Returns to Market Coordination Mechanisms and Implications for Partial Bilateral Contracts for Commodity Exchange in Central Uganda

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Abstract:

Governance of economic exchange can be realized through various coordination mechanisms and thus, farmers must choose alternative mechanism through which to channel their primary commodity. This paper looks at two coordination mechanisms and returns accruable from farmer participation in either spot market arrangement or bilateral contract arrangement, or both. Participation in two coordination mechanisms is observed as safe-guard of expected benefits against market uncertainty. Based on survey data from 349 smallholder farmers in central Uganda, we find that farmers derive higher benefit from participation in bilateral market coordination compared to spot market coordination. It is shown that there the difference in yield among the farmer categories is insignificant and that farmers who participate in both spot market and bilateral contracts earn twice compared to farmers under only spot markets. For returns to labor, every dollar cost of labor yields US$ 1.1 under single market coordination and about US$ 1.5 under double market coordination system. The trade-off analysis showed that adoption rate for bilateral contract system is about 56.5% and there are gains in adoption of bilateral contract market coordination. Thus, promotion of bilateral contracts requires provisions that allow farmers to participate in more than one markets while limiting contract reneging.

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Keywords: Market coordination, Spot marketing, bilateral contracts; gross margin, trade-off analysis, Uganda

1.0 INTRODUCTION

To remain relevant in future food system, smallholder farmers in Africa must adopt better technology and market coordination mechanisms aligned to buyer requirements. This requires market incentives that redirect farmers choice without private or public orders. In Zambia for instance, evidence shows that market price incentive under the dual marketing system has stimulated intensification and extensification of maize production (Mason, Mason, Hall, & Lansing, 2012). In the debate on the future of smallholder farmers in the commodity market space, it is recognized that refocus of market policy is critical if smallholder farmers are not to be made worse-off. A unifying theme across the literature, however, is that informal and formal institutional development remains important in creating efficient market systems for the development of smallholder agriculture (Masakure & Henson, 2005). Limited success in market governance reforms has exposed farmers to high transaction costs which reduces the incentive for market participation (Abdulai & Birachi, 2008). Currently, the expansion of domestic, regional, and global markets; institutional innovations in markets, finance, and collective action; and revolutions in biotechnology and information technology all offer a profound opportunity to use agriculture for development (Alexandratos & Bruinsma, 2012). The foregoing set of opportunities offers a chance for reducing information asymmetry and transaction costs which have failed the classical market system. Going forward, seizing of opportunities that present to farmers requires social and political will for reforms that improve the governance of agricultural markets. Contracting between producers on one hand and buyers on the other hand, is one of the instruments which can strengthen vertical coordination in commodity supply chains (Bijman, 2008).

Prospects and constraints of smallholder farmer production

With about 80% of Sub Saharan Africa population deriving a livelihood from subsistence farming, agriculture is still the sector key for economic transformation, poverty reduction and sustainable development. Agriculture development has the potential to reduce rural poverty if smallholders become direct suppliers in modern food markets (WB, 2008). The WB adds that the use of agriculture as the basis for economic growth in the agrarian countries requires a productivity revolution in smallholder farming. If this revolution is to occur, it must be backed by relevant production and market incentives. Where farm production is primarily, to secure household food needs, the first set of incentives for improving production can spring from the threat to family life. This can be viewed as a negative incentive which may foster self-adoption and own-policing. Where income to meet other household demands is considered the secondary objective for smallholder producers, then the second set of in-

centives can be modelled around institutions of market governance especially tailored about market functions including: the physical functions (-distribution, processing, & storage), the facilitative functions (-standardization, financing, physical/market risk bearing, management of uncertainty, & market intelligence), and thirdly, the exchange function (which includes buying and selling). How the three functions are managed profoundly impacts on transaction costs and returns. Agribusiness firm decision to expand activities through formal contracting rather than plantations, buying directly from open markets or other means reflects differences in transaction costs found in distinct types of procurement systems (Simmons, 2002).

Depending on how the market is organized and how the market delivers on its functions, incentives aligned with performance and risk management can be viewed as motivation for particular market governance choice for farmers (Masakure & Henson, 2005). Also, the total sum of production and market incentives can enhance quality and quantity of output supplied by smallholder farmers to certain buyers. However, studies also show that the impact of contracts on the lower performance indicators including productivity, income and poverty is highly variable in the context of smallholder farmers which makes broad policy direction and design ambiguous (Bijman, 2008; Glover, 1987; Warning & Key, 2002). This paper looks at the ex post benefits of market governance that may serve as elements that inform ex ante producer decisions and actions for subsequent strategies on market participation. At a producer level, evidence suggests that producers formally contract to earn more income (Glover, 1987; Key & Runsten, 1999; Little & Watts, 1994; Singh, 2010; Tripathi, Singh, & Singh, 2005). We look at tangible benefits as informative for market participation and as a case for institutional reform in the markets.

Subsistence surplus and market coordination mechanisms

Commodity exchange is coordinated under several market channels and agent relations. Any trade with a favour granted or expected, in return for something — must be mediated by some form of contract whether it be explicit or implicit (Hart & Holmstrom, 1986). Market coordination for commodity supply can be achieved through three renown forms of economic organization including: neo-classical spot market contracts, bilateral contracts, and hybrid arrangements (Williamson, 1991). Spot market exchange is an implicit contract requiring self-enforcement whereas a bilateral contract is an explicit contract with formal/legal mechanisms of enforcement (Masten, 1998). Hart & Holmstrom (1986) argued that in the case of spot trade, the contractual element is often down played yet it is not trivial simply because the two sides of the transaction occur almost simultaneously. Besides, bilateral contracts are arrangements where autonomous parties agree to enter a contract for more than one transaction. Bilateral contracts can be achieved either through internal market organization such as vertical integration or external market organization - where a buyer obtains a commodity from producers without indulging in any production arrangement.

According to Brousseau (2008), contracts may be considered either as analytical tools or as actual means of coordination, and organizing coordination among agents based on a set of agreed promises. As analytical tools, the contractual approach applies to almost any relationship between or among agents. However, this way of relying on a very abstract notion of a contract – which may be social, implicit, and explicit – does not take into consideration the conditions in which agreements are settled and enforced. Given that this study was not bent on establishing enforcement of contracts, the study maintains the lenses that view contracts as tools for coordination without dwelling much on how they are executed but rather more on the offerings, and transaction costs associated with coordination mechanisms and the benefits for producer participation.

Promotion of specific market coordination is often a whim of the buyer and depending on the sunk costs, the character of asset specificity and scale efficiency, either internal or external market organization will be adopted. Proponents have argued that external market organization wins out on efficiency compared to internal organization. This is because, opportunistic behaviour associated with specific investments aside, decentralized market arrangements have superior adaptive properties to internal organization. For transactions mediated through market based contracts, internal organization has the potential to better harmonize buyer-seller interests and provide for a smoother and less costly adaptation process, facilitating more efficient ex ante investment in the relationship and more efficient adaptation to changing supply and demand conditions over time (Brousseau & Glachant, 2008). However, Brousseau and Glachant suggest that agents should turn to internal organization as last resort especially only if contracting hazards and associated transaction costs are significantly high. In addition, although internal organization is capable of eliminating some internal information asymmetries in the short term, it is suggested that in a long run, it may be an inferior structure for obtaining, processing, and using external in-

formation about prices, costs, quality, and technological change compared to transactions organized through repeated market exchange. Under the transaction cost economics view, the make-or-buy decisions among alternative organizational arrangements is part of an agent's over-all optimization problem, and the net value of a transaction organized in a particular manner depends not only on the losses due to potential misallocations of resources but also on the costs of conducting the transaction itself (Masten, 1984). It turns out that both internal and external market governance have benefits and costs, and agents must thus, critically assess which coordination mechanism offers higher returns before acting on whether to produce or source by self and/or through another party. The choice is largely a function of transaction costs, organization cost and risk valuations.

Fundamentally, every transaction in a market governance arrangement has three basic elements: the allocation of gains from trade, the allocation of risk (when value is subject to uncertainty), and allocation of decision rights (Sykuta & Parcell, 2003). The rights of decision are defined, allocated, and reallocated by various types of devices particularly including: contracts, organizations, and institutions (Brousseau & Glachant, 2008). The task of consummating trade must confront a variety of potential transaction costs, contractual problems, and organizational hazards, which are related to the attributes of the transaction at issue and their interplay with the attributes of alternative market governance arrangements. Thus, within the realm of bounded rationality, contracting agents try to re-allocate risks with the foresight of market and contract uncertainty. A large body of literature refers a re-allocative bilateral contract in the farming sector as contract farming (CF).

Descriptively, contract farming is defined as an agreement between a farmer and a buyer established in advance of the growing season for a specific quantity, quality and delivery time of an agricultural output at a price or price formula fixed in advance (Setboonsarng, 2008). From an institutional economics perspective, contract farming choice is viewed as a way of creating positive externalities, which can result in overall rural development, if they are better created by agribusiness firms than by the open market or the state (Glover, 1987). Singh (2002) described contract farming as an economic system for the production and supply of agricultural produce under forward contracts. The essence of such contracts being a commitment to provide an agricultural commodity of a type, a standard, at a time and a price, and of a quantity for a known buyer (Singh, 2002).

The contract basically involves five aspects- pre-agreed product, product quality, quantity, price, and time of delivery. Singh (2002) adds that contract for farmers could be classed into three types: (1) procurement contracts under which only sale and purchase conditions are specified; (2) partial contracts wherein only some of the inputs are supplied by the contracting firm and produce is bought at pre-agreed price; and (3) total contracts under which the contracting agent is a supplier and manager of all the farm inputs whereas the farmer is merely a supplier of land and labour. The procurement contract type is generally considered as a marketing contract whereas the other two are referred to as production contracts. Considering spot market exchange as a base arrangement, we can compare benefits for participation in alternative contracts as coordination mechanisms for economic exchange. It is thus possible to conceive hybrid production and marketing bilateral contracts.

According to Eaton & Shepherd (2001), there are five models of CF arrangements, namely, the centralized contract farming model, nucleus contract farming model, the multipartite model, the intermediary model, and the informal contracting arrangement. All arrangements except the informal arrangement has some form of documentation. The centralized model involves a centralized processor and/or buyer procuring from many smallholder farmers with vertically well integrated cooperation and often services such as input pre-financing, extension, and transport are provided. The nucleus estate model is a variant of the centralized model where the contractor has own production facilities (an estate plantation) and additionally, sources extra produce from independent farmers. The multipartite contracting model involves a firm working with other organizations. A multipartite model is particularly helpful when establishing a new venture and usually, once cooperation between the firm and the farmers takes off, the link between the parties can be circumvented and so the multipartite slowly evolves into a centralized model (Mwambi, Oduol, Mshenga, & Saidi, 2016). The intermediary model has intermediaries who organize everything on behalf of the final buyer starting with input supply, extension service, payment of the farmers and transportation of the final product. Intermediaries handle several thousands of producers/out-growers and assemblers. Informal arrangements vary between casual oral agreements and regularly repeated marketing transactions but are chiefly characterized by the absence of written contracts and randomness. Formal contract forms are thus viewed as variants of bilateral contracts in that there are two parties involved and exchange is envisaged for more than one period.

Contingent on operating within the same market environment, transaction costs and exposure to risks by domain actors differ considering the governance structure adopted crop production and market coordination mechanism. The choice of a market coordination mechanism has implications on the transaction costs and risks (Wolf, Hueth, & Ligon, 2001). For instance, bulk purchases under the spot market mechanism has higher transaction costs than under vertically organized coordination mechanisms. However, even then, varied arrangements within vertical organization determines how high transaction costs can be high. (Sibiko et al., 2013).

Most studies have looked at causality for use of alternative governance structures. Moreover, most of the empirical research does not measure the costs of alternative governance arrangements directly, but, rather, measures the variables (often ordinally) that are thought to influence their relative costs, relying on the revealed preferences of economic agents, revealed through their choice of governance arrangements, to identify the importance of various causal variables (Brousseau & Glachant, 2008). This study examines two dominant producer/buyer market coordination mechanisms including: (a) coordination of the market exchange by way of (informal) spot market contract marketing (SM) and (b) coordination through the firm by way of (formal) partial bilateral contract market (BM). The formal buyer desires the producer to contract all his produce, but some contracted producers renege on the requirement and thus choose to participate in both the SM and BM. Both coordination mechanisms are distortionary to each other and smallholder farmers adopt one or both depending on the source and level of distortion. There is evidence that smallholder farmers who maintain alternative opportunities for production and sales, in addition to their contracted obligations to a company, are in a much stronger position than farmers whose say devote their entire land area to the contract crop (Porter & Phillips-Howard, 1997). The latter have little opportunity to secure another income should the company abrogate its contract or attempt to secure an agreement disadvantageous to the farmer, or where market prices collapse (Porter & Phillips-Howard, 1997). Returns to producer market coordination are proposed to be a function of farm characteristics, market organization, and socio-economic characteristics. The location of smallholder producers is commonly in the rural settings which are limited in communication infrastructure. This includes poor state roads and telephone network, and oligopolistic transport providers whose pricing impedes market access, economic organization, and good returns. Given the limited modes and means of communication, agents adopt certain practices and reconstruct behaviour with the goal of minimizing costs and risk and maximizing economic rents in an environment laden with market failures.

Commodity trade under thin and shallow market conditions tend to be more coordinated by spot market while commodities exchanged in deeper markets tend to be more associated with hierarchical markets such as vertical integration. Producer and buyer practices under different market coordination mechanisms are underpinned by the goal to minimize transaction costs and market risks and are continuously reshaped by the dynamic market conditions. Masakure & Henson (2005) showed that market uncertainty (of demand & prices), direct and indirect tangible benefits, and intangible benefits motivate bilateral contracting. To reduce uncertainty in spot market trade, agents tend to conduct personal transactions characterised by repeated exchange to secure commodities that match the buyer attributes while the producer tries to make certain the buyer(s). However, repeated and relational contracts are highly exposed to a mismatch on product attributes and price expectation due to adverse selection and strategic relationships. As a moral hazard problem, strategic relations have hidden knowledge and action only noticeable after a transaction. However, since there are no binding terms, there is no mechanism to seek redress if the contract turns out to be unfair to one party. In the case of bilateral contract mechanism, terms and conditions that limit the negative effects of moral hazard are set *apriori*. Nevertheless, again, it also suffers the problem of adverse selection and incomplete contracts. Incomplete contracts are premised on information gaps and bounded rationality as agents try to minimize costs and risks, secure markets and increase rents. Therefore, buyers may for instance provide a fixed price to make certain the price for the farmer and the set price becomes a price floor for the producer at the start of the season. Such an attempt remotely redistributes risks and benefits of the actors.

Conceptual framework

Due to inherent market and price uncertainty, the buyer cannot fully guarantee the set price will be higher than the going market price at the time of transaction execution which provides room for some producers to seek participation in alternative markets. The buyer is desirous of securing all the crop under only the ideal single market participation in the bilateral contract. To secure product quality and quantity under bilateral coordination mechanisms, monitoring and enforcement costs become contract borne. Enforcement must be frugal to forestall shirking. However, enforcement mechanisms including private ordering and court ordering involve resources

and withstanding the first-best need of minimizing transaction costs, self-policing devices are sought, and public enforcement and court ordering are a last resort due to the extent of resources that may be expended. Whichever enforcement sought, reneging on the contract should be made costlier than abiding to it and the relative benefits in the arrangement should be more attractive compared to the alternatives. This is the contract design issue which is hard to forestall due to limits of human cognitive ability, the measurement problem, incentive incompatibility, and the agency problem. Thus, contracts are ever incomplete and forestalling participation in two arrangements takes innovative design.

2.0. MATERIALS AND METHODS

Sampling and data

A survey design was used and with the aid of a structured questionnaire, data was collected from 349 smallholder farmers. The study was conducted in central Uganda in two randomly selected districts of Rakai and Lyantonde. The study sample was arrived at through multistage random sampling. Sampling was done with the aid of farmer listings for farmers that were under bilateral contract coordination (BCC) while farmers not in a BCC mechanism were randomly sampled within the study sites. Information was captured using CAPI. Ex-post clusters were generated from the randomly selected respondents following the choice of selling arrangement. As such, farmers were placed into three categories including: (1) bilateral contract farmers; (2) spot market farmers; and (3) both spot market and bilateral contract farmers. The data was collected in October 2016 with a reference period being the second season of 2015 hitherto denoted as 2015B.

Analytical framework

This study looked at two kinds of supply chain actors, the buyer and the seller, with the seller being participating in either a single market or two markets. Producers/suppliers of common beans chose to participate in one or two coordination mechanism based on value judgements on market uncertainty and expected returns.

Analysis of returns

Returns to market coordination were viewed and computed in three dimensions including: returns to produced output; returns to per unit investment (for variable costs); returns to labour (per man-day) deployed; and returns to labour investment. Gross margin analysis was used to establish the returns to adopted market coordination mechanism. The approach gives the per unit net returns from the operation under a given market coordination mechanism j where $j \in \{1,2,3\}$ (Eq. 1). Equation 2 and 3 shows the general expression for calculating returns to variable costs and labour respectively.

Eq. 1: $GM_{ij} = TR_{ij} - VC_{ij}$

Where: *GM* denotes gross margin of an i^{th} farmer in a j^{th} market coordination mechanisms; TR denotes total revenue from the crop as gross benefits and is defined as a product of total quantity of common beans output and the unit price. *VC* is the total variable cost derived from the sum of total cost input, labour cost, and transaction costs. Transaction costs included transportation cost, cost of linking to buyers, market charges, storage charges and institutional costs. Institutional costs included charges related to the contract such as monitoring cost and the cost of being a member in a farmer association.

Eq. 2. $RVC = \frac{GM}{VC}$

Where *RVC* denotes returns to variable cost which is considered as a proxy for returns to production investment.

Eq. 3. $Rl = \frac{GM}{MD_f + MD_h}$

Where Rl denotes returns to quantity of labour deployed in the production cycle; $MD_f \; and \; MD_h$ denote the sum of family and hired labour (mad-days) used in production. Eq. 4 shows the expression used to compute the returns to cost of labour.

Eq.4. $RL = \frac{\frac{1}{n}\sum_{i=1}^{n}(GR-LC)}{\frac{1}{n}\sum_{i=1}^{n}(VfL+VmL)}$

Where *RL* denotes returns to labour investment; *GR* denotes gross revenue; *LC* denotes total cost of labour; VfL and VmL denote total quantity of female and male labour.

Trade-offs analysis based on a system of market coordination mechanisms

The trade-off analysis minimum data (TOA-MD) model was applied to assess what there is to lose based on the adopted coordination mechanisms by smallholder producers. Trade-off model has been applied mostly in the analysis of multi-dimensional farm system interactions and application in the market systems is still scarce. The model is parsimonious, generic simulation model for multi-dimensional impact assessment of technology adoption and the consequences in heterogenous populations (Antle, 2011). The analysis involves defining the systems and activities and identifying the outcome variable for simulation based on a predetermined trade off number. In the case of this study, market coordination mechanisms are considered as the systems through which trade-offs are premised; and in the context of a single crop (of common beans), different varieties are the enterprise activities whereas the net return per dollar invested is considered the economic outcome variable of which quantitative simulation is dependent to indicate results under different scenarios; The farmer decides to adopt one or two MAs based on idiosyncratic expected utility evaluation and covariate market constraint. If a farmer adopts both the SMC and the BCC, we can then estimate the opportunity cost of a farmer adopting system II or system III, away from system I. Trade-offs and scenarios are constructed by varying the marketing parameters. The parameters varied affect the economic incentives perceived by farmers when deciding how to sell their crop. Price is considered an exogeneous variable which drives changes in the outcome variable under the different scenarios.

Based on the conceptual and empirical foundations of Antle (2011), farms are assumed to choose a system to maximize a function $v(j)$ where $j = 1,2$ indexes the production/marketing system and all attributes associated with it, including prices and other factors that affect adoption while the system outcome is indexed by $k(j) = v$. $v(j)$ is interpreted as expected returns which is an objective function that depends on the characteristics of the farms and the system adopted. This objective function induces an ordering $\omega \equiv v(1) - v(2)$ over all farms, such that for adoption threshold a, $\omega > a$ for those farms that produce based on system I and $\omega < a$ for those farms that produce based on system II. The opportunity cost w is spatially distributed across the landscape according to the density $\varphi(\omega)$, which is generally a function of prices and other exogenous variables, taken to be implicit in the function for notational convenience. The proportion of farms using system II, referred to as the adoption rate of system II, is given by the cumulative distribution function expressed in eq. 5.

Eq. 5. $r(2,a) \equiv \int_{-\infty}^{a} \emptyset(\omega)d\omega, \quad 0 \leq r(2,a) \leq 1,$ & the share of farms using system 1 is $r(1,a) \equiv 1 - r(2,a)$

It is assumed that the adoption ceiling is 100%. $r(1,a) \; and \; r(2,a)$ are referred to as adoption rates

In TOA-MD model, the only distinguishing feature of each system is that it gives rise to different expected returns for producers (Antle, 2011). Survey data was calibrated to adapt it to required data needs for TOA-MD analysis. Because the systems ought to have been played by the same producer, the PSM was applied to generate the counterfactual group from the farmers in the SMC which is the base system. Farmers were matched based on eight variables including location/strata, farm size, soil quality, farmer education, years of experience in bean production, farmer education, household size, and access to production finance. Matching was done at using the nearest neighbour method with scores generated with common-support at tolerance level of 0.01. Data on returns and correlation coefficients were computed and together with biophysical data, the parameter estimates of joint distributions are key for obtaining estimates of impact in the sub-populations of adopters of an alternative system hitherto considered as the market coordination system II or system III which are alternatives to the base system I. A key feature of this model is that it considers the fact that farmers systematically selected themselves into adopting and non-adopting groups. Incomplete adoption is eliminated by introducing a third system III. this selection must be clear to obtain accurate estimates of Trade-off scenarios impact on the outcome variable.

Antle (2011), showed that if the adoption premium is randomly distributed in the population with a non-zero mean and a positive variance, the effect on the adoption rate depends on the sign of the mean adoption premium and whether it is greater or less than the adoption threshold. With focus on only the economic outcome k, the conditional distributions for the outcome k is denoted by $\emptyset(k|\omega, j)$ where outcome k results given ω, for system j. The distribution for the sub-population using each system is the outcome distribution ω and $k = v$, truncated according to $\omega > a$ for system I and $\omega < a$ for system II. This distribution is denoted by $\emptyset(\omega, k|j, a)$ and over the interval $\omega > a$ for system I and over $\omega < a$ for system II gives the outcome distribution to $\omega > a$ for outcome to k, conditional on adoption threshold to a. This expression links the adoption process to the outcome distributions conditional on adoption and thus, plays a key role in the analysis of the properties of impact indicators. An outcome distribution for the entire population composed of non-adopters and adopters is thus a mixture of the distribution of each group, given the threshold a.

Eq.6. $x(k|a) = r(1, a)x(k|1, a) + r(2, a)x(k|2, a)$

With adoption threshold $a = 0$, the outcomes for farms that continue to use system I are represented by the positive outcome and the outcomes for adopters of system II is represented by the negative outcome. The mean outcome distribution $\mu_k(2,0)$, obtained by integrating over k for $\omega < 0$, and is higher for the adopter group than for the overall population. If the adoption threshold a is not zero, then the mean and threshold outcomes would change systematically.

3.0. RESULTS

Most farmers in economic sectors that are largely informal operate under spot market channels. Table 1 shows that generally most (63%) farmers in the study area marketed their beans produce through spot markets and rest routed it through either only the BC or both spot and bilateral contract channels. For the (n=129 sample of) farmers that did enrol under the bilateral contract mechanisms, about 42% do so with reservations in the sense that they have one leg in the spot market and another in the bilateral contract market.

Table 1: Sample distribution across market coordination choices

Category of farmers	Key characteristic	Percent of farmers (N=349)
Only spot contract farmers (SM)	Sell to numerous small scale informal buyers with not any prior agreement	63.0
Only bilateral contract farmers (BM)	Sell to one buyer with earlier written agreement at start of the season	21.5
Both spot & bilateral contract (SBM)	Sell to both spot markets and have a formal contract too	15.5

The producers under the bilateral contractual market coordination arrangement were matched with farmers under the spot market coordination mechanism using the propensity score approach to generate a counterfactual for contract farmers had they not participated in the bilateral contractual arrangement. After matching 100 spot market producers found one or two close partners in the contract.

Table 2: Sample size after PSM

Sample Category	Key feature	SM*	BM
Pair I	Produce & sell in only spot markets (SM also considered system M1a) or bilateral contract market (BM also denoted system M2)	100	129
Pair II	Producers for only one market (M1b) and two markets (M3)	80	54

Note: * *implies the study sample is a sub sample generated by propensity score matching using near neighbour approach. SM and BM are also considered as marketing system Ia and Marketing system II for pair I and under pair II, the sample looks at system Ib and system III.*

Descriptive statistics

Table 3 shows that most households are still male headed and as such, in most households, men may have a higher stake in decision making especially with regards to where to sell. Decisions regarding bean production were reported to be done by both the male and female partners. Importantly, there are significant differences in the proportion of farmers that use improved seed and later improved and quality (certified/declared) seed per se. It is observed that farmers more who fall under the BM (48%) and the SBM (57%) arrangements use quality seed compared to those under SM (12%). The results also show that a substantial percentage of producers (80%) sell to buyers within the locality compared to buyers from outside the district of residence.

Table 3: Descriptive statistics on discrete characteristics of farmers across coordination mechanisms

Variable	Pooled data (N=349)	SM farmers	BM farmers	SBM farmers	Chi value
Lyantonde	46.7	48.6	49.3	35.2	0.181
Rakai	53.3	51.4	50.7	64.8	
Male headed household	87.4	87.3	90.7	83.3	0.463
Both male & female decision making	75.1	75.0	82.7	64.8	0.157
Education (dummy for >=sec schooling)	21.8	22.7	21.3	18.5	0.794
Use improved and quality seed	26.7	11.8	48.0	57.4	0.000
Use improved seed	35.2	19.1	66.7	57.4	0.000
Dummy for grew 1 variety (vis-a-vi 2-4)	59.9	63.2	61.3	44.4	0.383
Sold to buyers from within the locality	79.9	84.6	61.3	87.0	0.000
Sold to buyers from outside district	42.7	36.8	58.7	44.4	0.004
Have access to market information	55.6	51.4	77.3	42.6	0.000
Access extension services	47.9	35.9	78.7	53.7	0.000
Member of a farmer association	71.1	54.1	100.0	100.0	0.000
Have nonfarm income	39.5	41.8	36.0	35.2	0.522
Had zero cost of transport to market	82.0	87.7	62.7	85.2	0.000
Zero cost of linkage to buyer	75.6	73.2	80.0	79.6	0.375
Zero monitoring cost market mechanism	98.6	99.6	94.7	100.0	0.006
Perceived SMC to be risky (1=Yes)	80.5	74.6	97.3	81.5	0.000
Perceived BMC to be risky	24.1	25.9	20.9	46.3	0.000

Note: *SBM denotes farmers who sold their crop in both the spot market and the bilateral contract market*

Table 4 shows a comparison of categorical variables after Propensity score matching (for system I and system II and system III). The results show that the comparison of proportions for farmers under system I and system II or system I and system III are statistically not different for most of the variables.

Table 4: Descriptive statistics on discrete choice variables of farmers across coordination mechanisms

Variable		Sys. I (n=100)	Sys. II (n=129)	Chi test	Sys. I (n=80)	Sys. III (n=54)	Chi test
		SMC*	BMC		SMC*	SBMC	
District location/strata	*Lyantonde*	46.0	43.4		37.5	35.2	
	Rakai	54.0	56.5		62.5	64.8	
Male headed household		86.0	87.6		83.6	83.3	
HH type (1=both M&F decision maker)		72.0	75.2		78.8	64.8	*
Higher education (1 is >=sec schooling)		19.0	20.2		17.5	18.5	
Use improved seed		16.0	62.8	***	37.5	57.4	**
Use improved and quality seed		8.0	51.9	***	26.3	57.4	***
Produced 1-2 varieties		67.0	89.1		91.3	88.9	
Sold to buyers from within the locality		80.0	72.1		77.5	87.0	

Sold to buyers from outside district	39.0	52.7	**	53.8	44.4	
Have access to market information	52.0	62.8		57.5	42.6	*
Access extension services on beans	41.0	68.2	***	50.0	53.7	
Have access to production finance/credit	54.0	76.0	***	67.5	70.4	
Member of a farmer association	65.0	100	***	78.8	100	***
Have nonfarm income	40.0	35.7		31.3	35.2	
Had zero cost of transport to market	88.0	72.1	***	81.3	85.2	
Zero cost of linkage to buyer	73.0	79.8		76.3	79.6	
Zero monitoring cost market mechanism	0.0	96.9	*	96.3	100	
Perceived SMC to be risky (1=Yes)	69.0	90.7	***	72.5	81.5	
Perceived BMC to be risky	31.0	20.9	*	28.8	46.3	**

Note: *, **, *and* *** *denote significant of the chi test at 10%, 5% and 1% respectively*. *SMC* means the counter factual spot market coordination*

Under subsistence farming, production for food and income security is not separable and the two objectives are coupled. This is so because of several household and farmer characteristics such as household size, limited resources, and various household demands. Table 4 shows that farmers in the study area had on average household size of six and household heads were averagely aged 47.

The average land size is shown to be about two hectares and the area allocated to beans is about half a hectare which is shown to accommodate 1 to 4 varieties of common beans in different parcels. The distance to the nearest selling point was reported to be about 2 km which also was said to take about 15 minutes by either footing or use of a *boda-boda*. Generally, supply of beans to the markets was about 70% of the harvested crop however, producers who were engaged in both market coordination mechanisms supplied more output (78%) to the market compared to farmers under either only SC mechanisms (67%) or only BC mechanism (70%).

Table 5: Descriptive statistics on continuous variables of farmers across coordination mechanisms

Variable	Pooled data (N=349)	SM farmers	BM farmers	SBM farmers	Prob>F
Household size	6.0 (0.12)	6.0	5.9	6.1	0.793
Age of farmer (Years)	44.4 (0.96)	44.3	42.9	47.3	0.426
Age of household head	47.0 (0.93)	47.2	45.9	48.9	0.553
Household land access (Ha)	1.7 (0.13)	1.8	1.4	1.7	0.529
Area (Ha) planted with beans (2015B)	0.6 (0.02)	0.4	0.4	0.4	0.520
Number of varieties grown	2.0 (0.04)	1.5	1.5	1.7	0.185
Number of agronomic practices applied	4.3 (0.07)	4.0	4.6	4.7	0.000
Number of agro-chemical inputs applied	1.4 (0.04)	1.3	1.8	1.6	0.000
Number of markets accessible	3.0 (0.11)	2.5	2.3	2.7	0.601
Number of market information channels	1.0 (0.05)	0.8	1.3	0.7	0.000
Bean information sources	1.0 (0.05)	0.6	1.4	0.7	0.000
Number of production incentives	0.1 (0.04)	0.0	0.4	0.3	0.000
Distance to nearest trading centre	2.2 (0.30)	2.4	2.1	1.7	0.698
Distance to nearest market	0.9 (0.10)	0.8	0.9	1.3	0.165
Duration in arrangement (Years)	7.1 (0.45)	9.0	3.6	4.5	0.175
Duration in beans production (Years)	15.9 (0.64)	16.0	14.0	17.9	0.000
Time to reach nearest market (Minutes)	14.2 (1.69)	10.9	9.7	33.6	0.000
Percentage of crop supplied to market	69.1 (1.15)	66.7	69.6	78.2	0.002
Total man-days	61.0 (2.70)	57.5	61.8	75.9	0.057

Note: Values in parenthesis are standard errors

Table 3 shows a comparison on continuous variables after Propensity score matching (for system I and system II and system III). The results show that the comparison of proportions for farmers under system I and system II or system I and system III are statistically not different for most of the variables.

Table 6: Descriptive statistics on continuous variables of farmers across coordination mechanisms

Variable	Sys. Ia (n=100)	Sys. II (n=129)	t test	Sys. Ib (n=80)	Sys. III (n=54)	t test
	SMC*	BMC		SMC*	SBMC	
Household size	6.1	6.0	0.708	6.0	6.1	0.756
Age of farmer (Years)	44.1	44.6	0.834	41.3	47.3	0.036
Age of household head	47.0	46.7	0.907	44.9	48.9	0.199
Household land access (Ha)	1.5	1.5	0.988	1.8	1.7	0.738
Area (Ha) planted with beans (2015B)	0.5	0.6	0.339	0.6	0.7	0.383
Number of varieties grown	1.5	1.6	0.377	1.5	1.7	0.093
Number of agronomic practices applied	4.0	4.7	0.000	4.3	4.7	0.040
Number of agro-chemical inputs applied	1.0	2.0	0.000	1.5	1.6	0.397
Number of markets accessible to the farmer	2.1	2.5	0.413	2.2	2.7	0.026
Number of market information channels	1.0	1.1	0.011	1.0	0.7	0.054
Bean information sources	1.0	1.1	0.005	1.0	0.7	0.280
Number of production incentives	0.0	0.3	0.000	0.0	0.3	0.070
Distance to nearest trading centre	2.1	1.9	0.837	2.7	1.7	0.252
Distance to nearest selling point for beans	0.5	1.0	0.001	0.9	1.3	0.227
Duration in arrangement (Years)	10.0	3.9	0.000	8.5	4.5	0.007
Duration in growing beans (Years)	17.0	15.6	0.389	17.9	17.9	0.998
Time to reach nearest market (Minutes)	9.4	19.7	0.009	10.9	33.6	0.001
Percentage of crop supplied to market (%)	64.8	73.2	0.002	65.6	78.2	0.000

Note: *SMC* denotes a counterfactual sub sample*

Gross margins

Beans have both food and income benefits. Sebuwufu, Ugen et al. showed that common beans in Uganda can yield about 2.0MT/Ha to 2.5MT/Ha depending on the variety. However, Table 7 shows that farmers yield is still generally low. The following results compare returns for farmers under the spot market system as a counterfactual and farmers under the bilateral contract marketing system after matching. The results show presence of significant difference in gross revenue, gross margin but no significant differences in the returns and net outcome to market coordination for participation in the spot market and non-participation (Table 7).

Results show that farmer productivity is higher for double market coordination producers and lowest for BM farmers. Under all coordination mechanisms, the returns are positive. Results show that the cost of production per Ha does not significantly, but returns do significantly differ. The results also show that returns to labour do NOT differ significantly. In only dollar terms, for every unit cost of labour injected in production of beans, the return is about same (US$ 1.1) for all coordination mechanisms and only slightly higher (US$ 1.5) for participants in both SM and BM coordination mechanisms.

Table 7: Gross margin analysis with a counterfactual

Variable	SM*	BM	t test	SM/BM*[1]	SBM[2]	t test
Area harvested (Ha)	0.5	0.6	0.030	0.6	0.6	0.625
Crop harvest (Kg/Ha)	841.1	866.2	0.724	795.7	948.3	0.043
Selling price (UGX)	1461.0	1596.9	0.001	1523.0	1481.5	0.507
Gross revenue (UGX)	**1211012.0**	**1447929.0**	**0.027**	**1203769.0**	**1533157.0**	**0.018**
Variable input costs						
Seed	174453.8	174332.6	0.994	190902.4	176478.4	0.525
Pesticides & fertilizers	16284.8	39394.1	0.021	22443.7	30434.5	0.526
Labour	789680.1	782856.2	0.928	807655.6	777774.3	0.781
Transaction costs (TML)	15613.7	14271.3	0.764	17213.6	9460.1	0.057
Total cost of production	**996032.5**	**1010854.0**	**0.856**	**1038215.0**	**994147.3**	**0.705**
Gross margin (UGX)	**214979.5**	**437074.4**	**0.055**	**165554.1**	**539010.0**	**0.019**
Returns (in US$)						
Returns to output (GM US$/Ha)	61.70	186.0	0.055	47.5	47.5	**0.019**

Returns to activity I (US$/Ha)	42.1	82.8	0.265	11.4	11.4	0.016
Returns to activity II (US$/Ha)	19.6	42.6	0.085	36.1	36.1	0.846
Returns to qty of labour (US$/MD)	2.8	4.0	0.350	2.4	2.4	0.213
Returns to cost of labour (U$/US$)	0.9	1.3	0.327	1.1	1.1	0.478
Outcome 1 (returns to a dollar)	0.6	0.6	0.866	0.5	0.7	0.404

Note: For TOA, variety I and variety II are considered as activities with variety I rank higher than variety II. SM denotes the counterfactual sub sample while SM/BM*[1] denotes counterfactual for participants in one market. MD denotes man days; TML means transport cost to input & output market plus market linkage cost; UGX is Uganda currency; US$ =UGX 3486.89; yield gap assessment is based on the median of 2.0-2.5Mt/Ha*

Results from the Trade-off analysis

The results show the adoption rate, returns per farm for the system in relation to activity 1 and activity 2, and the net behaviour of the net out come from adoption of system I and system III. Fig. 1 shows that as the adoption rate increases, there is an increase in opportunity cost as farmers shift from system I to system II. The predicted adoption rate for system II is 58.5% for activity 1 and 47.8% for activity 2.

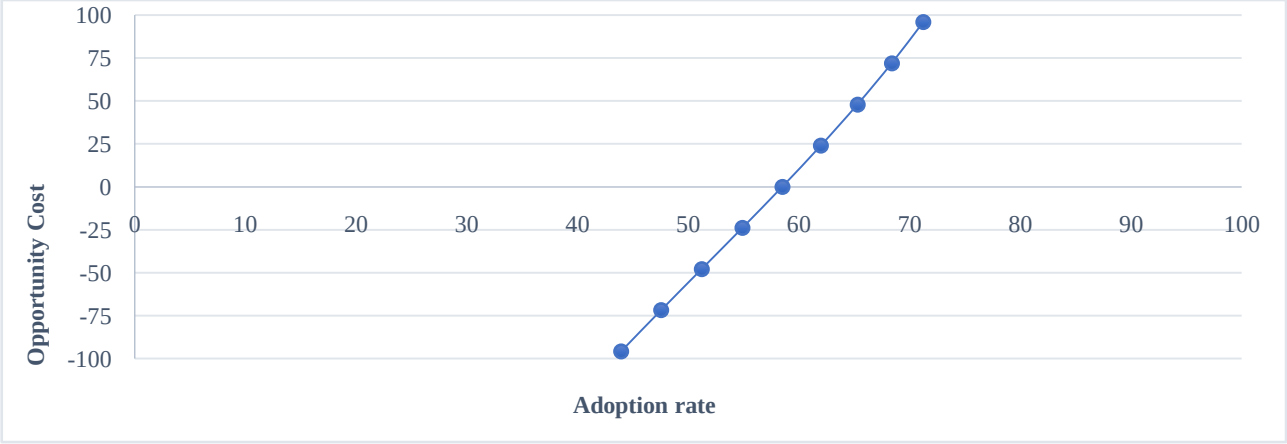

Figure 1: Adoption curve for system II with complete allocation to activity 1

The following results show results of system Ib and system III. Fig. 2 shows that as adoption rate increase, opportunity cost increases as farmers shift from system Ib to system III. Predicted adoption rate for system III is 56.5% under activity 1.

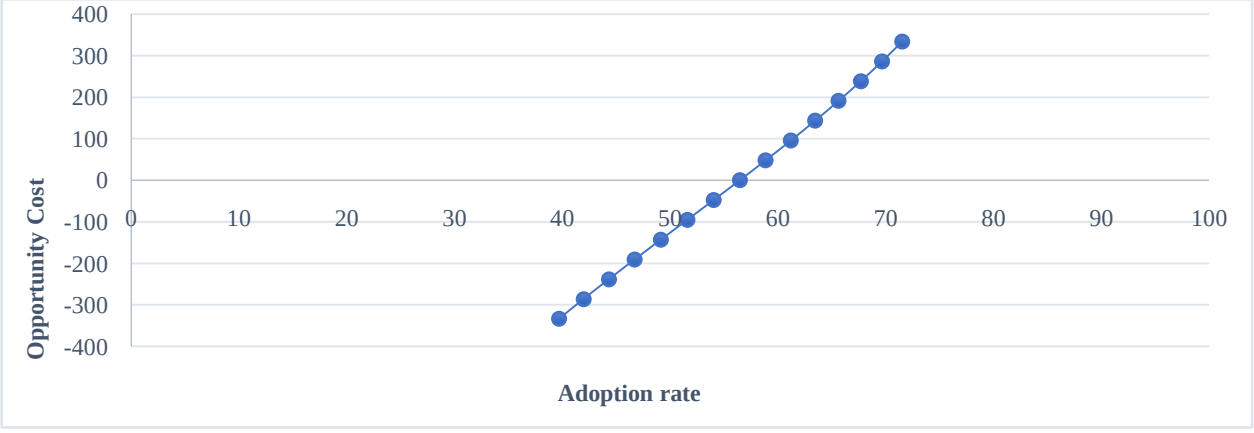

Fig. 2: Adoption curve for system III with allocation to activity 1

Fig. 3 and x shows the behavior of the mean net returns for non-adopters and adopter groups for variety activity 1 and activity 2. Considering increase in aggregate adoption rate, there is an increase in Net returns per farm as producers under system I (SM) adopt system II and vice versa (Fig. 1). Generally, beyond the adoption rate of 58.5% the returns start to show a marginal decline.

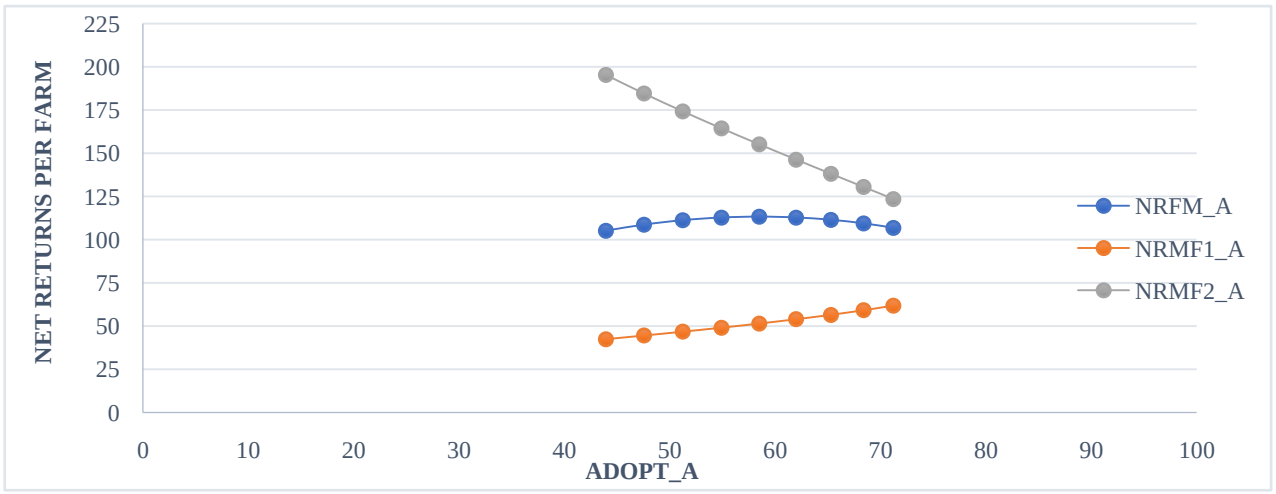

Fig. 3: Mean net returns per farm for activity 1 with adoption of system II

Fig. 4 shows the behavior of the mean net returns for non-adopters and adopter groups for variety activity 1 and activity 2. Considering increase in aggregate adoption rate, it is shown that net returns per farm increase as producers under system I (M1) adopt system III (M3) and vice versa (Fig. 4).

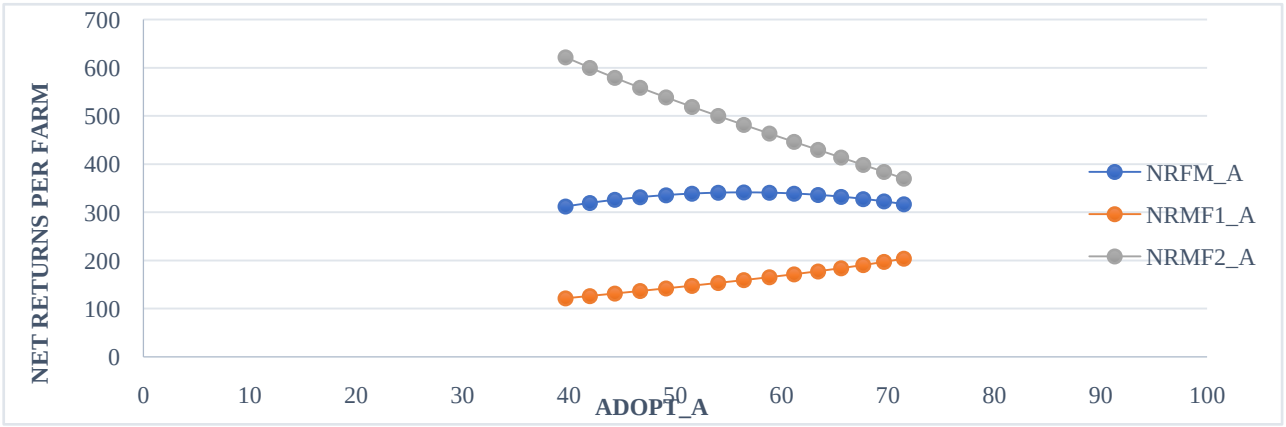

Fig. 4: Mean net returns per farm for activity 1 with adoption of system III

Figure 5 shows that there is a positive net gain in adopting marketing system II. It is shown that the net outcome from adoption of system II increases with adoption rate. At adoption rate of 43.9%, farmers have a positive outcome of 1.9 per dollar invested which gradually increases and intersects the net outcome from adoption of system I (at 62.0, 2.1). For contract producers, Fig. 5 shows that the predicted mean outcome for system II at the predicted adoption rate of about 58.5% is about US$ 2.1 per dollar invested.

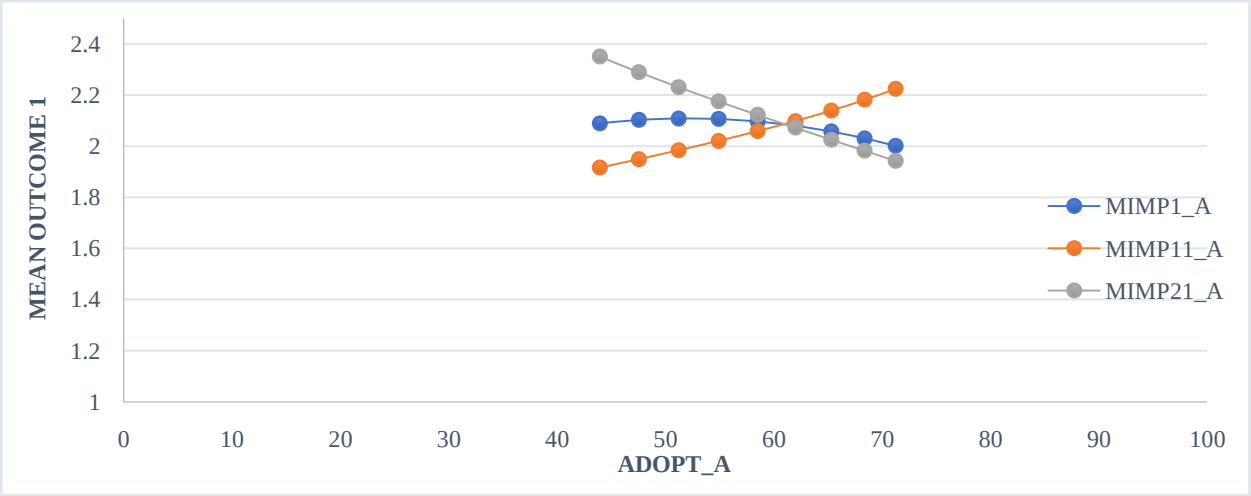

Fig. 5: Net outcome of activity 1 with adopting system II

Figure 6 shows that there is a positive net gain in adopting marketing system III. It is shown that the net outcome from adoption of system III increases with adoption rate. At adoption rate of 71.59%, there is a convergence of returns from system Ib and system III at a net outcome of US$ 2.2 per dollar invested.

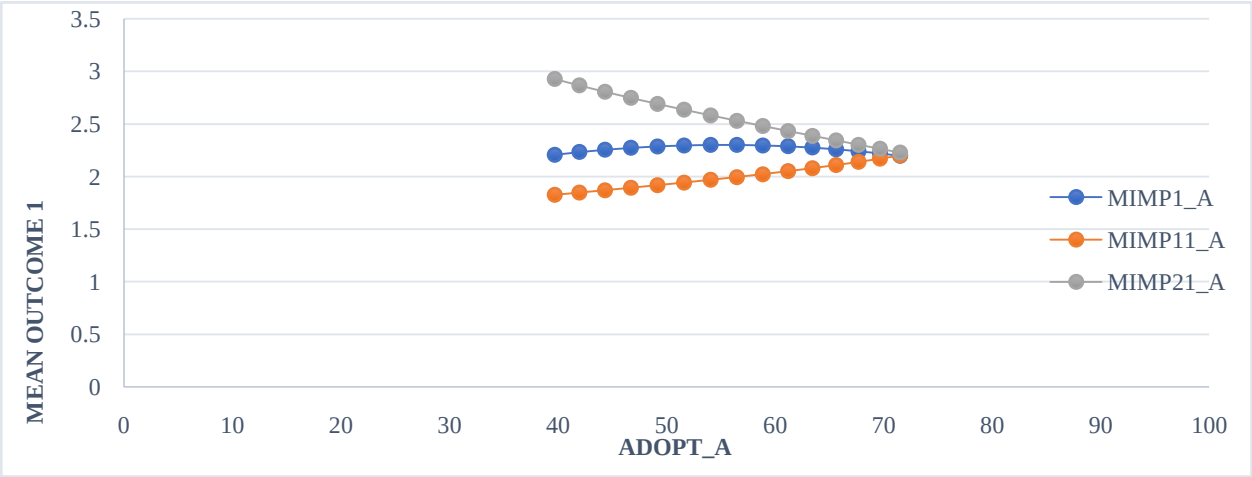

Fig 6: Mean outcome of activity 1 with adoption of system III

4.0 DISCUSSION

Farmer participation in spot markets is still high and the most preferred. This is attributed to constraints to market access underpinned by the deficits in infrastructure which raise transaction costs for formal agents with interest in trading with smallholder farmers in a rural setting. High transaction costs serve as a disincentive for private investment and contracting in rural areas. As such it is also observed that there is lower supply under is significantly lower under the spot market coordination compared to the bilateral contract mechanism. Differences in the proportion delivered to the market is explained by the expected net benefit less by resource allocation. Considering counterfactual results, a producer tends to supply significantly more under bilateral market coordination mechanism compared to if s/he were not under a contract arrangement. It is observed that the income benefit from the crop is higher when a farmer sells through a bilateral contract arrangement than through the spot market arrangement. Consistently, under the counterfactual measure, the returns to output under bilateral contract coordination are higher compared to returns under spot market coordination for both single market participation and double market participation. However, a deeper assessment of returns to labour and variable costs shows that the two market coordination mechanisms offer returns that are statistically not different. Addi-

tionally, the trade-offs show that there are gains in adoption of the bilateral contract market coordination mechanism. It is observed that as adoption rate increases, opportunity cost for adopting system II and system III increases too.

5.0 CONCLUSION

Farmer choice of a coordination mechanism is a function of the set of incentives under offer and within the realm of bounded rationality, the buyer strategically prefers farmers to sell through a certain market coordination mechanism as they try to avoid and/or minimize transaction costs whereas the farmer also strategically participates in a specific arrangement with the foresight of internalized uncertainty contingent on indulging in a selected market coordination mechanism. Spot market coordination and bilateral contract arrangements are the common coordination mechanisms through which farmers deliver their produce to the markets. The two mechanisms differ on how risk and uncertainty is managed to limit transaction costs. Upon setting transaction cost minimizing mechanisms, price often becomes the key differentiator. Since price directly impacts on farmers benefits, farmers often channel their produce through a selected marketing arrangement largely basing on price which is uncertain and limitedly basing on availability of the buyer(s). Buyers who front the bilateral contractual arrangement often set a fixed price at the season start to serve as an incentive as an attempt to white wash uncertainty in the mind of the producer and ideally, desire the producer to deliver all the realized output of the defined crop.

Results show that most farmers still do not buy into the bilateral contractual arrangements and for those who enrol into contractual arrangements, a considerable proportion participate in both spot market and bilateral contractual arrangements. It is observed that farmers who participate in both market coordination mechanisms realize higher returns compared to the who chose to participate in either only spot markets or only contract market. Double market participation is explained by the uncertainty that lingers in price and the contracting agent reneging on the promises made during the start of the cropping season. When the going market-price overrides the set price at the season start, the producer supplies less output to the contracted and more to the spot market to enhance accruable benefits. At she delivers some produce to avoid the full brunt of the cost of reneging on the terms but at the loss of the projected output for the contracting agent. The findings imply that success of contracting for a staple grain crop such as common beans under smallholder production is still challenging and to increase farmer participation in bilateral contract market coordination mechanism, buyers need to innovative devices such as flexible pricing during contract design.

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