Proceedings of 12th Agricultural Research Symposium (2013) 297-301

Factors Affecting Small Holder Black Pepper Production in Kurunegala District: Robust Regression Approach

G.M.M.U. JAYAWARDENE, A.M.T.P. ATHAUDA,
N.R. ABEYNAYAKE and H.M.T.K. HERATH

Department of Agribusiness Management, Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka, Makandura, Gonawila (NWP)

ABSTRACT

Even though black pepper production in Sri Lanka contributes about four percent to the annual world production, black pepper cultivation in Sri Lanka has succumbed to a variety of issues and challenges relating to productivity, marketing, cultivation technology and institutional related constraints. This study was designed with the objectives of identifying the socio economic factors related with black pepper production and to examine the constraints which lead to unsustainability of the system in the Kurunegala district. Multiple stage sampling was used to select 57 small scale farmers in Kurunegala district. A pre-tested questionnaire was used to collect data related to socio-economic background, marketing methods and constraints related with black pepper production. Due to several numbers of outliers in the data set, Robust regression analysis technique was carried out, since it is not as vulnerable as Least-Squares to unusual data. M-estimation of Robust regression was applied to determine the relationship between productivity and socio economic factors. Results revealed that the productivity is significantly affected by farmer's age, pepper farming experience, management level and the value of the subsidy given by Department of Export Agriculture. Similarly a Chi-Square test was carried out to check whether there are associations between yield levels and the agro ecological and farm characteristics. According to the results yield levels are associated with age of the cultivation, variety, recommended fertilizer usage, suitability of land and the precipitation of the area. Further, the constraint analysis revealed that lack of government subsidies, high cost of agro-chemicals and labor, poor marketing linkages and unfavorable weather at processing were the main constraints of the black pepper cultivation.

KEYWORDS: Black pepper production, Chi square analysis, Constraints, Robust regression

INTRODUCTION

Pepper, popularly known as the "king of spices" is the most widely used spice all over the world. Black pepper of commerce is the mature dried berries of the woody perennial evergreen climbing vine, *Piper nigrum*.

Vietnam, India, Brazil, Indonesia, Malaysia and Sri Lanka are the major pepper producers of the world, and Sri Lanka is the 6th largest producer contributing four percent to the total world production. Sri Lanka adds 2.8 percent to the total export trade of pepper. The total exportation of pepper was 5,420 tons in 2011 and earned 3,639 million rupees (Anon, 2012). Sri Lankan Black Pepper has higher Piperine content which conduces to fetch a premium price in international spice trade (Anon, 2010).

Pepper can be grown either as a mono crop or as a mixed crop in coconut and tea plantations and it is an ideal crop for home gardens. Pepper is cultivated over an area of 31,296 ha in Sri Lanka. Matale, Kandy, Kegalle, Kurunegala, Rathnapura and Nuwara Eliya are accounted as major districts of cultivation. Fifteen percent of the total pepper production of the country was from Kurunegala district with 1,668 tons (Anon, 2011).

Over the years, spice based farming has succumbed to a variety of issues and challenges including productivity, market, technology and institutional related constraints of which market related constraints have been most significant and alarming issues of concern. Disorganized marketing has generated a mismatch between standard quality and the quality of farm gate product. These constraints have led to low value added in the marketing chain, very frequent price fluctuations, declining of farm incomes and sluggish growth of this sector and ultimately creating unsustainability of farming system (Lindara *et al.*, 2004)

The objectives of this study were to identify the socio-economic factors related with black pepper production, constraints which lead to unsustainability of the system in Kurunegala district. Extent utilized in the district for pepper farming is 2,611 ha by 2011 (Anon, 2012) and a high potential is existing to expand the cultivation under intercropping with coconut and in home-gardens. However, the attention paid to black pepper cultivation and the farming community is relatively far less and this is evidenced by the lack of literature and related statistics. The study is an attempt to bridge this gap.

METHODOLOGY

Data Collection

The study covered major pepper growing areas in Kurunegala district namely, Rideegama, Mawathagama, Malsiripura and Dambadeniya. Multiple stage sampling method was used to select from 57 small scale pepper farmers in three stages as Divisional secretary divisions, Grama Niladari divisions and ultimately the pepper farmers. Primary data for the study were collected through a pre-tested structured questionnaire, during February 2013 via face to face interviews. Data were collected for the year from January 2012 to January 2013. Small holder sector is purposively selected due to its significant contribution towards total pepper production of the country. Data included information on production, socio economic characteristics and constraints of the small scale pepper farmers. Secondary data for the study was collected from the Kurunegala division of Department of Export Agriculture.

Data Analysis

Both descriptive and inferential statistics were used to analyze the data. The relationship between productivity and socio economic factors was analyzed using STATA statistical software version 11.

Presence of outliers in the data set can strongly distort the Linear Least-squares estimates and lead to unreliable results (Fox, 2002). Therefore, Robust regression analysis technique was employed since it is not as vulnerable as Least Squares to unusual data. M-estimation of Robust regression introduced by Huber (1964) was applied to determine the relationship between productivity (kg/acre/year) and socio economic factors related with black pepper production.

Consider the linear model,

$$y_i = \alpha + \beta_1 x_{i1} + \beta_2 x_{i2} + \ldots + \beta_k x_{ik} + \varepsilon_i$$
$$= \alpha + x_i'\beta + \varepsilon_i$$

Where,

α = Constant

β_1 to β_k = Coefficients

x_i' = vector of predictor variables

For the i^{th} of n observations, the fitted model is

$$\hat{y}_i = \alpha + b_1 x_{i1} + b_2 x_{i2} + \ldots + b_k x_{ik} + \varepsilon_i$$
$$= \alpha + x_i' b + \varepsilon_i$$

The general M-estimator minimizes the objective function,

$$\sum_{i=1}^{n} \rho(\varepsilon_i) = \sum_{i=1}^{n} \rho(y_i - x_i'\beta)$$

Where, the function ρ gives the contribution of each residual to the objective function.

In this study y_i is productivity (kg/acre/year) of i^{th} farmer. Variables used in x vector are abbreviated as follows.

b_1 to b_k = Coefficients

x_{i1} to x_{ik} are,

GEN = Gender of the i^{th} farmer

AGE = Age of the farmer (30-50yrs = AGE_1, 51-65yrs = AGE_2, >65yrs = AGE_3)

EDU = Years of education of the farmer

ENG = Engagement in pepper farming (Full time = 1, Part time = 0)

EXP = Years of experience of the farmer

OFI = Number of off farm income sources

CON = Contact between farmer and DEA (Contact = 1, Do not contact = 0)

ATC = Attendance to farmer training classes (Yes = 1, No = 0)

VOS = Value of subsidy in Rs.

MGT = Management level (Good = MGT_1, Average = MGT_2, Poor = MGT_3)

ϵ_i = Error term

Further, association between agro ecological characteristics and yield levels were studied using Chi square analysis.

RESULTS AND DISCUSSION

Descriptive statistics

Majority (82.4%) of the sample was male farmers. About 51% of the respondents cultivated pepper in their home gardens and 36.8% with coconut. Five percent of the sample cultivated with other spices such as Cinnamon and Clove. Majority of (59.6%) farmers were categorized into the age group of 51-65 years. None of the farmers in the sample was below 35 years. Most of the farmers (59.6%) in the studied area had more than 15 years of experience in pepper farming. About 60% of the respondents have completed their secondary education.

Table1. Demographic and farm characteristics of respondents

Variable	Frequency	Percentage
Gender		
Female	10	17.54
Male	47	82.46
Age(yrs.)		
30-50	13	22.81
51-65	34	59.65
>65	10	17.54
Educational level		
Primary	12	21.05
Secondary	34	59.65
Tertiary	11	19.30
Experience		
0-15	23	40.35
>15	34	59.65
Cropping pattern		
With coconut	21	36.8
With spices	3	5.2
Home garden	29	50.8
Mono crop	4	7.2

Results of Robust Regression

According to the results obtained from the Robust regression model, age category I (30-50 years) significantly affects the productivity (Table 2). When a farmer becomes younger his productivity is higher and it may be due to the good management levels of the cultivations maintained by them.

The coefficient for experience was positive and significant, indicating that more experienced farmers tend to be more productive. This may be due to good managerial skills, which they have learnt over the time.

Table 2. Results of Robust Regression

Variable	Coefficient	SE	P-value
GEN	25.163	85.52	0.77
AGE_1	308.816	114.22	0.01*
AGE_2	141.606	99.106	0.16
EDU	-2.952	9.926	0.768
ENG	80.933	89.478	0.371
EXP	10.862	4.651	0.024*
OFI	-44.406	46.591	0.346
CON	10.882	73.373	0.883
ATC	43.428	71.027	0.544
VOS	0.012	0.006	0.045*
MGT_3	-252.009	104.66	0.021*
MGT_2	-242.077	82.177	0.005*
CONSTANT	123.318	249.58	0.49

**Significant at <0.05*

Coefficient for management level showed positive and significant with the productivity. Hence, awareness programs and management strategies should be introduced to the farmers to increase their productivity. Similarly coefficient for value of subsidy given by Department of Export Agriculture (DEA) was positive and significant. Majority (50%) of farmers in the study cultivated pepper in their home gardens and only 22% of the sample farmers had commercial orientation and were willing to improve productivity. Sixty eight percent of the sample was consisted with part time farmers with other sources of income and was not very much interested in pepper cultivation. Many other (10%) owners were subsistence level farmers who were not willing to invest in productivity improvement programs unless there is a government support. Therefore the subsidy significantly affects the input levels of the cultivation and ultimately on productivity.

Gender of the pepper farmers in studied area did not significantly affect the productivity. Similarly there was no enough evidence in the sample to see a significant effect of education and off farm incomes on the productivity. But coefficients showed a negative relationship with productivity.

Engagement in pepper farming was not significant with the productivity in the studied area. But the coefficient suggested that full time farmers have higher productivity levels than others. Coefficients for participation of farmer training classes and contact between DEA and the farmer showed positive values, but not significant. However, coefficient suggests an increment in productivity with the increased participation in farmer training classes.

Association of Yield Levels with Agro-Ecological and Farm Characteristics

Productivity was categorized as low (<500 kg/ac/year) and high (>500kg/ac/year) by considering the expected average per acre yield of Kurunegala district given by DEA. Pearson Chi-square test was carried out to reveal the association between productivity levels and different agro-ecological and farm characteristics (Table 3).

Table 3. Results of Pearson Chi-Square test

Variable	Chi-square	P-value
Age of cultivation	2.038	0.129
Cropping pattern	10.3	0.016*
Variety	8.688	0.013*
Rec. fertilizer usage	5.613	0.018*
Suitability of land	10.03	0.002*
Precipitation level	6.546	0.011*

**Significant at <0.05*

Table 4. Constraints associated with black pepper production

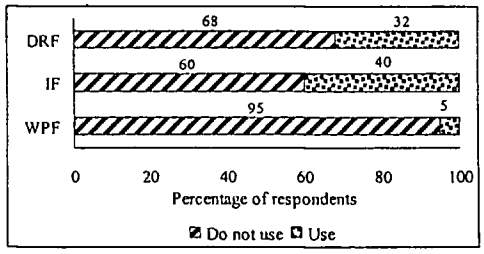
Constraints	Percentage		
	Strongly agree/agree	Neither agree/nor disagree	Disagree/ strongly disagree
Lack of government subsidies	56	6	38
Issues related with marketing	53	30	17
Unfavorable weather at harvesting	24	26	50
Higher cost of agro chemicals	60	7	33
Lack of extension services	7	32	61

According to the results cropping pattern, variety, recommended chemical fertilizer usage, suitability of land and precipitation levels were significantly associated with the productivity levels (Table 3). Hence awareness of farmers on above characteristics should be improved to increase their productivity with correct decision making regarding their present and future cultivations.

Constraint Analysis

Gravity of the constraints was obtained through a ranking method. Results revealed, higher cost of agro chemicals and labor, lack of government subsidies, issues related with marketing and unfavorable weather at processing as major constraints (Table 4).

Only 40% of the farmers in the study used inorganic fertilizer for cultivation, and only 32% of the sample used adequate amounts of DEA recommended fertilizer which were given at subsidized price (Figure 1). Reason for not using inorganic fertilizer was high cost.



Note: IF=Inorganic fertilizer, DRF=DEA recommended fertilizer, WPF=Weedicide, Pesticide and Fungicide

Figure 1. Agrochemical usage of the respondents

All the farmers in the study area reported that they are willing to use inorganic fertilizer regularly if given at a subsidized price. But 68% of the sample was not getting government subsidies and they found it as a major constraint towards productivity improvement.

Similarly farmers are reluctant to adopt productivity improvement practices such as land and soil conservation practices and shade management, because of scarcity of labor and higher labor costs. Some farmers (16%) respond to high labor cost by selling the standing crop to the traders during harvesting time though it diminishes their returns (Figure 2).

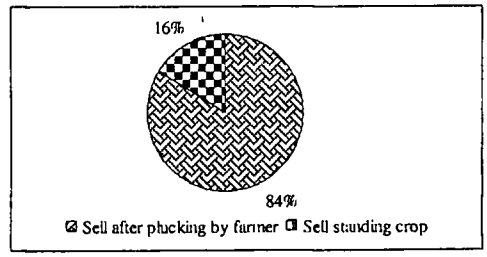


Figure 2. Plucking methods practiced by the respondents

Another significant constraint was the poor market linkage between farmers and exporters. Intermediaries earn higher profits while farmers get lower prices at the farm gate. Farmers do not have appropriate facilities to store the product when the market price goes down. Even though the DEA encourages the cultivation, it has no responsibility for marketing the products.

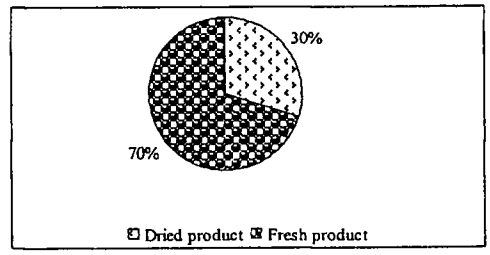


Figure 3. Nature of marketed product by the respondents

A related important issue with production is the quality. Many farmers (95%) did not have proper processing facilities and they were also not aware of the quality parameters. Subsistence farmers sell small quantities of spices to finance regular household

requirements and it is not feasible to process those small quantities to the preferred qualities. Attractive and differentiated farm gate prices could not be seen even better quality products. Hence, farmers do not attempt to process their crop to the standard qualities.

The respondents supposed that the unfavorable weather as another constraint towards the productivity. As Kurunegala district is located in intermediate zone, it gets seasonal heavy rains and prolonging dry periods. Droughts at flowering reduces yield and rains at harvesting periods interrupt the drying process of the crop which ends up with mold growth and low quality of product. Farmers respond this problem by selling the crop in fresh form (Figure 3). They concern about the risk of deteriorating of their product, though it reduces their turnover by 66.6%.This consequence could be overwhelmed with providing proper machineries to the farmers. However, processing technologies for small scale producers were lack and inventing appropriate technologies should be concerned by the relevant authorities. Only 5% of the sample had post-harvest equipment for processing.

CONCLUSION

The results of the study revealed that, the black pepper productivity is significantly affected by socio economic factors such as; age of farmer, experience on farming, value of subsidy and management level of the farm. Similarly significant associations between yield levels and agro ecological variables such as; cropping pattern, variety, usage of chemical fertilizer, suitability of land and precipitation are observed.

Black pepper producers face constraints related with processing, storing and marketing of their product. Price instability causes lack of farmers' interests for productivity improvements and eliminates the attention of younger generation towards this sector. Consequently, abandonment of pepper cultivations and reliance on annual cash crops such as Chili and Cassava are observed.

According to the study respondents were almost satisfied with the extension services regarding agronomic practices and they expect inputs at a subsidized price, approaches to process their crop with minimal influence of detrimental weather and the involvement of government with marketing of their product. The potential for improved Black Pepper productivity will be higher if government and other related institutions pay more attention to this sector especially regarding the above stated factors.

ACKNOWLEDGEMENT

Authors wish to express their profound gratitude to all the extension officers of DEA and the respondents of Kurunegala district.

REFERENCES

Anon, (2012). Department of Census and Statistics. Available from: http://www.statistics.gov.lk/DistrictStatHBook.asp?District=Kurunegala&Year=2011 (Accessed 24 January 2013).

Anon, (2010). Pepper - spice council of Sri Lanka. Available from: http://www.srilankanspices.com/sl_spices_pepper.html (Accessed 24 January 2012).

Anon, (2011). Stata for Students: Basic Statistics, Regression and Graphs. Availablefrom:http://www.ssc.wisc.edu/sscc/pubs/stata_students2.htm (Accessed 24 January 2012).

Anon, (2013). Stata Data Analysis Examples RobustRegression,Availablefrom:http://www.ats.ucla.edu/stat/stata/dae/rreg.htm (Accessed 24 March 2013).

Fox, J. (2002). Robust Regression: book review of Appendix to An R and S-PLUS Companion to Applied Regression. Available from: http://cran.r-project.org/doc/contrib/FoxCompanion/appendix-robust-regression.pdf (Accessed 24 March 2013).

Huber, P.J. (1964). Robust Estimation of a Location Parameter. *Journal of Annals of Mathematical Statistics*. **35**:73-101.

Lindara, L.M.J.K., Johnsen F.H. and Gunatilake H.M., (2004). Technical efficiency in the spice based agro-forestry sector in Matale, Sri Lanka , Noragric Agricultural University of Norway.