Factors Influencing Commercialization of Beans among Smallholder Farmers in Rwanda

Kimei Stephen[1]*, Mshenga Patience[1], Birachi Eliud[2]
[1]Department of Agricultural Economics and Agribusiness Management, Egerton University
[2]The International Center for Tropical Agriculture (CIAT), Rwanda
Corresponding Author: Kimei Stephen

Abstract: *Commercialization of agriculture provides farm households with a means to alleviate poverty and food insecurity in the rural areas. In Rwanda, common bean is largely grown for both domestic and market purposes. Based on increasing demands, farmers face tradeoff as to what proportion to consume and to market. The paper sought to determine factors influencing decision and extend of bean commercialization using the double hurdle approach. Results show that age, number of livelihoods a household head engages in, quantity of beans produced, market information and type of beans influenced decision to commercialize common beans. On the other hand, quantity of beans produced, number of crops a household cultivates, number of livelihoods of a household and market distance influenced level of bean commercialization. Therefore, the study recommends the need for increased measures to improve skills of farmers to engage in other livelihood activities, increased beans production, collective action among farmers and effective flow of market information.*
Keywords: *commercialization, tradeoff, livelihoods,*

I. Introduction

Agricultural sector is among the major pillars of Rwandan economy. This sector supports close to 40% of the Gross Domestic Product (GDP), employs 90% of country's active population and accounts for well over 60% of all exported goods in the country [1]. Common bean is one of the major focus crop in the country cultivated by almost every farmer in Rwanda. It is estimated that close to 95% of the Rwandan households engage in common bean production thus making the country among the countries with high yields [2]. Beans occupy the largest area under food crop production nationally to a tune of 23% of total land under cultivation [3]

Due to the special nutritional value and affordability; beans are among the most consumed food crops in many households. The pulse is rich in quality globulin protein, energy, fiber and micronutrients especially iron, zinc and vitamin [4]. Further, dried beans have long shelf period, comparatively cheaper than animal proteins and some species mature faster [5]. Rwanda has the highest per capita bean consumption in the world [6] Smallholder farmers produce beans for household subsistence purposes and for local and regional markets [7]. Both bush and climbing bean varieties are the most important traded crop in rural and urban areas of Rwanda with tradable volume increasing over time.

The common bean market in Rwanda is competitive and risky due to its link to international market shocks [9]. It is documented that markets are functioning relatively well and food is flowing easily within and outside the country in great lakes regions [10].The network of bean trade has widened to include cross-border trade making small towns serve as collection centers [11]For instance Rwanda exported 20,000 tons of beans to Uganda out of the total 35,000 tons exported [12]. Consequently, production of beans has shifted from subsistence production to semi-commercialized or even commercialized production. Consequently, the study sought to establish factors that influence the decision to commercialize and the extent of commercialization in the pursuit of food security threshold and household income.

II. Materials And Methods

The study was carried out in Musanze, Gakenke, Gasabo, Kireheand Nyamagabe districts across Rwanda. Multistage sampling procedure was used to get atotal of 252 respondents. The data was analyzed using STATA and SPSS statistical programs. Double Hurdle model was used to determine both factors influencing the decision to commercialize and level of commercialization of beans. In this model, decisions are divided into two sequential tiers/ hurdles. In the first stage, Probit regression model is used to determine whether the farmer decides to commercialize or not. The second stage involved use Ordinary least Square (OLS) regression where farmers who engaged in commercialization were considered. The empirical model can be specified as follows:

$$y_i^* = X_{i1}\beta + \mu_i, \mu_i \sim N(0,\delta^2) \text{ where } y_i = \begin{cases} 1 \ if \ y_i^* > 0 \\ 0 \ if \ y_i^* \le 0 \end{cases} \dots\dots\dots\dots\dots\dots\dots (1)$$

$$Z_i^* = X_{i2}\alpha + \varepsilon_i \ \mu_i \sim N(0,\delta^2) \text{ Where } Z_i = \begin{cases} Z_i^* if \ Z_i^* > 0 \ and \ y_i = 1 \\ 0 \ otherwise \end{cases} \dots\dots\dots\dots (2)$$

Where y_i^* in equation (1) is latent variable describing farmer's decision to commercialize beans, β_{is} and α are vector of parameters, X_{i1} and X_{i2} represents the vector of variables explaining the decision to commercialize and the variables explaining the extent of bean commercialization respectively [13]. In equation (2) Z_i represent the household level of commercialization which depends on latent variable Z_i^* being greater than zero and conditional to decision to commercialize y_{i*}. Household bean commercialization index was used to draw different levels of commercialization among households [14]. For this study, the ratio of the gross value of bean sales by the household in season j to the gross value of all common beans produced by the same household was calculated. That is:

$$HCI = \frac{gross \ annual \ value \ of \ beans \ sold}{gross \ annual \ value \ of \ all \ beans \ produced} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (3)$$

Proportion of total crop income reveals the dependency ratio of farm households on income derived from common bean sales and the possible household uses. The household commercialization index lies between 0 - 100 percent, that is $0 \le HCI \le 1$

III.   Results And Discussion
The econometric results from Probit model are as shown in Table 1 below where five variables were found to be significant.

Table 1: Factors influencing the decision to commercialize beans

Variable	Marginal effects	Standard Error	$p > |z|$
Age	-0.0095355	0.0036	0.008***
Household size	-0.0318785	0.01996	0.110
Total income	2.71E-07	0.00000	0.616
Land size	-0.0019236	0.00161	0.233
Number of crops cultivated	0.0146084	0.0516	0.777
Number of livelihoods	-0.1953243	0.06203	0.002***
Bean type	-0.1932464	0.08111	0.017**
Quantity of bean	0.0023139	0.00046	0.000***
Group membership	-0.0844238	0.07295	0.247
Time taken to the market	-0.0796868	0.06811	0.242
Bean storage	-0.08898	0.07311	0.224
Market information	-0.0921258	0.0423	0.029**
Market distance	0.047294	0.06261	0.450

Log likelihood = -124.57971, LR chi^2 (13) = 91.64; Prob> chi^2 = 0.0000
Pseudo R^2 = 0.2403*, **, *** significant at 10% 5% and 1% respectively.

The age of household head had a negative influence on the decision to commercialize beans at 1% significance level. A one year increase in age of the household head had probability of 0.01 of not participating in commercialization of beans. Younger farmers are more receptive to agricultural innovations like adoption of high yielding climbing beans and tend to have smaller households hence relatively higher marketable surplus compared to the aged household heads that are risk-averse [15]

The quantity of beans produced had a positive influence on commercialization at 1% significance level. A farm household with higher volume of bean produce has a high chance of devoting more quantity as marketable surplus and therefore higher probability of commercialization. The findings are in line with the findings of [16]), who found that output quantities of maize, horticulture and dairy product had a positive effect on common bean commercialization.

Households with more than one livelihood activity had a higher chance of deciding not to commercialize beans than those with one livelihood. An addition of one more livelihood activity caused a decrease in the probability of commercialization by 0.19 at 1% significance level. Apart from consumption, farm households engaged in crop cultivation for increasing their agricultural income. Agricultural diversification has a tendency of increasing ways at which a farmer can increase the household income. It has been observed that alternative sources of income are positively associated with high volume of cereal grain sales [17]. Therefore, smallholder farmers with more sources of livelihoods tend to offset domestic pressure to sell their bean harvests by settling it using off farm income. The study found that the choice of the type of beans produced had a positive influence on decision to commercialize bean output 5% significance level. This implies that the probability of engaging in bean commercialization was high for farmers who planted bush bean type

compared to climbing bean. A change from bush beans to climbing beans reduced the probability of commercialization by 0.19. The findings of the study were contrary to the expectation that farmers with climbing beans would have a higher chance of commercialization since climbing beans have more favorable production attributes than bush beans.

Market information has a vital role in linking famers and buyers to the market. In this study farmers chose on what best suited their position on market information from a scale of 'very satisfied' to 'not satisfied' about market information. It was found that market information significantly influenced the farmer's decision to commercialize their bean produce at 5% level. This implies that farmers who were satisfied by the information about the market at their disposal had a high probability of commercialization than others. The study corroborates the findings of [17] who concluded that access to better and reliable market information on prices and market increases the probability of market participation. It is also advanced that more information on marketing helps households to reduce transaction costs [18].

4.4.2 Factors influencing extent of bean commercialization
The extent of common bean commercialization was analyzed using the OLS regression model and results observed as in Table 2.

Table 2: Factors influencing extent of bean commercialization

Variable	Marginal effects	Standard Error	$p > |z|$
Age	0.0032554	0.00352	0.354
Household size	-0.0144782	0.01931	0.453
Land size	0.001513	0.00182	0.407
Total income	-6.09E-07	0.0000	0.088*
Number of livelihoods	0.156437	0.05284	0.003***
Number of crops cultivated	-0.0744468	0.04355	0.087*
Quantity of beans	0.0016679	0.00028	0.000***
Price per kg	0.0007621	0.00035	0.029**
Group membership	0.0965468	0.05657	0.088*
Bean storage	0.1614216	0.05528	0.003**
Market information	0.0189939	0.03357	0.571
Market distance	0.0886516	0.03698	0.017**

$R^2 = 0.8803$, Adjusted $R^2 = 0.8647$; *, **, *** significant at 10% 5% and 1% respectively.

The number of livelihood activities the household participated in positively influenced the volume of bean sold at 1% significance level. If a household adds one more livelihood activity, the probability of increasing the volume of sales increases by 0.15. Increased number of sources of livelihood increases the sources of household income and thus offsetting pressure on high dependence on agricultural income. A farmer can comfortably sell more beans with anticipation of other income from other sources in future. This study further concurs with the findings of [19] that non-farm income contributes to more marketed output if the non-farm income is invested in farm technology and other farm improvements.

The quantity of beans produced positively influenced the extent of commercialization at 1% significance level. This implied that Households with relatively large quantities of produce had a marketable surplus. Farmers with low output tended to have larger percentage of produce retained for household consumption. The finding of this study corroborates findings of [20] revealed that quantity of cassava produced is associated with a higher level of cassava sales.

The extent of bean commercialization was negatively influenced by the number of crops cultivated by a household at 10% significance. An addition of one more type of crop decreased the probability of increasing volume of bean commercialized by 0.07. The possible explanation to this is that addition of non-food crop or food crop with relatively high output price has tendency of reducing the volume sold due to diversified sources of income in other crops. Further, increased number of crops cultivated in a piece of land subject to constant land size causes low quantity of beans produced and hence decreasing volume of beans sold.

Distance to the market was found to positively influence the extent of commercialization where an increase of distance by a kilometer caused an increase in probability of increasing volume sold by 0.08. This may be attributed to effort made to reduce transportation and transaction costs through lump sum selling. The other possible reasons could be better prices offered at distant markets compared to nearby markets and bulkiness of commodities in selling small portions [18].

Higher household's income negatively influenced the volume of bean sales at 10% Significance level. A 1% increase in household's income reduced probability volume of commercialization by -6.09E-07%. Households with relatively high income levels tended to sell lesser volumes. In addition crop sales form large portion of small household income. If a farm household has lower incomes it implies that higher volume of sales will help offset more expenditure needs compared to households with higher income. Farmers in the region relied more on beans for agricultural income. It has been argued that if household income is not channeled to

production it has a tendency of increasing off farm economic pursuits and consequently cause marketed output to drop [20].

Price per kilogram of beans had a positive influence on intensity of commercialization at 5% significance level. Price is an incentive for farmers to increase the amount of produce engaged in commercialization [21]. Since farmers are assumed rational in the decisions, farmers would appreciate to gain much from the surplus produce and any marginal increase of common bean prices encourages more commercialization.

Farmers who store their common bean had a tendency to increase the extent of commercialization. The results show that storing beans an extra month increased extent of commercialization by 0.16. This may be attributed to the fact that better storage of beans could give a farmer a chance to sell at a better price compared to time of harvests. The other reason could be postharvest losses are reduced and hence surplus produce for markets are maintained. The findings are in line with findings of [22] who argued that farmers who used storage facilities had higher probability of market participation.

A household head that was in a farmer in group membership had a 0.097 chance of 10% increasing the intensity of bean commercialization. Collective action has many benefits ranging from production to marketing decisions because of enhanced bargaining power and information access [21]. Despite the low membership to groups by target population, group membership has been revealed to be important factor in common bean commercialization. The other factors did not significantly influence common bean commercialization.

IV. Conclusion And Recommendation

The study recommends that stakeholders devise means to improve socioeconomic, infrastructural and institutional factors affecting farmers to encourage diversified livelihoods, and free flow of market information. Further, farmers should have cheap options to utilize farmer group membership as a means of effective flow of market information and other agricultural extensions services. Through these, smallholder farmers would offset pressure mainly piled on available food stock while farmers acquire enough agricultural income to ensure food security among households.

Acknowledgement

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