soybean production or visits by agricultural experts increase the likelihood of non-participation at follow-up period by about 5 and 20 percentage points, respectively. Moreover, households located one km away from the SMAE's office are 0.2 percent more likely to not participate in VC service use, further confirming accessibility constraints with regards to participation in VC service use.

Lastly, we examine factors that influence another form of non-participation in VC service use at follow-up, called irregular participation (Column 7). In relation to individual or farm-household characteristics, household size and insecure land user rights are the main determinants of irregular participation. Larger households are less likely to continue utilizing value chain services, while insecure land user rights increases the likelihood of irregular participation by about 8 percentage points. Households with many dependants will likely prioritize other needs such as food, health care and education thereby, reducing investments in inputs supplied by the SMAEs.

Concerning value chain characteristics, irregular participators had access to extension services from agricultural experts visiting homes/farms directly prior to the CRAFT project (panel D). We also observe irregular participation driven by reduced linkages with the SMAEs.

We also find (in panel C) that residence in urban settings reduces the likelihood of irregular participation by 3 percentage points. Irregular participators are also located further away from input markets but reside closer to output markets.

The phased enrolment of farmers into the CRAFT program is thus leveraged to examine factors influencing participation in VC service use. The results show that new participation is largely driven by improved availability of (or access to) VC services resulting from enhanced linkages with the SMAEs. A mobile phone appears to play a central role in facilitating farmers' linkages, driving their dependencies on the SMAEs' VC services; this is consistent with resource dependency theory. Specifically, the device facilitates communication enabling information sharing amongst farmers as well as between farmers and service providers. Farmers with mobile phones may also be the first to learn about availability of services; and are more easily contacted and notified about visits to the learning sites as well as the arrival of inputs from the SMAEs (Fischer & Qaim, 2012).

Moreover, the services seem to benefit farmers who are poorly connected to output markets. It is plausible to argue that the SMAEs have the incentive to target such farmers as a risk minimization strategy since the probability of defaulting through side-selling by such farmers is lower. However, they may also self-select into the SMAE's value chain when the output market is guaranteed. So the question arises as to whether such farmers will continue to utilize SMAEs VC services when access to output markets improves. Results show that participation in VC service use ceases once farmers get closer to output markets. Hence, local VC services appear to be mostly relevant for underserved farmers residing in remote rural areas. There also appears to be gender inequalities with regards to new participation – VC service utilization is skewed towards men than women. This is suggestive of limited access to land and other resources by women, which is in line with resource dependency theory.

Some behavioral drivers also play a key role in driving new participation. Consistent with agency theory, our results show that new participation is driven by expectation of short-term participation benefits as well as farmers trusting that the SMAEs will fulfil their obligations. Effective relational contracting, client retention or loyalty requires strong mutual trust between service providers and users (MacChiavello & Morjaria, 2015; Macchiavello & Morjaria, 2021). Therefore, the SMAEs should care

to avoid or address any issues that would likely escalate distrust among farmers. Participation could be sustained through timely purchases/payments or timely delivery of services.

For sustained VC service utilization, women's participation is required. The SMAEs are likely to target female-headed households with access to land for trust reasons. Anecdotal evidence suggests women tend to be loyal and trusted, compared to their male counterparts. Sustained VC service utilization also requires that decision-makers are better educated. Education enables farmers to negotiate better contract terms, thereby minimizing opportunistic behaviour by SMAEs. The results also show that sustained participation in VC service utilization and in contract farming requires ownership of sufficient land, secure land user rights or access to credit for farmers to invest in inputs. Insecure land user rights not only diminish the incentive for small and medium farmers to invest in land, it also impedes efficient allocation of resources (Mwesigye & Barungi, 2021). The SMAEs would preferably offer certain incentives such as input or in-kind credit to farmers with sufficient amount of land, secure land user rights and whose repayment capabilities are known to minimize or overcome costs associated with moral hazard and adverse selection. The SMAEs also target farmers in closer proximity to their offices or service points (village-agents) to safeguard themselves against risks and losses.

The results also point to exclusion of some early participators based on certain characteristics such as urban residence or proximity to input/output markets. These exclusionary measures could be premised on the SMAEs' limited control over side-selling among farmers with better access to output markets or high costs associated with delivering services in remote rural areas.

Thus far, we have demonstrated that improved participation in local VCs does not necessarily imply equal participation and we have documented both the demand-side and supply-side drivers and barriers to participation in VC service use. The next section examines factors influencing the utilization of different VC services, among participants.

5.2.2. Use of value chain services

Table 3 presents the MNL marginal effects associated with the use of different VC services during the follow-up period.[10] Column 1 shows users of FLT, while columns 3 and 5 show users of IMS/OMS and FLT + IMS/OMS respectively. The individuals/farm-household, behavioral, regional/community, and value chain characteristics are respectively shown in panels A, B, C, and D.

Users of only FLT services are younger (column 1, panel A), have had prior exposure to seasonal drought at baseline, and are located further away from the SMAEs office (panel C). FLT users also have limited prior experience in soybean production or utilizing IMS/OMS but have had prior experience of participation in farm-level training organized by SMAEs' competitors.

[10] The MNLM parameter estimates are shown in Appendix A7.

Table 3. Drivers of utilization of different value chain services (MNL marginal effects)

	FLT		IMS/OMS		FLT + IMS/OMS	
	ME (dy/dx)	SE	ME (dy/dx)	SE	ME (dy/dx)	SE
	(1)	(2)	(3)	(4)	(5)	(7)
Panel A. *Individual and farm-household characteristics*						
Female head	0.018	0.034	0.029	0.029	-0.047	0.031
Age	-0.003**	0.001	0.001	0.001	0.002*	0.001
Education	-0.005	0.005	0.005	0.003	0.000	0.004
Household size	0.003	0.005	-0.004	0.004	0.001	0.005
Landholding	-0.008	0.010	-0.002	0.006	0.010	0.009
Extra land	-0.018	0.021	-0.008	0.017	0.026	0.021
Insecure land user rights	-0.036	0.053	-0.006	0.036	0.043	0.051
Phone ownership	0.044	0.041	0.025	0.025	-0.070*	0.038
Agric. wage labour - base	-0.004	0.040	0.004	0.031	0.000	0.042
Off-farm employment - base	-0.008	0.039	0.020	0.024	-0.012	0.036
Enterprise ownership - base	0.034	0.030	-0.029	0.020	-0.005	0.027
Formal credit - base	0.004	0.055	0.012	0.043	-0.015	0.054
Panel B. *Behavioral characteristics*						
Risk lover	-0.012	0.046	0.024	0.035	-0.012	0.044
Risk averse	-0.024	0.038	0.001	0.028	0.023	0.035
Risk–missing values	0.124	0.138	0.013	0.107	-0.137	0.100
Time preference	-0.007	0.026	-0.018	0.018	0.025	0.023
Distrust	-0.051	0.037	0.012	0.026	0.039	0.035
Distrust missing values	-0.091	0.154	-0.067	0.104	0.157	0.142
Panel C. *Regional and community characteristics*						
Urban location	0.002	0.048	0.024	0.032	-0.027	0.040
Distance to all-weather road	0.009	0.010	-0.003	0.008	-0.006	0.009
Distance to input market	-0.002	0.004	0.002	0.002	0.000	0.003
Distance to output market	-0.003	0.004	-0.001	0.002	0.004	0.003
Distance to SC headquarters	0.006	0.004	0.003	0.003	-0.009**	0.004
Distance to the SMAE's office	-0.005	0.004	0.007***	0.002	-0.002	0.003
Distance to office squared	0.000*	0.000	-0.000***	0.000	0.000	0.000
Seasonal drought at baseline	0.059**	0.030	-0.003	0.020	-0.056**	0.027
Seasonal floods at baseline	0.038	0.031	0.025	0.019	-0.063**	0.028
Panel D. *Value-chain characteristics*						
Soybean producer at baseline	-0.071*	0.037	0.039	0.024	0.031	0.038
FLT - baseline	-0.038	0.044	-0.022	0.025	0.060	0.040
IMS – baseline	-0.292***	0.082	-0.015	0.044	0.307***	0.087
OMS – baseline	-0.147*	0.085	0.002	0.040	0.145	0.089
Intensity of participation - base	0.120	0.081	-0.049	0.042	-0.071	0.075
Expert visit – baseline	-0.069	0.063	-0.045	0.029	0.114*	0.059
Competition - baseline	0.104**	0.048	-0.078***	0.026	-0.026	0.044
Enrolment season	-0.047	0.040	0.008	0.020	0.039	0.035
ALITO	-0.039	0.052	-0.053**	0.026	0.092**	0.047
OKEBA	0.071	0.063	-0.170***	0.024	0.099*	0.059
Pr(VC service utilization)	0.583		0.149		0.268	
No. of observations	749		176		401	

*, **, *** denote significance at the 1%, 5% and 10% levels, respectively. SE stands for robust standard errors; while ME stands for marginal effects. dy/dx for dummy variables is the discrete change against the base category (FLT+IMS/OMS).

Utilization of only IMS/OMS is positively associated with residences further away from the SMAEs office, while utilization reduces when distance increases further (column 3, panel C). IMS/OMS users are also less likely to participate in competitor-organized FLT, while utilization is 5 and 17 percentage points lower for farmers affiliated with ALITO Joint or OKEBA (panel D).

Lastly, the probability of using FLT + IMS/OMS increases by 0.2 percent the older farmers become but surprisingly farmers without a mobile phone are 7 percentage points more likely to utilize FLT + IMS/OMS (column 3, panel A). This result suggests that contract services are targeted towards farmers with limited access to market information to circumvent side-selling issues. FLT + IMS/OMS tend to be early users of IMS - the probability of using FLT + IMS/OMS at the follow-up period increases by 31 percentage points for farmers that utilized IMS previously, while previous agricultural expert visits are associated with 11 percentage points increase in utilization of FLT + IMS/OMS. Improved linkages with ALITO Joint or OKEBA enhance the utilization of service bundle by about 9 or 10 percentage points, respectively (panel D). FLT + IMS/OMS users also reside closer to sub-county headquarters and are less than 6 percentage points likely to experience seasonal drought or floods (panel C).

The question at hand is, why did farmers use different types of services? Client retention or relationship building by the SMAEs or farmers' intrinsic motivation such as entrepreneurial abilities or eagerness to learn appear to be some of the key determinants for using different services during the follow-up period (Barrett et al., 2022; Ghani & Reed, 2022; MacChiavello & Morjaria, 2015; Macchiavello & Morjaria, 2021). For client retention or relationship building, regular buyers of SMAE's inputs such as improved seed would be prioritized by the SMAEs for a full bundle of services (FLT + IMS/OMS). The SMAEs would also be more inclined to prioritize farmers who make timely repayments for inputs acquired on credit.

As noted earlier, most farmers in rural areas face limited access but also the lower quality of inputs (Bold et al., 2017). Utilization of FLT + IMS/OMS bundle could also signal improved awareness of the services and their quality among new participators. Therefore, farmers likely utilize only FLT services due to limited access to IMS/OMS. It appears that the SMAEs also successfully identify and exclude farmers utilizing competitors' services. Note that FLT + IMS/OMS services are offered under a contract. The results show that some farmers participating in competitors' FLT also participate in the SMAE-organized FLT but are excluded from IMS/OMS offered under a contract.

On the demand side, older farmers tend to have more resources such as land and capital that enable investments in inputs under a contract. As young farmers' capacity to invest in inputs under a contract becomes limited, their opportunity to utilize FLT + IMS/OMS also diminishes. This confirms earlier findings that resource-constrained households – including young farmers as well as new participators are less likely to be offered a contract to access the SMAEs' input/output market channels. Therefore, linkages through a contract appear to benefit loyal and less resource-constrained farmers who are located closer to the SMAEs services.

4.2.4. Intensity of value chain service utilization

We next examine factors influencing the intensity of VC service use, based on a two-part model and pooled OLS for robustness purposes (Table 4). Conditional on participation in VC service use, female-headed households use 0.08 more VC services than men. We also see a positive association with education and landholding. Households with insecure land user rights use 0.09 fewer VC services than households with secure rights, while households with access to credit from formal sources utilize 0.14 more VC services than households without access. This underscores the importance of credit access in facilitating investments in agricultural farm inputs.

For behavioral characteristics we find a positive relationship between time preference and the intensity of VC service use, implying that households use 0.05 more VC services if they expect earnings in a shorter term, than when earnings materialize in a longer term. Distrust for the SMAEs is associated with 0.06 less VC service used by farmers.

Concerning value-chain characteristics, soybean growers use 1.07 more VC services. For regional and community characteristics, households residing farther away from sub county headquarters use relatively fewer VC services. We showed previously that the SMAEs do not deliver services to hard-to-reach communities to minimize delivery costs. The village-agents or farmer field schools were found around the sub county headquarters, hence, households located farther away from these service points had limited access to the SMAEs services.

Together, these results point to differences within and across the SMAEs and/or regions. For the SMAEs, differences in supply of VC services could be due to application of varied business models, varied service delivery capacities such as differences in staffing levels; knowledge, skills and experience of extension workers; and extension workers' intrinsic and extrinsic motivation.

Besides supply-side factors, demand for VC services appears to vary across regions resulting from differences in the size of produce buyers (competition). Competition from buyers is particularly higher in northern region where agroecological conditions favour soybean production and productivity. Competition for supplies requires more services and associated incentives delivered to farmers. Moreover, field observations and focus group discussions with farmers revealed high demand for seed. Due to high seed demand, the SMAEs prioritized loyal farmers as well as households found closer to their office or sub counties around which farmer field schools and village-agents were found. Higher competition also means that the price guaranteed in the contract is bound to fluctuate in case of weather shocks. Higher competition for soybean output and associated increased demand for services could result into further exclusion from contract services due to increased probability of side-selling. For instance, results show that farmer linkages with ALITO Joint is associated with utilization of 0.169 less services. For central/western regions with lower competition, farmers would also consider it risky to engage in the production of a new crop with few buyers.

Table 4. Intensity of value chain service use

			Two-part model			
	Pooled OLS		Selection equation		VC service use intensity	
	Coef.	SE	Coef.	SE	ME (dy/dx)	SE
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. *Individual and farm-household characteristics*						
Female head	0.049	0.031	0.166*	0.097	0.077**	0.035
Age	-0.001	0.001	-0.004	0.003	-0.001	0.001
Education	0.007*	0.004	0.021*	0.011	0.008*	0.004
Household size	0.004	0.004	0.024*	0.013	0.005	0.005
Landholding	0.018*	0.010	0.086***	0.032	0.023*	0.012
Landholding squared	-0.001**	0.000	-0.004***	0.001	-0.001**	0.000
Extra land	0.008	0.023	0.052	0.071	0.018	0.025
Insecure land user rights	-0.075*	0.045	-0.209	0.140	-0.086*	0.051
Phone ownership	0.009	0.034	0.130	0.097	0.011	0.039
Agric. wage labour	0.040	0.034	0.067	0.085	0.036	0.033
Off-farm employment	0.035	0.033	0.137	0.093	0.043	0.036
Enterprise ownership	0.025	0.026	0.107	0.079	0.026	0.029
Formal credit	0.164***	0.046	0.356***	0.124	0.144***	0.045
Panel B. *Behavioral characteristics*						
Risk lover	-0.038	0.040	0.001	0.112	-0.017	0.042
Risk averse	0.005	0.034	0.037	0.095	0.011	0.035
Risk – missing values	0.139	0.104	0.381	0.326	0.122	0.118
Time preference	0.056**	0.027	0.090	0.072	0.046*	0.027
Distrust	-0.037	0.031	-0.167*	0.090	-0.059*	0.034
Distrust – missing	-0.128	0.111	-0.394	0.330	-0.114	0.122
Panel C. *Regional and community characteristics*						
Urban location	-0.007	0.042	0.099	0.119	-0.006	0.042
Road distance	-0.002	0.007	-0.020	0.018	-0.005	0.007
Input market distance	0.001	0.003	0.010	0.009	0.003	0.003
Output market distance	-0.001	0.003	-0.013*	0.008	-0.004	0.003
Subcounty distance	-0.018**	0.008	-0.038	0.023	-0.019**	0.008
Subcounty distance squared	0.000	0.000	0.001	0.001	0.001*	0.000
Distance to SMAE office	-0.005	0.005	-0.006	0.011	-0.005	0.004
Distance to SMAE squared	0.000	0.000	0.000	0.000	0.000	0.000
Seasonal drought	0.029	0.026	0.171**	0.072	0.048*	0.027
Seasonal floods	0.056**	0.025	0.197***	0.070	0.085***	0.027
Panel D. *Value-chain characteristics*						
Soybean grower	0.965***	0.046	1.307***	0.094	1.074***	0.044
ALITO	-0.212***	0.075	-0.153	0.179	-0.169***	0.063
OKEBA	0.234***	0.060	0.558***	0.168	0.244***	0.057
Wave	0.489***	0.031	1.104***	0.083	0.484***	0.030
Constant	-0.157	0.210	-2.570***	0.535		
Number of observations	4,931		4,931		2,053	
R^2	0.335					
Wald chi-square			528.21			
Prob > chi-square			0.000			
Pseudo R^2			0.135			

*, **, *** denote significance at the 1%, 5% and 10% levels, respectively.

6. Conclusions

Smallholders' integration into AVCs is a key strategy for transforming food systems to improve their resilience, productivity and sustainability. Achieving these goals may not be reached unless food systems become more inclusive. Many value chain development initiatives are criticized for their lack of inclusiveness. Therefore, we need to increase our understanding of the drivers and barriers to VC service use, in order to inform on the design of more inclusive value chain development initiatives. In this study, we analysed how appropriate VC participants are selected, what factors influence their continuous participation or lead to drop out; which and why certain VC services packages that guarantee inclusion of bottom-of-the pyramid smallholders are not utilized.

We used field survey data from prospective soybean smallholder farmers collected in two consecutive years in three regions of Uganda with the aim to assess key factors that influence differences in the use of support services including training, seed and bio-fertilizer supplies and output marketing contracts, provided by regional small- and medium-scale agribusiness enterprises. It appears that some farmers are early participants while others engage in later periods or eventually drop out. Early participation was driven by increased availability of VC services, complemented by information about their existence. Mobile phones played a key role in service use and soybean uptake. In addition, continued smallholders' integration into the SMAEs value chains was not possible unless specific barriers related to late purchases are resolved. For (new) participators, integration into the AVCs implies that most of them have possibilities to start growing soybean. Linkages to the SMAEs' value chains have to be beneficial for new farmers with less land to overcome trade-offs with other crops for soybean production, especially in the central/western regions. Hence, new participators could be experimenting to ascertain whether it is worthwhile engaging in soybean value chain, relative to other crop activities.

Participation in service use is hampered by lack of education, small farm size, insecure land tenure, and limited access to credit. In addition, lack of a mobile phone, expected delays in purchases/payments, distrust, longer distance to the SMAEs office and limited prior exposure to the SMAEs VC services reduce the likelihood of (continued) participation. Non-participation is mainly experienced by marginal smallholders with very small land area. Most of the factors that favour regular participators are reinforced by positive experience using the VC services.

There are also important differences with respect to the type and package of VC services used by participating households. Utilization of single FLT services is higher among new participators, while shortages in seed supplies lead to exclusion from complementary IMS/OMS by the SMAEs that aim for minimizing their risks and losses. The offer of a contract is therefore made conditional on FLT participation in order to identify and exclude (potential) VC service users that are already receiving services from competitors. Weather shocks such as seasonal drought and floods also affect utilization of FLT + IMS/OMS. Hence, utilization of FLT + IMS/OMS services is mainly influenced by supply-side factors, while non-utilization is influenced by both supply- and demand-side factors.

These differences in VC service use are influenced by specific factors. First, especially smaller soybean producers face dependencies and uncertainties in terms of their access to resources. Consequently, farmers with more stable (or more diversified) incomes, better credit access and mobile phones can reduce these uncertainties and are able to engage into more regular adoption. Second, smallholders located in remote regions, further away from the SMAEs or operating in more monopolistic VCs are likely to face higher transaction costs due to incomplete contracts or late delivery. Reducing these risks asks for access to information through training and extension services. Third, commercial soybean farmers increasingly face behavioral uncertainties forthcoming from lack of trust or limited contract compliance by the SMAEs. Irregular participation is therefore mainly related to disturbed agency relationships.

When the CRAFT project has been designed to offer support for intensifying the delivery of VC services, the SMAEs were assumed to be a risk-neutral delivery channel. However, the results point to the fact that service providers employ certain exclusionary measures to minimize risks and losses. A potential explanation is that agribusinesses have their own objectives and try to reduce risks and losses in order to maximize profits. Consequently, the SMAEs employ a series of measures and look for safeguards that exclude resource-poor households.

VC service delivery fulfils a dual function: first for the early selection of most appropriate participating farmers for soybean production, and thereafter to ensure an alignment between these farmers and SMAEs for continuous deliveries. This implies that achieving inclusive and resilient food systems is complicated unless adequate extension strategies and different incentives are put in place to motivate agribusinesses to take risks by relaxing exclusionary measures when dealing with smallholder farmers. Studies by German et al. (2020) and Martiniello & Azambuja (2019) reach a similar conclusion. Resource constraints need to be addressed to improve participation by smaller farmers. Better contracts that involve inputs and insurance based on 'pay-upon-supply' may be helpful to reduce transaction costs and enhance inclusiveness. More transparent, long-term and mutual contracts addressing major risks and constraints faced by farmers but also share risk with agribusinesses can reinforce agency relationships. Finally, insurance for agribusinesses associated with non-delivery by farmers can be an important risk-sharing mechanism (Casaburi & Willis, 2018).

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Declaration of interest statement;

The authors report there are no competing interests to declare.

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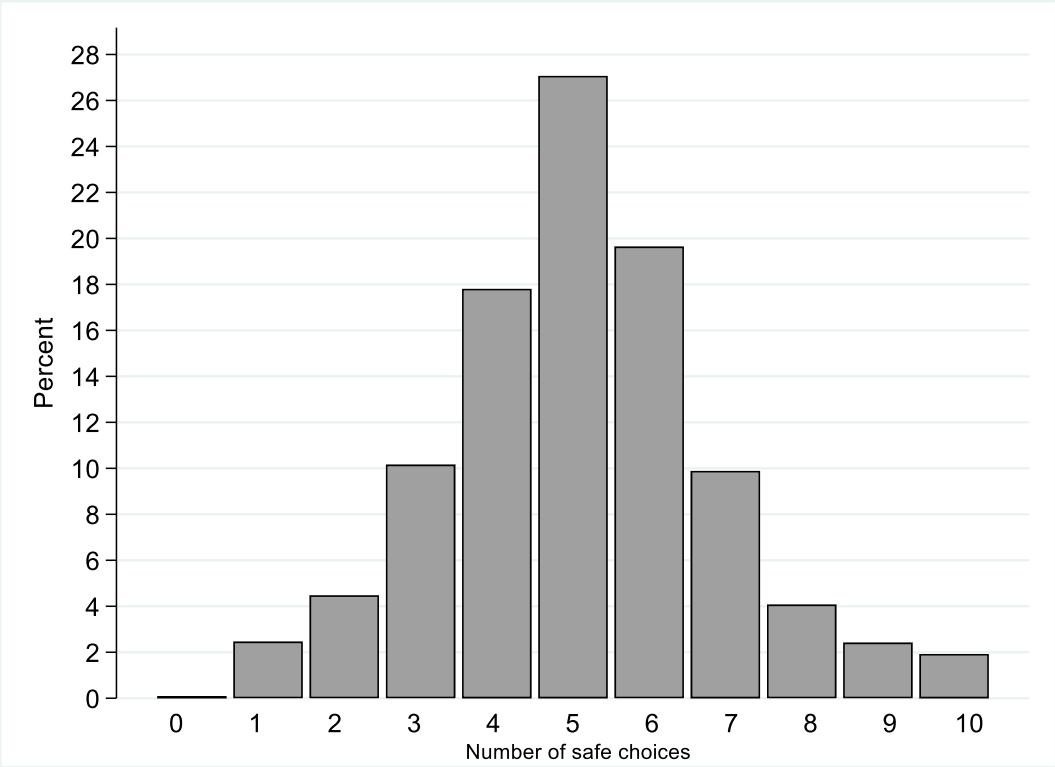
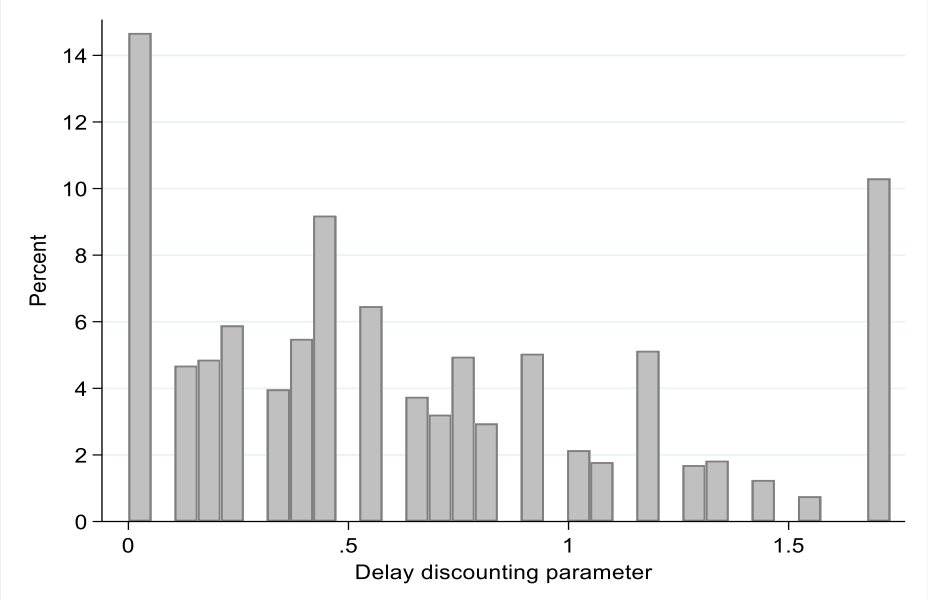
Appendices (not for publication, but available online)

A1. Determination of risk preferences



Note: 0 – 3 safe choices represents risk-lovers; 4 represents risk-neutral; while 5 – 10 safe choices represent risk-aversion (H. Ihli et al., 2016).

A2. Choices in the discounting task



A3. Definitions and summary statistics of the variables used in the study.

Variable	Description	Obs.	Mean
Panel A. *Individual and farm-household characteristics*			
Female head	Sex of the household head (= 1 if female)	2,398	0.216
Age	Age of the household head, complete years	2,398	45.063
Years of education	Education of the household head, years	2,398	6.767
Household size	Number of members in a household	2,398	6.886
Landholding	Total amount of land owned by the household (Ha)	2,398	2.185
Extra land	Amount of land rented-in/borrowed in by the household (Ha)	2,398	0.287
Land user rights	1 = concerned that somebody might dispute land ownership/use rights	2,398	0.078
Phone	1 = households owns a mobile phone	2,398	0.832
Agric. wage labour–base	1 = if household engaged in wage labour on other people's farms - base	2,398	0.133
Off-farm employ–base	1 = if household engaged in off-farm employment at baseline	2,398	0.187
Enterprise–base	1 = if household owns and earns from an enterprise at baseline	2,398	0.234
Formal credit–base	1 = if household borrowed from a formal lending institution at baseline	2,398	0.063
Panel B. *Behavioral characteristics*			
Risk lover	1 = if the decision-maker is a risk taker	2,137	0.170
Risk neutral	1 = if the decision maker is neither a risk taker nor risk averse	2,137	0.183
Risk averse	1 = if the decision maker is risk averse	2,137	0.647
Time preference	Time discounting by the decision-maker – small values mean patience	2,142	0.651
Trust for the SMAEs	1 = if the decision-maker trusts incentive providers	2,161	0.243
Panel C. *Regional and community characteristics*			
Urban	1 = if household is located in an urban setting	2,398	0.193
Road distance	Distance from household to the nearest all-weather road (Km)	2,398	1.140
Input distance	Distance from household to the nearest input dealer (Km)	2,398	4.460
Market distance	Distance from household to the nearest output market (Km)	2,398	4.307
Sub county distance	Distance from household to sub county headquarters (Km)	2,398	5.658
Distance to SMAE's office	Distance between the household and the SMAE	2,398	38.959
Seasonal drought–base	1 = if household reports having experienced seasonal drought at base	2,398	0.656
Seasonal floods–base	1 = if household reports having experienced seasonal floods at baseline	2,398	0.318
Panel D. *Value chain characteristics*			
Soybean producer–base	1 = if household grew soybean in any of the two seasons at baseline	2,398	0.316
New soybean grower	1 = if household grew soybean at only baseline or only follow-up	2,398	0.287
Participation intensity–base	Share of households in a farmer group utilizing VC services at baseline	2,398	0.303
Competition–base	1 = if household participated in competitor-organized FLT at baseline	2,398	0.146
Expert visit – base	1 = if agric. expert visited home of the household for advice - baseline	2,398	0.054
ACILA	1 = if value chain service provider is ACILA Enterprises (eastern)	2,398	0.404
ALITO	1 = if value chain service provider is ALITO Joint (northern)	2,398	0.265
OKEBA	1 = if value chain service provider is OKEBA (central and western)	2,398	0.331

A4. Characteristics of participators and non-participators in VC service use.

	Non-participation		New participation		Regular participation		Irregular participation	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Panel A. *Individual and farm-household characteristics*								
Female head	0.232	0.017	0.202	0.014	0.226	0.020	0.195	0.031
Age	45.349	0.541	45.412	0.553	44.508	0.644	43.805	0.892
Education	6.358	0.144	6.741	0.159	7.449	0.203	6.996	0.273
Household size	6.806	0.107	6.749	0.105	7.052	0.136	7.367	0.194
Landholding	1.941	0.092	2.306	0.119	2.471	0.134	2.047	0.170
Extra land	0.278	0.024	0.257	0.022	0.347	0.033	0.306	0.038
Insecure land user rights	0.079	0.011	0.071	0.010	0.060	0.014	0.142	0.026
Phone ownership	0.796	0.014	0.856	0.014	0.865	0.017	0.810	0.028
Agric. wage labour – mid	0.227	0.020	0.207	0.017	0.196	0.022	0.230	0.031
Agric. wage labour - base	0.134	0.013	0.138	0.013	0.116	0.017	0.142	0.025
Off-farm employment – mid	0.111	0.012	0.157	0.014	0.157	0.018	0.133	0.023
Off-farm employment - base	0.181	0.014	0.171	0.014	0.215	0.021	0.212	0.026
Enterprise ownership – mid	0.279	0.017	0.366	0.018	0.366	0.023	0.305	0.034
Enterprise ownership - base	0.209	0.016	0.254	0.016	0.249	0.021	0.212	0.029
Formal credit – mid	0.061	0.009	0.121	0.013	0.153	0.018	0.088	0.020
Formal credit - base	0.046	0.008	0.055	0.008	0.105	0.017	0.066	0.017
Panel B. *Behavioral characteristics*								
Risk lover	0.155	0.013	0.187	0.014	0.176	0.017	0.137	0.022
Risk neutral	0.191	0.015	0.174	0.015	0.175	0.018	0.194	0.029
Risk averse	0.653	0.017	0.638	0.018	0.650	0.023	0.562	0.036
Time preference	0.607	0.021	0.704	0.022	0.625	0.030	0.552	0.037
Distrust	0.267	0.020	0.230	0.018	0.237	0.022	0.221	0.028
Panel C. *Regional and community characteristics*								
Urban location	0.169	0.022	0.228	0.027	0.209	0.031	0.119	0.026
Road distance	1.238	0.101	1.145	0.104	0.917	0.091	1.215	0.193
Input market distance	4.399	0.189	4.514	0.230	4.097	0.229	5.227	0.397
Output market distance	4.427	0.222	4.463	0.261	3.867	0.226	4.171	0.290
Subcounty distance	5.795	0.233	5.785	0.230	5.390	0.281	5.220	0.280
Seasonal drought – mid	0.625	0.020	0.666	0.019	0.662	0.023	0.619	0.033
Seasonal drought -base	0.647	0.021	0.646	0.021	0.697	0.025	0.650	0.035
Seasonal floods – mid	0.279	0.017	0.330	0.019	0.342	0.021	0.345	0.036
Seasonal floods - base	0.301	0.020	0.303	0.020	0.331	0.026	0.407	0.039
Panel D. *Value chain characteristics*								
Soybean grower – mid	0.213	0.020	0.576	0.025	0.602	0.032	0.221	0.032
Soybean grower - base	0.260	0.022	0.287	0.025	0.439	0.033	0.385	0.038
New soybean grower	0.191	0.015	0.364	0.023	0.318	0.024	0.288	0.033
Distance to the SMAE	40.271	1.392	39.534	1.499	36.137	1.857	37.660	1.759
Proximity to recipients	5.476	0.171	5.545	0.196	5.403	0.211	5.208	0.208
Participation intense – mid	0.351	0.014	0.663	0.016	0.705	0.017	0.426	0.021
Participation intense - base	0.210	0.012	0.231	0.012	0.533	0.022	0.446	0.023
Competition – mid	0.000	(.)	0.285	0.021	0.443	0.028	0.327	0.037
Competition - base	0.000	(.)	0.000	(.)	0.508	0.030	0.504	0.041
Expert visit – mid	0.100	0.013	0.223	0.018	0.327	0.026	0.111	0.021
Expert visit - base	0.021	0.006	0.024	0.005	0.138	0.017	0.115	0.022
ACILA	0.506	0.035	0.290	0.030	0.357	0.040	0.553	0.045
ALITO	0.197	0.026	0.302	0.032	0.338	0.041	0.230	0.038
OKEBA	0.297	0.032	0.408	0.034	0.305	0.037	0.217	0.035

SE = Robust standard errors. The number of observations per variable remain unchanged (see Table 3).

A5. Characteristics of non-users and users of different VC services.

	Non-user		FLT		IMS/OMS		FLT+IMS/OMS	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Panel A. *Individual and farm-household characteristics*								
Female head	0.224	0.015	0.227	0.016	0.193	0.031	0.187	0.020
Age	45.023	0.499	44.503	0.548	45.148	1.172	46.177	0.771
Education	6.493	0.135	6.730	0.163	7.722	0.344	7.152	0.224
Household size	6.924	0.095	6.829	0.113	6.869	0.241	6.898	0.155
Landholding	1.964	0.091	2.249	0.123	2.569	0.262	2.489	0.138
Extra land	0.284	0.021	0.279	0.022	0.284	0.046	0.309	0.037
Insecure land user rights	0.092	0.011	0.064	0.010	0.063	0.018	0.075	0.014
Phone ownership	0.799	0.013	0.864	0.014	0.886	0.025	0.838	0.020
Agric. wage labour – mid	0.228	0.018	0.204	0.017	0.239	0.034	0.185	0.022
Agric. wage labour - base	0.135	0.011	0.131	0.014	0.131	0.029	0.130	0.020
Off-farm employment – mid	0.116	0.011	0.163	0.014	0.131	0.025	0.157	0.021
Off-farm employment - base	0.188	0.013	0.175	0.015	0.233	0.037	0.187	0.022
Enterprise ownership – mid	0.285	0.016	0.383	0.019	0.256	0.031	0.382	0.025
Enterprise ownership - base	0.210	0.014	0.266	0.017	0.199	0.031	0.252	0.021
Formal credit – mid	0.067	0.008	0.111	0.012	0.131	0.030	0.172	0.021
Formal credit - base	0.050	0.007	0.068	0.009	0.080	0.028	0.077	0.015
Panel B. *Behavioral characteristics*								
Risk lover	0.157	0.012	0.187	0.014	0.196	0.032	0.168	0.019
Risk neutral	0.191	0.013	0.182	0.016	0.153	0.030	0.176	0.019
Risk averse	0.652	0.015	0.631	0.019	0.650	0.039	0.658	0.024
Time preference	0.611	0.020	0.683	0.024	0.630	0.044	0.703	0.032
Trust	0.265	0.018	0.226	0.018	0.202	0.037	0.245	0.028
Panel C. *Regional and community characteristics*								
Urban location	0.159	0.020	0.244	0.029	0.159	0.037	0.204	0.034
Road distance	1.233	0.107	1.157	0.115	0.901	0.104	0.965	0.120
Input market distance	4.574	0.180	4.279	0.188	4.726	0.381	4.375	0.366
Output market distance	4.373	0.194	4.120	0.193	4.553	0.414	4.374	0.383
Subcounty distance	5.673	0.207	5.895	0.242	5.411	0.346	5.286	0.325
Seasonal drought – mid	0.624	0.018	0.680	0.020	0.642	0.039	0.646	0.027
Seasonal drought -base	0.647	0.019	0.690	0.020	0.602	0.042	0.641	0.028
Seasonal floods – mid	0.293	0.016	0.334	0.020	0.369	0.036	0.319	0.025
Seasonal floods - base	0.324	0.020	0.302	0.022	0.420	0.036	0.287	0.026
Panel D. *Value chain characteristics*								
Soybean grower – mid	0.215	0.018	0.266	0.024	1.000	0.000	1.000	0.000
Soybean grower - base	0.286	0.022	0.262	0.024	0.472	0.041	0.429	0.039
New soybean grower	0.212	0.015	0.186	0.016	0.528	0.041	0.571	0.039
Distance to the SMAE	39.721	1.323	41.072	1.698	36.288	1.611	34.147	2.082
Proximity to recipients	5.419	0.160	5.579	0.206	5.621	0.427	5.283	0.180
Participation intense – mid	0.367	0.014	0.642	0.015	0.630	0.024	0.765	0.019
Participation intense - base	0.260	0.014	0.336	0.018	0.293	0.025	0.358	0.028
Competition – mid	0.069	0.010	0.465	0.025	0.080	0.020	0.222	0.023
Competition - base	0.106	0.011	0.198	0.017	0.068	0.019	0.190	0.021
Expert visit – mid	0.103	0.012	0.260	0.019	0.142	0.028	0.309	0.030
Expert visit - base	0.041	0.007	0.048	0.008	0.051	0.016	0.100	0.017
ACILA	0.516	0.034	0.282	0.030	0.557	0.053	0.267	0.039
ALITO	0.204	0.025	0.259	0.030	0.364	0.051	0.397	0.046
OKEBA	0.280	0.029	0.459	0.036	0.080	0.029	0.337	0.047

A6. Factors motivating or hindering participation in VC service use – MNLM results.

	New participation		Regular participation		Irregular participation	
	Coef.	SE	Coef.	SE	Coef.	SE
Panel A. *Individual and farm-household characteristics*						
Female head	-0.073	0.145	0.323*	0.167	0.055	0.235
Age	0.009	0.026	-0.015	0.032	-0.007	0.038
Age squared	0.000	0.000	0.000	0.000	0.000	0.000
Education	0.020	0.018	0.049**	0.020	0.025	0.025
Household size	0.009	0.021	0.037	0.026	0.069**	0.032
Total landholding	0.061	0.054	0.192***	0.057	-0.029	0.069
Total landholding squared	-0.002	0.002	-0.009***	0.003	0.001	0.003
Extra land	-0.083	0.105	0.106	0.123	-0.082	0.143
Insecure land user rights	-0.146	0.208	-0.432	0.298	0.602**	0.245
Mobile phone ownership	0.321**	0.140	0.253	0.176	-0.073	0.221
Agric. wage labour – base	0.293*	0.160	0.173	0.198	0.090	0.238
Off-farm employment – base	-0.182	0.147	-0.138	0.178	0.020	0.211
Enterprise ownership – base	0.169	0.125	0.171	0.156	0.041	0.211
Formal lender's credit – base	0.027	0.250	0.511*	0.267	0.110	0.364
Panel B. *Behavioral characteristics*						
Risk lover	0.194	0.186	-0.011	0.206	-0.050	0.274
Risk averse	0.073	0.153	0.099	0.165	-0.028	0.223
Risk – missing values	0.425	0.554	0.208	0.638	0.706	0.693
Time preference	0.269***	0.104	0.116	0.136	0.188	0.159
Distrust	-0.312**	0.127	-0.230	0.164	0.055	0.187
Trust – missing values	-0.340	0.525	-0.299	0.665	-0.418	0.667
Panel C. *Regional and community characteristics*						
Urban location	0.222	0.166	0.253	0.221	-0.325	0.259
Distance to all-weather road	-0.013	0.030	-0.076*	0.042	0.017	0.035
Distance to input market	0.007	0.016	0.005	0.019	0.054***	0.019
Distance to output market	0.010	0.014	-0.020	0.017	-0.051**	0.021
Distance to SC headquarters	-0.012	0.014	-0.010	0.020	-0.030	0.023
Seasonal drought – base	-0.060	0.116	0.245*	0.142	0.035	0.177
Seasonal floods – base	0.145	0.124	0.125	0.140	0.329*	0.176
Panel D. *Value-chain characteristics*						
Grew soybean – base	0.010	0.164	0.550***	0.180	0.374*	0.194
New soybean grower	1.004***	0.140	0.793***	0.158	0.445***	0.173
Distance to SMAE's office	-0.002	0.013	-0.034*	0.019	-0.027	0.016
Distance to office squared	0.000	0.000	0.000	0.000	0.000	0.000
Expert visit – base	0.182	0.338	1.840***	0.281	1.525***	0.305
Enrolment season	0.310**	0.140	0.208	0.188	0.129	0.171
ALITO	1.121***	0.196	0.590**	0.275	0.063	0.270
ACILA	1.216***	0.191	0.790***	0.280	-0.016	0.258
Constant	-1.863***	0.713	-1.694*	0.908	-1.506	0.957
Number of observations	861		465		226	
Wald chi-square	510.56					
Prob > chi2	0.000					
Psudo R-squared	0.083					

*, **, *** denote significance at the 1%, 5% and 10% levels, respectively. SE stands for robust standard errors, dy/dx for dummy variables is the discrete change against the base category (Non-participation).

A7. Factors driving utilization of only FLT or only IMS/OMS – MNLM results.

	FLT		OMS/IMS	
	Coef.	SE	Coef.	SE
Female	0.217	0.174	0.416	0.295
Age	-0.010*	0.006	0.003	0.008
Education	-0.011	0.024	0.037	0.031
Household size	-0.006	0.026	-0.055	0.042
Land holding	-0.020	0.026	0.031	0.039
Extra land	-0.119	0.107	-0.122	0.185
Insecure land user rights	-0.239	0.257	-0.255	0.394
Mobile phone ownership	0.307	0.195	0.441	0.297
Agric. wage labour	0.000	0.213	0.055	0.355
Off-farm employment	0.041	0.199	0.249	0.253
Enterprise ownership	0.082	0.147	-0.238	0.234
Formal credit	0.048	0.290	0.157	0.447
Risk lover	-0.004	0.236	0.213	0.366
Risk taker	-0.154	0.188	-0.087	0.298
Risk – missing	0.871	0.752	0.795	1.133
Time preference	-0.112	0.125	-0.244	0.192
Trust	-0.237	0.181	-0.011	0.267
Trust – missing	-0.794	0.775	-1.217	1.179
Urban location	0.106	0.232	0.300	0.311
Road distance	0.041	0.048	-0.001	0.085
Input distance	-0.004	0.020	0.018	0.021
Market distance	-0.024	0.017	-0.026	0.016
Subcounty distance	0.044*	0.024	0.057*	0.031
Distance to SMAE's office	-0.001	0.019	0.069***	0.023
Distance to SMAE's office squared	0.000	0.000	-0.001**	0.000
Seasonal drought	0.322**	0.147	0.191	0.210
Seasonal floods	0.306*	0.163	0.429**	0.204
Soybean grower	-0.261	0.192	0.196	0.265
Farm-level training	-0.290	0.217	-0.414	0.283
IMS	-1.540***	0.450	-0.906*	0.506
OMS	-0.750*	0.425	-0.381	0.467
Intensity of participation	0.503	0.420	-0.181	0.488
Expert visit	-0.497*	0.289	-0.812	0.389
Competition	0.295	0.246	-0.766*	0.414
Enrolment season	-0.238	0.198	-0.067	0.222
ALITO	-0.388	0.250	-0.781***	0.292
OKEBA	-0.220	0.312	-2.418***	0.474
Constant	0.861	0.690	-2.059**	0.991
Wald chi-square	306.74			
Prob > chi2	0.000			
Psudo R-squared	0.114			
No. of observations	749		176	

*, **, *** denote significance at the 1%, 5% and 10% levels, respectively. SE stands for robust standard errors, dy/dx for dummy variables is the discrete change against the base category (FLT + IMS/OMS).

A8. Construction of trust variable through factor analysis

Trust variable was constructed through factor analysis using variables below where we asked:

How much trust do you have in:	For each sub question, the responses were as follows:
a) Companies that buy produce from farmers b) Agents that buy produce on behalf of companies c) Fellow farmer group members d) Neighbors	1. A lot of trust 2. Quite a bit of trust 3. Little trust 4. No trust at all.

Factor analysis resulted in only one factor with factor loading (pattern matrix) and unique variances below.

Variable	Factor	Uniqueness
T5 = Companies	0.8109	0.3424
T6 = Agents	0.8251	0.3191
T9 = Fellow group members	0.6433	0.5861
T11= Neighbors	0.6214	0.6138