TOWARDS COMMERCIAL AGRICULTURE IN RWANDA: UNDERSTANDING THE DETERMINANTS OF MARKET PARTICIPATION AMONG SMALLHOLDER BEAN FARMERS

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ABSTRACT

Agricultural transformation is key to poverty reduction and food security in sub-Saharan Africa (SSA). In Rwanda, this transformation has focused on shifting subsistence-based production to market-oriented farming. Over the last one decade and a half, major emphasis has been placed on the intensification of production systems, promotion of farmers' cooperatives, and enhancement of farmers' access to markets. Although the country recorded an increase in food crop commercialization, subsistence farming is still prevalent amongst smallholder farmers. Yet, in the few studies conducted on agricultural transformation, smallholder commercialization has received scanty attention. As the country aims to achieve commercialized agriculture, there is a need to understand what factors can influence farmers' decisions to participate in the output markets. This study analyses the levels of market participation and drivers of output commercialization, using a sample of 256 Common bean farmers from northern Rwanda. A double-hurdle model was used to analyse the data. Results indicated that 30% of the farmers participated in the market with an average commercialization index of 0.42. Land size, agricultural training and group membership of household head had a positive effect on households' participation to bean market. The distance to the nearest access road that can be used throughout the year reduces the probability of commercialization at household level. The degree of market participation was positively influenced by price, education level of the household head and livestock income. On the other hand, distance to key markets had a negative effect on the degree of households' commercialization. The findings of this paper show that participation in bean markets is still low, with disparities in the commercialized quantities amongst those who participate. Female-headed households were more likely to participate in bean markets, selling higher volumes than male-headed households. This gender difference suggests that bean production can be an important source of income for women smallholder farmers. The study recommends more efforts in improving road networks connecting to key markets, facilitating cross-border trade and increasing agricultural training amongst the farmers. Additionally, the use of improved inputs in bean production as well as income diversification through livestock rearing should be encouraged. All the interventions should be gender-sensitive so as not to deny women their source of livelihood through bean production and marketing.

Key words: Agricultural transformation, Commercialization, Markets, Gender, Double-hurdle, Smallholder farmers, Beans, Rwanda

INTRODUCTION

Most of the sub-Saharan African countries, including Rwanda, have recently renewed their commitment to transform the agricultural sector. In these agriculture-based countries, the transformation of agriculture is adopted for poverty reduction and food security of the population as well as for overall economic growth [1].

The transformation has generally been considered as shifting from subsistence farming, which is characterized by low productivity to a market-oriented production system [2]. It is accompanied by using improved inputs, which are designed to lead to higher agricultural production for food self-sufficiency and commercialization. With increased commercialization, agricultural transformation is then seen as an effective way to boost household income and stimulate pro-poor growth [3]. In addition, transformation is intended to benefit the rural landless through wage labour creation and food availability. However, the benefits are only possible if commercialization is accompanied by growth in agricultural productivity and the promotion of intra-regional trade [4].

Since smallholder farmers in Africa have a large share of the arable land, it is not feasible to envisage agricultural transformation without considering them [5]. From the view of most development agencies, research centres, and governments, the transformation targeting increased productivity among smallholders would be the best way to enhance rural income in the short and medium term [6]. Some researchers also argue that transformation of smallholder farmers should be the dominant approach for agricultural-led growth in Africa [7]. Others indicate that improving the production systems of the smallholders as well as their access to markets is becoming a strategy for rural development and poverty reduction [8]. Additionally, when focusing on commercialization, smallholder market participation has been recognized as crucial for the transformation to significantly bring the expected growth [9].

With this transformation, the strategies to boost farm productivity are expected to lead to agricultural surplus, and hence the commercialization of smallholder farmers. Consequently, as these farmers begin to produce for the market, they are more likely to increase the productivity through intensification and then through their market participation [1]. Thus, their commercialization can be considered as an indicator of transformation as well as a step towards market-oriented farming [10].

Despite their importance for the transformation of agriculture, smallholder farmers face many challenges either in the production or the commercialization process. Such challenges make some observers pessimistic about agricultural development approaches that focus on smallholders [3, 11]. The transformation for agriculture-based growth requires the use of production technology, finances, logistics, and marketing skills and facilities to which smallholder farmers do not have easy access. In most cases, the limited access is a consequence of institutions related factors such as poor access to extension and financial services as well as lack of good infrastructure [4]. Additionally, factors such as gender dynamics have also been recognized as influencing smallholders' efforts to their commercialization. As such, transformation towards commercial agriculture tends to involve more men than women. The common explanation is that more

limitations are faced by women in accessing the productive assets and the technologies that accompany the so-called transformation [12].

Agricultural transformation in Africa and its implications on smallholder farmers has been widely debated [11, 13]. However, there are few empirical works on the actual drivers of farmers' commercialization. Most of the studies have focused on transaction costs and farmers' collective action. These are, for instance, recent studies conducted on maize and pigeon peas in Tanzania, on tomato production in Nigeria, on mushrooms producers in South Africa, and on pigeon peas and banana in Kenya [14 – 17]. In these studies, the institutional factors have been observed to be influential in determining the market participation of smallholders. However, as the policy environment and the infrastructure contexts differ among countries, these factors do not carry the same weight across SSA region. Some factors may be important in one country while insignificant in another. This heterogeneity of the supporting environment in the region needs more context-specific efforts [7]. Indeed, differences in agricultural performance observed between countries are largely due to the heterogeneity in the basic enabling conditions [1].

In Rwanda, the last one and a half decades have seen the government striving to encourage farmers to shift from subsistence to market-oriented production while mainstreaming gender in all policies. Efforts have been put on intensification of the production systems, farmer cooperative promotion, and enhancement of farmers' access to markets [18]. As a result, increases in the use of improved inputs as well as productivity for crops such as maize and potato have been realized. The commercialization of crops which were mainly grown for home consumption has also emerged. However, subsistence production has remained dominant despite the invested efforts. Apparently, the conducive policy environment benefited by all farmers has not been sufficient enough for all smallholders to change their production systems. Since commercialization remains a major step needed to move toward the intended transformation, there is need to understand the factors which may be influencing the farmers' market participation or non-participation under the prevailing environment. The objective of this study was to analyse the level of market participation and its determinants among smallholder bean farmers in Northern Rwanda.

The study is based on the same context as others previously conducted in Rwanda related to agricultural transformation plan. The other studies have focused on the analysis of the effects of cooperative membership on agricultural performance, the impact of credit on productivity, or on how agricultural innovation is received by the smallholders [18, 19, 20]. There are also those who focused on the implementation of Vision 2020, a framework for the development of Rwanda, whose pillars include agricultural transformation [21]. Yet, little attention was given to the commercialization of the smallholder farmers in the undergoing changes toward market-oriented production. This study shed light on the factors that contribute to the farmers' market participation for more informed efforts in the transformation to commercially-oriented farming.

CONCEPTUAL FRAMEWORK

This study is based on the agricultural household model in which production and consumption decisions are linked, with the household playing a dual role of producer and consumer of agricultural commodities. In a perfect market, own produced and purchased agricultural products are considered as substitutes and farming households are assumed to be indifferent in using either of them [22, 23]. In this case, farm production decisions are made separately from households' consumption preferences and needs [23]. As a supplier of agricultural products, the household behaves as a profit maximizer and it will increase the level of participation in the pursuit of profit. With this assumption, the output market participation is expected to be high among the agricultural households, which is not the case among the smallholders in developing countries.

An alternative assumption applies for these smallholder farmers: the 'non-separability' of farm households which describes their inability to separate production and consumption decisions. Farmers are faced with imperfect markets with high transaction costs and this makes the indifference between own-produced and purchased food mostly implausible [23]. For the agricultural household, selling prices and buying prices of commodities are rarely the same. Thus, the variation in the prices is due to transaction costs and household consumption preferences, which determine whether the household participates in the output market or not.

This inability to separate production and consumption decisions was highlighted by Barrett, modelling the market participation behavior of smallholder farmers [24]. In this model and letting U_i be the utility obtained from the consumption of a specific commodity i (we will use beans later), represented by C_i, the objective of a farming household is to maximize its utility from the consumption of the commodity, U_i, which applies for both tradable and non-tradable goods and services. Thus, the need to fulfill this objective leads to commercialization of agricultural commodities (beans in this case) and services by this household, such as non-farm employment. With respect to farm production, the quantity produced is a function of the production inputs (T), such as land and seed used, as well as the institutional factors (I) such as roads, extension services, and market information, which directly affect the household's decisions. The income (W) earned from both agricultural commercialization and non-farm activities, if any, depends on prices and wages, which are themselves linked to household-specific characteristics. The household characteristics include education, age, social capital and gender of the agricultural household head. Income plays a role in boosting the agricultural technology and market orientation through farm investments, coping with shocks, and risk reduction among smallholders.

The adaptation of the model by Barrett suggests that the decision to participate in the bean market as a seller (M_b) will take a value of 1, if the household decides to sell, or 0 otherwise. Since households cannot sell and buy at the same time, the net sale (NS_b) of beans is equivalent to the difference of the production and the consumption (C_b) of this commodity as presented below:

$$NS_b \equiv f_b(T, I) - C_b$$

When NS_b is non-zero and positive, this indicates that $f_b(T, I)$ is greater than C_b and there is surplus, so the household participates in the output market (M_b=1) as a net seller of beans. For the households with M_b=0, all the production is kept for consumption due to either the households' needs (particularly the household size) or the failure to produce enough. Hence, the participation of farming households in bean market will depend on their bean production (function of T and I) and their preferences (or needs) on bean consumption.

METHODS

Study area, sampling technique and data collection
Common beans are produced by the majority of the farming households in Rwanda. However, Northern and Eastern Provinces are the leading regions in bean production. This paper uses data collected in the Northern Province, using a structured questionnaire on a sample of 256 individuals from farming households. The sample was selected using a multi-stage sampling technique. In the first stage, three out of the five districts in the province were selected. These were Gakenke, Musanze and Burera, and they were chosen based on the predominance of farming activity and their geographic advantage of being close to either important local markets or to Uganda for cross-border trade. In the second and third stages, two sectors from each district and 2 cells (lower administrative units) from each sector were chosen. In the final stage, lists of farming households were obtained from the village leaders from which the 256 households were randomly selected. From the sampled household, only the household head or his or her spouse was interviewed.

Analytical framework
A Household Commercialization Index (HCI) was used to evaluate the degree of commercialization in the households [25]. This index has been used in many studies to measure the extent of output commercialization among smallholders [26, 27]. In this paper, the HCI was used as a proxy for the degree of bean commercialization, as indicated in the following equation:

$_b$ is the commercialization index of the household which had grown common beans in both seasons of 2015. S_{bi} is the gross value of bean sales and Q_{bi} is the gross value of bean production. The closer the HCI is to 100, the higher the level of commercialization in the target households. is the gross value of bean production. The closer the HCI is to 100, the higher the level of commercialization in the target households.

For the analysis of determinants of market participation, commercialization is assumed to be a two-step process in which the decision to sell beans and the extent of participation (quantity to sell) are independent [28]. These decision components can have different determinants. In this analysis, a double-hurdle model (DH) was used in STATA 14 to separately estimate their effects. The general form of the model is given by the following:

$$y_{i1}^* = w_i\alpha + v_i \quad \text{First step (hurdle)}$$
$$y_{i2}^* = x_i\beta + u_i \quad \text{Second step (hurdle)}$$

For: $y_i = x_i\beta + u_i$ if $y_{i1}^* > 0$ and $y_{i2}^* > 0$, where: y_{i1}^* and y_{i2}^* are respectively the latent dependent variables representing an individual/household decision to participate and the extent of participation.

y_i is the observed dependent variable, w_i and x_i are respectively, the sets of independent variables explaining the decision to participate and the extent of participation. v_i and u_i are independent error terms, assumed to be normally distributed. The explanatory variables (in w_i and x_i sets) of the specified regressions of the DH model are given in Table 1.

RESULTS AND DISCUSSION

Descriptive results

Among the sample households, 81% were headed by men and 19% were headed by women. The average age of the household head was 46 years while the household size was 5 persons. The majority (80.08%) of the respondents were living with spouses, being either officially married (67.19) or only cohabitating (12.89%). The average landholding was 0.37 Ha with a maximum of 9 Ha. The findings on education level showed that men had more years of schooling than women (Figure 2). In addition, 74% of women household heads had no formal education.
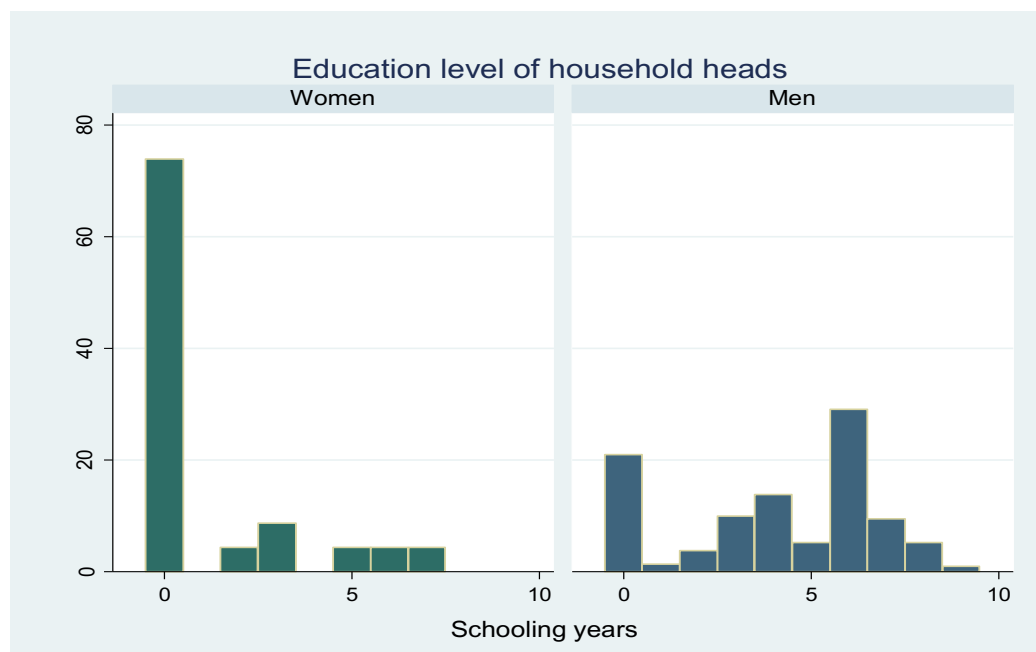
Figure 1: Education level by gender

The main occupation for both men and women was self-employment in farming (Figure 3). Among the respondents, 78.3% of women and 63.8 % of men reported farming as their main occupation. Compared to men, more women were working as family labour (10.9% versus 2.9%).
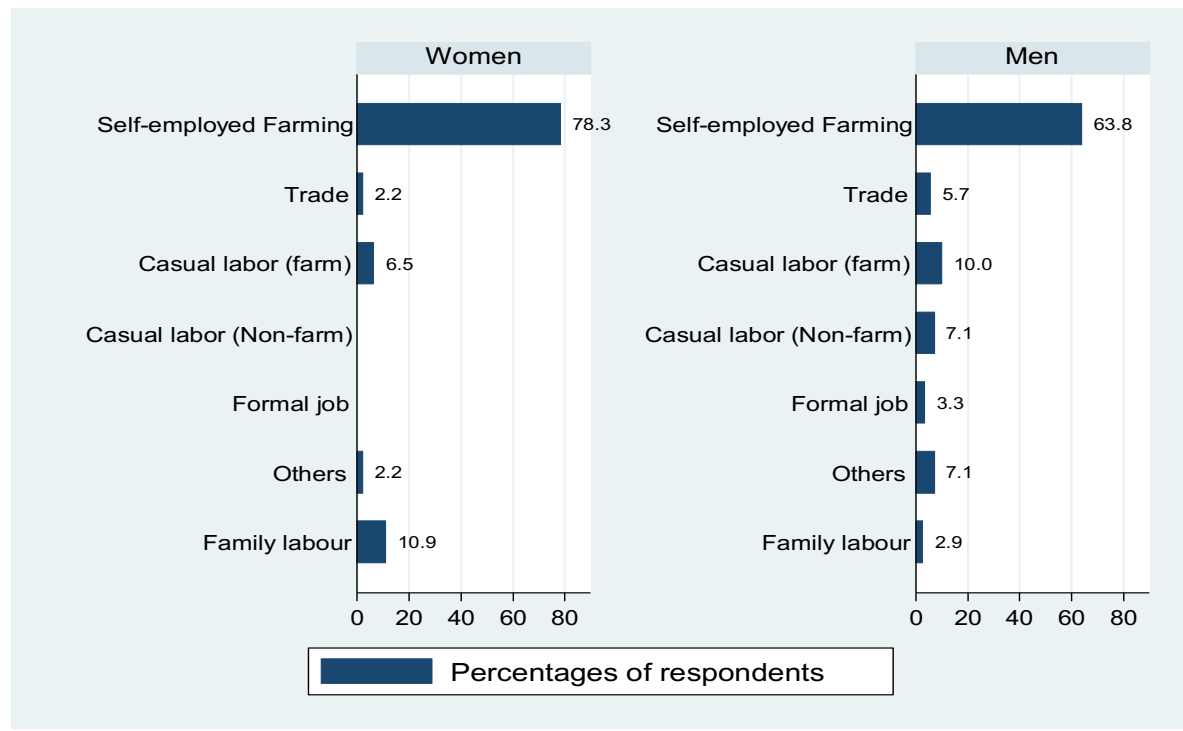
**Figure 2: Main occupation by gender of household head**

In addition, 66% of respondents were members of at least one farmer group. However, women heads of households were found to be largely underrepresented in these groups. The major groups were farmers' cooperatives and informal saving associations.

Extent of market participation
The results in Figure 3 show that 30% of respondents participated in the bean market as sellers, while 70% produced mainly for home consumption. Among the sellers, 11% sold at least 50% of the harvest, while 19% sold less than 50% of the harvested produce. The Household Commercialization Index (HCI) showed that households that participated in the market sold on average 42% of their production, with a minimum of 7% and a maximum of 87.5%, revealing market participation disparities among farmers. Among the sampled districts, Burera was found to be relatively advanced in terms of bean commercialization with an average HCI of 48%, followed by Musanze (43%) and Gakenke with 23%. These differences among the districts were statistically significant (p=0.0002). A Tukey post-hoc test revealed a significantly higher commercialization level in Burera compared to Gakenke (p=0.000). The difference between Musanze and Gakenke was only significant at 10% but there was no statistically significant difference between Musanze and Burera. The difference between the districts could be explained by the low level of accessibility and poor soil fertility characterizing a great part of Gakenke district. On the other hand, Musanze and Burera were not very different except their position to the major markets like Kigali and Uganda.
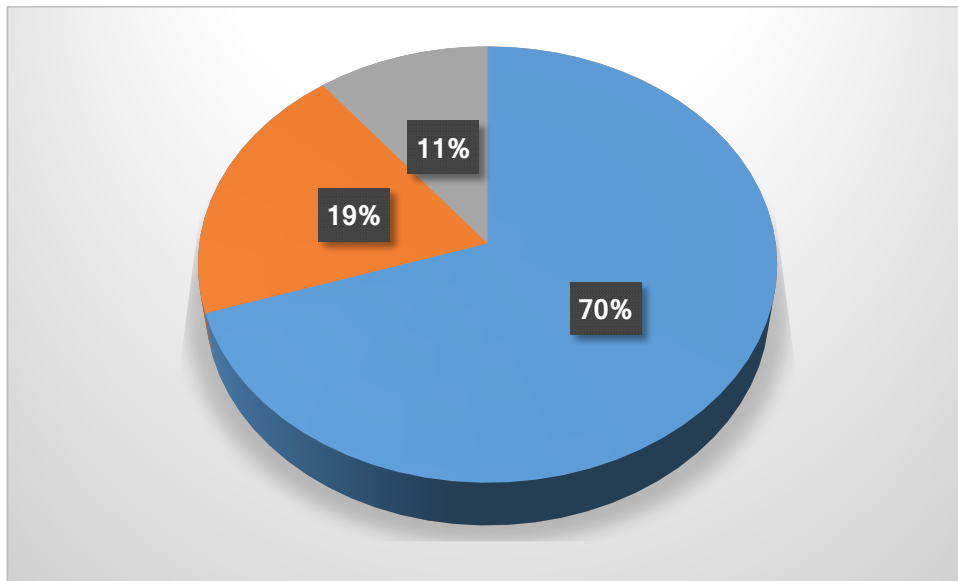
Figure 3: Extent of market participation

Determinants of market participation
Results from the double-hurdle model estimation showed that the households' market participation and the extent of participation are determined by different factors, as shown in Table 2. The model estimation results show that the value of Wald chi-squared (39.56) was significant at the 5% level, indicating that the joint effect of the considered variables is significant.

The results for the first hurdle showed that the gender of the household head has a negative relationship with the probability of a household's market participation. This indicates that the probability of market participation reduces if a household is headed by a man. The probability of farmers' market participation also reduces with an increase in the distance from household to the road. So, the farmer living farther away from the access and practicable road, connecting to the main market in the area had a reduced probability of selling their bean harvest. On the other hand, land size, training on agricultural practices, and membership in either a farmers' cooperative or self-help group were found to be positively related to the probability of participation in the bean market.

Results further revealed that the extent of market participation (second hurdle) in Table 2 was influenced significantly by many factors. The gender, use of improved inputs, and distance to the border had a negative effect on the commercialized proportion. The results of the study also showed that the years of schooling, income from livestock, as well as bean market price increased the commercialized portion of the produce. Additionally, households that have faced a serious illness among household members had an increased level of bean commercialization.

DISCUSSION

The results show that most bean farmers produce the crop for home consumption. Among farmers that participated in the market, only a few can be categorized as market-oriented [26]. This suggests that beans are still mainly grown for subsistence, a finding that is consistent with research conducted on pulses in Ethiopia [27]. Amongst the households that participated in bean markets, findings revealed a disparity in terms of the levels of commercialization, which is consistent with other studies conducted on smallholders' market participation [24]. Even though most sold a small quantity of their bean production, the HCI of some farmers showed a higher progress to commercially-oriented production. The farmers from Gakenke district had the lowest level of bean commercialization. This could be explained by their low access to practical roads connecting to selling points in all seasons and longer distances to key markets as compared to the other two districts.

With respect to the determinants of market participation, the unexpected negative sign on gender indicates that male-headed households are less likely to participate in the bean market, *ceteris paribus*. The results in the second hurdle also revealed that male-headed households sold smaller proportions of their production. Though uncommon, the results are consistent with a study done in Ghana [28]. In the Rwandan context, there are two possible reasons. First, bean production is not as costly as the other emerging commercial crops such as Irish potato and pyrethrum. Since women have lower access to production resources, they take bean crops as an alternative cash crop for them. However, men have access to other cash crops and their bean production may be mainly considered for household consumption. In fact, beans have traditionally been regarded as a woman's crop. The recent agricultural transformation efforts may have also provided men with more options for cash crops beyond beans. The other reason lies in the perceptions households have about beans as a staple food in Rwanda. The sale of beans has implications for the household's food security and, traditionally, having granaries of beans has been a sign of wealth. Hence, economically better-off households may still consider bean commercialization as reserved for the less wealthy. Most of women-headed households fall in the latter category. This also indicates that women use bean commercialization as a source of income as they have fewer opportunities to diversify their livelihoods. The findings also reveal that farmers would be more commercialized if they could have more access to roads that are practicable throughout the year and connecting to local markets. Long distances to these roads increase transaction costs, which discourages farmers' participation in bean markets. The increased transaction costs reduce the profitability of bean production, leading to more subsistence farming. As expected, the land size had a significant and positive sign suggesting that, as the size of land allocated to bean farming increases, the production and the probability to commercialize increase. The finding is consistent with studies conducted in Kenya, Mozambique and Tanzania where land access was found to positively affect market participation [29]. Additionally, the probability of market participation increases in households where the head has been trained in agricultural practices. This shows the importance of access to knowledge in agricultural commercialization [24]. In households where the heads are members in groups, the probability of selling beans was found to be

higher. Membership in groups helps farmers to network with others, leading to more access to information and knowledge that can support commercialized agriculture.

Among hypothesized determinants of the extent of market participation, distance to the border with Uganda was significantly and negatively related with the proportion of commercialized output. The negative sign indicates that as the distance increases, the quantities sold reduces. This suggests a possibility of cross-border bean commercialization and a more remunerative bean market in Uganda. Thus, the proximity to the border may be among other factors explaining the higher level of bean commercialization in Burera district. The sign for education level was positive, meaning that the number of schooling years increases the proportion of beans taken to the market. As education increases access to knowledge and information, this may have positive effects on commercialization. Livestock income had a positive influence on the quantity of beans sold. Households with diversified incomes, particularly from animal rearing, have higher market participation. This income may be used to buy more beans for home consumption thereby replenishing beans sold earlier by the household. The reservation to sell beans reduces with assured alternative income from livestock. The extent of market participation is also positively influenced by the price of beans and is consistent with research conducted on maize in Kenya [30]. Though price alone is not sufficient to stimulate commercialization, it is considered a key incentive for market participation among smallholders [26]. The unexpected negative sign of the use of improved inputs such as fertilizers and pesticides suggests that households may be using them on crops other than beans. Finally, livelihood shocks and serious illness in particular were found positively related to the extent of participation. The results highlight the significant role of bean production as a source of income and its commercialization can be seen as one of the livelihood coping strategies of smallholder farmers, especially women.

CONCLUSION

This study showed that most smallholder farmers grow beans for household consumption. However, some farmers have embarked on commercial bean production with associated higher levels of market participation. Women-headed households were more likely to participate in bean marketing than men, as the latter may have more other farm or non-farm opportunities to generate income. Similarly, households with larger land holdings or that have access to roads connecting them to the market and useable throughout the year were more likely to participate in bean marketing. Moreover, availability of training opportunities and membership in groups increased the chance of households participating in the market. Differences in the extent of market participation among the farmers were explained by gender, education attainment, and alternative income sources such as livestock, bean prices, and distance to key markets. Bean commercialization was also used as a strategy in case of shocks, such as serious illness in the households.

Policy efforts should be focused on improving roads connecting to local markets as well as the promotion of cross-border flow of agricultural commodities and information. The access to improved infrastructure will reduce the transaction costs. Moreover, increasing the opportunities of income diversification for the smallholder farmers should be

considered to increase market orientation of the farmers. Access to agricultural training and education should be increased to improve market participation. Finally, as the commercialization of beans may be an important source of income for women, any intervention for the development of bean production and commercialization should be gender-sensitive. This should be done to increase the integration of women, whose livelihood currently seems to be highly linked to bean crops.

ACKNOWLEDGEMENT

Table1: Definition of explanatory variables

Independent variables	Description	Expected sign	
		Participation (1=Yes,0=No)	Extent (Continuous)
Land	Total agricultural land size in hectare (Ha)	+	+
Education	Years of schooling (continuous)	+	+
Age	Age(continuous)	-	NA
Gender	Gender of the household head (1=Male headed, 0=Female headed)	+	+
HHsize	Household size (continuous)	-	-
Distboarder	Distance to the Ugandan Boarder (Continuous in Km)	-	-
Distroad	Distance to the nearest access road connecting to the market and which is practicable throughout the year (continuous in Km)	-	-
Distmarket	Distance to the market town (continuous in Km)	-	-
Livestock	Having livestock (Yes=1, No = 0)	+	NA
Agtraining	Having attended an agricultural/agribusiness oriented training (Yes=1, No = 0)	+	NA
Group	Membership to either cooperative or self-help group of the household head (Yes=1, No = 0)	+	NA
Credit	Use of credit in farming (1 if yes,0 otherwise)	NA	+
MarkPrice	Price of the output per kg in Rwf (continuous)	NA	+
Remittances	Having received remittances (Yes=1, No=0)	NA	-
Incomeliv	Income from livestock (Different to zero=1, Otherwise=0)	NA	-
Nfemplo	Household head has a non-farm employment (Yes=1, No=0)	NA	-
Agrtech	Having used improved inputs (Yes=1, No=0)	NA	+
Shockill	Having experienced a serious illness in the household (Yes=1, No=0)	NA	+

NA- Not applicable

Table 2: Determinants of market participation and extent of commercialization

	Coefficient.	Std. Err.	Z	P>z	[95% Conf.Interval]	
Hurdle 1: Y= Bean market participation (1=Yes, 0=No)						
Gender	-0.466	0.272	-1.710	0.087*	-1.000	0.068
Age	-0.009	0.007	-1.320	0.187	-0.022	0.004
Education	0.057	0.036	1.570	0.117	-0.014	0.128
Land	0.231	0.099	2.340	0.019**	0.038	0.425
HHsize	0.039	0.038	1.030	0.301	-0.035	0.112
Distmarket	0.032	0.074	0.430	0.664	-0.114	0.178
Distborder	-0.082	0.056	-1.480	0.139	-0.192	0.027
Distroad	-0.241	0.085	-2.830	0.005***	-0.407	-0.074
Livestock	0.044	0.052	0.840	0.399	-0.058	0.145
Agtraining	0.713	0.349	2.040	0.041**	0.028	1.397
Group	0.340	0.206	1.650	0.099*	-0.064	0.745

Significant at 10%, 5%, and 1%, respectively

Hurdle 2: Y= Commercialization index (continuous)

	Coefficient.	Std. Err.	Z	P>z	[95% Conf.Interval]	
Gender	-12.366	6.852	-1.800	0.071*	-25.795	1.063
Education	1.782	0.897	1.990	0.047**	0.023	3.541
HHsize	0.567	0.988	0.570	0.566	-1.369	2.503
Land	-1.002	1.365	-0.730	0.463	-3.678	1.674
MarkPrice	0.126	0.033	3.850	0.000***	0.062	0.190
Incomeliv	0.407	0.192	2.120	0.034**	0.031	0.783
NFemplo	3.853	5.387	0.720	0.474	-6.705	14.412
Credit	-0.760	5.272	-0.140	0.885	-11.093	9.572
Remittances	-12.369	12.678	-0.980	0.329	-37.217	12.479
Distmarket	-0.752	1.775	-0.420	0.672	-4.232	2.727
Distboarder	-5.113	1.617	-3.160	0.002***	-8.282	-1.944
Agrtech	-16.440	9.477	-1.730	0.083*	-35.015	2.135
Shockill	14.948	5.337	2.800	0.005***	4.488	25.409
Sigma _cons	16.623	1.544	10.77	0.000	13.603	19.656

Significant at 10%, 5%, and 1%, respectively

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