

Factors that influence banana supplied to the market in Muhanga District, Rwanda

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Abstract: Linking smallholder farmers to modern value chains is one of the rural development strategies promoted to address the challenge of smallholders' integration in markets. However, smallholder prospect inclusion in modern value chains is still limited. This study examines factors that influence banana supplied to the market in Muhanga district, Rwanda. A multi-stage sampling design was used to select 178 households from seven banana producing Sectors in Muhanga district in South Province of Rwanda. A Heckman two stage selection model was used to estimate data collected through semi-structured questionnaires. The key factors that determined volume of banana supply were access to transport facilities, distance to nearest town, distance to nearest training centre, farming experience, banana trader collection, yield, market centres and farm gate/home, better price and closeness in distance were statistically significant to influence volume of banana sold to the market. Based on these findings, policies that guide the federal, state and local governments towards increased investment in rural infrastructure is recommended as this will help reduce transaction costs and thereby improve participation of smallholder farmers in the market.

Index Terms— Value chain, Market, Heckman selection model, Smallholder farmers, Muhanga District, Rwanda

1. INTRODUCTION

Banana production in the region is mainly subsistence oriented with low input application. In Rwanda, bananas are grown on 213,000 ha of land, occupying 23% of total arable land and contributing more than 50% of the annual crop production in terms of fresh weight, [1].

Current national banana production is estimated by the FAO statistics division at about 2.65 million MT per annum. The consumption of bananas in Rwanda is one of the highest in the Great Lakes region. In the year 2000, annual per capita consumption was estimated at 258 kg. About 80% of Rwandan households practice banana production mainly for household food security and income generation. A typical household's agricultural enterprise regime comprises 50% tubers, 30% bananas and 20% legumes, cereals and vegetables, [2].

In Rwanda, the commonly produced banana types include the beer and cooking varieties. Generally, the beer banana types comprise 64% of the total banana production in Rwanda while the cooking types comprise 30% and the dessert types about 6%, [3]. It is worth noting however, that the distribution of the different banana types varies across regions. For instance, in the Lake Kivu region, beer banana types comprise 85 to 90% of total banana production compared to 60 – 80% in Rusizi and Nyamasheke while in Nyagatare, Ngoma, Kirehe, Kayanza and Rwamagana, cooking bananas predominate with beer bananas accounting for only about 20 to 30%. The beer bananas are processed into beer mainly at the farm level and sold to local consumers or intermediaries, [3]

Banana value chain mappings show absence or minimal involvement in regional markets or high-value domestic chains such as supermarkets. This is completely absent in the cooking banana value chain but present in minimal levels, about 16% of total sales volume of bottled banana beer in the small-scale semi-industrial banana beer processing chain. Participation by the rural population in high value markets has been shown to have high poverty reduction impacts since such chains are

associated with lucrative product prices, in addition, it revealed that poor linkages within the value chain as each value chain actor (producer, assembler, wholesaler and retailers) seem un-integrated with other chain players, [4]. Based on evidence from previous studies little is known about the factors influencing the smallholder banana farmers' participation in banana value chain and existence of linkages between actors along the value chains is also not known in Rwanda and the study area in particular. Understanding of the factors will lead to identification and generation of appropriate intervention measures that enable the rural populations to benefit from banana value chain.

2. REVIEW OF EMPIRICAL FINDINGS

According to [5], the Heckman two-stage econometric estimation procedure was employed to identify factors that determine milk market participation decision and milk sale volume of the farm household in the area. The results revealed that marketable milk volume was found to be strongly and significantly affected by the number of cross breed milking cows owned, family size, age squared and annual non-dairy income source of sampled dairy household. According to [6] studies, the two-stage least square regressions (2SLS) model results shows that malt barley marketable surplus is significantly affected by total volume of output, selling price, access to market information and distance to the market.

A study by [7], on fish marketing and value chain reveals that the value chain of fish is long and very complex and the lack of good road and transport networks with the landing (assembling) centers deprives fishery to get fair price. In addition to this, middlemen in the fish marketing chain bear the most cost of marketing while retailers enjoy the share of the profit. Farmers receive relatively higher share (approximately 70%) of the retail value for all species under study.

A study by [8], on farmers' involvement on value added pro-

duce finds out several issues limiting the exploitation and maximization of value-added products. Some of them are growers sold all their produce, and therefore did not see a clear need to become involved in adding value to the remaining produce, lack of resources preventing them from adding value to their foods, the lack of physical facilities to process food, the absence of financial means, sanitary and other requirements are currently impeding many farm operators to fully optimize or maximize their food.

3. METHODOLOGY

Study Area

The present study was carried out in Rwanda, Southern Province, in Muhanga District. The described zone have been chosen due to the fact that Muhanga district is the best producer of Banana in southern province and the banana value chain is developed and advanced with potential buyers and being near Kigali city helps the banana value chain compared to other districts.

Research design

This study adopted a cross-sectional survey. Both quantitative and qualitative data was collected. Depth interviews of key informants from selected banana actors (NGOs, Microfinance institutions, banana assemblers and supermarkets) will be conducted. Primary data was collected from respondents through semi-structured questionnaires.

Target population

The target population was all actors involved in Banana value chain including producers, wholesalers, brokers, retailers, consumers, micro-finance institutions. Out of 320 actors in value chain only 120 will be selected.

Sampling techniques

A purposive sampling method was used to select banana agropreneurs in the seven administrative sectors of Muhanga District that is Mushishiro-Rugendabali-Kibangu-Nyabinoni-Rongi-Kiyumba-Kabacuzi. The interview was based on a structured interview questionnaire and duration of existence (more than 5 years) was used to choose other stated banana value chain actors. A two-stage cluster sampling design was applied to randomly pick the primary (standard enumeration areas) and secondary (households) sampling units.

Probability proportional to size was used to select the sampled standard enumeration areas, while simple sampling was employed to choose a sample of 120 participating in banana value chain.

Research Instruments

This study used structured interviews, to collect the quantitative and qualitative data required. The questionnaire contained information related to factors influencing participation in value chain, key actors and marketing channels, production inputs and production costs. Semi-structured interviews involved a total of 120 household units.

Application of Heckman two stage model

Heckman two stage selection models is applied if two decisions involve participation and volume of supply. Heckman selection model is used for analysing factors affecting sales volume of banana. This model estimates volume of banana supplied to the market by smallholder banana market participants. In the first place probit model was specified as yes or no called dummy variable regression models in which determinants of an event happening and not happening is identified. It identifies whether banana producing smallholder farmers participate in the market or not participate. In such circumstances, the probit model estimation was employed.

$$(y)_{1i} = X_{1i}\beta_1 + u_{1i} \quad u_{1i} \sim N(0,1) \quad (i)$$

$MMP = 1$, if $Y_{1i} > 0$ or (participated)

$MMP = 0$, if $Y_{1i} \leq 0$ or (Not participated)

Where Y_{1i} is the latent dependent variable which is not observed, Participated or not Participated X_{1i} is vectors that are assumed to affect the probability of sampled banana household banana market participation. β_1 is vectors of unknown parameter in participation equation. Are residuals that are u_{1i} : independently and normally distributed with zero mean and constant variance. In the second place, Heckman selection model was used for analyzing factors affecting sales volume of banana. This model estimates volume of banana supplied to the market by smallholder banana market participants. The model is specified as:

$$MMV = Y_{2i} = X_{2i}\beta_2 + u_{2i} \quad u_{2i} \sim N(0, \delta^2) \quad (ii)$$

Y_{2i} is observed if and only if $BMP=1$. The variance of u_{1i} is normalized to one because only BMP , not Y_{1i} is observed. The error terms, u_{1i} and u_{2i} , will be assumed to be bivariate, normally distributed with correlation coefficient, δ , β_1 and β_2 are the parameter vectors.

Y_{2i} is regressed on the explanatory variables, X_{1i} and the vector of inverse Mills ratios (γ_i) from the selection equation by ordinary least squares. Where Y_{2i} is the observed depended variable, it is the volume of supply in the second step; X_{2i} is factors assumed to affect sale volume. β_2 is the vector of unknown parameter in the supply equation, u_{2i} is residuals in the supply equation that are independently and normally distributed with zero mean and constant variance.

$\gamma_i = \frac{f(x\beta)}{1-F(x\beta)}$ (iii), $f(x\beta)$ is the density function and $1 - F(x\beta)$ is the distribution function.

4. RESULTS AND DISCUSSION

Results from table 1, the heckman two stage regression result shows that distance to nearest town and distance to nearest training centre were statistically significant at 5% level of significance influenced banana supplied to market but were also statistically significant to influence market participation. Expectedly to prior expectation from the Operationalization, distance to training centre and town affect negatively the banana supplied. This implies that household's tendency to participate in banana marketing increase as far as the household Locational is near to markets.

This is because as the distance to town and other nearest physical infrastructure market increases, the transportation cost increase as well; this is a disincentive to market participation, increase in the distance travelled might contribute to high transaction cost. The farther away a household is from the market, the more difficult and costly it would be to access market thus high transaction costs are barriers among resource poor smallholders. These high transaction costs result from individual produce transportation and selling, difficulties in getting trading partners and poor bargaining power. This is in line with the findings of [9] who reported that the distance to nearest market was the significant factor that affected the farmers' degree of commercialization in Tanzania.

Results from heckman model presented in table 1 showed that the access to transport facilities was statistically significant influencing the banana producer and positively affected the banana producers to participate in banana markets channels outlets ($Dy/dx < 0.05$) respectively. Unexpectedly, negative coefficient of the transport facilities ownership indicates that there is a negative relationship between transport facilities and banana production.

This means that road accessibility can have important influence on markets from both the supply and demand side because it reduces the imperfect information and transaction costs [10].

Better road accessibility, for example, could help to get market information because of lower transaction costs. It could also encourage people to produce more for markets.

From the lender's point of view also, road accessibility could play a positive role because it makes it easier to get information about the borrower's activity and reduce the default by risky borrowers and these results are similar to the study findings of [11], in their study on contribution of rural roads to access to- and participation in Markets:

Results from the heckman model showed that farming experience was statistically significant to influence banana production and supply at 5% significance level for banana producers in Muhanga district. This is an implication that more experienced farmers accumulate easily new technological package for banana production than lesser experienced and they are linked with markets transaction than their counter parts for markets participation. Unexpectedly, farming experience affect negatively the volume of banana supplied to the markets. The result of informal discussions confirms that households having many years of banana farming experiences own local banana varieties and live at very edge of the town where demand for banana produce is very low. [12].

The summary results from the heckman regression model showed that banana production was statistically significant to influence quantity of banana volume supplied to markets ($0.003 < 0.05$) at 5% significance level, but not marginally statistically significant to affect market participation in the study area. This is an indication that higher banana production, higher quantity supplied to markets and higher farmer's income. The high production generated by the banana household producers was found as an important motivational factor for households to participate in market. Quantity of banana supplied was examined to observe the influence of demand to market access among farmers, implying that when banana demand is high might necessitate traders to follow farmers at field. Following crops at field means buying them at farm gate price and farmers are likely to sell all spices to traders and have little to offer to other market channels. In order to make other market channels active, farmers have to explore market demand information before sell their products. This finding concurs with the finding of [13] who reported that farmers' decision on market entry is significantly related to the amount of farm income from supplied production.

The results from the heckman regression model presented in table 1 showed that there are other moderating factors like banana trader collection, market centre, good price and closeness in distance that influence quantity of banana supplied to markets statistically significant at 5% significance level, but not affect market participation significantly. With closeness to roads, this variable was found to have positive association with market participation as proximity to road and positively influenced volume of banana supplied to markets. Proximity to road significantly affected household's market participation at less than 5% significance level. This implies that the farther from main road, the lesser will be household's tendency to participate in market.

Our finding concurs with the finding of [14] who reported negative association between nearness to road and adoption of fruit-tree based agro forestry system. [14] noted that the nearer to the main road, the better would be access to information and market. Another finding on commercialization of smallholders in Ethiopia by [15] noted that proximity to all weather road encourages market orientation due to its effect of reducing marketing costs. Accordingly, households further away from market places have lower market participation. [15].

A finding by [16] also revealed that as the distance from the nearest market increases, variable transport costs increase and this discourages smallholder farmers from selling high volumes.

The findings also showed that price was statistically significant at 5% significance level influence quantity of banana supplied to markets, but not affect market participation significantly. It is an implication that good price is a fundamental economic factor that may increase profitability of farmers. The results of this study also show that farm gate prices negatively affected profitability in the study area (the price offered to farmers is considered very low by respondents if compared to

the costs of production). Additionally, if farm markets prices were increased, household income should also be increased and subsequently farmer will be able to predict the farm inputs for next farming season and other associated transaction costs. The findings of the study agree with the research results [17].

Results from table 1 showed that collection center was statistically significant at 5% significance level influence quantity of banana supplied to markets, but not affect market participation significantly along the banana marketing chain, producers, brokers, urban collectors, rural assemblers, wholesalers, primary cooperative and cooperative union could buy easily banana supplied through collection centre and were found to be the major market actors. The producers mainly sold their banana to urban collectors, rural assemblers, primary cooperative, and wholesalers. Urban collectors bought higher quantity of banana directly from farmers and resold to wholesalers. Wholesalers handled huge quantity of banana produces and sold it to other markets outside Muhanga district. They were the major actors in channeling banana produces to markets outside the district. This finding corroborates that of [18], who found that in Alaba Special District wholesalers were the major outlet of red pepper to other markets through collection centre. The findings also showed that family size was statistically significant at 5% significance level to influence market participation significantly. It is an implication that increase in number of family size increase the family labor force number and reduce the cost of hired labor.

In terms of analyzing the factors affecting the quantity of banana supplied in the market, the first step of the regression result revealed that household size had positively and significantly affected the participation of households in banana products market and the supply of banana to the market was

not statistically significant to influence banana supplied.

The positive association between household size and quantity of banana supplied in the market indicates households with more members likely to actively participate in market. Consistent to this finding, [19], found that a household with more number of labor produce (family size) highly participate in market.

Inverse Mills Ratio to Determine Banana Supplied to the

Market

The Inverse Mills Ratio (Lambda) or selectivity bias correction factor has significantly affected the marketed surplus of banana at less than 5% significance level (Mills ratio=2979.413). This discloses the fact that there is sample selection bias; which implies the existence of some unobserved factors responsible for banana growers' likelihood to participate in market and thereby the level of market participation. The positive sign of lambda shows that there are unobserved factors that are positively affecting both participation decision and marketed surplus of banana justifying the appropriateness of the Heckman model for identifying the determinants of banana market participation and marketed surplus. The rho is positive; this indicates that unobserved factors are positively correlated with one another.

Sigma=-592.35907 represents the adjusted standard error for the level of market participation equation regression; and the correlation coefficient between the unobserved factors that determine decision in to market participation and unobservable that determine participation level is given by rho=0.76313 respectively.

Table 1: Banana supply market and marginal effect for market participation

Banana producer	Coef.	Std.error.	Z	Dy/dx	P> z
Institutional factors					
Distance to nearest town (Km)	0.055	0.021	2.600	0.043*	0.009*
Distance to nearest training centre (Km)	-0.175	0.059	-2.980	0.574	0.003*
Distance to nearest markets (Km)	0.105	0.065	1.630	0.412	0.103
Access to transport facilities	-0.321	0.179	-1.800	0.027*	0.043*
Access to extension services	-0.254	0.195	-1.300	0.062	0.193
Access to credits	0.078	0.136	0.570	0.820	0.566
Socio-economic factors					
Marital status of HH	0.192	0.182	1.050	0.079	0.293
Education level (years)	0.011	0.032	0.340	0.655	0.734
Family size (persons)	0.001	0.002	0.770	0.616	0.444
Farming experience	-0.025	0.008	-3.120	0.52	0.002*
Income from Banana	0.000	0.000	-1.610	0.079	0.108
Marital status of HH	0.192	0.182	1.050	0.308	0.293
Education level (years)	0.011	0.032	0.340	0.237	0.734
Family size (persons)	0.001	0.002	0.770	0.022*	0.444
Farm level factors					
Quantity produced/ Yield (Kg)	0.000	0.000	-2.930	0.308	0.003*
Quantity consumed (kg)	0.000	0.000	-0.540	0.297	0.587
Quantity sold (Kg)	0.000	0.000	-0.620	0.084	0.537
Quantity processed (Kg)	0.000	0.000	-1.100	0.286	0.272
Price (Frws)	0.000	0.000	-0.810	0.111	0.416
Market factors					
Banana trader collection	0.871	0.226	3.850	0.982	0.000*
Market centre (Any place)	1.554	0.468	3.320	0.303	0.001*
Farm gate (Home)	-0.590	0.248	-2.380	0.616	0.017*
Good price	0.605	0.170	3.550	0.237	0.000*
Transportation availability	0.000	-	-	0.982	-
Closeness in distance	0.329	0.160	2.060	0.21	0.039*
Secured markets	-0.108	0.208	-0.520	0.52	0.604
_cons	1.664	0.356	4.670	0.977	0.000
Mills Lambda= 2979.413, Rho= 0.76313; Sigma= -592.35907					

5. RECOMMENDATIONS

Based on the findings, the study recommends the following for improvement of banana value chain.

There is need to strengthen banana value chain in which a number of banana markets can be increased and developed.

There need to decrease the marketing channels that makes banana market less informal but also increase demand for banana which is necessary for farmer market access.

Agricultural development programmes should target Farmers' Based Organizations as well as support them with technical training to enhance their technology uptake and encourage farmers to sell their banana produce at highest market outlet channel with higher price and reduce other transactional costs.

Banana farming business requires support and services based on market focused collaboration and strengthen their collabo-

ration to traders.

There should be a formation of stronger banana farmers' associations or networks. The associations could enable banana farmers to pool resources and benefits from economies of scale instead of competing between themselves through formation of farmers marketing groups this can have a direct impact on raising farmer incomes and encouraging a more commercial approach to production.

There should be banana price regulatory authority for banana to be supplied to market. This can also involve creating clear price structure for banana products to be sold. Therefore, efforts aimed at expanding the banana industry could employ price policies such as floor prices and increased farm gate site prices through enhanced farmer bargaining power and value

added.

vii. Improved contract enforcement regulations, particularly at rural level, will reduce trading risks and encourage greater transaction cost efficiency through its medium-term competitiveness strategy and institutional arrangements need to be put in place to assist in the spread of contract benefits.

Community access roads should be given priority in future investment transport infrastructure investment programmes

and repair current roads. The benefits to farmers of investment in community access roads will be felt directly through greater market access and decreased transport costs.

The introduction of intermediate means of transport (such as bicycles, pack-animals, animal drawn carts, motorcycles and single axle tractors) has the potential to increase market access and reduce marketing costs to farmers.

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