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Research Article

Modelling the Relationship between Black Pepper Price and its Determinants for Half a Century Period using Panel Quantile Regression

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Abstract: This study intends to test the relationship between black pepper price and its determinants in the international market. Area harvested, production of pepper, yield of pepper, export of pepper, consumption of pepper and inflation are taken as the determinants of black pepper price in this study, based on the review of previous literature. The researchers have used panel quantile regression for investigating the relationship between the variables and thus ensured the uniqueness of the study. The study revealed that the variables, area, production, yield and export are significant predictors of pepper price in all the countries, while consumption cannot be considered as a significant determinant of pepper price. This study contributes to the literature on agricultural economics and specifically on black pepper pricing, as there are very few studies conducted in this field. This study provides primary evidence of non-economic factors influencing commodity prices in the international market.

Key Words: Black pepper price, area harvested, production, inflation, panel quantile regression

1. Introduction

Black pepper, being a trade dependent commodity, shows high degree of price fluctuations. The world pepper market is rather well integrated. Prices move in parallel in producing and consuming countries hence it is important to analyse the various determinants of pepper price in the international market. As pepper is highly used in food and other products like pharmaceuticals, the export performance by producing countries is increasing at a faster rate. The current supply is not able to meet the demand in the international market, which has made the exports more profitable. And this has led some of the countries to focus on black pepper export by increasing the area, production and yield. Recently, pepper consumption in the producing countries is increasing steadily. Change in food habit and the increasing preference for flavorful and healthy foods has resulted in improved consumption across world. With the increase in demand, it is seen that the old crop stocks are persistently declining in these countries. The growth in production, area harvested, yield, exports and consumption would generate rural employment and income to the producers and bring in efficiency to entire production process through better technology and international quality standards, which in turn will further improve the price of the commodity. Area under harvesting, production and lagged export quantity have been pointed out by previous literatures as the main drivers influencing pepper price in the world. The study has therefore been undertaken to identify the drivers for its price in the international market. To ascertain the drivers of pepper price at the macro level, an empirical analysis was carried out using regression analysis. It is expected that besides farm-level inputs, other external factors also influence the current price of black pepper such as inflation.

This study considers Area harvested, production, yield, export, consumption, and inflation, as the most important determinants of black pepper price in the international market, hence attempted to find out the nexus between these variables. The study is conducted based on the data of five pepper producing and exporting countries, such as India, Brazil, Indonesia, Sri Lanka and Vietnam. The study is focussing only on fifty years data from the year 1969 to 2018, relating to these drivers of pepper price. The study has used annual data of the variables and has not looked into the daily /weekly/quarterly price of black pepper in the international market. There are only limited researches examining the factors influencing black pepper price across the globe. Available literature on the subject is not adequate enough to capture the relationship quantitatively. Moreover, the existing literature in both agricultural economics as well as price theory remain silent about the role of various agriculture related, and non-economic drivers of price in general. Thus, this study is a pioneering attempt to understand the complex and unveiled relationship among black pepper price and its determinants in the international market.

2. Literature Review

The study is intended to understand the factors that affect the price of black pepper across the globe. With that objectives in mind, the researcher has conducted a thorough literature review and the six variables namely area harvested, production of pepper, yield of pepper, export, consumption and inflation were found used repeatedly in many studies. Hence, the researchers also selected these six variables as the determinants of pepper price in this study. The previous studies reviewed for the current study are presented below:

In a study of Hema, Kumar & Singh (2007), it has been found that area under the crop and lagged export quantity are the main drivers of pepper production in India. Along with this, the authors have performed a co-integration analysis also so as to trace the long-term relationship between farm harvest price, domestic price and export price of black pepper. The result of the same indicated that the farm harvest price had been highly integrated with domestic price and export price of pepper. The study of Anoopkumar (2012) regarding the instability of black pepper price in India for short term period elucidated that the crop has shown a less degree of instability due to its storable attribute and more possibility for inter-temporal arbitraging. In addition to this, it was also revealed that the quantum of intra year price instability found to be higher during the times of crop failure and low during bumper crop seasons for black pepper. In essence, it study revealed the inverse relationship between supply and price, where the price will go down when there is excess supply of the commodity and vice versa. The study was concluded with a policy recommendation that the price stabilisation programme of the government should be crop specific since the price instability phenomenon found to be different for storable and non-storable crops. Aviral, Dash & Dutta (2015) analysed the stationarity characteristics of prices of 46 agricultural commodities, including black pepper. They have analysed data from the beginning of 2000 to the beginning of 2013. They have tested the null hypothesis of unit root test and the null hypothesis of stationarity. The results indicated that there existed stationarity for black pepper along with some other commodities, thus implying that any policy that influence the price of such commodities, including pepper would not have a permanent impact since the forecasting of their prices would give reliable results due to the stationarity nature. Sinharoy & Nair (1994) tried to reveal whether the price of Indian pepper reflected that of international market conditions i.e., whether both are co integrated. They have conducted this study on the backdrop of trade liberalisation of India and the results said that due to the open status of trade for pepper (which has been so since the time of colonialisation) have moved synchronously, meaning the world pepper markets were integrated. As a result, there could be a chance for responsiveness of domestic supply variables in tandem with the international market conditions. Chopra & Bessler (2005) have also mentioned about the storability or longevity factor of pepper. Their study was to find out the interrelationship between three inter-temporal related markets i.e., the spot market, the nearby futures market and distant futures market. They have analysed data from to for the study and the results indicated that the spot market did respond to information emanating from both the futures markets, but they could not sort out which one of these futures market dominated the price discovery in the spot market. In other studies abroad, the researchers were able to establish a relationship either between the spot price and nearby futures contracts or between spot price and distant futures contract. In the present study, the authors ascribe the absence of such a result to the storability of pepper and the issue of pepper futures contracts in consecutive months. The results of ARCH, GARCH and trend analysis indicted that the trade liberalisation of India in the early 1990s has indeed worsened the price volatility major cash crops, especially black pepper *inter alia.* It was recommended in the study that the trade liberalisation in agricultural sector can be acceptable for developing countries only if it is convinced of its potential benefits as it is source of livelihood for a lion share of people and ensuring food security (Santhosh Kumar, Lagesh & Saleena, 2012). Sabu, Kuruvila & Manojkumar (2019) also tried to study the price behaviour of black pepper in pre liberalisation and post liberalisation periods. Their result showed that the variance in price of black pepper has increased in the post liberalisation period. The prices of the crop showed cyclical behaviour and the length of low price periods were higher than the periods of price hike. In addition to this seasonal trend has also been identified in the price pattern with low price coinciding with harvesting seasons and price hike attached to off-season periods. They have employed trend, Coefficient of Variation around Trend etc. for the analysis. Madan (2000) looked at price fluctuation from a different angle of the nexus between the farm price, production decisions and export price. He observed that the production decision was to an extent influenced by the farm price, which in turn was influenced by the export price. Hence, in order to stabilise the export price i.e., international price of black pepper, he put forth the suggestion of entering into cartel with other pepper producing countries like Vietnam. Besides, grooming a big domestic market also would protect the Indian pepper economy from the violent perturbations of international pepper economy. The study of Jeromi & Ramanathan (1993) tried to shed light upon growth and instability of world pepper market during the period between 1975 and 1990; and export performance of Indian pepper with regard to growth, direction, competitive position and terms of trading between 1950-51 and 1990-91. For the analysis, the researchers have fitted an exponential model of type using Ordinary Least Squares (OLS) technique. The results indicated that the unfavourable price trend posed a serious problems to the pepper producing countries. The prices and the fluctuations of the commodity in international arena were mainly due to changes in supply conditions rather than demand factors, as it was assumed that the demand for the commodity would not vary significantly in view of specific and fixed nature of use. Introduction of an efficient supply management system and strengthening the bargaining power by including the then non-members of International Pepper Community (IPC) such as Vietnam, Sri Lanka and Thailand have been recommended by the researchers as the solutions to these issues. Besides, it was also made clear that the competitive power of India in terms of relative prices had been on a declining trajectory due to increased unit cost of production in India as compared to other producing countries and negligible domestic demand for pepper in other producing countries. The researchers have suggested for product diversification to overcome this shortcoming. Ibrahim & Maad (2016) tried to find out the factors that

influence the price of black pepper in Malaysia. It was done through comparing two methodologies: (i) multiple linear regression model and (ii) Vector Autoregreesive Model (VAR). The result of the study delineated that the previous year on the amount of production, export and the pricing itself were the factors that significantly influence the annual pricing of black pepper in Malaysia. Besides, it was also revealed that VAR model is comparatively reliable than multiple linear regression model as the former showed higher multiple R square value and its ability to withstand autocorrelation problem among the error terms.

3. Objectives of the Study

Studies investigating the relationship between black pepper price and its determinants are very scanty across the globe. Available literatures on the subject either addressed some of the determinants or gave theoretical explanations for the existence of such relationship and failed to address the issue quantitatively. However, this study primarily intends to answer the research questions such as what is the nature of linkage between black pepper price and its determinants, whether there is any country effect or year effect in the relationship between black pepper price and its determinants quantitatively. To answer these research questions, the following objectives were formulated:

- To find out whether there is country effect in the relationship between black pepper price and its determinants
- To find out whether there is year effect in the relationship between black pepper price and its determinants
- To find out the relationship between black pepper price and its determinants

4. Research Methodology

The study is quantitative in nature and is primarily based on secondary data. Data were collected for a period of 50 years from the year 1969 to 2018, for five pepper producing and exporting countries, namely India, Brazil, Indonesia, Sri Lanka and Vietnam. Data were collected from secondary sources like International Pepper Community, FAO Stat.

The data collected were analysed using STATA 13.0 software. This study is based on panel data of seven different variables from five different countries for a period of 50 years ranging from 1969 to 2019. Thus, a model that is capable of handling multiple independent variables at multiple time periods across multiple regions is necessary. It is in this background, the panel data regression model has been identified for data analysis. In addition to this, panel data model can efficiently handle the issue of heteroscedasticity associated with a time series data. Panel quantile regression models are specified as follows for quantiles 10^{th}, 25^{th}, 50^{th}, 75^{th} and 90^{th}:

$$Y_{it} = \alpha_{q_{it}} + \beta_{q,1}\,\text{area}_{it} + \beta_{q,2}\text{prod}_{it} + \beta_{q,3}\text{yie}_{it} + \beta_{q,4}\text{exp}_{it} + \beta_{q,5}\text{cons}_{it} + \beta_{q,6}\text{inf}_{it} + e_{q_{it}} \quad (1)$$

where Y_{it} denotes price of pepper and 'q' stands for different quantiles 0.10, 0.25, 0.50, .075, and 0.90; $e_{q_{it}}$ is the error term across quantiles .

5. Results and discussions

Descriptive Statistics

Table 1
Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Price	250	2280.304	2099.500	40.500	9764.050
Production	250	41174.423	32208.710	1505	175000
Yield	250	0.827	0.570	0.080	2.530
Export	250	0.808	0.627	0.000	3.000
Consumption	250	14458.691	14568.900	-10000	61000
Inflation	250	59.752	346.540	-30.670	4116.200
Area	250	77014.211	67988.970	2211.00	358570.000

Source: STATA Output

It is clear from the Table 1 that the average price of pepper is 2280.30 with a standard deviation 2099.50. However, the average pepper production is found to be 41174 MT and the standard deviation is 32208 MT. The Yield of pepper is having an average score of 0.827 with a standard deviation of 0.570. The total export of pepper is having an average of 0.808 and a standard deviation of 0.627. Consumption of pepper is reported to have a mean value of 14458 with a standard deviation of 14568 MT. The average inflation across the panel is found to be 59.75 with a standard deviation of 346.54, while area harvested is found to have an average of 77014 Ha and standard deviation of 67988 Ha. Price showed huge variation among the values hence the study used log of price as the indicator of price in all the further analysis.

Correlations among the Variables

After the summary statistics the study tested the correlation between the variables. Table 2 provides the correlation among the variables. None of the variables reported high correlation except price and area harvested and export and yield, which is quite reasonable to have high correlations.

Table 2
Correlations

	Area	Production	Yield	Export	Consumption	Inflation	Price
Area	1.000						
Production	0.1468	1.000					
Yield	-0.0928	0.2803	1.000				
Export	-0.1832	0.2442	0.9611	1.000			
Consumption	0.5058	0.0338	-0.4558	-0.4987	1.000		
Inflation	-0.0964	-0.0581	0.1648	0.1601	-0.1113	1.000	
Price	0.8371	0.2083	-0.1682	-0.2374	0.4266	-0.0653	1.000

Source: STATA Output

Country Effect

We have also tested for possible country effect in the data. The results are given in Table 3. The analysis revealed that there is no country effect in the data.

Table 3
Country Effect

lnprice	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Area	0.00057	2.89E-05	19.720	0.000	0.000513	0.000626
Production	7.76E-06	1.60E-06	4.841	0.000	4.60E-06	1.09E-05
Yield	-0.42192	0.322121	-1.312	0.191	-1.05638	0.21253
Export	-0.07052	0.295089	-0.243	0.811	-0.65173	0.510691
Consumption	1.60E-06	4.73E-06	0.342	0.736	-7.72E-06	1.09E-05
Inflation	0.000318	0.000143	2.233	0.027	3.71E-05	0.000598
country	0.20081	0.038874	5.171	0.000**	0.124243	0.277376
Constant	5.145514	0.18269	28.17	0.000	4.785686	5.505343
Prob.>F=0.000;R-Squared = 0.7550; Adjusted R-squared= 0.7480 Observations: 255; No.of Country: 5						

Source: STATA Output

Year Effect

It was also attempted to test for year effect in the data. The result is given in Table 4. The result confirms the absence of year effect in the data.

Table 4
Year Effect

lnprice	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Area	0.0006	2.93E-05	20.49	0.000	0.000542	0.000657
Production	6.70E-06	1.65E-06	4.06	0.000	3.47E-06	9.93E-06
Yield	-0.36745	0.342206	-1.07	0.283	-1.03816	0.303263
Export	-0.06267	0.311613	-0.2	0.841	-0.67342	0.548079
Consumption	-5.82E-06	4.62E-06	-1.26	0.208	-1.5E-05	3.24E-06
Inflation	0.000158	0.000147	1.08	0.282	-0.00013	0.000445
Year	-0.00846	0.003538	-2.39	0.017**	-0.01539	-0.00152
Constant	22.64961	7.037762	3.22	0.001	8.855849	36.44337
Prob.>Chi^2=0.000; R-Squared = 0.6800; Wald Chi2(7) = 683.81 Observations: 255; No.of Country: 5						

Source: STATA Output

Determinants of Pepper Price: Panel Quantile Regression

GMM (1991) and GMM System (1998) dynamic estimators are not robust in explaining the relationship envisaged in the model. Further to the specific advantages of quantile regression estimation over the OLS, GMM, fixed effect and random effect estimations, we have examined the 10th, 25th, 50th, 75th and 90th quantiles for the model specified. The equations are presented below:

$$Q_{\alpha 10}(lnprice)it = \alpha_{\alpha 10} + \beta_{\alpha 10,1}(area)it + \beta_{\alpha 10,2}(prod)it + \beta_{\alpha 10,3}(yie)it + \beta_{\alpha 10,4}(exp)it + \beta_{\alpha 10,5}(cons)it + \beta_{\alpha 10,6}(inf)it + \varepsilon it \quad (a)$$

$$Q_{\alpha 25}(lnprice)it = \alpha_{\alpha 25} + \beta_{\alpha 25,1}(area)it + \beta_{\alpha 25,2}(prod)it + \beta_{\alpha 25,3}(yie)it + \beta_{\alpha 25,4}(exp)it + \beta_{\alpha 25,5}(cons)it + \beta_{\alpha 25,6}(inf)it + \varepsilon it \quad (b)$$

$$Q_{\alpha 50}(lnprice)it = \alpha_{\alpha 50} + \beta_{\alpha 50,1}(area)it + \beta_{\alpha 50,2}(prod)it + \beta_{\alpha 50,3}(yie)it + \beta_{\alpha 50,4}(exp)it + \beta_{\alpha 50,5}(cons)it + \beta_{\alpha 50,6}(inf)it + \varepsilon it \quad (c)$$

$$Q_{\alpha 75}(lnprice)it = \alpha_{\alpha 75} + \beta_{\alpha 75,1}(area)it + \beta_{\alpha 75,2}(prod)it + \beta_{\alpha 75,3}(yie)it + \beta_{\alpha 75,4}(exp)it + \beta_{\alpha 75,5}(cons)it + \beta_{\alpha 75,6}(inf)it + \varepsilon it \quad (d)$$

$$Q_{\alpha 90}(lnprice)it = \alpha_{\alpha 790} + \beta_{\alpha 90,1}(area)it + \beta_{\alpha 90,2}(prod)it + \beta_{\alpha 90,3}(yie)it + \beta_{\alpha 90,4}(exp)it + \beta_{\alpha 90,5}(cons)it + \beta_{\alpha 90,6}(inf)it + \varepsilon it \quad (e)$$

Panel Quantile Regression (10th Quantile)

The study used seven different panel quantile regression models, to explain the relationships envisaged in the study. First model is run with all the independent variables. Second model considers all the independent variables except area harvested. The third model is run with all the independent variables except production of pepper. The fourth model tested the relationships in the absence of the independent variable yield of pepper across countries. The next model considers all the independent variables except export of pepper by the participating countries. The sixth model is run with all the independent variables except consumption of pepper and the last model is run to test the relationship between the variables in the absence of macro-economic indicator, inflation. The details of the first model is given in Table 5

Table 5
Panel Quantile Regression (10th Quantile)

lnpric	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Area	0.000658	5.14E-05	12.79	0.000***	0.000557	0.000759
Production	5.07E-06	2.93E-06	1.73	0.085**	-6.99E-07	1.08E-05
Yield	-0.90764	0.594486	-1.53	0.128	-2.07853	0.263246
Export	0.313357	0.543199	0.58	0.565	-0.75651	1.383228
Consumption	-1.9E-05	8.04E-06	-2.35	0.020***	-3.5E-05	-3.03E-06
Inflation	0.000265	0.00026	1.02	0.308	-0.00025	0.000777
Constant	4.87602	0.232491	20.97	0.000***	4.418112	5.333929
Observations =255; No. of country=5						

Source: STATA Output

In model 1 we have tested the relationship between the dependent variable, price of pepper and all the independent variables specified in the study. It was found that the variables area and production are positively influencing pepper price while export, consumption and inflation are negatively contributing to it. It was also noticed that yield of pepper is not having an impact on price of pepper in these countries at the 10th quantile.

Panel Quantile Regression (25th Quantile)

Quantile regression was run for 25th quantile also. The purpose is to test whether the results obtained in the 10th quantile is robust in explaining the relationship between the variables used in the study. Here also we have run seven different models. The results of the first model are given in Table 6

Table 6
Panel Quantile Regression (25th Quantile)

lnpric	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Area	0.000703	0.00007	10.05	0.000***	0.000565	0.000841
Production	8.72E-06	3.98E-06	2.19	0.030***	8.75E-07	1.66E-05
Yield	-0.62092	0.808448	-0.77	0.443	-2.21322	0.971378
Export	-0.17549	0.738702	-0.24	0.812	-1.63042	1.27944
Consumption	-1.2E-05	1.09E-05	-1.05	0.296	-3.3E-05	1.01E-05
Inflation	0.000477	0.000353	1.35	0.179	-0.00022	0.001172
Constant	5.269763	0.316167	16.67	0.000	4.647048	5.892478
Observations =255; No. of country=5						

Source: STATA Output

The second model is used to test the relationship between price of pepper, area harvested, production of pepper, yield of pepper, export of pepper, consumption of pepper and inflation. It was found from Table 4.4.13.1 that the variables, area and production are positively influencing pepper price while yield, export, consumption of pepper and inflation are not significantly contributing to it at the 25th quantile.

Panel Quantile Regression (50th Quantile)

Quantile regression was run for 50th quantile also. The purpose is to test whether the results obtained in the 10th and 25th quantiles are robust enough in explaining the relationship between the variables used in the study. Here also we have run seven different models. The results of the first model are given in Table 7

Table 7
Panel Quantile Regression (50th Quantile)

lnpric	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Area	0.000493	0.000053	9.3	0.000***	0.000389	0.000598
Production	3.80E-06	3.02E-06	1.26	0.210	-2.15E-06	9.74E-06
Yield	0.422062	0.612916	0.69	0.492	-0.78512	1.629245
Export	-0.45786	0.560038	-0.82	0.414	-1.5609	0.645178
Consumption	-1.17E-06	8.29E-06	-0.14	0.888	-1.8E-05	1.52E-05
Inflation	7.15E-05	0.000268	0.27	0.791	-0.00046	0.000599
Constant	6.167055	0.239698	25.73	0.000	5.694951	6.639159
Observations =255; No. of country=5						

Source: STATA Output

The next model intends to test the relationship between pepper price, area harvested, production, yield, export of pepper, consumption of pepper and inflation. The analysis revealed that the area harvested is the only determinant of pepper price in this model across the participating countries at 5 percent level of significance. It

was observed that production, yield, export, consumption and inflation are not contributing to pepper price significantly at the 50th quantile. Area harvested is found to have a positive influence on pepper price.

Panel Quantile Regression (75th Quantile)

Quantile regression was run for 75th quantile also. The purpose is to test whether the results obtained in the 10th and 25th and 50th quantiles are robust enough in explaining the relationship between the variables used in the study. Here also we have run seven different models. The results of the first model are given in Table 8

Table 8
Panel Quantile Regression (75th Quantile)

lnpric	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Area	0.000439	6.16E-06	71.23	0.000***	0.000427	0.000451
Production	1.85E-06	3.51E-07	5.27	0.000***	1.16E-06	2.54E-06
Yield	0.155618	0.071193	2.19	0.030***	0.015398	0.295837
Export	-0.13733	0.065051	-2.11	0.036***	-0.26545	-0.0092
Consumption	8.45E-07	9.63E-07	0.88	0.381	-1.05E-06	2.74E-06
Inflation	-3.1E-05	3.11E-05	-1	0.319	-9.2E-05	3.02E-05
Constant	6.523787	0.027842	234.31	0.000	6.46895	6.578624
Observations =255; No. of country=5						

Source: STATA Output

This model tests the relationship between pepper price, area harvested, production of pepper, yield of pepper, export of pepper, consumption of pepper and inflation. The analysis revealed that the area harvested, production of pepper, yield of pepper and export of pepper are contributing significantly to pepper price in this model, across the participating countries at 5 percent level of significance. It was observed that consumption and inflation are not contributing to pepper price significantly at the 75th quantile. The analysis also reported that area, production and yield of pepper are positively contributing to the dependent variable, price of pepper, while export of pepper is negatively contributing to it.

Panel Quantile Regression (90th Quantile)

To ensure the robustness of the results, we have done quantile regression for the 90th quantile also. The purpose is to test whether the results obtained in the 10th and 25th and 50th and 75th quantiles are robust enough in explaining the relationship between the variables used in the study. Here also we have run seven different models. The results of the first model are given in Table 9

Table 9
Panel Quantile Regression (90th Quantile)

lnpric	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Area	0.00044	3.24E-06	135.810	0.000***	0.000434	0.000447
Production	1.65E-06	1.85E-07	8.960	0.000***	1.29E-06	2.02E-06
Yield	0.072338	0.037475	1.930	0.055**	-0.00147	0.146147
Export	-0.10533	0.034242	-3.080	0.002***	-0.17277	-0.03789
Consumption	-2.54E-07	5.07E-07	-0.50	0.617	-1.25E-06	7.44E-07
Inflation	3.68E-05	1.64E-05	2.250	0.026***	4.51E-06	0.000069
Constant	6.640862	0.014656	453.130	0.000***	6.611997	6.669728
Observations =255; No. of country=5						

Source: STATA Output

The last model intends to confirm whether the relationship established in the previous models are robust and to understand whether there is any change in the relationship specified in the model. The analysis revealed that the area harvested, production of pepper, yield of pepper, export of pepper and inflation are contributing significantly to pepper price in this model, across the participating countries at 5 percent and 10 percent levels of significance respectively. It was observed that consumption is not contributing to pepper price significantly at the 90^{th} quantile. The analysis also reported that area, production, yield and inflation are positively contributing to the dependent variable, price of pepper, while export is negatively contributing to it, thus confirming the results of the previous models.

It was found that area harvested, is significant and positive in determining the price of pepper at all the three quantiles across countries. Production is positively and significantly contributing to pepper price at 10^{th} , 25^{th} , 75^{th} and 90^{th} quantiles, while it is not significant at 50^{th} quantile. However, the results revealed that export, consumption and inflation are not really good indicators of pepper price these countries. Export is positive and statistically significant in determining pepper price at 75^{th} quantile, while it is negatively significant at the 90^{th} quantile. Yield of pepper is positively contributing to pepper price at 75^{th} quantile, while it was not significant at the other quantiles. The focus of this study was to investigate whether or not price of black pepper can be predicted using its determinants such as area harvested, production, yield, export, consumption and inflation and to validate the theoretical model explaining the linkages between black pepper price and its drivers. The current study involves analysis of data on multiple variable over a period of time and hence is designed as panel data study. The study results reported that area, production, yield, consumption and inflation are positively contributing to the dependent variable, price of pepper, while export is negatively contributing to it. As pepper is highly used in food and other products like pharmaceuticals, the export performance by producing countries is increasing at a faster rate. The current supply is not able to meet the demand in the international market, which has made the exports more profitable. And this has led some of the countries to focus on black pepper export by increasing the area, production and yield. Change in food habit and the increasing preference for flavourful and healthy foods has resulted in improved consumption across world. With the increase in demand, it is seen that the old crop stocks are persistently declining in these countries. The growth in production, area harvested, yield, exports and consumption would generate rural employment and income to the producers and bring in efficiency to entire production process through better technology and international quality standards, which in turn will further improve the price of the commodity.

6. Conclusion

The study concluded that there is no statistically significant difference in pepper price and its determinants, area harvested, production and yield of pepper across the participating countries, India, Brazil, Indonesia, Sri Lanka and Vietnam. It is also observed that the growth in all these variables are showing an upward trend, however, all the variables are highly volatile during the study period. It is found that the variables, area and production are significant predictors of pepper price in all the countries, while yield cannot be considered as a significant determinant of pepper price. Area and production being the major determinants of pepper price, it is advisable for countries to focus on these critical aspects to improve the pepper price in the domestic and international markets. Appropriate policy interventions are required to ensure that farmers are motivated and to cultivate pepper in more areas and to improve production by using innovative cultivation technologies, which will foster yield of pepper. Policy level interventions are required to increase the area of cultivation, and to motivate the farmers to use advanced agricultural technologies for better performance. Institutional level interventions can promote group farming of black pepper, which can increase the area harvested and production of black pepper.

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