Impact of Vegetables Production in Rwanda: A Case Study of Bugesera, Kamonyi and Rulindo Districts

Gaspard Ntabakirabose[1], Joseph Museruka Ntezimana[1], Godfrey Gatete[2], Gilbert Rwaganje[2]
[1]Ministry of Agriculture and Animal Resources, Kigali, Rwanda
[2]Department of Agriculture and Resources Economic, Jomo Kenyatta University of Agriculture and Technology (JKUAT), Nairobi, Kenya
Correspondent Email: gmutago@gmail.com

Abstract

Agricultural activities provide the basic source of livelihood upon which rural life depends on, providing food and income for sustenance. This study assessed the impact of vegetables production in Rwanda. A multistage sample procedure was used to select seventy (70) farmers of vegetables and data were collected with structured questionnaire. Cobb Douglas production function was used as analytical tool. The study pointed out that the factors such as fertilizer, seeds, irrigation system used, pesticides, farmers experience, yield, agricultural credits, and extension services, land, and poor rural feeder roads positively influenced vegetables production. The study revealed that elasticity of production function is 1.314, implying that vegetables farmers in the area are producing in the first stage of production. The marginal physical product were higher than the average physical product, which also suggest that, the farmers were producing in the first stage of production. Farmers should improve production of vegetable farmers through appropriate use of inputs especially improved seeds and fertilizers to increase vegetables production both in quality and quantity.

Keywords: Impact, Vegetables, Production.

Introduction

Agriculture is at the crux of the Rwandan economy. It accounts for 29% of the total GDP, and 66.5% of the working population is engaged in agriculture and related sectors. This makes agriculture the largest employment sector in Rwanda and the second largest sectoral contributor to the GDP behind Services, a broad sector that includes government (NISR, 2017). Despite their huge contribution, the 3.9 million farmers in Rwanda face various persistent challenges. These include land degradation, soil erosion, land use issues, and land distribution problems (NISR, 2019). A key feature of Rwandan agriculture is the dominance of smallholder farms, which constitute an important and invaluable component of the Rwandan economy. Agricultural activities provide the basic source of livelihood upon which rural life depends, providing food and income for sustenance. The agricultural sector plays a major role in operationalizing EDPRS II to achieve national growth and export targets, while also reducing poverty. The sector provides jobs and trade opportunities, but is further key to improving incomes for the majority of the population who still rely on agriculture for their livelihoods. In fact, the agricultural sector contributes to a third of the national Gross Domestic Product and employs 70% of the country's labour force (MINAGRI, 2015).

They are the same as conventional vegetables, but the difference is that they are much smaller. Vegetables are effective in preventing micronutrient deficiencies and in the prevention of diseases. They create opportunities for smallholder farmers and are a source of a better life and income as well as significant for improving the feeding behaviour for the people of Rwanda (MINAGRI, 2009).

Vegetable production in Rwanda is both seasonal and off seasonal produced. In Rwanda, vegetables cultivation activity is undertaken countrywide. Vegetables cultivation provides exceptional opportunities for farmers in the country through employment creation and income generating businesses (NAEB, 2020). This makes it a unique sector for economic development at rural level, national level and foreign exchange earner. There are many vegetable products produced in Rwanda. They include tomatoes, cabbages, onions, sweet pepper, chili, baby corns, broccoli, French beans, green pepper, carrots, Okra, Eggplant and mushroom among others (NAEB, 2020).

The demand of vegetables in urban areas is almost inelastic rather than the demand of vegetables in rural areas is almost elastic (Mavimbela *et al.,* 2010). For a successful production of vegetable crops, the grower needs to diligently observe certain practices at each stage from field selection upon crop harvesting and selling. The general principle is to apply fertilizers appropriately at planting and top dressing for effective flowers and fruits setting (JICA, 2019).

Production Economics Theory (microeconomic) theory deals with production of goods using a set of inputs. It was noted earlier that the Cobb–Douglas production function exhibits a number of useful mathematical properties. One of these properties is the important technological relationship known as the law of diminishing marginal product (law of diminishing returns). A production function is a model used to formalize this relationship. Below is a specification of a production function

$$Q=f\{L, K, F...\}$$

where Q represent a firms output, L may represent the amount of labour, K represents quantity of seeds used in production of Q while F represent the amount of fertilizers applied.

Adebayo (2007) studied the factors determining rain-fed rice production in Adamawa state in Nigeria using production function analysis. The results showed that the size of the farm and amount of seed significantly affect the productivity of rain-fed rice. Likewise, Bezabih and Hadera (2007) examined the utilisation of low-level agricultural technologies, risks related to natural occurrences such as storms and disease outbreak to be the major sources of the decline in productivity. Furthermore, rapid population growth, the size of land allocated to each household has reduced resulting to a decrease in production. Bezabih and Hadera (2007) further identified pest, drought, shortage of fertiliser, and price of fuel for pumping water as the major obstacles of vegetable production in Eastern Ethiopia. They also reported that insufficient knowledge in product sorting, grading, packing, and traditional transportation affect the quality of produce taken to the market.

The purpose of the study was to assess the impact of vegetables production in Rwanda. A case study of Bugesera, Kamonyi, and Rulindo districts. Specifically the study sought to identify the factors influencing vegetables production, to determine the constraints of vegetables production, and to suggest the way forwards for improvement its output.

Methodology

Study area, data collection and sample size

The study was carried out in the three districts namely Bugesera, Kamonyi, and Rulindo. A representative sample was selected for the study using a multistage sampling technique. Four sectors for each district were purposively selected based on their vegetables production intensity making 12 sectors. From each sector, six vegetables farming households were randomly selected giving at total sample size of seventy (70) professional farmers. Data collected for this study include farm yield, amount farm

inputs such as farm size, fertilizer, seeds, Herbicide/pesticide, labour, irrigation system used, extension services, education level, farming experience, agricultural services, yield, pest Market price fluctuations, Lack processing technologies, rural feeder roads, and diseases control and distance to market. These data were generated from both primary and secondary sources using the following instrument of date collection: questionnaire, interviews and field observation.

Data Analysis

The data collected from the respondents were used to run regression analysis as well as to find out the relationship between inputs and the output of vegetables. The study used both descriptive statistics and econometric model to analyse the data. Descriptive statistics included means, percentages, standard deviation and frequencies. A multiple linear regression model was employed to analyse factors influencing vegetables production and constraints hindering its production.

Model specification

Specifically, the Cobb-Douglas production function was explicitly specified as follows:

$$Q=\beta_0 X_1^{\beta 1} X_2^{\beta 2} X_3^{\beta 3} X_4^{\beta 4} X_5^{\beta 5} X_6^{\beta 6} X_7^{\beta 7} X_8^{\beta 8} X_9^{\beta 9} X_{10}^{\beta 10} X_{11}^{\beta 11} X_{12}^{\beta 12} X_{13}^{\beta 13}$$

where,

β_0 = constant, X1 = Land (ha), X2 = fertilizer (kg), X3 = Herbicides (lit), X4 = seeds (kg), X5 = labour (man/day), X_6= irrigation system used, X_7= distance to market (km), X_8=Years of vegetables farming experience.

The function is easy to estimates in logarithmic form as by

$$Q = \beta 0 + \beta_1 ln\, x_1 + \beta_2 ln x_2 + \beta_3 ln\, x_3 + \beta_4 ln x_4 + \beta_5 ln\, X_5 + \beta_6 ln\, X_6 + \beta_7 ln\, X_7 + \beta_8 ln\, X_8 + \beta_9\, ln\, x_9 + \beta_{10}\, ln x_{10} + \beta_{11} ln\, x_{11} + \beta_{12} ln x_{12} + \beta_{13} ln\, X_{13}$$

Results and Discussion

Socio-economic characteristics of vegetables farmers sampled

The results obtained are shown in the table 1.

Table 1: Socio-economic characteristics of vegetables farmers sampled

Descriptive characteristics	Frequency	Percentage
Gender of respondents		
Male	49	70
Female	21	30
Family size		
1-2	4	5.7
3-4	7	10
5-6	44	62.8
6-8	12	17.1
Above 8	3	4.2
Education level respondents		
Illiterate	4	5.7
Primary	35	50
Secondary school	14	20
Vocation	10	14.3
University	7	10
Experience of respondents		
Above	35	50
4-5	28	40
3 and less	7	10

The study indicated that 49(70 %) of the respondents were male and 21(30%) were female. This implies that most of those who participated were male and are the most likely to be participating in vegetables farming. This should positively influence the increase in vegetables production as male are main leaders of family. The findings displayed that (84.3%) of the respondents are in the range of between 5-8 members of household in study area. This is a very significant impact on output through the supply of labours from same household and that minimize the costs of respondent due to low demand of labours. This was supported by the studies like Seidu (2008) which emphasize those large households are better in providing free labour, indicating the usefulness of larger households in improving farm efficiency. Result also indicated that majority of farmers in the study area are educated. The results showed up that 94.3% are educated, while 5.7 % are illiterate. This high percentage of educated farmers should have positive impact on the increased vegetables production through quick understanding of the advice given on the crops management like cultural best practices, pests and diseases control and the adoption of new techniques of production. The support for this study is the study of Nyagaka *et al.,* (2009) on Irish potato producers in Kenya, farmer's education positively influenced farm economic efficiency. It was argued that farmers with higher levels of education were more efficient in production and this was attributed to the fact that educated farmers positively perceive, interpret and respond to new technologies on seeds, fertilizer, pesticides, fungicides, herbicides or markets much faster than their counterparts respond. Results demonstrated that (35)50% of the respondents are experienced in producing vegetables crops over than six years as commercial purpose followed by (28)40% of respondents producing vegetables crops between 4 and 5 years. This is supposed to have positive impact on vegetables output through adoption new use of inputs like improved vegetables varieties and fertilizers. Various authors have found that experience in farming enhances efficiency Mulwa *et al.,* (2009) in western Kenya observed that farming experience had a positive influence on economic efficiency. Mbanasor and Kalu (2008) also found similar results for vegetable farmers in Nigeria, which coincides with their findings for age. It is expected that experienced farmers have over the years learned from their mistakes and improved their efficiency in production. The farmers with high experience are also easy to be trained on cultural best practices and diseases control through farmers field school in region.

Factors influencing vegetables production

The data collected from the respondents were analysed used using a multiple linear to find out the factors influencing vegetables production in study area. The findings obtained are presented in the Table 2.

The results indicated that twelve explanatory variables were positively related to the output of vegetables while only three variables were negatively related to vegetables production. The R^2 of 0.835 implied that 83.5% of variation in the output of vegetables in the area is explained by the inputs and the remaining 16.5 % due to random error (U) in the model. All these inputs were scientifically specified in the Cobb-Douglas production function. The test of significance shows that Fertilizer, Seeds, Irrigation system used, Pesticides, Farmers experience, Yield, Agricultural credits, Extension services, Land, and Poor rural feeder roads were positively and statistically significant at 1%,5 % and 10% respectively. This revealed a positive relationship with the vegetables output. On the other hand, the coefficients of distance to market, Pests and diseases, and market price fluctuations showed up negative signs, implying inverse relationship with vegetables output. However, other inputs such as labour and Lack processing technologies affect the

output of vegetables positively but are not significant.

Table 2: Regression analysis of factors influencing vegetables production

Explanatory Variables	Coefficient	Standard Error	p-value
Constant	4.113	2.559	0.000
Land size	0.053	0.404	0.051
Fertilizer	0.410	0.797	0.007
Improved seeds	0.371	0.186	0.019
Pesticides	0.457	0.234	0.000
Labour	0.023	0.131	0.673
Irrigation system used	0.701	0.450	0.003
Distance to market	-0.270	0.101	0.006
Farming experience	0.613	0.510	0.000
Yield	0.440	0.945	0.002
Pests and Diseases	-0.650	0.056	0.035
Market price	-0.364	0.287	0.042
Agricultural credits	0.428	0.708	0.000
Extension services	0.033	0.073	0.027

Number of observation = 70; Prob > F = 0.0000; F(13, 56) = 68.36; R-squared = 0.835

Thus, it can be implied that a 1% increase in fertiliser application will lead to 41 % increase in the output of vegetables; a 1% increase in pesticides will lead to 46 % increase in the output of vegetables while a unit increase in the irrigation system used especially in dry season lead to 70.1% increase in the output of vegetables. By inverse, a 1% increase in pests and diseases in vegetables will lead to 65 % decrease in the output of vegetables. A one kilometer increase in distance to market lead to 27% go down in the output of vegetables while a unit increase in the market price fluctuations lead to 36.4 % reduce in the output of vegetables.

Table 3: Values of estimates of parameters EP, APP, MPP, MVP

Variables	EP	APP	MPP	MVP
Land (ha)	0.053	7.64	10.04	125500
Fertilizer(kg)	0.410	11.1	14.59	182375
Pesticides (lit)	0.371	8.79	11.55	144375
Seeds (kg)	0.457	24.71	32.47	405875
Labor (man/day)	0.023	5.28	6.94	86750

An average of 42 bags of 50 kg of vegetables were produced by 70 farmers in the study area using a total of 385 hectares of land, 265bags of fertilizer, 346 litres of herbicides, 119 bags of seeds of vegetables and 557 man hours of labour respectively. An average price Ceiling of a bag of vegetables was fixed at 12500 Rwf. By comparing the values of APP and MPP in the table for all the inputs, it suggests that the farmers are producing in the first stage of production since all the MPPs were higher than the APPs. The values of the MPP show that the farmers are more efficient in the use of seeds and least efficient in the use of labour. The table revealed that all the ratios for the inputs are greater than unity. This suggests that all the inputs are under-utilized. This means that vegetables output in the study area can be increased if more of

such inputs (seeds, fertilizer, pesticides, land and labour respectively) are taken into consideration.

In the consideration of the main five explanatory variables. The elasticity of production, which is the sum of the coefficients of Cobb-Douglas production function (β1 + β2 + β3+ β4+ β5), is 1.314 which suggests that vegetables farmers in the area can increase their output by increasing their use of certified seeds, fertilizer application and pesticides use. The study shows that yield has the highest responsiveness to seed, followed by fertilizer and pesticides. This discover that the vegetables farmers are producing in the first stage of production. This implies an increasing return to scale as ΣEP > one.

Conclusion

This study set out to assess the impact of vegetables production in the near side of urban areas in Rwanda. A case study of Bugesera, Kamonyi, and Rulindo districts. The study pointed out that the factors such as fertilizer, improved seeds, irrigation system used, pesticides, farming experience, yield, agricultural credits, and extension services, and land size positively influenced vegetables production. While the distance to market, pests and diseases, and market price showed up negative signs, implying inverse relationship with vegetables production. The elasticity of production, which is the sum of the coefficients of Cobb-Douglas production function, is 1.314 that suggests that vegetables farmers in the area can increase their output by increasing their use of certified seeds, fertilizer application and pesticides use. The study shows that yield has the highest responsiveness to seed, followed by fertilizer and pesticides**.** Constraints to vegetables production were found to be mainly pests and diseases, and market price fluctuations, lack of collection centres, poor rural feed roads, lack of adoption of technology used in irrigation, high cost of inputs were the most serious problems.

Recommendations

The following are the recommendations of this study:

i. Farmers should form strong cooperatives or unions through where for example the price bargaining and good agriculture plan should be done, as well as to improve their production and increase their income.
ii. Ministry of Agriculture and Animal Resources should facilitate vegetable farmers to build postharvest handling in order to reduce the high losses in the perishable crops especially vegetables.
iii. Government should ensure that farm inputs are made available to the farmers at the right time as well as to achieve the high production in both quality and quantity.

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