Indian Journal of Agricultural Economics
Vol.75, No.2, April-June 2020

Price Volatility of Black Pepper in Kerala: Could Institutional Mechanism such as Contract Agreement be a Solution?

Sachu Sara Sabu*, **Anil Kuruvila*** **and S.P. Subash****

ABSTRACT

Black pepper, the oldest and best known spice in the world, is a highly traded commodity and prone to price fluctuations. The present paper focuses on the extent of volatility in prices of black pepper at the macro-level and explores at micro level whether an institutional support such as a contract agreement could be a solution to the problem of price volatility. The study shows that the intra-annual volatility indices for black pepper prices decreased marginally after trade liberalisation in India, whereas the inter-annual volatility has increased in the post-liberalisation era. These fluctuating prices increases the uncertainty faced by the farmers in their planting decisions and in earning reasonable as well as stable returns. The study also identified disease and pest incidence as the major constraint in black pepper production, whereas price volatility ranked to be the fourth constraint. The study also analysed the effect of an institutional contract agreement by comparing the outcomes such as price received, net-income and replanting decisions. Using Heckman endogeneity adjustment model the study shows that membership of farmers in such an institution has led to better price realisation. Even though the members received slightly higher prices when compared to non-members, there was no significant difference in net income. The members showed higher replanting in years with lower prices. It was found that a contractual agreement alone could not protect the farmers from price fluctuations.

Keywords: Black pepper, Contract agreement, Income, Price volatility.

JEL: D86, Q02, Q11, Q12, Q17

I

INTRODUCTION

Volatility is the variability of commodity prices around the trend, while wide price movements over a short period of time typify the term high volatility (Kuruvila *et al*., 2012). Volatility in prices is a major issue for the participants of any commodity supply chain. The impact of price volatility can either be ex-ante or ex-post effects. The ex-ante effects arise because of the decisions of the producers to alter their allocation towards or away from risky activities, whereas the ex-post effects are lower expectations of future income as there is reduction in current expenditure to income shortfalls (Dehn *et al*., 2005). A high degree of variability in commodity prices has serious consequences in the terms of trade, real incomes and fiscal position of commodity-dependent countries (Hazell, 1988; Cashin and McDermmot, 2006). The commodity price trends and volatility affect the incidence of poverty through its impact on employment opportunities and earnings of the

*Ph.D. Scholar and Professor, respectively, Department of Agricultural Economics, College of Horticulture, Vellanikara, Kerala Agricultural University, Thrissur, Kerala-680 656 and **Scientist, Agricultural Economics, ICAR-National Institute of Agricultural Economics and Policy Research (NIAP), Pusa, New Delhi-110 012.

producers. The vulnerability of the poor to fluctuations in international prices, has arguably increased as the liberalisation of markets has shifted price risk from governments to households (Hallam and Sarris, 2006). Higher price volatility means higher costs of managing risks which would eventually translate into higher consumer prices (Tothova, 2011). At the farm household level, the impact of price volatility depends on the extent of transmission of the global and border price trends to the producer and the extent to which productivity and production growth compensates for falling prices.

Black pepper as an export-oriented commodity has always been associated with price fluctuations, which are caused by several factors like dynamics in domestic and international production and consumption, international prices, exchange rates, trade agreements and export-import policies (Sabu and Kuruvila, 2016). The area under black pepper in Kerala has declined from 2.04 lakh hectares in 2000-01 to 0.87 lakh hectares in 2017-18, while the decline in terms of production during the above period was from 58,240 tonnes to 22,000 tonnes (Spices Board, 2018). The limited flexibility in the cropping pattern to market forces in the case of trade dependent perennial cash crop like black pepper has been causing income volatility and increased risk for the producers. This has been dissuading the farmers from undertaking long term investments, which resulted in many farmers either shifting to other cash crops or neglecting the crop for many years (Harilal, 2010; Kuruvila *et al*., 2012 and Sajitha, 2014).

There are several market based mechanisms; including minimum support price, contract farming, e-markets, futures market and warehousing to protect the farmers from price volatility and support their livelihood (Pingali *et al*., 2019). Even though futures trading is an effective strategy for covering the price risk, in India it has so far proved advantageous only for few agricultural commodities with stringent and timely regulatory actions. Futures trading had an adverse impact on most of the commodities and has not benefited majority of the small farmers (Lingareddy and Tulsi, 2008; Singh and Singh, 2014; Das and Chakraborty, 2015). The traders of black pepper were not interested in futures trading as it was a seasonal crop and they obtained a fairly good price during the off-season when the demand for black pepper was high (Sumalatha, 2019). Institutional agreements such as contract farming are emerging as a potential solution for small holder farmers in developing countries (Singh, 2002; Sartorious and Kirsten, 2007). Even though smallholder pepper contracts were found to be important in competitive markets, they were found to facilitate high returns to more established pepper producers (Saenz-Segura *et al*., 2009).

With this background, the study has assessed the extent of volatility in the prices of black pepper in Kerala and explores whether an institutional support such as a contract agreement could be a solution to the problem of price volatility and to ensure livelihood security of the farm households. The study compares farmers with assured prices through contract agreement with Peermade Development Society (an NGO in Idukki district) and those without any contractual agreement, at two points of time.

This could help in identifying the differential impact of such an agreement on the stability of prices received and for formulating suitable price stabilisation policies.

II

MATERIALS AND METHODS

The present study is based on both primary and secondary data. The data on monthly prices of black pepper[1] from January 1980 to December 2018 were collected from Spices Board, Kochi to find out the extent and determinants of price volatility. To assess the effect of membership in an institutional contract agreement, primary data on individual characteristics of the farmer or household head, household level characteristics and farm level characteristics such as input use, production, employment and income were collected from member and non-member farm households in Idukki[2] district of Kerala state.

2.1 *Volatility of Commodity Prices*

The extent of volatility in the prices of black pepper and the temporal changes in volatility are examined by constructing a series of annual observations from monthly data by using the intra-annual standard deviation of changes in log prices (Gilbert, 2006) and scaled inter-annual range as suggested by Parkinson (1980), Garman and Klass (1980) and Kunitomo (1992). Inter-year volatility captures variations in prices between years which has crucial bearing on the long term planning of the sector, whereas intra-year volatility captures variation in prices within a year which adds to the unsteadiness in the sector by adversely affecting farmer's returns (Anoopkumar, 2012).

2.1.1. *Intra-Annual Volatility*

The intra-annual volatility in monthly prices was measured as the intra-annual standard deviation of the changes in log prices, which is defined as

$$S_{YM} = \sqrt{\frac{1}{11}\sum_{m=1}^{12}(\ln P_{y,m} - \ln P_{y,m-1} - \delta y)^2} \quad \text{for year 'y',}$$

where $\delta y = \frac{1}{12}$ $(\ln P_{y,12} - \ln P_{y,0})$ is the y-th year drift and $P_{y,0} = P_{y-1,12}$

This estimate is scaled onto an annual basis using the factor of $\sqrt{12}$

2.1.2. *Inter-Annual Volatility*

The inter-annual volatility measure or the scaled inter-annual range called as the Parkinson's measure as suggested by Parkinson (1980) and modified by Garman and

Klass (1980) and Kunitomo (1992) was used to estimate the inter-annual volatility of monthly prices.

Parkinson's measure is defined as $S_y^p = (\frac{(\ln^{P_y^H} - \ln^{P_y^L})}{2\sqrt{\ln 2}})$

where, $P_y^H = Max_{m-1}^{12} P_{y,m}$, is the highest monthly average price in the year and $P_y^L = Min_{m-1}^{12} P_{y,m}$, is the lowest monthly average price in the year.

2.2 *Constraints in Production of Black Pepper*

There are many constraints in the production of black pepper in Kerala. Garett ranking technique was used to identify the constraints in production and to understand the role of price volatility as a constraint in black pepper production, As the first step in constraint analysis, the major problems faced in production and marketing of black pepper were identified. The respondents were then asked to rank the identified problems and the major constraints were identified by Garett ranking technique. In this method, the ranks assigned to different constraints were transformed into percentage positions using the formula:

$$\text{Per cent position} = \frac{100(R_{ij} - 0.5)}{N_j}$$

where, Rij = Rank given for i-th factor by j-th individual
Nj= Number of factors ranked by j-th individual

The percentage positions were transformed into scores on a scale of 100 points referring to the table given by Garett and Woodworth (1969). From the scores so obtained, the mean score level was derived and constraints were ranked based on the mean score level.

2.3 *Institutional Mechanism of Contract Farming in Black Pepper*

To assess the impact of the institutional mechanism of contract agreement on reducing price volatility in black pepper, a micro-level study was conducted in Idukki district of Kerala. The study has assessed the effect of a contract agreement for the farmers by Peermade Development Society situated in the Idukki district. The district accounted for 51 per cent of the area under black pepper in Kerala in triennium ending (TE) 2014-15. The study employed a multistage sampling procedure. In the first stage two blocks in the district having the largest area under black pepper viz., Nedumkandam and Azutha, which accounted for 51.8 per cent and 30.6 per cent respectively of the area under black pepper in the district, were purposively selected. From each of the block, two panchayats having maximum area under black pepper

viz.., Vandiperiyar and Peruvanthanam panchayats from Azutha block and Rajakkad and Rajakumary panchayats from Nedumkandam block were selected. Thereafter, stratified random sampling procedure was followed for the selection of the farmers.

The farmers in the study area having black pepper as the major crop in the gross cropped area of their farms were randomly selected from a combined list of black pepper farmers obtained from field offices of Spices Board and Krishi Bhavans in Idukki district. Before selection, these farmers were categorised into two groups, as members of the Peermade Development Society (PDS) who are having a contractual agreement with the society and non-members of PDS. In each of the two categories, 10 farmers were selected from each of the panchayat and therefore, 20 farmers were selected from each of the block. Data was collected from 40 farmers in each of the category. Thus, the total sample size for the micro-level study was 80. For the assessment of implications of price volatility, primary data was collected from the same 80 farm households at two points of time, the first in May-June 2014 and the second one during May-June 2015 using a pretested interview schedule.

2.3.1 *Impact of Contract Agreement on Farmer's Welfare*

The direct impact of a contract agreement on black pepper producer households is through the effect on the price realised. The contract agreement guarantees an assured as well as an additional price to the members. This in turn will lead to an increase in the total income from the sale of black pepper. The members are supported by inputs from PDS, which results in higher input cost. The actual impact of a contract agreement could be measured by assessing the additional net income generated from black pepper by the members of the PDS. This additional income, in turn affects the investment decisions of the farm households. Black pepper being a perennial crop, producers show the tendency to neglect the crop during years of negative shocks (lower prices), and are less likely to replant in those years. When the prices are higher, producers would be motivated to increase the area under the crop or make replanting decisions and also undertake the management practices for the existing crop, at times even leading to overuse of inputs. Consequently, the intensity of input use including fertilisers, manures, labour etc., would be either increasing or decreasing based on the direction of the prices and the resultant investment decisions. Also being a commodity with higher volatility in prices, storing the produce is a good mechanism to manage price volatility (FAO, 2011). The study thus measures the prices (during 2014 and 2015), net-income, replanting and storage as the outcome measures for assessing the impact of the contract agreement.

2.2.3 *Impact of Contract Agreement - Heckman Endogeneity Correction Model*

To understand the impact of membership in an institution with contract agreement, we could model the outcome variables. The model specification is:

$$Y_j = \alpha_j + \beta_j T_j + \delta_j X_j + \varepsilon$$

where, Y_j*'s* are the set of outcome variables (see Table 1), T_j is the treatment variable (membership in PDS), and X_j are the control variables (age in years, total area in hectares, experience in farming in years, number of family members, percentage share of income from black pepper in total income and education). Assessing the impact of membership in PDS by comparing the outcome variables between members and non-members (β_j) could be biased and inconsistent due to endogeneity[3] (self-selection of members in the organisation). The model need to account for factors influencing the selection of the members and control for other variables influencing the outcome variables. Following Aditya *et al*. (2017), the study used the Heckman model (Heckman, 1979) to control for potential endogeneity. The model is build using a two stage equation; the selection equation (membership in PDS) and regression equation (outcome variables). The selection equation estimates the probability of an individual belonging to a treatment group (as the dependent variable) on a set of observed independent variables. The Inverse Mills ratio (IMS) is estimated using a probit model (selection equation and it explains that part of the

TABLE 1. VARIABLES USED IN THE HECKMAN ENDOGENEITY CORRECTION MODEL

Sl. No. (1)	Variables (2)	Mean (3)	Standard deviation (4)	Minimum (5)	Maximum (6)
I Outcome variables					
1. Price in 2014 (₹/kg)	Price of black pepper in 2014	670.8	67.6	500.0	745.0
2. Price in 2015 (₹/kg)	Price of black pepper in 2015	610.3	43.0	520.0	710.0
3. Net income in 2014 (₹)	Net income from black pepper cultivation	242471.8	266378.4	-180475.6	1027064.0
4. Net income in 2015 (₹)	Net income from black pepper cultivation	288780.8	242255.5	-79829.6	1072500.0
5. Replanting in 2014 (nos.)	Number of black pepper vines replanted	215.4	111.1	30.0	600.0
6. Replanting in 2015 (nos.)	Number of black pepper vines replanted	226.9	108.2	0.0	600.0
7. Storage (days)	Number of days black pepper is stored	385.5	203.9	182.5	1095.0
II Treatment variables					
1. PDS*	Membership in PDS	0.5	0.5	0.0	1.0
III Control variables					
1. Age (years)	Age of the member/ household head	53.3	9.5	32.0	80.0
2. Education*	Education of the member/ household head	0.4	0.5	0.0	1.0
3. Land (ha)	Total area in hectare	1.3	1.1	0.2	8.0
4. Family (nos.)	Number of family members	4.2	1.3	1.0	7.0
5. Share income (per cent)	Percentage share of income from black pepper	66.6	26.1	10.3	100.0

Notes: *Dummy variables (PDS= 1, 0= otherwise; Education: 1=Above Secondary, 0=Less than Secondary). Nos-Numbers.

error term which captures the difference in outcome variables due to the selection and not the programme itself. In the second stage, outcome variable is regressed with treatment dummy variable and a set of control variables, including IMS as an explanatory variable to minimise the effect of endogeneity. The empirical specification of the model is

Regression equation

$$Y_j = \alpha + \beta_j T_j + \delta_j X_j + \mu_{2j}$$

where Y_j is the outcome variable, T_j is the treatment variable (membership in PDS), and X_j are the control variables (age in years, total area in hectares, experience in farming in years, number of family members, percentage share of income from black pepper in total income and education).

Selection equation

$$M = Z_j\gamma + \mu_{1j} \text{ and observed only if } Z_j\gamma + \mu_{1j} > 0$$

where M is equal to membership in PDS

$\mu_1 \sim N(0, \sigma)$

$\mu_2 \sim N(0, \sigma)$

$Corr\left(\mu_1, \mu_2\right) = \rho$

when, $\rho \neq 0$ standard regression techniques are applied to get the first equation. Heckman provides consistent, asymptotically efficient estimates for the parameters of the model. Summary of the variables used in the model is given in Table 1. The variables such as age, education and land holding were considered as control variables in the model. Higher percentage of income from black pepper, large household size and higher transportation costs were expected to increase the probability of farmers being engaged in contract. The linear relationship between the dependent variable and independent variables were tested using the scatter plot. The dependent variable showed a linear relationship between the independent variables as it was evident from the linear scatter plot and random pattern of the residual plots.

III

RESULTS AND DISCUSSION

3.1 *Magnitude of Volatility in Prices of Black Pepper*

The volatility in prices of black pepper is highly evident from price movements of the commodity. The prices of black pepper in the domestic (Malabar Garbled (MG) Cochin) and international markets (MG1 New York) moved closely especially in the pre-liberalisation period. After 1995, there was a slight divergence between the two market prices and during the last four years this deviation was found to be increasing.

The annual average price of MG black pepper in Cochin market increased from ₹33 per kg in 1990-91 to ₹215 per kg in 1999-00, which subsequently decreased to as low as ₹66 per kg in 2005-06. Then the price variation showed an increasing trend and was ₹140 in 2007-08, which again decreased to ₹129 in 2008-09. After that the price has been continuously increasing and was as high as ₹750 in August 2014 which subsequently decreased to ₹387 in December 2018 (Figure 1).

Notes: Plot based on price data from Spices Board, Kochi.
Pre-liberalisation (January 1980 to December 1994), post-liberalisation (January 1995 to December 2018).

Figure 1. Price Movements of MG Black Pepper in Cochin and MG1 Black Pepper in New York (₹/kg).

Intra-annual volatility measures the dispersion of prices within a year. It could be observed that the intra-annual volatility of monthly black pepper prices in domestic (MG Cochin) as well as international market (MG1 New York) declined in the post-WTO period, but the decline was more in the international market (Table 2). Intra-annual volatility measure indicates the uncertainty that farmers face in their planting decisions. Typically, farmers can diversify to different seasonal as well as perennial crops instead of a single perennial crop like black pepper. The higher the intra-annual volatility, the more difficult the optimal planting choice will be.

TABLE 2. INTRA-ANNUAL AND INTER-ANNUAL VOLATILITY INDICES OF MONTHLY BLACK PEPPER PRICES

(*per cent*)

Commodity/ Market specifications	Pre-liberalisation	Post-liberalisation
(1)	(2)	(3)
Intra-annual volatility		
MG Cochin	6.99	6.33
MG1 New York	8.53	6.15
Inter-annual volatility		
MG Cochin	21.2	22.3
MG1 New York	24.1	20.4

Note: Pre-liberalisation (January 1980 to December 1994), post-liberalisation (January 1995 to December 2018).

The inter-annual volatility measures the dispersion of black pepper prices between two successive years. The inter-annual volatility as indicated by the Parkinson's index increased for MG Cochin in the post-liberalisation period, whereas declined for MG1 New York (Table 2). Inter-annual volatility measure specifies the struggle of the producers to make returns over the fluctuating price, in turn resulting in poor crop management and lower replanting.

The intra-annual and inter-annual volatility indices of monthly black pepper prices from 1980 to 2018 are plotted in Figure 2 and Figure 3 respectively. The divergence between the intra-annual volatility indices for MG Cochin and MG1 New York narrowed down in the post-liberalisation period and the pattern became closer from the mid-1990s. The decline in intra-annual volatility in the post-liberalisation period was also distinctly noticeable in the plotted Figure 2. The inter-annual volatility indices moved closely in the pre-liberalisation as well as post- liberalisation periods (Figure 3).

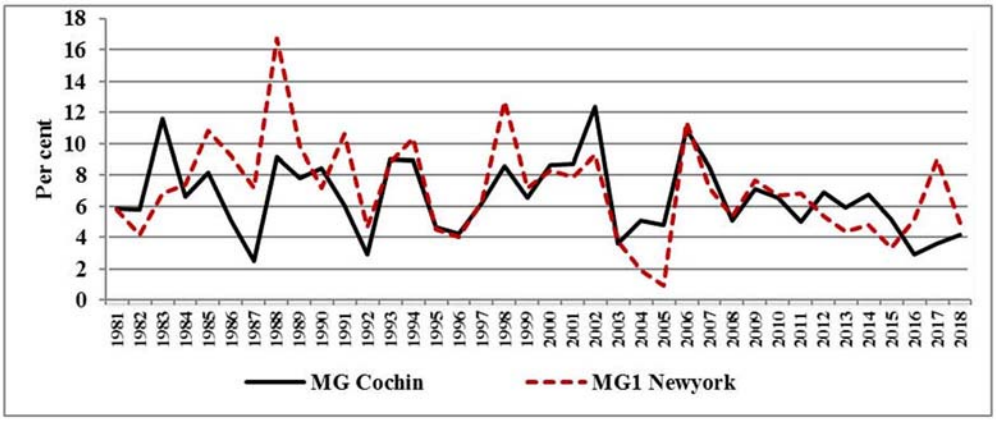


Figure 2. Intra-Annual Volatility of Monthly Black Pepper Prices (Per cent).

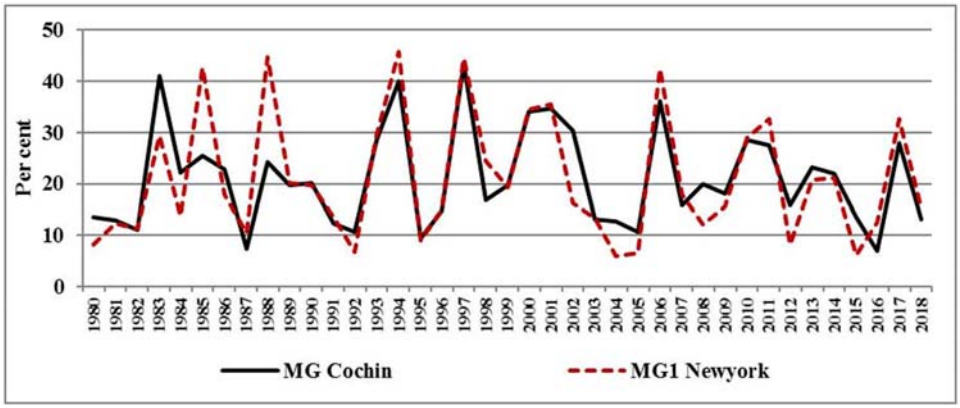


Figure 3. Inter-Annual Volatility of Monthly Black Pepper Prices (Per cent).

3.2 *Determinants of Price Volatility*

The extent of price volatility in black pepper depends on many factors like changes in international trade (export and import), variations in production and consumption in India and other countries, behaviour of the prices, rupee-dollar exchange rate, etc. (Sabu and Kuruvila, 2016).

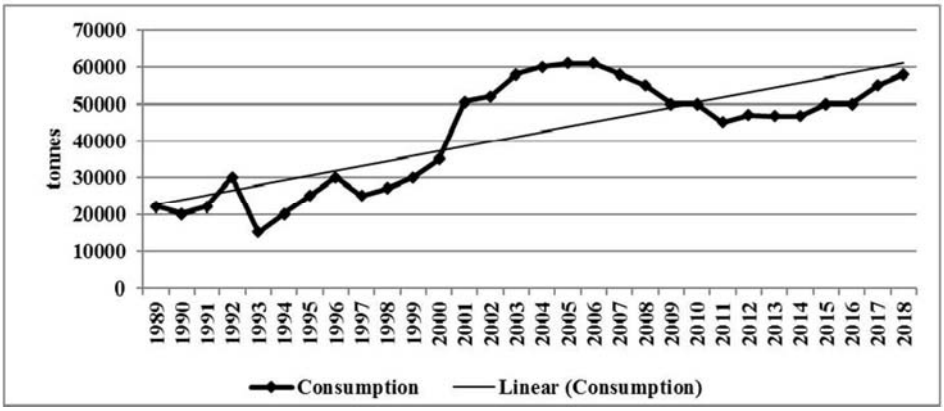
3.2.1. *Changes in International Trade in Black Pepper*

India is one of the major exporters of black pepper to the world after Vietnam, Indonesia and Brazil. India has lost its position as the top producer and exporter of black pepper to Vietnam, since 1999. The share of export of black pepper in production has declined in India. The country exported almost three-fourth of the production in TE 1972-73, while it declined to one-third share in TE 2002-03, which further increased to 38 per cent in TE 2017-18 (Table 3). This could be attributed to the increasing domestic consumption of black pepper in India from 22,000 tonnes in 1989 to 58,000 tonnes in 2018 (Figure 4) and also increasing competition from other producers, especially, Vietnam. As per International Pepper Community (IPC) estimates about 50 to 60 per cent of the Indian production is consumed in the country itself.

TABLE 3. EXPORT INTENSITY OF BLACK PEPPER PRODUCTION IN INDIA

Trienniums (1)	Production (tonnes) (2)	Export quantity (tonnes) (3)	Percentage share of export in production (4)
TE 1972-73	26170	19059	73
TE 1982-83	28443	23188	82
TE 1992-93	50240	24780	49
TE 2002-03	65043	22105	34
TE 2012-13	48667	20517	42
TE 2017-18	58500	22383	38

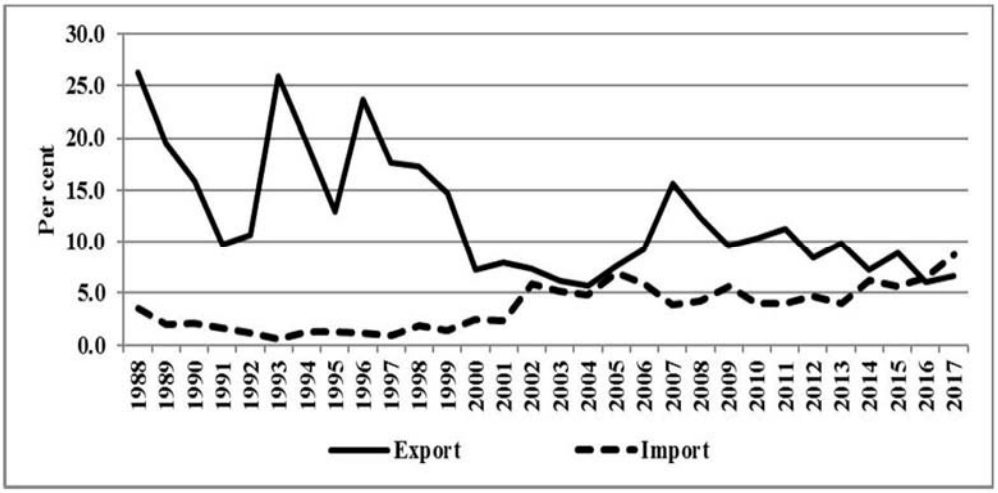
Source: Calculations based on data published by Spices Board.



Source: Various issues of Pepper Statistical Yearbook, International Pepper Community.

Figure 4. Consumption of Black Pepper in India.

The share of India in world exports declined from 26 per cent in 1988 to about 10 per cent in 1991 which, further increased to about 25 per cent in 1993. From 1996 onwards the share has shown a continuously declining trend from about 24 per cent to as low as six per cent in 2004. It again increased to 15.8 per cent in 2007 and then showed a declining trend, and exported about 6.6 per cent in 2017. The share of India in world imports has increased from 3.5 per cent in 1988 to 8.7 per cent in 2017 (Figure 5) and the country became a net importer of black pepper in 2016.



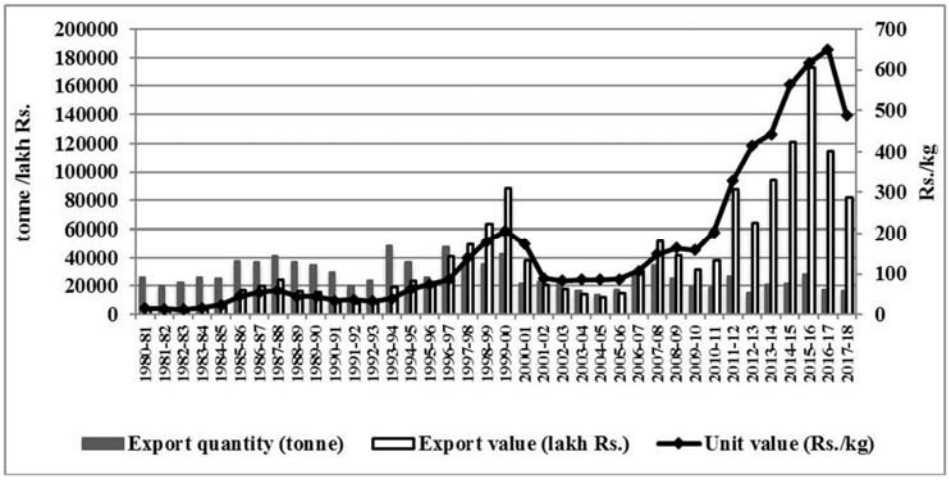
Note: Estimated using WITS data.

Figure 5. Share of India in World's Exports.

It could be observed from Figure 6 that the unit value of black pepper exports were very low in the 1970s and it remained low up to mid 1980s, because of that the value of exports were very low when compared to the quantity of exports from India. After 1985, the unit value of pepper exports started increasing due to which the value of exports also increased and this trend continued up to 1998-99. This increase could be attributed to the devaluation of rupee and liberalisation policies implemented in India. From 2000 onwards the exports declined in both value and quantity terms upto 2005 and the unit value was less than ₹100 in some of the years. From 2006-07, the unit value started increasing, whereas the quantity of exports exhibited a declining pattern and consequently the value of exports increased. The export unit value has declined suddenly after 2014-15, which affected the export quantity and value.

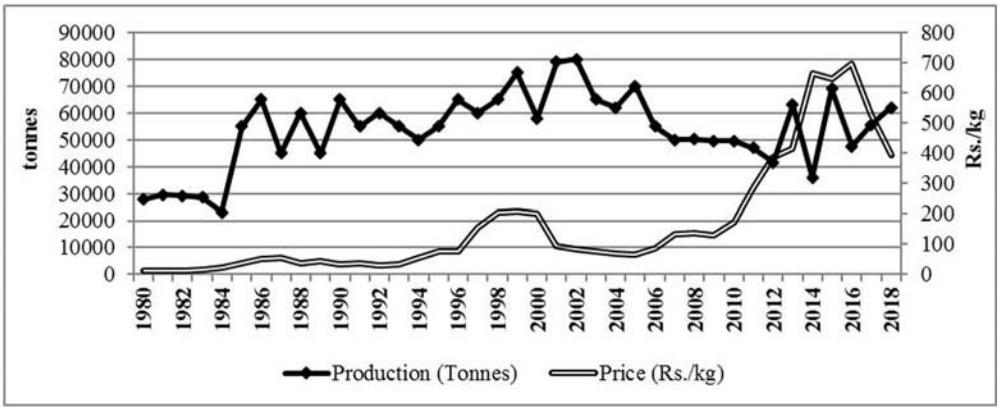
3.2.2 *Variation in Production*

Pepper production is influenced by the price movements. The movement of production and price of black pepper in India is depicted in Figure 7. An inverse relationship between production and price could clearly be detected from the figure.



Note: Plot based on data from Spices Board, Kochi.

Figure 6. Exports of Black Pepper from India.



Note: Plot based on data from spices Board, Kochi.

Figure 7. Production and Prices of Black Pepper in India.

Since black pepper is a perennial crop, the production response by increase in area as a result of rise or fall in price in a particular year can only be observed at a lag of three to four years. When world black pepper prices are high, new vines are planted and fertiliser usage goes up. The pepper exporters also try to reduce their stocks during the periods of high price. Then, as the newly planted vines start to yield, production increases and the prices fall. This corresponds to the classical Cob Web phenomenon; the supply of agricultural produce is a function of lagged prices. Similarly, when world pepper prices are low, pepper vines are neglected and fertiliser usage decreases. Because producers neglect management, black pepper production stagnates or even declines, tightening the supply situation until the prices increase again. This cycle in the production and prices of black pepper continues.

3.2.3. *Exchange Rate Volatility*

The variability in exchange rates often differs within a year and between the years. The intra-annual and inter-annual volatility for average monthly rupee-dollar exchange rates are presented in Table 4. The magnitude of intra-annual volatility in comparison with the inter-annual volatility was considerably low. The intra-annual volatility of monthly average rupee-dollar exchange rate exhibited only a negligible decline in the post-WTO period, whereas the inter-annual volatility declined from 7.6 per cent in pre-WTO period to 5.67 in the post-WTO period. The marginal decrease or no change in the intra-annual volatility and a decrease in inter-annual volatility of black pepper prices could be directly attributed to these behavioural patterns of the volatility of the rupee-dollar exchange rates.

TABLE 4. INTRA-ANNUAL AND INTER-ANNUAL VOLATILITY OF RUPEE-DOLLAR EXCHANGE RATES

(*per cent*)

Volatility/Period	Pre-liberalisation	Post-liberalisation
(1)	(2)	(3)
Intra-annual volatility	2.0	1.8
Inter-annual volatility	7.6	5.67

3.3 *Impact of Contract Agreement on Farmer's Welfare*

3.3.1 *Peermade Development Society (PDS)*

PDS is a Non-Governmental Organisation (NGO) working for the integrated and sustainable development of the rural poor in Idukki district of Kerala state. It was established in 1980 and during the last two decades, PDS as one of the leading NGOs in Kerala, is actively engaged in various socio-economic development activities. 'PDS Organic Spices', a unit of Peermade Development Society, is promoting cultivation, processing and marketing of quality organic spices to help the marginal farmers achieve sustainable livelihoods. It is an exporter of certified organic spices from India since 1998 to countries like USA, Japan, Germany, U.K, The Netherlands, France, Belgium, Australia etc. PDS has more than 2000 certified organic farmers and these farmers are being monitored by an Internal Control System (ICS). The ICS monitors and verifies the activities of the farmers as per the stipulated standards, identifies new areas and farmers, conduct trainings and motivates the farmers, acts as an intermediary between the government departments and farmers, arranges external inspection and certification, maintains all documents and relevant data for individual farms with regard to the farming activities. The ICS consists of nine executive officers and for each executive officer around 250 farmers are being allotted. The farmers are inspected and certified by control union as per National Programme for Organic Production (NPOP), Demeter, National Organic Programme (NOP), Bio-Suisse and Japanese Agricultural Organic Standard (JAS) regulations. The products

exported include black pepper, white pepper, green pepper, turmeric, ginger, clove, cardamom, nutmeg and mace.

Black pepper farmers could sell their produce to PDS only after a conversion period of three years required for a farm to be considered as fully organic. PDS was giving premium price to the farmers, which was based on the prevailing market price and during 2014-15, an additional amount of ₹25-30 per kg over the market price was paid as premium to the member farmers who were selling organic black pepper to PDS. Once the commodity was sold to PDS, the full amount was not settled on that day and the farmers had freedom regarding price settlement. Only 50 per cent of the amount was settled based on the price of black pepper prevailing on that day and the price of the remaining 50 per cent of the produce could be settled on any day within six months as per the request of the farmers at the prevailing market price on that day.

3.3.2 *Constraints in the Production of Black Pepper*

The PDS and non-PDS farmers' face several constraints in the production of black pepper. The major constraints were listed and then ranked based on the responses of the sample farmers during the survey. The ranks were then converted to mean scores (Garett ranking) for getting a real picture of the constraints prevailing in the study area. The constraints in production of black pepper as identified by the respondent farmers were ranked and are presented in Table 5. Disease and pest incidence has been identified as the major constraint in black pepper production by both PDS and non-PDS farmers. The mean score for this constraint was 51.55 and 61.1 respectively for PDS and non-PDS farmers. Climate change was identified as the second major constraint by both the groups of farmers. The other constraints identified are labour shortage, price variability and high wage rate. Variability in prices was identified only as the fourth major constraint by the farmers. This could possibly be due to the fact that the problem of price volatility was prevalent over years, while disease and pest incidence, climate change and labour shortage were of recent origin. Price variability could be increasing or decreasing prices and the prices were on the higher side of price cycle in recent years.

TABLE 5. CONSTRAINTS FACED BY FARMERS IN BLACK PEPPER PRODUCTION

Problems	PDS farmers		Non-PDS farmers	
	Garett score	Rank	Garett score	Rank
(1)	(2)	(3)	(4)	(5)
Disease and pest incidence	51.55	1	61.1	1
Climate change	43.35	2	45.75	2
Labour shortage	41.27	3	30.17	3
Price variability	28.78	4	21.28	4
High wage rate	7.53	5	10.02	5

3.3.3 *Welfare Implications of Membership in PDS*

The impact of contract agreement was studied by comparing the price, net-income, storage and number of plants replanted in two years (2014 and 2015) for PDS and non-PDS farmers.

It is evident from the results presented in Table 6 that there was slight reduction in price realised in 2015 when compared to 2014, for both PDS and non-PDS farmers. The decline in price of black pepper received by the non-PDS farmers was found to be marginally higher than the decline for the PDS farmers, which could be attributed to the additional amount of ₹25-30 per kg paid to the PDS farmers as premium in addition to the market price. The prices received by PDS farmers were ₹25.30 (significant at 10 per cent) higher than non-PDS farmers, while in 2015 it was to an extent of ₹30.5 (significant at 1 per cent). Even though the average production of black pepper has increased in PDS as well as non-PDS farms, the growth in production was slightly high in the case of PDS farms, but with no significant difference. Hence, the non-PDS farms experienced a higher decline in income between 2014 and 2015 when compared to the PDS farmers. Consequent to the reduction in price, the number of black pepper plants replanted per farm decreased for PDS and non-PDS, but there was higher percentage decline in the case of non-PDS farmers (29.58 per cent). When the replanting of black pepper per hectare was considered, it was found that the number of plants replanted increased by 53 in 2015 as compared to 2014 in the case of PDS members whereas, it decreased by 30 in non-PDS farms. On an average the PDS members were replanting 48 more plants as compared to the non-PDS farmers. Thus, it could be observed that for a decline in price of a similar nature, there was differential impact on PDS and non-PDS farms and the replanting decisions per hectare varied for the two groups of sample farmers. For the PDS members while the replanting per hectare increased by about 27 per cent, for the non-PDS farmers it decreased by 13 per cent. Consequently, the cost incurred on labour and inputs also showed a similar nature of increasing pattern in PDS farms and a decreasing pattern in non-PDS farms. Even though the membership in PDS and the contractual agreement for purchase of black pepper did not insulate the farmers from price volatility, the implications of price volatility reflected as a reduction in input use or a fewer number of replanting or neglect of the crop were

TABLE 6. DIFFERENCE IN OUTCOME VARIABLES BETWEEN PDS AND NON-PDS FARMERS

	2014		2015		Mean difference		Percentage change	
Particulars	PDS	Non-PDS	PDS	Non-PDS	2014	2015	PDS	Non-PDS
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Average price (₹/kg)	683	658	625	595	25.30*	30.05***	- 8.5	-9.55
Average production (kg/ha)	528	473	569	487	55.32	82.01	7.75	3.03
Average net-income (₹/ha)	266985	217959	318413	259148	49025.5	59264.9	- 1.95	-2.96
Average replanting (No./ha)	198	233	251	203	-34.88	47.75**	26.65	-13.00
Average labour cost (₹/ha)	75753	77296	78335	77115	-1543.53	1220.26	3.41	-0.23
Average input cost (₹/ha)	17532	16930	18932	16231	602.78	2700.93	7.98	-4.13

found to be comparatively minimal in the case of PDS farms. This could be attributed to the effective monitoring as well as extension support by the executive officers involved in the ICS developed by the PDS.

3.3.4 *Socio-Economic Profile of the Sample Farmers*

A brief description of the general and socio-economic particulars PDS and non-PDS farmers is shown in Table 7. The socio-economic characteristics such as age, gender, education, experience in farming, and family size, which could help in providing the necessary background information for a proper understanding of the farm as well as the farming situations have been included in this table. Majority of the farmers in PDS and non-PDS groups were aged between 45 and 60 years. There were no farmers aged less than 30 years in any of the groups, indicating the lack of enthusiasm among youngsters in taking up farming as a profession, which is one of the major problems confronting the agricultural sector in Kerala state. There was no significant difference between the mean difference in age between PDS and non-PDS farmers. Almost all the black pepper growers in two categories were male farmers, i.e., 95 per cent of farmers were male and only five per cent were female farmers. All the sample farmers were literate and majority of them in both the sample categories were having education up to SSLC. Eighty per cent of the non-PDS farmers were having more than 30 years of experience in farming and the corresponding percentage in the case of PDS farmers was 55 per cent. The PDS farmers were having less years of experience in farming when compared to the non-PDS farmers. The majority of the PDS farmers (60 per cent) were having four to six members in their families and in the category of non-PDS farmers, Seventy per cent of them were having families with one to three members. The average number of family members in PDS farmer's family (4.53) was significantly (at 5 per cent significance) higher than that of the non-PDS farmers (3.83). The share of black pepper in total income among PDS member (73.51 per cent) was found to be significantly (at 5 per cent significance) higher than non-PDS farmer (59.69 per cent).

TABLE 7. SOCIO-ECONOMIC PROFILE OF PDS AND NON-PDS FARMERS

Particulars	PDS	Non-PDS	Mean difference	Significance
(1)	(2)	(3)	(4)	(5)
Age	52.98	53.55	0.58	
Share of black pepper in total income	73.51	59.69	13.81	**
Number of family members	4.53	3.83	0.70	**

Note: Statistical test - two sample t test.

3.3.5 *Impact of PDS Membership*

The estimates of the Heckman endogeneity correction model assessing the impact of membership in PDS is given in Table 8. The selection model estimates using the probit model are given in Column (2). The variables like age, education

and number of household members showed no significant relationship, whereas the share of income from black pepper and total area were found to be significant. Households which had higher share of income from black pepper and larger land under cultivation were more likely to be a member in PDS. Columns (3) to (8) are estimates from the regression model. Co-efficient of PDS in the models are the impact of PDS on the corresponding outcomes. The results show that after controlling for observed variables such as share of black pepper income in total income and total area cultivated, the price received by PDS members in 2014, on an average was ₹31 (significant at 10 per cent) higher than the non-PDS member while in 2015, the PDS members on an average received ₹17.64 (significant at 10 per cent) more than the non-PDS members. This lower significance might be due to lower sample size. These results were opposite of the ones from the summary analysis (Table 6), in which it was found that the increase in price difference were higher in 2015 compared to 2014. This emphasises on the need for models to get robust results. These years in terms of prices received exhibited a unique feature; the prices were lower in 2015 compared to 2014. So for the period in which the prices in general were generally lower, the effects were lesser. The spill-over effect of increase in prices was not visible in net-income, while the replanting rates were higher in 2015 (53 plants) compared to 2014. Since there is an inter-year variation in case of replanting, this inference needs further validation.

TABLE 8. ESTIMATES OF THE HECKMAN MODEL ON IMPACT OF PDS MEMBERSHIP

	Selection model	Regression model					
Variables	Probit model	Price in 2014	Price in 2015	Net-income from black pepper 2014	Net-income from black pepper 2015	Replanting in 2014	Replanting in 2015
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
PDS member		31.097*	17.642*	-64,198.623	-47,565.378	-55.229**	53.126*
		(17.227)	(10.545)	(65,011.492)	(57,790.979)	(26.627)	(28.393)
Age	-0.006	-0.072	-0.675	-811.839	-2,911.553	0.821	0.227
	(0.022)	(1.096)	(0.671)	(4,136.749)	(3,677.300)	(1.694)	(1.807)
Education	-0.256	-17.015	-18.117	-139,648.795	-112,021.941	17.626	-29.575
	(0.474)	(23.022)	(14.092)	(86,879.658)	(77,230.354)	(35.584)	(37.944)
No of family members	0.185	0.715	4.667	68,976.777*	59,588.558	-20.980	0.462
	(0.135)	(10.843)	(6.637)	(40,919.604)	(36,374.861)	(16.760)	(17.871)
Share of income from pepper in total income	0.017**	0.985	0.817	9,119.251***	9,673.623***	-1.020	-0.145
	(0.007)	(0.843)	(0.516)	(3,181.749)	(2,828.368)	(1.303)	(1.390)
Total area	0.864***	47.264	27.481	396,698.561**	390,545.494**	-149.231*	-63.964
	(0.265)	(49.416)	(30.249)	(186,483.578)	(165,771.746)	(76.380)	(81.446)
Inverse Mills Ratio		-77.007	-33.658	-510,582.032*	-533,495.146**	230.428*	65.103
		(76.368)	(46.747)	(288,195.470)	(256,186.989)	(118.039)	(125.868)
Constant	-2.490	609.216***	566.028***	-556,156.232	-389,947.770	322.748**	227.814
	(1.562)	(94.471)	(57.829)	(356,513.627)	(316,917.378)	(146.021)	(155.705)
Observations	80	79	79	79	79	79	79
Pseudo/R-squared	0.234	0.098	0.211	0.215	0.253	0.179	0.099

Notes: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Pseudo R^2 value is 0.234, Likelihood Ratio Chi^2 value is 26.01***

IV

CONCLUSIONS AND POLICY IMPLICATIONS

The study revealed that the black pepper prices were highly volatile, especially the inter-annual volatility has increased in the open trade regime. The prices received by the PDS farmers are higher than non-PDS farmers. Even though the average prices were higher among PDS the effects were not visible in the net-income. But the farmers in PDS were replanting more plants than non-PDS farmers in years of lower prices. Disease and pest incidence has been identified as the major constraint in black pepper production by both PDS and non-PDS farmers.

Based on the study it was found that contractual agreement alone could not protect the farmers from price variations. Proper implementation of the warehouse receipt system for a storable commodity like black pepper could enable the farmers to borrow from banks using the warehouse receipt as collateral. This will help the farmers to meet their immediate cash needs and reduce the vulnerability of farmers to price volatility by preventing distress sales. The dissemination of timely market intelligence and training the farmers on the use of market intelligence for making suitable selling decisions based on the price movements are very important for a commodity like black pepper which is characterised by volatile prices. Most of the farmers were lacking in understanding and capacity to use market intelligence in guiding their production and marketing decisions. Hence, dissemination of market intelligence and equipping the farmers on the use of market intelligence are very important. As the price volatility dynamics are different for different crops, a practically implementable, black pepper specific price stabilisation mechanism which could adjust for changes in cost of cultivation as well as guarantee a stable and minimum income for the farmers need to be developed.

Received January 2019. *Revision accepted July 2020.*

NOTES

1. Malabar Garbled (MG) pepper in Kochi and Malabar Garbled 1 (MG1) pepper in New York.
2. Idukki district accounted for more than 50 per cent of the area under black pepper in Kerala.
3. Endogeneity in the model specification is due to self-selection bias. Self-selection bias is a situation in which individuals selected themselves into a group.

REFERENCES

Aditya, K.S.; S.P. Subash, K.V. Praveen, M.L. Nithyashree, N. Bhuvana and A Sharma (2017), "Awareness About Minimum Support Price and Its Impact on Diversification Decision of Farmers in India", *Asia and the Pacific Policy Studies*, Vol.4, No.3, pp.514–526.

Anoopkumar, M. (2012), "Commodity Price Instability Under Globalization: A Study of India's Plantation Crops on Building Competitiveness in a Globalised World: Experience of India's Plantation Sector", Proceedings of a National Seminar, Trivandrum, 23-24 January 2012, National Research Programme on Plantation Development, Centre for Development Studies, Trivandrum. pp.92-126.

Cashin and McDermmot (2006), "Parity Reversion in Real Exchange Rates: Fast, Slow or Not at all", Available at: https://www.imf.org/External/Pubs/FT/staffp/2006/01/pdf/cashin.pdf. Accessed on 02 February 2019.

Das, J.K. and G. Chakraborty (2015), "The Hedging Performance of Commodity Futures in India: An Empirical Study on Some Agricultural Commodities", *International Journal of Information, Business and Management*, Vol.7, No.3, pp.159-162.

Dehn, J.; C.L. Gilbert and P. Varangis (2005), "Agricultural Commodity Price Volatility", in J. Aizenmann and B. Pinto (Eds.) (2005), *Managing Economic Volatility and Crises – A Practitioner's Guide*, University Press, Cambridge, pp.137-185.

Food and Agriculture Organization of the United Nations (FAO) (2011), *Price Volatility in Food and Agricultural Markets: Policy Responses,* Rome.

Garett, H.E. and R.S. Woodworth (1969), *Statistics in Psychology and Education*, Vakils, Feffer and Simons Pvt. Ltd., Bombay, pp. 329.

Garman, M.B. and M.J. Klass (1980), "On the Estimation of Price Volatility from Historical Data", *Journal of Business*, Vol.53, pp.67-78.

Gilbert, C.L. (2006), "Trends and Volatility in Commodity Prices", in A. Sarris and D. Hallam, (Eds.) (2006), *Agricultural Commodity Markets and Trade – New Approaches to Analyzing Market Structure and Instability*, Edward Elgar, U.S.A., pp.31-60.

Hallam, D. and A. Sarris (2006), *Agricultural Commodity Markets and Trade – New Approaches to Analyzing Market Structure and Instability*, Edward Elgar, U.S.A., pp. 480.

Harilal, K.N. (2010), *ASEAN-India Free Trade Noises of Dissent from Deep South*, Kerala State Planning Board, Trivandrum. 88p.

Hazell, P.B.R. (1988), "Changing Patterns of Variability in Cereal Prices and Production", in W.M. John and A. Raisuddin (Eds.) (1988), *Agricultural Price Policy for Developing Countries*, The Johns Hopkins University Press, Baltimore, pp.27-52.

Heckman, J. (1979), "Sample Selection Bias as a Specification Error", *Econometrica*, Vol.47, No.1, pp.153-161.

Kunitomo, N. (1992), "Improving the Parkinson Methods of Estimating Security Price Volatilities", *Journal of Business*, Vol.65, pp.295-302.

Kuruvila, A.; L.C. Bastine and J. Joseph (2012), *Assessing the Implications of International Price Volatility and Transmission on Indian Agricultural Prices in the Context of Trade Liberalization*, SANEI Working Paper Series No. 12-01, South Asia Network of Economic Research Institutes, Dhaka,

Lingareddy and Tulsi (2008), "Expert Committee on Commodity Futures: Agreements and Disagreements", *Economic and Political Weekly*, Vol.43, No.34, 23 August, pp.35-42.

Parkinson, M. (1980), "The Extreme Value Method for Estimating the Variance of the Rate of Return", *Journal of Business*, Vol.53, pp.61-65.

Pingali, P.; A. Aiyar, M. Abraham and A. Rahman (2019), *Transforming Food Systems for a Rising India,* Palgrave Macmillan, Switzerland.

Sabu, S.S. and A. Kuruvila (2016), "Price Instability in Black Pepper: A Comparative Analysis of Pre-Liberalisation and Post-Liberalisation Periods", *Journal of Tropical Agriculture*, Vol.54, No.1, pp.41-49.

Saenz-Segura, F.; M. D'Haese and S. Speelman (2009), "The Influence of Contracts on Smallholder Pepper (Piper nigrum L.) Producers in Costa Rica under Different Market Conditions", *Fruits*, Vol.64, No.6, pp.371–382.

Sajitha, A. (2014), Regional *Variations in the Performance of Black Pepper Cultivation in Kerala: An Exploration of Non-Price Factors,* Discussion paper No. 33, National Research Programme on Plantation Development, Centre for Development Studies, Trivandrum, 60 pp.

Sartorius, K. and J. Kirsten (2007), "A Framework to Facilitate Institutional Arrangements for Smallholder Supply in Developing Countries: An Agribusiness Perspective", *Food Policy*, Elsevier, Vol.32, No.5, pp.640-655.

Singh, A. and N.P. Singh (2014), "Commodity Futures Market Efficiency and Related Issues: A Review of Existing Literature", *Asian Journal of Business and Economics*, Vol.4, No.4.4, pp.1-21.

Singh, S. (2002), "Contracting Out Solutions: Political Economy of Contract Farming in the Indian Punjab", *World Development*, Vol.30, No.9, pp.1621–1638.

Spices Board (2018), *Spice Wise Area and Production*, Available at: http://indianspices.com/pdf/Major%20spice%20wise%20areaandproductionsr.pdf. Accessed on 25.11.2018.

Sumalatha, B.S. (2019), "Traders' Participation in Commodity Futures Markets in Kerala: A Case Study of Pubber and Pepper Trade", *Economic and Political Weekly*, Vol.54, No.1, 5 January, pp.44-52.

Tothova, M. (2011), "Main Challenges of Price Volatility in Agricultural Commodity Markets", in Piot-Lepetit, I. and R.M. Barek (Eds.) (2011), *Methods to Analyse Agricultural Commodity Price Volatility*, Springer, New York, pp.13-29.