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An Economic Analysis of High-Value Horticulture Crop Productivity: Green Peas (Pisum sativum) in Zimbabwe

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Abstract
In Zimbabwe the potential of the horticulture crops is not being fully realized. In this study we use green peas, an important high-value horticultural vegetable crop to help understand what has been happening to the horticultural sector. We found that although green pea output and area under green pea production are on an upward trend in Zimbabwe, productivity is on a downward trend. As a means of increasing green pea productivity we recommend the following: credit and finance to horticultural farmers should be enhanced; farmers should be encouraged to be efficient in their production and they should be encouraged to target premium markets such as urban centres and the export markets where they would get better prices to enable them to cover productions costs. In that way, the horticultural sector could help address the problems of poverty, food insecurity and malnutrition thus contributing to the economic welfare of the nation.
Keywords: Economic analysis; Green peas; Horticulture; Market; Productivity

1. Introduction

In Zimbabwe just like the other Sub-Saharan Africa countries, the horticultural sector has three major potential functions, that is, it could contribute to poverty alleviation, food and nutrition security, and could be one of the major foreign currency earners (Heri 2000; Weinberger and Lumpkin 2007; Akibode 2011; Hillocks 2011). However, all of these functions are not being fully realized due to several socio-economic constraints being experienced in Zimbabwe. Proctor et al. (2000) states that in spite of the successes that were realized in the horticultural sector and other sectors of the economy, over 50% of the population continues to live in poverty. The contribution of horticulture to national income and employment in Zimbabwe is currently very low (Kuhudzai 2012). Trade is important for growth and in turn growth is crucial for poverty reduction to occur. There has been continuous decline in contribution from Zimbabwe and other African countries to global trade in horticultural exports. For example, exports from sub-Saharan Africa accounted for 3.1% of world horticultural exports in 1955, but by 1990 this fell to 1.2%, which translated to annual trade losses of $65 billion in current terms (World Bank 2005). One of the reasons for this is that most African countries are still mainly relying on exporting a limited number of the traditional bulky agricultural commodities, such as coffee, cocoa, or cotton, whose terms of trade have been continuously declining. The World Bank (2003) notes that high-value products like fruit and vegetables provide an opportunity for farmers in developing countries to access the lucrative export markets. With appropriate policies and technologies, horticultural production can significantly contribute towards increasing the incomes of both large and small-scale farmers, expanding employment opportunities, enhancing rural development.

Fruits and vegetables are some of the common horticultural crops and are a potential source of valuable nutrition (Flyman and Afolayan 2006). However, a large proportion of the population in Zimbabwe is food and nutritionally insecure which is an indicator of widespread poverty that manifested through hunger and malnutrition. Poverty, hunger, malnutrition and widespread epidemic disease such HIV/AIDS are some of the major problems being faced by Sub-Saharan Africa countries. These problems are interconnected and share the same root causes which have to be tackled in order avoid a huge humanitarian disaster. While we acknowledge that there are many possible strategies for improving food production, we have noticed that there is little attention paid to the nutritional aspect of food security. Most governments synonymously measure food and nutritional security as adequate quantities of grain in the country. One of the hypotheses of this study is that the integration of horticultural crops, that is, fruits and vegetables into agricultural production systems in sub-Saharan African countries is one of the practical and sustainable ways to achieving nutritional security.

Furthermore, the horticultural sector could potentially contribute significant amounts of foreign currency through exports (World Bank, 2005). However for Zimbabwe, the horticultural sector's contribution to foreign currency earnings has been dwindling over the years especially after the land reform programme embarked on by the government in 2000. At one time the horticultural sector was one of the fastest growing export industries. It was once in the top six in the agricultural sector in terms of its contribution to foreign currency earnings amongst tobacco, cotton, cereal, sugar and tea (Tekere et al. 2003). However, its contribution to revenue fell from an all-time-high annual revenue of US$142 million in 1999 to less than US$40 million in 2010 (Mutenga 2013). Nonetheless, the demand for horticultural produce is potentially very high since horticultural produce and processed products from the developing countries are becoming increasingly popular

both in domestic and international markets (World Bank 2005; Karambakuwa et al. 2010). Heri (2006) stated that the demand for horticultural products continues to outstrip supply particularly with the growth of the local processing market and access to the huge unsatisfied South African market while the United Kingdom market has hardly been explored.

There is therefore need to understand what has been happening to the horticulture sector in Zimbabwe so that its roles in contribution to food and security nutrition, and foreign currency earnings could be restored and fully realized. There is also need to understand the characteristics of the horticultural farmers so as to be able to make appropriate recommendations for interventions in this sector. However, the horticulture sector is too broad. In this paper we therefore choose to study green peas also known as garden peas, *Pisum sativum*, an important high-value horticultural vegetable crop. Green pea is rich in nutrients with protein (25%), sugars (12%), vitamin A, B and C, lutein, calcium, phosphorus and small quantities of iron (Department of Agriculture, Forestry and Fisheries 2011). Green peas also play an important role in soil fertility restoration being a suitable rotation crop that fixes nitrogen. Therefore, increasing its production should help many people who are experiencing food shortages and suffering from malnutrition arising from lack of balanced diet. We also choose to take the supply side, that is, the production of green peas. This is because the demand for both local and export markets for horticultural goods is still not being satisfied, implying that there are still some bottlenecks on the supply side. We first look at the national picture on what has been happening to production, area, and productivity of green peas. We then look at the producers of green peas both small and large-scale to analyze what factors determine green pea productivity. By so doing we hope to come up with appropriate recommendations that would result in boosting green pea production and productivity thus contributing to poverty alleviation, food and nutrition security and foreign currency earnings.

Green peas are an example of horticultural crops grown in Sub-Saharan Africa which we will use in this study to highlight experiences of the horticultural sector. In Zimbabwe green pea is a commercially produced crop and the major green pea growing regions are found in peri-urban areas of Harare, Mutare and Marondera. Horticultural producers in Zimbabwe can be grouped into 3 main groups, namely the large scale commercial sector (comprising of the remaining white, company owned farms and the A2 farms), the small scale commercial farming areas and the small holder sector (comprising of the resettlement [old resettlement schemes, and A1 farms]). A2 farms are the newly resettled large scale farming areas whilst A1 are small-scale. Furthermore a new group that is emerging is the urban and peri-urban producers which practice horticulture in green-houses in the backyards of their residential properties (Heri 2006). However, for this study we will focus at the large and small scale farmers.

Although a number of horticultural studies have been done by various institutions and individuals, their focus has been on the general factors that are affecting the horticultural sector with little attention being paid to the relative importance of these factors in determining the productivity of the farming systems. In addition, none of the studies has provided an in-depth analysis of the economics of green peas' cultivation particularly in Zimbabwe. This study will contribute to this cause by looking at the trends in production and productivity of green peas from 1990 to 2011. We will also try to identify the factors affecting productivity of green peas by both large and small-scale farmers in Zimbabwe. The identification and addressing of factors affecting productivity is required to help achieve goals of increasing output levels, living standards of people and economic development. The study will also look at the relative importance of different factors influencing the productivity of green peas and therefore aims to assist policymakers to effectively intervene.

2. Methodology

2.1 Study area

To get an overview of green pea production in Zimbabwe, national statistics on green pea production were used. However, to get the details on the factors affecting green pea production, the study area was restricted to Mutare District mainly because of time and resource constraints. Mutare District lies in Manicaland Province, eastern region of Zimbabwe where a considerable number of green pea farmers are found because of the area's ideal climatic conditions. The average annual temperature is about 19°C. The coldest month is July with minimum average temperature of 6 °C and maximum average temperature of 20°C, the ideal conditions for green pea production. The hottest month is October with average minimum temperature of 16°C and average maximum temperature of 32°C. The study area lies within the Natural Region I of Zimbabwe's agro-ecological zones given the relatively high annual rainfall of 818-1000 mm per year.

2.2 Sampling and data collection

In literature, the concepts of HMS were associated with a myriad of technical measures. McFarlane (1995) Sampling frame of farmers who grow green peas was obtained from the extension officers in Mutare District of Manicaland Province. Systematic random sampling was done to select a sample of 50 farmers from the sampling frame of green pea growing farmers. Then data collection from the selected green pea farmers was done using a

structured questionnaire. The data collected included green pea output, amount of seed used, amount of basal and topdressing fertilizers used, land size, number of extension visits, distance from the market, household size, household head's attributes (such as age and gender, level of education and main occupation) and amount of credit accessed by the farmer. In addition, secondary data on land area under green pea from 1990 to 2011 was collected from Zimbabwe national statistics agency (ZIMSTAT) and data on green pea national output was obtained from FAOSTAT website.

2.3 Data analyses

At first we conduct trend analyses for national green pea production, and area under green pea from 1990 to 2011. We divide green pea production by area allocated to green pea in the corresponding years to calculate green peas yields for the years 1990 to 2011.We then explain the overall patterns and specific patterns observed in the trends for green pea production, green pea hectarage and green pea yields.

We then zeroed in on the green peas yields and examined the factors affecting green pea productivity using the Mutare District case study. To determine the relative importance of various factors affecting green peas' productivity, we used a linear regression model. We hypothesized that green pea productivity (denoted by Y) is affected by the following explanatory variables: number of years in formal education (X_1); farmer's experience in growing peas (X_2); green pea acreage (X_3); food crop acreage (X_4); number of extension visits (X_5); distance from market (X_6); credit accessed by the farmer (X_7); cost of production (X_8); full time farming (X_9); and type of farmer (X_{10}).

The regression model used is expressed in equation (1) as follows:

$$Y = B_0 + B_1X_1 + B_2X_2 + B_3X_3 + B_4X_4 + B_5X_5 + B_6X_6 + B_7X_7 + B_8X_8 + B_9X_9 + B_{10}X_{10} + u \quad (1)$$

Where: B_0 is the Y-intercept and B_1 up to B_{10} are coefficients for the respective explanatory variables in the model which are going to be estimated for significance and value using the liner regression model; u is the error term.

The expected sign (relationship and their explanation) between the dependent variable, green pea productivity and each independent variable is given in Table 1.

Table 1: Hypothesized effect of explanatory variables on the dependent variable, green pea productivity

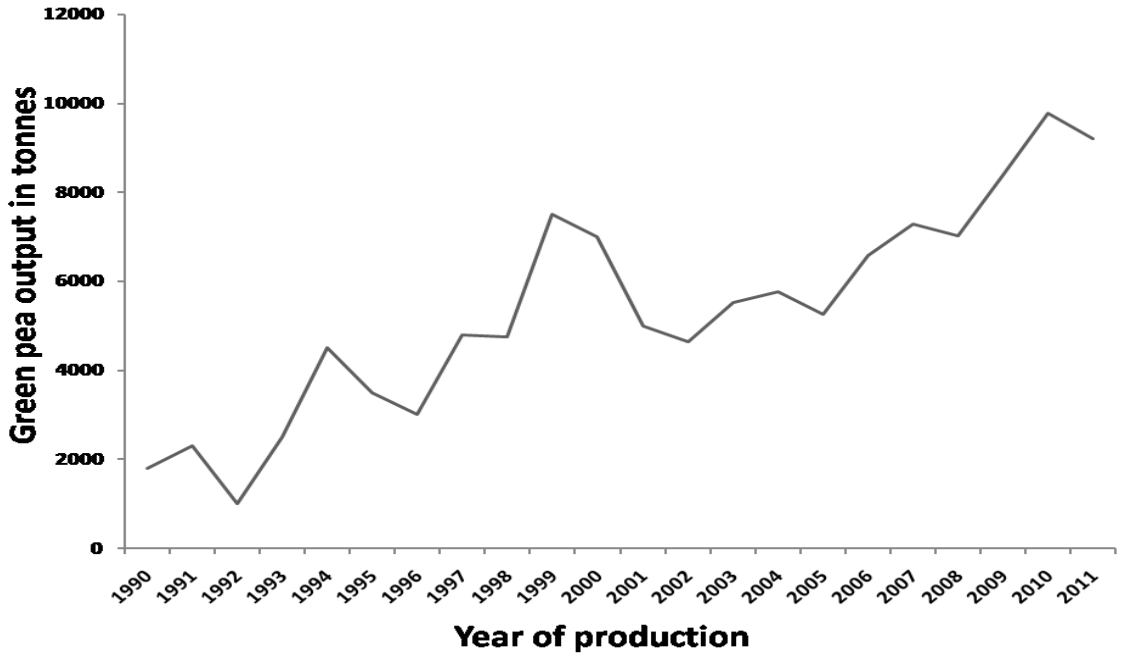
Explanatory variable	Expected sign	Explanation of the variable effect
Number of years in formal education	+	Better educated farmers are quicker to adopt new technologies which may improve productivity because they understand better the benefits.
Farmer's experience in growing peas	+	Households with more experience in green pea production are expected to produce more output per unit of land.
Green pea acreage	+	Economies of scale from green pea production should lead farmers to realize higher yields.
Food crop acreage	_	More resources devoted to food crops would mean fewer resources for green peas.
Number of extension visits	+	Extension bring to the farming community knowledge, information and new technologies whose adoption help people to make better informed decisions and increase productivity.
Distance from the market	-	Long distance increases costs which reduce productivity.
Credit accessed by the farmer	+	Farmers who receive more credit are able to secure the required inputs thus increasing output per unit size of land.
Cost of production	+	The higher the cost of production, the more of the required inputs are used resulting in increased productivity.
Full time or part time farmer (1 = Full time; 2 = Part time)	-	Full time have enough time to devote their resources on farming thus increasing productivity.
Land size	+	Large scale farmers have more resources hence devote more resources to green pea production, so they achieve higher productivity.

3. Results and Discussion

3.1 Green pea national trend analyses

Analysis of national green pea trends is important as it provides a general overview of the performance of the green pea sector over the years in the country. We now analyse the trends from 1990 to 2011 for the following: green pea output; green pea acreage and green pea yields.

From Figure 1, the trend line shows that green peas output generally rose steadily from 1990 to 2011. However, there are some noticeable deeps in the green pea production trend. For instance there was a sharp decline of green pea output to below 2000 tonnes in 1992 due to drought that was experienced in that year (Figure 1; Heri 2000). In addition, there was a marked decline in production realised from 1999 to 2002. This was due to the worsening off of the economic environment in Zimbabwe. This was a terrible period not for only green pea production but all the other sectors of the economy. During this period the country experienced hyperinflation which resulted in sharp decrease in national food production, the crumbling of the markets, and food insecurity problems (Gasana et al. 2011). However from 2009 there was as sharp increase in green pea production due to the introduction of multicurrency system which resulted in stabilisation of the economy in terms of lowering the inflation rate among other things.

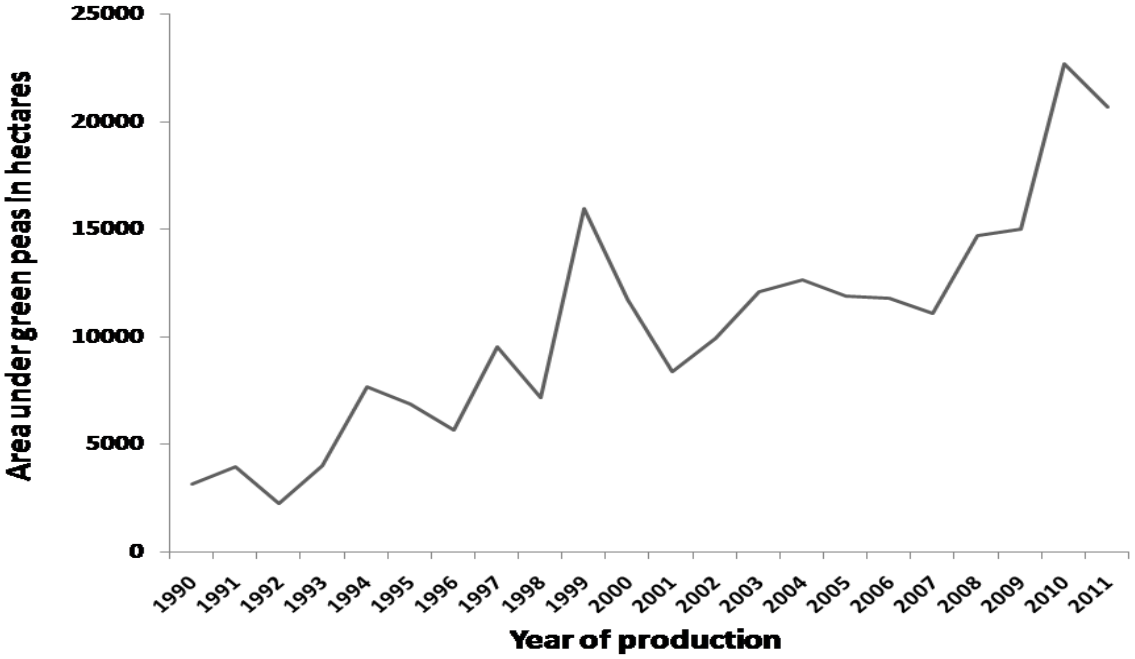


Data source: FAOSTAT 2013

Figure 1: Trends in total green pea output from 1990 to 2011.

Figure 2 shows the trends in area allocated to green pea production in Zimbabwe. Generally there was an increase in area allocated to green pea from 1990 to 2011. The trend was similar with the trend of green pea output. This explains the increases in green pea output over the years. A decline of area allocated in green pea from 1999 to 2001 was due to the land reform program which was taking place. This suggests that most farmers where afraid to fully utilize their resources in an uncertainty land tenure situation.

From Figure 3 it can be seen that in Zimbabwe productivity (kgs per hectare) from 1990 to 2011 was generally decreasing given by the negative slope of the trendline. Given the discussion on production and area for green pea which were both generally increasing over the years, this means that the rate of increase in green pea output has been lower than the rate of increase in area allocated to green peas. The low productivity of pulses affects the production, availability of pulses for consumption and processing. According to Akibode 2011, the productivity of pulses is one of the lowest among staple crops and in Sub Saharan Africa, the average yield of pulse crops was estimated to be just over 500 kg/ha as of 2008. Productivity in the horticultural sector is low hence local farmers face stiff competition on the international market. Despite having demand on the international market as well as local market, output and productivity levels are still lower.



Source: ZIMSTAT 2013

Figure 2: Trends in area under green peas from 1990 to 2011

Yield increases have been smaller in comparison to area growth and it has been insignificant or even negative in some developing countries (Weinberger and Lumpkin 2007). Horticulture can offer good opportunities for poverty reduction since it could result in income increase and employment generation.

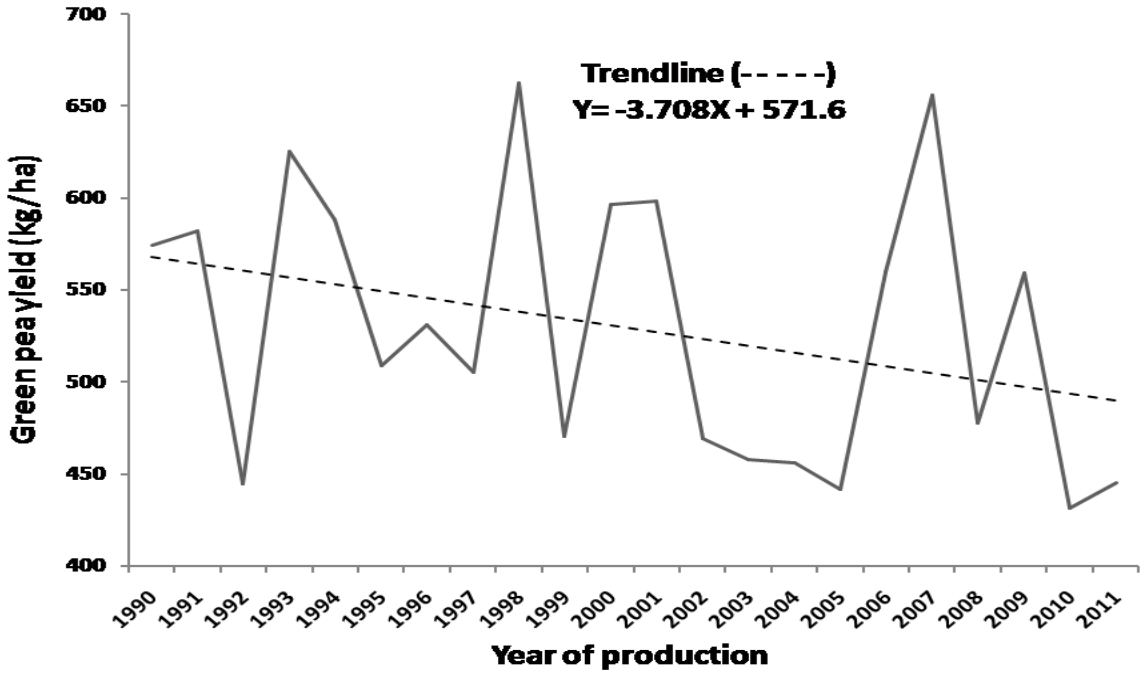


Figure 3: Productivity trends from 1990 to 2011 in kgs per hectare

3.2 Factors affecting green pea productivity at farmer level

The overall model with green pea productivity as the dependent variable was very significant where 53.2% of the variation in green pea productivity is explained by independent variables the model ($p<0.01$; Adjusted R^2 = 0.532; $F_{10,33}$= 5.881). The following variables were found to be significantly affecting green pea productivity: distance from market, credit accessed by the farmer, cost of production and number of years in formal education (Table 2). On the other hand the following variables were found not to be significantly affecting green pea

productivity: farmer's experience in growing peas, number of extension visits, green pea acreage, food crop acreage, land size and whether a farmer practised full or part time agriculture. We now explain the significant explanatory variables in order of their importance.

Table 2: Model summary of the factors affecting green pea productivity

Variable	B	t-value	Part correlation
Number of years in education	95.548*	2.011	0.233
Farmer's experience in growing peas	-10.669	-0.236	0.027
Green pea acreage	76.764	0.952	0.110
Food crop acreage	3.511	0.127	0.015
Number of extension visits	-0.022	-0.004	0.000
Distance from the market	16.876***	2.961	0.343
Credit accessed by the farmer	0.216**	2.349	0.272
Cost of production	-0.238**	-2.323	-0.269
Full time or part time farmer	244.012	1.364	0.158
Land size	0.080	0.003	0.000

*** Significant at 1%; ** Significant at 5%; * Significant at 10%

Distance from the market was found to be the most important factor affecting green pea productivity, given that it has the highest part correlation (Part correlation = 0.343; $p<0.01$; B = 16.876; Table 2). This variable explains 34.3% variation in green pea productivity and is significant at 1%. The relationship between green pea productivity and distance from the market was found to be positive which is in contrast to our expectations (Table 1). The result means that the further away a farmer is located from the market the more the green pea yields obtained. When we correlated distance from market and income from green peas per hectare we found that the relationship was positive and significant ($r = 0.47$; $p<0.01$). This means those farmers that are located further away from their respective green pea markets obtained more income than those that have nearer markets. This result is in contrast with researchers such as Agbola et al. (2010) and Buckmaster (2012) who found a negative relationship between distance to the market and farm income with the explanation that the longer the distance the more the cost. This holds true for most of agricultural produce. Our result is different mainly because the type of produce we are dealing with, green peas are a high-value vegetable relative to their weight. Green pea market in Zimbabwe is depressed in rural markets but exists in urban areas and export markets. Usually price obtained for green pea from local markets, such as within a local rural setting, are low. However prices obtained in far away markets such as towns even export markets, premium prices are obtained. This therefore means that farmers that target premium markets can afford to use adequate inputs which ensure they get higher yields. In markets located further from the farmer, premium prices are realized and thus obtaining relatively higher income from green pea production.

Credit accessed by the farmer was found to be the second most important factor affecting green pea yields (Part correlation = 0.272; $p<0.05$; B = 0.216; Table 2). Credit accessed explains 27.2% of the variation in green pea yields and is significant at 5%. The relationship between credit assessed and green pea productivity is positive as per our expectations (Table 1). This implies that an increase in credit accessed results in increased green pea productivity. Finance is one of the major constraints faced by farmers. Credit provides funds that help the farmer to acquire necessary inputs hence increasing productivity since a farmer can afford to apply the right quantities of inputs. This result is in tandem with what was found by Dong et al. (2010) who also found a positive relationship between credit and crop productivity. They suggested that if a household was credit constrained, most resources could not be brought into full play resulting in lower output and productivity. When there are no credit constraints, farmers can make full utilization of all the resources at their disposal. This shows that a large number of green pea farmers rely on credit facilities to finance their activities. Sidhu et al. (2011) also reported that the major constraint as perceived by the selected farmers was high cost of labour in harvesting of green peas which is highly labour-intensive, thus indicating the great need for credit and loans. Studies by Fayaz et al. (2006) indicated the relatively lower farm yields are a result of lack of finance. In agreement, Shah et al. (2008) indicated that lack of finance is one of the main reasons for low productivity in the agricultural sector.

In Zimbabwe, Agro-food processing companies like Cairns Holdings, National Foods, Heinz, Valley Canners, Fresca Hodings, Utopia Fresh Exports, HORTICO and Selby Enterprises sometimes offer contracts to horticultural products and promise to buy their produce which meet agreed quality standards. Sub-contracting smallholder farmers to grow horticultural products for exports has been a positive development for small holder horticultural producers. Contract farming offers opportunities for small producers to expand their production without worrying about risks that are associated with marketing and other logistics (Mpande and Madziwa 2011). Therefore contract farming could be another way of providing finance to the green pea farmers in particular and horticultural farmers in general.

Cost of production is the third most important variable in the model given that it has the third highest

absolute part correlation (part correlation = -0.269; $p<0.05$; B = -0.0238; Table 2) which means that it explained 26.9% of the variation in green pea productivity. This variable is significant at 5%. The relationship between cost of production and green productivity is negative contrary to our expectation (Table 1). The result indicates that those farmers with lower costs of production are more productive. This has to do with efficiency meaning that farmers who are more efficient are able to be more productive than those who are less efficient. Kuhudzai (2012) identified very high start up costs especially for new farmers (infrastructure like greenhouses, cold rooms and working capital) as one of the challenges for horticulture in Zimbabwe. This requires farmers to be more efficient, otherwise it would take a very long time to recoup the sunk costs. So those farmers who are efficient are more productive. According to Idiong (2007), the productivity of farmers can be raised by improvement in efficiency. This means that farm efficiency directly determine productivity. Efficiency entails applying adequate amount of inputs and timely carrying out of all the critical farming operations (Shah et al. 2008).

Number of years in formal education is the fourth and final significant factor affecting green pea productivity in the model (Part correlation = 0.233; $p<0.1$; B = 95.588; Table 2). The variable explains 23.3% of the variation in green pea productivity and is significant at 10%. The relationship between number of years in formal education and green pea productivity is positive according to our expectation (Table 1). This means that farmers who are more educated got higher yields compared to those who had less education. This might be because farmers who are more educated are literate and are open to new ideas in farming. There is need for farmers to have knowledge which makes them aware of the new, improved technologies and better production systems that may help to increase their output and productivity. Ukpong and Idiong (2013) did a study to determine the determinants of productivity of vegetable farmers of Akwa Ibom State of Nigeria. Their results showed that education level amongst other factors like age of the farmer, land size, farmer's experience, soil quality and size of household were important variables influencing the productivity of vegetables. This is because educated farmers are committed to the farming business and are willing to adopt new and improved technologies quickly since they have a better understanding of the benefits of the technologies, hence increasing their productivity.

4. Conclusion

We found that green pea productivity was affected by distance from market, credit accessed by the farmer, cost of production and number of years in formal education. Those farmers that targeted premium distance markets had higher productivity than those farmers targeting local markets which holds for high-value horticultural products such as green peas. This result implies that farmers growing high-value horticultural products need not place much emphasis on distance to the market unlike those farmers growing traditional bulky agricultural commodities, such as coffee, cocoa, or cotton as long as transport and other logistics are in place (World Bank 2005). In high-value horticultural crops, although distance to market is still an important factor, its importance is somehow reduced. Furthermore credit is an essential input to horticulture produce such as green peas and as such those farmers who accessed credit realized higher yields than those who did not. Farm efficiency is also an important factor in green pea productivity just like any other farm production process. Efficiency ensures that there are minimal losses and inputs are effectively used. Farmer's understanding of the farming process and ability to follow the recommended technology processes is salient in farm production. Those farmers who are better educated are able to understand and apply recommended technology processes thus obtaining better yields.

At national level, we saw that although green pea output and area under green pea production are on an upward trend in Zimbabwe, green pea productivity is on a downward trend. This is because the rate of increase in output is lower than the rate of increase in area under green peas. Therefore efforts should be biased towards increasing yield, since land is limited. This study suggests some of the means of increasing green pea productivity. Farmers should be encouraged to target premium markets such as urban centres and the export markets where they get better prices than the local market. In addition, provision of credit and finance to horticultural farmers should be enhanced. The financial sector should avail finance and credit facilities to the horticultural farmers so that they obtain adequate inputs on time thereby enabling the farmers to obtain higher yields. There is therefore need for the ministry of agriculture and other stakeholders to come up with more initiatives through which farmers can access adequate credit facilities at affordable interest rates, so that they can invest more in farming to increase their productivity and economic efficiency. Contract farming offers good financial opportunities especially for small producers to expand their production with reduced marketing and logistical risks. Therefore contract farming could be another way of providing finance to the green pea farmers in particular and horticultural farmers in general.

Since education was found to be an important variable influencing productivity, provision of appropriate extension service and training to farmers on green pea and horticultural crops production is required. There is need to build capacity of farmers on horticultural crop production processes and how they can take advantages of certain production processes. There is need to capacity build small scale farmers on the expertise required in handling fresh and highly perishable produce. Farmers should also be encouraged to be efficient in

their production by applying adequate amounts of inputs and timely carrying out all the critical farming operations. Addressing the problems of the large and small scale horticultural farmers is an important task which will result in better conditions that will improve employment opportunities and incomes for both the farmers and their employees. Promotion of the production of high-value horticultural crops will increase the flow of foreign currency earnings thus contributing to poverty alleviation, and will improve household nutrition levels and food security in general. In that way, the horticulture sector could help in alleviation of poverty, decrease food insecurity and malnutrition levels thus contributing to the economic welfare of the nation at large.

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