DYNAMICS IN PRICES AND TRADE OF INDIAN SMALL CARDAMOM AND ITS IMPLICATIONS ON PRODUCERS

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2019

DECLARATION

I, hereby declare that this thesis entitled **"DYNAMICS IN PRICES AND TRADE OF INDIAN SMALL CARDAMOM AND ITS IMPLICATIONS ON PRODUCERS"** is a bonafide record of research work done by me during the course of research and the thesis has not previously formed the basis for the award to me any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.

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CONTENTS

Chapter	Title	Page No
1	INTRODUCTION	1-6
2	REVIEW OF LITERATURE	7-40
3	METHODOLOGY	41-65
4	RESULTS AND DISCUSSION	66-139
5	SUMMARY AND CONCLUSION	140-146
	REFERENCES	i-xviii
	APPENDICES	[i]-[x]
	ABSTRACT	i-iii

LIST OF TABLES

Table No.	Title	Page No.
3.1	Land utilization pattern of Idukki district in 2016-17	44
3.2	Distributions of sample farmers in Idukki district	45
3.3	Panchayat-wise area according to type of land	46
3.4	Components of change in export value of small cardamom	57
3.5	Policy Analysis Matrix	61
4.1	Operation-wise establishment cost of small cardamom in Idukki district	68
4.2	Input-wise establishment cost of small cardamom (₹ per hectare)	69
4.3	Operation-wise annual maintenance cost of small cardamom cultivation (₹ per hectare)	70
4.4	Input-wise annual maintenance cost of small cardamom cultivation (₹ per hectare)	72
4.5	Cost of cultivation of small cardamom (₹ per hectare)	73
4.6	Cost of production of small cardamom (₹ per kg)	74
4.7	Net returns from small cardamom cultivation in Idukki	74
4.8	Distribution of farmers based on selling behavior	78
4.9	Marketing cost in different channels (₹/kg) of small cardamom	80
4.10	Price spread in different marketing channels (₹/kg) of small cardamom	81
4.11	Marketing efficiency for small cardamom in different marketing channels	82
4.12	Results of the stationarity tests for monthly prices of small cardamom in rupee	85
4.13	Results of the stationarity tests for monthly prices of small cardamom in US dollar	86
4.14	Results of pair-wise cointegration tests between Indian (ungraded) and international prices of small cardamom in rupee	87
4.15	Results of pair-wise cointegration tests between Indian (ungraded) and international prices of small cardamom in US dollar	87
4.16	Results of the multiple cointegration tests between Indian (graded) and international prices small cardamom in rupee	89
4.17	Results of the multiple cointegration tests between Indian (graded) and international prices small cardamom in US dollar	90
4.18	Results of the pair-wise cointegration tests between Indian (graded) and international prices small cardamom in rupee	90

4.19	Results of the pair-wise cointegration tests between Indian (graded) and international prices small cardamom in US dollar	91
4.20	Results of the multiple cointegration tests between Indian small cardamom (graded) prices in rupee	91
4.21	Results of the multiple cointegration tests between Indian small cardamom (graded) prices in US dollar	92
4.22	Results of the pair-wise cointegration tests between Indian small cardamom (graded) prices in rupee	92
4.23	Results of the pair-wise cointegration tests between Indian small cardamom (graded) prices in US dollar	93
4.24	Co-integration between different price series of Indian small cardamom	95
4.25	Estimates of Error Correction Model for Indian ungraded (UG) and Indian extra bold in New York (IEB) in rupee	96
4.26	Estimates of Error Correction Model for Indian ungraded (UG) and Indian extra bold in New York (IEB) in US dollar	98
4.27	Estimates of Error Correction Model for Indian graded (AGEB) and Indian extra bold in New York (IEB) in rupee	99
4.28	Estimates of Error Correction Model for Indian graded (AGEB) and Indian extra bold in New York (IEB) in US dollar	99
4.29	Estimates of Error Correction Model for Indian graded cardamom AGEB and AGB in rupee	100
4.30	Estimates of Error Correction Model for Indian graded cardamom AGEB and AGB in US dollar	101
4.31	Estimates of Error Correction Model for Indian graded cardamom AGB and AGS in rupee	102
4.32	Estimates of Error Correction Model for Indian graded cardamom AGB and AGS in US dollar	103
4.33	Estimates of Error Correction Model for Indian graded cardamom AGS and AGS1 in rupee	104
4.34	Estimates of Error Correction Model for Indian graded cardamom AGS and AGS1 in US dollar	105
4.35	Results of the Granger causality test for monthly prices of small cardamom in rupee	107
4.36	Results of the Granger causality test for monthly prices of small cardamom in US dollar	108
4.37	Estimates of the Nerlovian supply response for small cardamom	111
4.38	Price elasticities of supply of small cardamom	111
4.39	Compound Annual Growth Rate (CAGR) of Indian small cardamom export from India	113
4.40	Instability in export of small cardamom from India	114
4.41	Decomposition of components of change in average export value of small cardamom	116
4.42	Components of change in variance of export value	117
4.43	Geographic concentration of Indian small cardamom export	119

4.44	Transition probability matrix for small cardamom export from India for overall period (1970-71 to 2017-18)	122
4.45	Transition probability matrix for small cardamom export from India in the pre-WTO period (1970-71 to 1994-95)	123
4.46	Transition probability matrix for small cardamom export from India in the post-WTO period (1995-96 to 2017-18)	124
4.47	Transition probability matrix for small cardamom export from India in period I (1970-71 to 1979-80)	125
4.48	Transition probability matrix for small cardamom export from India in period II (1980-81 to 1989-90)	126
4.49	Transition probability matrix for small cardamom export from India in period III (1990-91 to 1999-00)	127
4.50	Transition probability matrix for small cardamom export from India in period IV (2000-01 to 2009-10)	128
4.51	Transition probability matrix for small cardamom export from India in period V (2010-11 to 2017-18)	129
4.52	Major importing countries of small cardamom from India in the order of stability	130
4.53	Dynamics in export of small cardamom from India	131
4.54	Estimates of demand and supply elasticities of small cardamom exports from India	133
4.55	Policy Analysis Matrix	135
4.56	Competitive measures for small cardamom	137
4.57	Decomposition of price variance for small cardamom	139

LIST OF FIGURES

Figure No.	Title	Between Pages
1	Map of the study area	42-43
2	Market structure of small cardamom	75-76
3	Annual average auction price and production of small cardamom in Kerala	110-111
4	Comparison between domestic market price and export of small cardamom from India	114-115
5	Instability in export of small cardamom	114-115
6	Decomposition of sources of growth in small cardamom export value	115-116
7	Trend in geographic concentration of small cardamom export from India during pre-WTO period	119-120
8	Trend in geographic concentration of small cardamom export from India during post-WTO period	119-120
9	Trend in geographic concentration of small cardamom export from India during overall period from 1970-71 to 2017-18	119-120
10	Change in the share of different countries in Indian small cardamom export	119-120

LIST OF PLATES

Plate No.	Title	Between Pages
1	Survey of small cardamom farmers in Idukki district	46-47
2	Survey of small cardamom traders	46-47
3	Spices Board auction centre for small cardamom	75-76
4	Post-harvest activities for small cardamom	75-76

LIST OF APPENDICES

Appendix No.	Title	Page No.
I	Survey questionnaire	[i]-[ix]
II	Details of secondary data	[x]

Introduction

1. INTRODUCTION

Small cardamom (*Elettaria cardamomum*), the aromatic queen of spices, is one of the oldest and most expensive spices in the world. Evergreen forests of Western Ghats of South India are considered as the centre of origin as well as the natural habitat of small cardamom. Indian cardamom is known worldwide for its quality and is exported to several countries.

Guatemala is the largest producer and exporter of small cardamom in the world, with an average annual production of 38,000 tonnes in 2015-16. India, formerly the largest producer, is now the second largest producer in the world, with an annual production of 20,640 tonnes in 2017-18 (Spices Board, 2018). In India, Kerala accounts for the major share in cardamom cultivation with 57 per cent of the area and 89 per cent of the production in the country during the Triennium Ending (TE) 2016-17 (Spices Board, 2018), followed by Karnataka and Tamil Nadu. In Kerala, Idukki district accounts for the major share under small cardamom cultivation with 31,166 hectares of area and 17,914 tonnes of production in 2017-18.

Kerala is characterized by the cultivation of trade dependent plantation crops which are either export oriented or import substituting. The cultivation of cardamom as a plantation crop in Kerala has evolved under unique socio-political, economic and ecological conditions. The introduction of a high yielding variety of cardamom "Njallani" in late 1980s and high prices in recent years have transformed cardamom cultivation by increasing the number of small and marginal holdings in Kerala (Krishna, 2014).

The increase in production from 3,170 tonnes in 1970-71 to 17,990 tonnes in 2016-17, even with 24 per cent decline in area, could be attributed to the fourfold increase in productivity during the period. The declining export intensity of production from more than 50 per cent in TE 1972-73 to about 25 per cent in TE 2016-17, even with a six-fold increase in production, is not only due to rising domestic demand but also because of the fall in share in the international market

because of the emergence of countries like Guatemala as a competitive producer and exporter.

Cardamom is not a freely traded commodity and as per the Cardamom (Licensing & Marketing) Rules, 1987 it is mandatory for the producers to sell through licensed auctioneers and auction system. The institutional context in which marketing of cardamom takes place has been characterised by regulations in the form of restricting the entry of participants *viz*., auctioneers, dealers and exporters in the auction system with the objectives of ensuring a fair price and timely payment of sale proceeds. The small and marginal farmers sell immediately to traders after drying, without grading, realizing a comparatively lower price, while the medium and large farmers get reasonably fair price, as they offer their produce in the auctions (Bhadouria *et al*., 2012).

The major market centres of small cardamom are located in Bodinayakanur (Tamil Nadu) and Vandanmettu (Kerala). The Spices Board introduced the e-auction of cardamom that replaced the traditional out-cry method of auctions in Kerala and Tamil Nadu. The first e-auction centre for cardamom was established in Bodinayakanur in Tamil Nadu during August 2007. Later in December 2007, the second e-auction centre was formed in Vandanmettu in Idukki district of Kerala. In the system of e-auction, bidders are unaware of the prices quoted by their rival bidders, which ensures healthy competition and a fair price for the commodity. This system has led to transparency in the auction process and has been functioning successfully in both the centres.

Subsequent to the introduction of e-auction in Kerala, there was significant increase in the production and productivity of cardamom compared to mid-1980s. Notably, the export intensity of production i.e., share of export in production steadily declined from over 60 per cent in mid-1980s to less than 10 per cent since 1990s. In terms of the market structure, the domination of a single auctioneer that prevailed in mid-1980s was replaced by an oligopolistic market structure, while the market concentration at the level of dealers appeared to have declined significantly. The price wedge between different lots of cardamom sold through auctions also reduced significantly after the introduction of e-auction system (Joseph, 2011).

As an exception to the commonly observed pattern of commodity prices, the peak price for cardamom is observed during peak season itself (Joseph and George, 2010), because of the inherent property that the green coloured cardamom is available more in the peak season and also the nature of demand (Joseph, 1985). This price behaviour is still evident even after cardamom had become a domestic market-oriented crop (Joseph and George, 2010).

The trade liberalization policies have brought challenges as well as opportunities for the state of Kerala because of the increased integration of the country with the world, with serious implications for price stability and trade competitiveness (Chand, 2001). Price risk, one of the most serious challenges in the neo-liberalized era, apart from making the farmers' income unstable, has many long-run consequences. Price volatility of cash crops has severely inhibited investment and destabilized the earning of small holders. The market price volatility is the major challenge faced by the cardamom exporters in the international market (George and Cherian, 2017). Cardamom shows the highest intra-year instability among the plantation crops because of low storability and seasonality which makes inter-temporal arbitraging by keeping in stocks less possible (Anoopkumar, 2013).

The extent of global price transmission to domestic markets is governed by several factors: transport and marketing costs, domestic policies, exchange rate dynamics, market structure, degree of processing of final consumption goods, the market share of production and consumption, and trade policy measures. Frequent variations in the world prices have led to uncertainty in the decisions of the farmers on what crops to grow and the decision of countries on when to import the commodities, as their decisions highly rely on the past price levels**.** The state has experienced a number of challenges during the past two decades including the volatility in prices, shift in the cropping pattern, and delayed implementation of policies. All these problems had adverse impact on the production of the plantation crops, which has severely affected small and marginal farmers (Anitha *et al*., 2012).

Even though the expansion of domestic market is moderating the shocks from international price fluctuations, Kerala's share in the value of cardamom output in India has declined from 78 per cent in 1999-00 to 70 per cent in 2015-16 (CSO, 2018). Karnataka is emerging as an efficient producer and in the long run, Kerala has to be competitive both in terms of price and quality for achieving a sustainable farm trade security system.

It is the value of output and the cost of cultivation that determine the relative profitability of the crop at the farm-gate and thereby influencing the resource allocation, including the allocation of land among alternative crops (George, 1988). Even though prices of the commodity also fluctuate in accordance with its supply and demand situation, studying the supply response in perennial crops is a greater challenge owing to the gestation/pre-bearing period of these crops and also an extended period of output flow, which are almost two years and 25 years respectively for small cardamom. The future output adjustments are actually defined by the present planting decisions of the farmers of perennial crops. Also, farmers can change their future productive capacity by altering their planting decisions. Any adjustment in the productive capacity of a particular plantation crop during a particular year is the net effect of the plantation decisions that modify both the total cultivated area and the age composition of the tree stocks in the past (Kalaitzandonakes and Shonkwiler, 1992).

The intensity of competition faced by Indian spices continues to increase as a result of the provisions of WTO and globalization. All the categories of spices exporters, irrespective of scale of operation, form of business or experience levels are affected adversely due to the competition in the international market. The price fluctuations and trade competitiveness of cardamom ultimately affect the returns of the producers and thus have significant impact on their overall welfare. The studies on producer level implications of changes in prices and trade of cardamom assist the producer households to cope up with the market uncertainties and studies with such a perspective are limited in the Kerala context.

The present study was undertaken with the objectives to estimate the cost of cultivation of small cardamom in Kerala by considering both establishment and

maintenance costs and identified the marketing channels and estimated the marketing cost, margin, price spread and efficiency. The price formation and the extent and direction of price transmission between Indian and international markets were also studied. It also aimed at measuring the integration between cardamom prices in the Indian and international markets. The supply response analysis studied the influence of cardamom prices on its production through the response of farmers. The export performance was analysed through growth, instability, concentration and structural changes in export and the export competitiveness measures were also estimated. The implications of changes in price and trade at the farm level were also assessed.

The specific objectives of the study were

1. To study the economics of small cardamom cultivation and marketing
2. To study the price formation, transmission and integration between the domestic and international markets of small cardamom
3. To study the supply response of small cardamom in Kerala
4. To analyse the trade performance and estimate the measures of export competitiveness of small cardamom
5. To analyse the implications of changes in prices and trade on producers of small cardamom

LIMITATIONS OF THE STUDY

As the micro level study, which includes the estimation of cost of cultivation and marketing efficiency of small cardamom was based on a limited sample size of cardamom farmers and market intermediaries confined to a particular area, and relied on the respondent's memory to gather information pertaining to certain variables, adequate care should be taken while generalizing the results. However, utmost care was taken while collecting data to minimize the errors and misconceptions. For the analyses of price and trade related aspects, secondary data was employed, which were collected from various published sources. As data from different sources may not agree with each other, efforts to choose the best among

them are inevitable. Nevertheless, such decisions were made with caution to avoid personal bias.

PLAN OF THE THESIS

The thesis has been divided and presented in five chapters. The first chapter gives a general introduction to the thesis explaining the theoretical background of the study, its relevance and significance, objectives, scope and major limitations of the study. The second chapter is intended for providing review of literature pertaining to the present study. The third chapter describes the study area and methodology followed. The fourth chapter provides the results and discussions of the study conducted. Summary of the study is presented in the fifth chapter followed by references, abstract and appendices.

Review of literature

2. REVIEW OF LITERATURE

Indian small cardamom is known worldwide for its quality and is exported to various countries. Formerly, India enjoyed monopoly in the production and export of small cardamom in the world. Since 1980s, the country lost its international market share to Guatemala due to comparatively higher price in the domestic market and increasing domestic demand for the commodity. In this context, the present study was undertaken to study the dynamics in prices and trade of Indian small cardamom and assess its implications at the farm level. This chapter presents the review of important studies relevant to the objectives of the present study. The review of literature, which is the crucial examination and summary of literature related to a research area aids the researcher in arriving at a better way of approach for conducting the study. The reviews are presented under the following headings:

2.1 Small cardamom economy

2.2 Cost of cultivation

2.3 Economics of marketing

2.4 Price formation and price transmission

2.5 Supply response

2.6 Growth in export

2.7 Instability in export

2.8 Export diversification

2.9 Dynamics in export

2.10 Export supply function

2.11 Export competitiveness

2.12 Implications of changes in prices and trade on producers

2.1 SMALL CARDAMOM ECONOMY

As per the report of Sivanandan *et al*. (1985), till the first quarter of the nineteenth century, small cardamom was collected from the wild and from the ryots' plantations by the government, which was then transported to Alleppey port for sorting, grading and selling in the auction. But later, due to the wide fluctuations in the small cardamom price, the trade was passed from the government to a group of traders who belonged to the state of Tamil Nadu. With this, the marketing centre shifted from Alleppey to Bodinayakanur, which eventually became the "cardamom city", owing to the large quantity of small cardamom traded in the centre.

Mahabala *et al.* (1991) studied the resource use efficiency in cardamom plantations in Chikmagalur district of Karnataka and reported that the total returns in cardamom plantations were influenced significantly by the expenditure on labour and the amount of capital invested. The study also found that labour and capital were underutilized by small and large farmers, in both pure and inter-cropped situations.

Joseph (2011) examined the price variation and factors influencing price formation under e-auction of small cardamom and concluded that e-auction was successful in addressing the subordinated/unequal exclusion. Prior to the introduction of e-auctions, the institutional innovations have had the effect of market power concentration in the hands of a few at all levels of marketing. In the conventional auction system, there was price discrimination across different lots sold through auctions in which the smaller lots realised a lower price as compared to the larger lots. The situation changed with the introduction of e-auction in Kerala as there was significant increase in the production and productivity of cardamom in 2009-10 compared to the mid-1980s. Regarding the market structure, the dominance by a single auctioneer was replaced by an oligopolistic market structure and the market concentration at the level of dealers declined significantly. The e-auction was also found to have significantly reduced the price wedge between different lots of cardamom sold through auctions.

Anitha *et al*. (2012) studied the production conditions of plantation crops in Kerala and found that most of the small farmers cultivated black pepper and cardamom as both mono-crop and mixed crop in the study area. The study concluded that cardamom was preferred to black pepper under both mono cropping and mixed cropping and under the former about 43 per cent of total area was assigned to cardamom plantation. It was also observed that there was an increase in the productivity of cardamom with increase in the land holding and there was varying trend in the production per plant. The overall production of the crop was found to be higher during the period of study as compared to the earlier period. The study reported that the highest production was in Udumbanchola, while Kallupalam recorded the lowest production.

Bhadouria *et al.* (2012) analysed the post-harvest handling of cardamom and its marketing and majority of the farmers were found to sell the cardamom after curing. Though there were interferences and novelties in the marketing of the commodity, the number of farmers selling green cardamom directly as garden sales was identical in the past and the present. The reasons were absence of amenities for transportation and greater distance to the curing houses. It was also found that both the average quantity sold and the average price received for cardamom declined, while there was increase in the percentage of farmers selling to local dealers. There was no significant increase in the number of farmers who were selling the produce in the e-auctions. The farmers who were making use of the auctioning facility were found to be mostly those having more than six acres under cardamom cultivation, which showed that small farmers were getting excluded from the institutional system.

Hameedu (2014) in the study on supply chain analysis of cardamom in Kerala reported that there was increase in area, production and productivity and Udumbanchola Taluk was found to have the major area under cardamom production in Kerala and there existed potential for further expansion of area under cardamom. The study also found that the cultivation was highly labour intensive

and it offered employment and regular income but in the case of e-auction, the farmers' participation was very low.

Govindasamy (2015) studied the production performance of cardamom in India and found that area, production and productivity of cardamom had exhibited a constant trend during the reference period, while export had shown an increasing trend. It was suggested that government need to take steps for increasing the area and productivity of cardamom.

Mathew and James (2017) studied cardamom cultivation in Idukki district of Kerala. The major problems of the farmers were found to be the predominance of marginal growers and low productivity as the productivity per hectare was below 200 kg/ha annually.

Krishnakumar (2018) reported that export of small cardamom to Saudi Arabia had virtually stopped since May, 2018 as the Saudi Arabian government tightened the standards on pesticide residues and rejected some Indian consignments. However, the setback in export at that time was compensated by a strong demand from the north Indian market, which increased the price to ₹ 1,000 per kg.

2.2 COST OF CULTIVATION

The cost of cultivation of cardamom in Idukki, Wayanad and Nelliyampathi were estimated by Jose (1976). Production cost and maintenance cost were found to be ₹59 per kg and ₹1,200 per acre respectively, while the establishment cost was estimated as ₹2,765 per acre.

The cost of cultivation for small cardamom in Idukki district was estimated by John (1993). The estimates showed that the establishment cost for the first two years was ₹16,601 per hectare and the maintenance cost ranged from ₹12,056 to ₹14,674 per hectare during 3rd to 12th year, while during 13th to 15th year, it was ₹11,287 per hectare. Cost of production during the first year of economic yielding

phase (third year) was worked out to ₹172 per kg and in the later stage (fourth to eighth year) it was found to be ₹125 per kg.

Korikanthimath (2000) analysed the performance and economics of cardamom replanting in Karnataka and the results showed that the total investment incurred for replanting was ₹56,698 per ha, while the total annual maintenance cost was ₹82,411 per ha. The study revealed that charges incurred for labour accounted for the highest share i.e., 69.45 per cent of the total cost of cultivation of cardamom in Karnataka.

Based on a primary survey, Varghese (2007) estimated the costs, returns and relative profitability of cardamom cultivation and reported that the cost of cultivation for cardamom in Kerala was significantly high. The cost of production for small planters was 17.5 per cent and 14 per cent high compared to medium and large planters respectively. The study also reported very low yield per acre among small sized cultivators and higher imputed value of family labour was quoted as the main reason for higher cost of production. The study concluded that the economic appraisal of cardamom farms at cost C and cost D levels necessitated solid action on the part of the Government and Spices Board.

Balakrishnan (2008) studied the economics of cardamom cultivation in Kerala and estimated the costs and returns on the basis of primary survey conducted in Idukki district. The results of the study revealed that for cultivating one hectare of mature plantation the total cost was lower for small planters compared to the larger planters and hence the profitability was higher for the small planters as compared to large planters.

Rasmi (2010) analysed the production and marketing of small cardamom in Kerala and the results revealed that the total establishment cost during the first two years was ₹1,29,522 per hectare, while the total maintenance was worked out to be ₹1,10,875 per hectare. Total variable cost accounted for 62.73 per cent of the total cost and the cost of production of small cardamom in Idukki district was found to be ₹306 per kg.

2.3 ECONOMICS OF MARKETING

Asokarajan (1985) identified four marketing channels for small cardamom in Bodinayakanur of Tamil Nadu. The marketing cost of small cardamom was found to be high in channel I (grower - commission agent (auctioneer) - exporter - export market), while the price spread was highest in channel IV (grower pre harvest contractor / village merchant - commission agent).

Two major marketing channels were identified for cardamom by Sarker and Das (2005) in Cooch Behar district of West Bengal. The identified channels were Channel I: Producer – wholesaler I – wholesaler II – retailer – consumer; Channel II: Producer faria wholesaler I wholesaler II retailer consumer. The wholesaler I and wholesaler II in both the channels were from Siliguri and Cooch Behar respectively.

Balakrishnan (2008) studied the marketing of small cardamom in Kerala and identified four marketing channels. The major marketing channel identified in the study area was, producers - auction centre – wholesalers – retailers – consumers, which had maximum price spread for large planters. The study also analysed the marketing cost and revealed that storage and transportation costs accounted for the major share of the total cost and large planters incurred higher marketing cost compared to the small planters.

Rasmi (2010) analysed the marketing of small cardamom in Kerala. Among the marketing channels identified for cardamom, channel I (producer – hill produce dealers – wholesalers – retailers - consumers) and channel II (producer – auction centre wholesalers retailers - consumers) operated within the state. The channel III (producer – auction centre – traders – upcountry wholesalers – retailers – consumers) was within the country mainly for marketing in North India, while channel IV (producer auction centre traders exporters consumers) was used

for the purpose of exports. The net price received by farmers was found to be highest in channel I compared to that in the other three identified channels.

The system of small cardamom marketing typically consists of large number of sellers, a small number of exporters, many of whom were dealers and few dealers-cum-growers, and few auctioneers. Among the participants, auctioneers were the major actors in the marketing of cardamom who brought the buyers and sellers together (Joseph, 2011).

Kakaty and Borah (2011) analysed the impact of emerging marketing channels in agriculture with regard to orange and potato in Assam. The study analysed the price spread and revealed the existence of wide gap between the prices received by the farmers and those paid by the consumers in Traditional Marketing Channels (TMC), while the gap was comparatively narrow in Emerging Marketing Channels (EMC). The difference in price spread between TMC and EMC were due to the complicated marketing channels that involved large number of handlings in TMC and the less involvement of market intermediaries in EMC that led to reduced marketing cost and marketing margin.

Tangjang and Sharma (2018) analysed the pattern of marketing of large cardamom in Tirap district of Arunachal Pradesh and identified three marketing channels. The results revealed that the cost of marketing was highest in channel III (producer - primary wholesaler - processing unit - secondary wholesaler - retailer - consumer). The producer's share in consumer rupee and price spread were found to be higher in channel I (producer - primary whole seller - secondary wholesaler - retailer - consumer), while the marketing efficiency determined using different methods (conventional method, Shepherd's formula and Acharya's model) was found to be higher in channel II (producer - primary wholesaler - retailer - consumer).

2.4 PRICE FORMATION AND PRICE TRANSMISSION

The study on the extent of integration of the maize markets in Malawi was conducted by Goletti and Babu (1994) to identify the effect of market liberalization. The co movement of monthly retail prices and the price adjustment process of maize during the period from January 1984 to December 1991 were analysed. The main conclusion was that liberalization had led to greater market integration.

The multivariate cointegration analysis of cardamom prices by Rajesh (2002) revealed that the price of small cardamom was high in the domestic markets due to higher production cost than in the other competing countries in the international market, which has resulted in the failure of liberalization to increase the strength of price integration among different cardamom markets.

Baffes and Gardner (2003) examined the responsiveness of domestic prices to world price using Error Correction Model (ECM) for 31 commodities from 1980s to 1990s. The results concluded that the elasticity of price transmission was low during the study period.

Conforti (2004) analysed the transmission of prices in 16 countries using the ECM and concluded that price transmission was relatively complete, mixed and low in Asia, Latin America and Africa respectively. There were significantly long-run relationships between world and domestic prices in Ethiopia, in most of the cases. In the case of Ghana, there was a long-run relationship between world and domestic wheat prices. In Senegal, it was found that there was a long-run relationship in rice. It was finally concluded that the degree of price transmission was less in the sub- Saharan African countries compared to the Asian and Latin American countries.

Joseph (2004) analysed the integration of coffee, tea, cardamom, black pepper, rubber and coconut prices in Kerala with international prices by estimating the Error-Correction Model and concluded that with the exception of cardamom, the markets were integrated in the short-run rather than the long-run even before liberalization, and the extent of integration got accentuated in the post reform period. In the case of cardamom, reform measures resulted in increased integration of domestic market with the international market.

Jha *et al*. (2005) studied integration in wholesale rice markets in India and discovered that market integration was far from complete and the major reason was found to be the excessive interference by the government agencies.

Bakucs *et al*. (2007) examined the price transmission in the Hungarian vegetable sector and found that tomato and green pepper prices had large transmission elasticities, and causality runs from the retailer to producer level. It was reported that the short-run price transmission for all the vegetables considered was symmetric, while the long-run price transmission was asymmetric for the tomato market.

Hema *et al*. (2007) analysed the prices of black pepper in India and concluded that the three series of prices namely farm harvest, domestic, and export prices have been moving together over the years and the prices moved towards equilibrium faster in the long-run than during the pre-liberalization period. It was also found that the absolute value of error-correction term had been higher during post-liberalization period than the first period which indicated that the prices tended to find equilibrium faster in the long-run.

Jayasuriya *et al*. (2007) reported that the reforms in 1994 had a major impact on market integration of the Indian rice market that led to much faster price convergence between domestic and international prices. The velocity of price convergence was affected by the quality of the infrastructure in the states and the market surpluses, possibly because of the asymmetric nature of liberalisation of foreign trade in rice.

Bastine *et al*. (2010) assessed the transmission of black pepper prices between Indian and international markets by employing pair-wise and multiple cointegration analysis. They found that there was improvement in the price transmission between the two markets, confirming the co-movement of prices after liberalization

Adeoye *et al.* (2011) analysed the data on prices of plantain and banana in urban and rural markets using Granger causality test and found that the leadership

position in price formation and transmission was occupied by the urban plantain markets. They recommended that any planned government reform should target the leader markets.

The impact of globalisation on production and export of turmeric was assessed by Angles *et al*. (2011). The study found that there was positive association of the domestic prices with the international market prices during the pre-WTO period. During post-WTO period, a positive correlation was found, but with a lower degree. The study reported that domestic and international prices have shown high integration.

Ghoshray (2011) analysed the international price transmission in several agricultural commodities and found that cointegration existed for nine out of the 13 commodities considered. The ECM analysis showed that in India, wheat and tea were the two commodities that displayed a long-run relationship between international and domestic prices. For both these commodities, the short-run elasticities were found to be insignificant and was therefore concluded that any changes to the world prices would have no immediate impact on the domestic prices of tea and wheat in India.

Nakajima (2011) by analysing the price transmission in the soybean export from US found that there was positive and asymmetric transmission from 1967 to 1977, which later became neutral and then negative. The study reported that the U.S. lost long-term excess profit from soybean by the way of asymmetric transmission of prices, as Brazil and Argentina emerged as major soybean exporters in the world.

Akintunde *et al*. (2012) examined price formation and transmission of staple food stuffs in Nigeria and reported that rural beans market was occupying the leadership position in staple food price formation and transmission in the markets investigated. They recommended targeting of leader markets for any planned national pricing policy.

Kuruvila *et al*. (2012) assessed the transmission of international price volatility to the domestic market of plantation crops using the cointegration analysis and causality tests. It was concluded that there existed transmission, co-movement and causality of prices between the Indian and international markets in both pre-WTO and post-WTO periods.

A study was conducted by Zorya *et al.,* (2012) on transmission of global food prices to domestic prices in developing countries. It was concluded that for countries in which domestic and international prices were linked, there was a lag of several months for the changes in international food prices to be reflected in local prices. Among the several markets that were integrated, changes in international prices were rarely fully transmitted. It was also reported that in most of the developing countries, prices were spatially transmitted quite well.

Felix and Liefert (2014) by analysing over 60 country/commodity pairs found that consumer markets of developing countries were co-integrated with world markets. It was also found that the transmission of changes in world prices and real exchange rates to domestic consumer prices was not high, and also, the movement of domestic consumer prices to new equilibrium with world prices after a shock to the latter was relatively slow.

Kanungo (2015) studied the influence of market arrival on price formation of turmeric and found that price formation was greatly influenced by the market arrivals and there existed an inverse relationship between market arrivals and prices.

Jena (2016) assessed the commodity market integration and price transmission. It was found that there were both short-run and long-run relationships between domestic commodity price index and international commodity price index, but there was no relationship between domestic agriculture price index and international agriculture price index.

Paul *et al*., (2016) examined the price transmission and integration for major pulses in India using Johansen cointegration approach and Error Correction Model (ECM). For the major pulses, both the wholesale and retail prices showed a strong cointegration, while the Vector Error Correction Model (VECM) revealed that the dis-equilibrium in the system got corrected and thus restoring the equilibrium situation.

2.5 SUPPLY RESPONSE

Flinn *et al*. (1982) estimated the supply response and input demand by rice farmers using profit function analysis. It was concluded that farmers maximised short-term profits and also responded efficiently to price changes. The rice profit and supplies were found to be greatly influenced by changes in real wages.

Chaudhary *et al*. (1998) estimated the farm output supply and input demand elasticities in three cropping zones *viz*., cotton zone, rice zone and mixed cropping zone of Punjab and reported that farmers were price-responsive and concluded that the prevalence of fair output and input prices was essential for preservation of incentives for higher production by farmers.

Leaver (2004) estimated the price elasticity of supply for tobacco output in Zimbabwe using Nerlovian model and concluded that tobacco farmers were highly unresponsive to price changes. The study concluded that the farmers were likely to cultivate tobacco even with significant decline in price as they felt that there was no other viable alternative.

Mythili (2006) estimated supply response for major crops in India during the pre and post reform periods using Nerlovian adjustment cum adaptive expectation model. It was concluded that food grains were less responsive to price changes than non-food grains. The study also found that there was no significant difference in supply elasticities between pre and post reform periods and farmers responded to price incentives equally by more intensive application of inputs other than land.

Kanwar and Sadoulet (2008) estimated output response of cash crops in India using the Nerlovian model and found that there was statistically significant positive impact of expected profit on the crop acreages for five out of seven crops studied.

Using the data for the period from 1970-1971 to 2004-2005 across India, Mythili (2008) estimated short and long-run supply elasticities for a set of crops in the country. It was found that Indian farmers responded to price incentives in the form of both acreage expansion and yield improvement. The study also indicated that acreage adjustment to desired levels was slow in India.

OECD (2008) in its study on causes and consequences of rising food prices reported that the oilseed prices remained strong and a supply response was expected to be brought about by higher prices that resulted in allocation of more land to oilseed sector.

Vitale *et al*. (2009) analysed supply response for major staple crops in Southern Mali and reported that the acreage responses were statistically significant to own crop prices and in many cases the response to cross-prices was also found.

Suriagandhi (2011) conducted a micro level study on supply responsiveness of banana and found that the sample farmers were highly responsive to changes in banana price which was thus considered as an effective tool to increase output supply. Sugarcane and paddy were found to be the substitutes for banana due its nature of increased responsiveness to changes in price.

Kumawat and Prasad (2012) studied the supply response of sugarcane in India and different states for the period from 1990-91 to 2009-10 using Nerlovian partial adjustment model by including both price and non-price factors influencing sugarcane production. Sugar price was the major factor that was found to affect the area under sugarcane at the all-India level and in the major producing state, Uttar Pradesh; while in Maharashtra along with sugar price, rainfall was also found to be an important factor influencing the area allocated for sugarcane.

Richards *et al*. (2012) estimated supply response equations for soybean in three Latin American countries. It was concluded that there was significant response of soybean acreage to own output prices in all the countries and the stronger response was found in Brazil, followed by Bolivia and Paraguay.

Karunakaran and Gangadharan (2014) studied the supply response of coconut in Kerala using the area response and yield response models. The irrigated area, rainfall and price risk factors were found to be significantly affecting the area allocation, while in the case of yield response, irrigated area, rainfall and expected price risk were reported as the influential variables.

Edison (2015) studied farmers' supply response and input demand for rice in Jambi Province and found that farmers maximise their profit in short term and respond to price changes efficiently. Changes in real wages were estimated to have a greater impact on profit and supplies than changes in real prices of land preparation, fertilizer or pesticides.

Wani *et al*. (2015) studied the supply response of apple and pear in Jammu and Kashmir using Nerlovian model and found that the lagged price of apple had a positive influence on production which indicated that the growers responded to the previous year's price in order to determine the future drift in price.

Rahman *et al*. (2016) assessed international competitiveness, profitability, output supply and input demand of maize production. Maize farmers were found responsive to changes in market prices of inputs and outputs and land was found to be the most dominant factor affecting the maize supply and input demand.

Ehirim *et al.* (2017) studied the supply response of soybean to price and non-price factors in Nigeria. It was found that in the short-run, domestic and export prices were inelastic and positive, while in the long-run it was slightly elastic. The study concluded that the rise in actual supply was not instantaneous and the increase in actual production using cost-effective inputs was important.

Kumar (2017) studied the supply response of food grain crops in terms of area and yield at the all-India level. Among the price factors, real farm harvest price of own crop was found to be most significant with a positive sign, while the competing crop price was found to be significant with a negative sign. Rainfall was found be significant with a positive sign among the non-price factors for all crops except for wheat, rice and rabi coarse cereals, for which irrigation was found to be positive and significant. It was concluded that irrigation had positive effect on yield and thus emphasised the need for increasing irrigation by means of check dams.

Dupdal and Patil (2018) assessed acreage response of cotton in Karnataka using Nerlovian lag adjustment model and concluded that the cotton acreage was positively influenced by lagged acreage followed by lagged price and lagged yield. Long run elasticity of price was found to be higher than short run elasticity which indicated that the acreage under cotton was more elastic in the long run than the short run period.

Kim and Moschini (2018) estimated supply responses of corn and soybean in United States and found that corn and soybean acreages responded more in the short run than in the long run. Cross-price elasticities of responses were found to be negative and whenever corn and soybean prices moved together, the response of total acreage allocated to these two crops was extremely inelastic.

Savadatti (2018) analysed the agricultural supply response of chickpea in India using Nerlovian model. It was found that decision on allocation of area by the farmers was affected by lagged area and yield, and response of farmers to risk factors. The facilities for irrigation had significant and positive impact on the production of the crop. It was also found that reducing price risk and enhancing the irrigation facilities motivate the farmers to enlarge the area under crop, which would further increase the production to meet the rising demand.

Shahzad *et al*. (2018) estimated the supply response of tobacco growers to price and non-price variables in Khyber Pakhtunkhwa and confirmed the existence

of long run relationship between the variables. The short run elasticities of lagged production, price and area were found to be positive and statistically significant while for the competing crop wheat, the elasticity value was negative and statistically significant. The long run elasticities of price and area were positive and statistically significant, while for wheat the elasticities were found to be negative and statistically significant. It was concluded that in the long run, tobacco growers were responsive towards the price variable and thus increase in tobacco prices will in turn boost tobacco production.

2.5 GROWTH IN EXPORT

Rohini (2001) analysed the growth in export quantity, value and unit value of South Indian tea by dividing the overall period into pre-liberalisation and post-liberalisation periods. The results of the study revealed that the export growth rates in terms of quantity, value and unit value were significantly higher in the post-liberalisation period and the reason for higher export was credited to emerging free trade among nations and the increase in production of tea in the post- liberalisation era.

Rajesh (2002), analysed the export performance of major spices of India and found that there was a higher growth in terms of export value in post-liberalization period for all major spices, except for turmeric and chilli. In the case of cardamom export, negative growth rate was found in terms of quantity and value exported, while in terms of unit value there was a positive growth in the pre-liberalization period and the negative growth rates in quantity and value might be due to the high cost of production, low quality, effective entry of Guatemala and the inconsistent export policy of the Government of India. In the post-liberalization period, cardamom export was found to show positive growth rate in terms of value, quantity and unit value.

Nagoor (2009) examined the performance of India’s tea exports and found a steadily declining trend in its export from India. The major reasons identified were increasing demand in the domestic market, sluggish increase in yield, slow growth

in the area under tea, inability to cope with major competitors, rise in supply of tea compared to demand in the international market, loss of traditional markets and increased orientation towards the domestic market. The major exporting countries *viz.,* Srilanka, Kenya, China, Indonesia and India have not economically gained as there was surge in global supply of the commodity, drop in import by the developed countries and price competition between major exporters. It was concluded that share of India in tea export in the developing countries was increasing.

Boyal and Mehra (2016) studied the growth in export of major seed spices from Rajasthan and found that there was increasing trend in the export of coriander, cumin, fenugreek and total spices in terms of both quantity and value. They also suggested that suitable measures need to be taken in order to stabilise and boost the export earnings from spices.

Choubey (2017) analysed the growth of spices export from India and concluded that there was an average growth of 8.8 per cent annually in terms of value revealing much faster growth than the overall agricultural exports. The study found the US as the major importer of Indian spices, followed by China, Vietnam, the UAE, Malaysia, the UK, Germany, Saudi Arabia, Thailand and Sri Lanka.

Balakrishnan and Chandran (2018) assessed the export performance of coffee in India and found that in both pre-WTO and post-WTO periods, there were significantly high growth rates in the exports of coffee.

Patil *et al.* (2018) assessed the growth and export performance of mango from India and reported that the highest growth rate in terms of value was found in the export to Kuwait (23.80 per cent) and lowest was found in the case of Bahrain (8.19 per cent).

2.6 INSTABILITY IN EXPORT

Hazell *et al* (1990) studied the relationship between world price instability and the farm prices in developing countries using the post-war data on individual commodity prices. The study revealed that traditionally, the world prices for

agricultural commodities were unstable and identified that in many developing countries real exchange rates, domestic marketing arrangements and government interventions were the factors controlling the movements of price in support of producers.

Veena (1992) analysed the Indian coffee export and found that the price instability was the major factor leading to instability in the total export earnings of Indian coffee. The study also identified the abolition of the International coffee agreement as an important reason for price instability.

Coppock's instability index was estimated for major spices export from India by Rajesh (2002) which showed a decline in the fluctuation in export value and unit value and increase in the variation in export quantity of black pepper and ginger during the post-liberalization period. The study revealed that the fluctuations in quantity, value and unit value of export for cardamom, turmeric and chilli declined in the post-liberalization period.

Sinha (2007) measured the export instability index using GARCH model and investigated the relation between export volatility and economic growth for Philippines and Thailand. The study found that the economic growth of both countries was based on their exports and also the volatility in export was permanent in these countries.

Bastine *et al.* (2010) studied the instability in export and import of black pepper in India. They reported that there was high instability in the export unit value of pepper, while in case of imports, there was high instability in the import unit value from ASEAN.

Angles *et al*. (2011) worked out the instability index for the export of turmeric during pre-liberalization and post-liberalization periods and concluded that India's turmeric export was highly unstable during both the periods. In the case of export quantity of turmeric, the instability was found high during pre-liberalization period

than post-liberalization period, which was attributed to reduced restrictions in trade and growing demand for Indian turmeric in the international market.

Samuel (2011) analysed the instability in cotton exports from India and showed that there was a higher instability of 133.62, 136.96 and 19.85 per cent in terms of quantity, value and unit value of exports respectively during post–WTO period. The interaction between changes in mean quantity and price variance (71.54 per cent) was pointed out to be the major reason for the increase in the variability of total cotton export earnings.

Rashid *et al.* (2012) analysed the consequences of instability in export on economic growth in countries of SAARC region (Pakistan, India, Sri Lanka and Nepal). The study concluded that the effects of export instability was deleterious for all the four countries studied and the magnitude was the highest for Sri Lanka.

Nazir and Saeed (2016) assessed the export instability of different agricultural commodities of Pakistan and concluded that there was higher instability in Pakistan's agricultural trade, especially in the case of dairy, fruits and vegetables.

2.7 EXPORT DIVERSIFICATION

Ngaruko (2003) studied the agricultural export performance in Africa in comparison with Asia and found that export of agricultural commodities was less diversified in sub-Saharan Africa than in Asia. However, the diversification was more in favour of Africa than to Asia for primary commodities, as opposed to processed agricultural exports.

Taylor and Francis (2003) explored the trend in export diversification of agriculture in various countries of Latin America and the Caribbean. The study reported that most of the countries except the OECD countries *viz*., Belize and Guyana showed an increase in agricultural export diversification during the post-1985 period, which might be due to the export promotion programs, and liberalization in trade and domestic market.

Sarada *et al*. (2006) measured the geographic concentration of India's sea food exports using Gini-Hirschman coefficient of concentration and reported that though there was a decrease in concentration index from 1981-1991 to 1991-2004, there existed a higher geographic concentration of sea food exports from India to Japan, U.S.A. and Western European countries

Ebrahim *et al*. (2015) investigated the role of agricultural export diversification on the economic growth of developed countries and found that the export diversity index of agricultural sector had a positive and significant impact on economic growth of studied countries. The study thus recommended that for a sustainable economic growth and development, the countries need to consider the policy of export diversification of agricultural sector, along with other factors affecting economic growth.

Mallika (2016) reported that for export of black pepper from India there was high dependency on the developed countries such as USA, UK and Germany which increased the risk in India's black pepper trade in the near future. The study suggested to diversify the geographic concentration through exploring new markets.

2.8 DYNAMICS IN EXPORT

Jayesh (2001) assessed the direction of black pepper and cardamom trade from India using the Markov chain model and found Russia and USA as the most stable and loyal markets for black pepper, while for cardamom, Japan was found to be most stable and reliable market. The study predicted that in future (for 2009-10) increase in the market share of Indian black pepper export to Russia and USA to 24.95 and 34.96 per cent respectively could be expected. In the case of Indian cardamom export to Japan, the increase in market share was predicted to be 47.25 per cent.

The dynamics in direction of major spices export from India was analysed by Rajesh (2002) and the study revealed that Japan and Saudi Arabia were the most

stable markets in the pre-liberalization period, while there was no stable market for Indian cardamom in the post-liberalization period as India lost its international market share to Guatemala.

Meena (2008) analysed the performance of groundnut export from India. Various markets were examined using Markov chain analysis and Singapore, Indonesia and Malaysia were identified as the stable markets for Indian groundnut.

Satishkumar *et al*. (2016) measured the stability of rice and dynamics in value of exports of both basmati and non-basmati rice from India to different markets by employing the Markov-Chain analysis. For Indian basmati rice, Iran and Saudi Arabia were found to be the stable importers whereas, Benin, Bangladesh and Senegal were found to be the major importers of non-basmati rice from India. South Africa and Liberia were found to be the most unstable markets among the non-basmati rice importing countries with zero per cent retention. It was concluded that to benefit from the stable markets there was the need for good trade relationships with these countries and the policies ought to be framed accordingly.

Naik and Nethrayini (2018) studied the export stability of Indian coffee using Markov Chain analysis and concluded that Spain was the least stable importer compared to other countries.

Patil *et al.* (2018) on analysing the export of mangoes from India using Markov chain analysis found that Bangladesh was the most stable importer of Indian mango followed by UAE, Bahrain and other countries respectively.

2.9 EXPORT SUPPLY FUNCTION

For the export of citrus from Pakistan, Haleem *et al.* (2005) estimated the export supply function, in which the long run elasticity of citrus export was measured using Johansen's cointegration test. The domestic citrus price elasticity was found to have negative impact of 0.98 per cent on quantity exported with one per cent rise in domestic price of citrus. The study also found that the long-run

elasticity for export price was 1.48 indicating that one per cent rise in export price led to 1.48 percent increase export quantity of citrus. It was thus concluded that the international price (export price) was having a stronger impact on commercial crop exports. Exchange rate elasticity which was found to be 1.31 revealed a very strong impact of currency devaluation on citrus exports and the devaluation in turn made the exports cheaper by increasing the country's competitiveness in international markets.

Kumar and Rai (2007) analysed the factors affecting export of tomato from India during the period from 1985 to 2004 using regression analysis. They found that the factors namely domestic production of tomato, volume of international trade, domestic to international export price ratio and exchange rate explained 98 per cent of the total variations in the export of tomato from India. All the variables with the exception of exchange rate were found to be significantly influencing tomato export from India. The study also found that the demand for Indian tomato increased by 108 per cent with one per cent increase in the world trade of tomato. Higher production of tomato in India was having a negative impact on its export due to the coincidence with the higher global production and the consequent depression in international prices.

Meena (2008) estimated the export supply function of groundnut and concluded that in the long run, export of groundnut from India was integrated with domestic price, exchange rate, export price and population. It was also reported that the export was related to domestic price and population (i.e. domestic demand) inversely, while it showed significant increase with exchange rate and export price.

Sengupta and Roy (2011) predicted the export supply function of various horticultural crops namely chilli, black pepper, banana, mangoes, coffee, fresh fruits, pepper, grapes, spices, tea and walnuts from India and also estimated long run elasticity of various price and non-price factors. The results showed that production, world demand, relative export price and producer price had impact on exports of individual products over the long run. The producer price, relative export

price and world demand in the long run had significant impact on exports of chilli and black pepper. Exports of banana and walnuts were found to have inverse relation with producer prices in the long run, which indicated that rise in producer prices for these commodities created a disincentive to export over the long run. In the long run, exports of banana, coffee and spices were found to have a significant and positive impact on production, which indicated that, an increase in production increases the export of these commodities. In the short run, with the exception of spices and walnuts, relative export price was the significant determinant of exports of horticultural products

Kannan (2013) studied the determinants of production and export of natural rubber in India during the period from 1991-92 to 2010-11 using Ordinary Least Squares (OLS) technique. The study found that the production of rubber was significantly influenced by export of natural rubber stock and domestic price. The variables such as stock, world market price, domestic price and world population were also found to be statistically significant at one per cent level. The stock of the natural rubber in the country was found to have a negative impact on total export quantity i.e., increase in the stock of natural rubber resulted in lower export quantity and vice versa, while international market price, domestic price and world population were having positively significant influence on export of rubber from India.

Ebi and Ape (2014) examined the export supply response of seven agricultural commodities that included cocoa, sesamum, rubber, palm-oil, groundnut, cotton seed, and soybeans in Nigeria using an Error Correction Model. The study revealed the positive response of export supply to changes in relative prices which was significant for all the commodities, except for cocoa and soybeans. There was positive and significant influence by output growth and credit to agricultural sector on the export supply of these commodities. Exchange rate was also found to have significant impact in the case of four commodities, which was positive in most cases. The response of short-run export supplies varied between 0.01 and 0.77 and was smaller than the long-run responses. There was also

significant response of the export of commodities to output growth, credit to agricultural sector and improved road network and thus suggested that price incentives alone were inadequate to generate the desired export.

Adhikari *et al*. (2016) analysed the factors determining rice export from India using multiple regression of log-log form for the period from 1980-81 to 2012-13. It was found that the rice export from India was significantly influenced by exchange rate and international prices, but was affected adversely by domestic consumption and price.

Choubey (2017) examined the determinants of spices export from India and reported that domestic price, exchange rate, world export price and lagged domestic production influenced the export of spices and it was found to depend mainly on the crop and domestic consumption rather than on the international market signals. It was also found that in the case of Indian pepper, the export price elasticity for Canada and Italy were elastic, whereas the income elasticity of demand was found to be significant for Saudi Arabia and for other importers during the pre-liberalisation period. In the case of cardamom, the export was price elastic for USA, France, Japan and Saudi Arabia. UAE, Saudi Arabia, USA and Bangladesh showed a significant export demand for ginger in the pre-liberalisation period, while the elasticity of demand to changes in price was significant for Bangladesh and the elasticity of demand to changes in income was significant for UK and UAE during the post-liberalisation period. The study concluded that the major challenge for India's spices export was the emergence of new competitors with no or little domestic consumption of the commodity.

Loganathan (2018) analysed the production and export of cashew nut during the period from 1980-81 to 2008-09 using Cobb-Douglas production function model. It was concluded that raw cashew production showed a low significance at five per cent level. It was found that one per cent increase in production of raw cashew caused 0.24 per cent increase in the quantity of cashew kernels exported in

the overall period, 0.09 per cent during the period from 1981- 82 to 1991-92, and 0.38 per cent during the period from 1991-92 to 2008-09.

George and Cherian (2017) studied the global marketing challenges for producers of cardamom from Kerala and reported that the supply situation in cardamom markets did not solely rely on the export trade or on the volume of supply directly from the growers. They found that the quality parameters and the stringent standards fixed by the Food and Safety departments of both India and most of the European and American governments were the most decisive factors determining the export supply of cardamom.

2.10 EXPORT COMPETITIVENESS

Selvaraj *et al.* (1999) analysed the protection for various crops in Tamil Nadu using Nominal Protection Coefficient (NPC), Effective Protection Coefficient (EPC), and Domestic Resource Cost Ratio (DRCR). It was concluded that sugarcane and groundnut were highly protected and had comparative disadvantage domestically when compared to global trade, while rice and cotton were dis-protected.

Mahesh (2000) estimated the competitiveness of Indian tea export using NPC and DRCR. The study found that under importable hypothesis, the value of NPC was below one indicating that Indian tea was an effective import substitute and DRCR was less than unity implying that the amount spent by the tea growers was less than one rupee equivalent of foreign exchange on production. The NPC and DRCR under exportable hypothesis were found to be less than unity indicating that Indian tea was an effective export commodity as it was competitive in the international market.

Rafeek and Samaratunga (2000) examined the trade intervention policies for rice using nominal and effective protection rates. Positive protection to the farmers was found and it was concluded that protection would be finally eliminated, and the farmers would be involuntary producing at competitive price.

Mohanty *et al*. (2002) used Policy Analysis Matrix (PAM) to assess the cotton trade in India and concluded that cotton was efficiently produced in the country. It was found that the area under cotton might move towards more profitable crops such as sugarcane and groundnut in the absence of government interventions. In the states studied, *viz.*, Punjab, Gujarat and Andhra Pradesh, domestic price was lower than the international price.

Rajesh (2002) estimated NPC for Indian cardamom during 1999-00 and 2000-01 and found an improvement in competitiveness in 2000-01 when compared to the previous year. The Gulf countries, Europe and Japan were identified as the major export markets while China, Vietnam and Tanzania were the emerging markets for Indian cardamom.

Bhalla (2004) studied the competitiveness of Indian agriculture with regard to trade liberalization and concluded that the measures such as NPC, EPC, ESC and DRCR for cardamom exports were unfavourable indicating its lower competitiveness.

Karnool *et al.* (2007) analysed the economics of production and global competitiveness of groundnut in Karnataka for a period of 20 years. The results revealed that the state had competitive disadvantage during the pre-WTO period, as indicated by NPC and DRCR which were more than unity. However, in the post-WTO period, the global competitiveness increased as evident from the NPC and DRCR values which turned out be less than unity.

Meena (2008) studied the export competitiveness of Indian groundnut using PAM and reported that the Indian groundnut was export competitive as indicated by the measures of NPC, EPC and ESC. The domestic resources were found to be utilised efficiently but private profit was negative, while social profit was measured as positive. The study concluded that total policy transfer was negative in all the major groundnut producing states and concluded that while groundnut in Andhra Pradesh, Gujarat, Maharashtra and Tamil Nadu was competitive, Karnataka needs attention to make the crop more remunerative to producers and exporters.

Shinoj and Mathur (2008) studied the comparative advantage of India in agricultural export in the post-reform period and reported that India had comparative advantage in the export of various agricultural commodities. India was reported to enjoy a comparative advantage in tea and coffee exports, whereas it showed a declining trend over the years. India's comparative advantage in spices and cashew also depicted a gradual decline, while India strengthened its position in the export of oil meals in international markets. The country was not having a comparative advantage in the case of fresh fruits and vegetables. The study concluded that the exports of tea, coffee and spices were adversely affected by the policies of trade reforms.

Nagoor (2010) studied the trade aspects of plantation sector in India and concluded that the export competitiveness of India in the international market was declining. This was attributed to the increasing domestic demand, emergence of new low-cost producers like Vietnam and the growth of European countries in exporting value added products. There was increasing dependency of India on import of black pepper, tea and coffee, which were increasingly becoming domestic oriented. It was also reported that India's plantation products were limited by logistic problems, which led to higher transaction cost and thereby affecting the export competitiveness of plantation crops.

Bastine *et al.* (2012) estimated the NPC for black pepper in India for the years 2009-10, 2010-11 and 2011-12 as 0.973, 0.966 and 0.899 respectively and found that India was competitive in the export of black pepper. The (1-EPC) values though positive were only marginal indicating the sensitivity of the domestic producers against their foreign competitors. The DRCR values of less than one indicated efficient and internationally competitive production.

Basavaraj *et al.* (2013) assessed the competitiveness of sweet sorghum for ethanol production using PAM approach and computed the private and social costs. It was found that the divergences between private and social costs for both tradable and non-tradable inputs were positive in Andhra Pradesh (807 and 6,808), while the

costs were negative in Maharashtra (-694 and -8,117). The EPC coefficients for Andhra Pradesh and Maharashtra were 0.89 and 1.03 respectively which indicated that cultivation of sweet sorghum was largely not protected by policies in both the states. The DRCR value was found to be low in Maharashtra (0.94) indicating its comparative advantage in cultivation of sweet sorghum.

Kanaka and Chinnadurai (2013) constructed the Policy Analysis Matrix (PAM) for rice export from Tamil Nadu and modelled the analysis of profitability under the observed conventional rice farming conditions. Given the current technologies, prices for inputs and outputs, and policy, the private profitability (Rs. 3811) exhibited the competitiveness of the agricultural system. The social profit (Rs.2046) indicated that the scarce resources were utilized efficiently and there was a static comparative advantage in the production of rice.

Mamza *et al*. (2014) investigated the competitiveness, comparative advantages and effect of government policy on beef processing using PAM in Borno state of Nigeria and concluded that beef processing was privately and socially profitable. The processors were found to be taxed and there was low value addition at domestic price. The study recommended that in order to increase competitiveness of beef processing, incentives need to be provided to the processors there by providing secured environment for private sector participation.

Rani *et al.* (2014) evaluated the trade competitiveness of groundnut in Andhra Pradesh during pre-WTO (1985-86 to 1994-95) and post-WTO periods (1995-96 to 2004-05) using Policy Analysis Matrix. The results revealed that DRCR was less than unity in both the periods and thus indicated comparative advantage for groundnut production in the state. EPC was found to be more than one in the pre-WTO period indicating that the state was not efficient in producing groundnut. However, EPC was measured as 0.53 in the post-WTO period, which indicated that the efficiency of groundnut production in the state has improved over the years. Positive SRP (Subsidy Ratio to Producers) in pre-WTO period indicated that groundnut production was protected by the government but the SRP started

declining in post-WTO period as revealed by its negative value. The study also found that value of NPC was less than unity during both the periods and it declined over the years from 0.9 in the pre-WTO period to 0.54 in the post-WTO period, which showed increased competitiveness.

Sankar and Kumar (2014) assessed the export competitiveness of certain commodities namely rice, cotton lint, chilli and turmeric in Andhra Pradesh during pre-WTO and post-WTO regimes and NPC was worked out for the commodities. All the commodities with the exception of rice were found to have export competitiveness in the international market in post-WTO period. However, rice export was competitive during pre-WTO period, but it lost the competitiveness and exhibited a declining trend during the post-WTO regime. In case of cotton-lint, the trend in export competitiveness was better than that of chillies and turmeric.

Deepika (2015) on studying the factors affecting export competitiveness of plantation commodities in India found that the tariff barriers were very limited, while the non-tariff barriers retarded the competitiveness of plantation commodities in India. The major non-tariff barrier found to affect tea and coffee was the need for certification.

Idris *et al.* (2013) analysed the competitiveness of India's horticultural trade and impact of food safety regulations on market access during the period from 1991-92 to 2013-14 along with its composition, direction and the comparative advantage. Based on the Revealed Comparative Advantage (RCA) index it was found that Asian countries were the preferred destinations for most of the Indian horticultural exports during the study period. India was found to have comparative advantage over China in the Asian market for fresh grapes, guava, and mango. For cashew, Tanzania and Vietnam were found to be having comparative advantage over India in the EU market, but not in the Asian markets.

Kanaka and Chinnadurai (2015) computed Policy Analysis Matrix for a sample of groundnut growers in Tamil Nadu and found that there was protection at

the state level. Comparatively, groundnut was found to be competitive but had comparative disadvantage in export.

Jagdambe (2016) examined the export competitiveness of Indian agricultural products with ASEAN countries. The results showed that India's export intensity in total agricultural trade increased compared to the ASEAN. It was also found that the comparative advantage was declining during the study period but it varied among the commodities. The study suggested the need for direct policy initiative in order to encourage the products having comparative advantage in exports.

Makama *et al*. (2016) studied export competitiveness of Indian rice using PAM and found that social revenues were much higher than the private revenues. It was concluded that the rice producers were dis-protected and export competitiveness was high. The domestic resources were efficiently used and had comparative advantage in production.

The competitiveness of Indian mangoes was evaluated by Baliyan (2017) and the major importing countries identified were the United States of America, Netherlands, Germany and U.K. Indian mango export was also found to have comparative advantage, but the domestic prices of mango was found to be higher than the international prices.

George and Cherian (2017) reported the competitive factor as the most dominant and influential factor in the international spices market. The components of the competitive factor were the international and domestic competition, speculative practices, government policies, and promotional activities.

Kanaka and Chinnadurai (2017) computed Policy Analysis Matrix (PAM) for export of sugarcane from India and found that NPC, EPC, ERP and DRC were unfavourable. They concluded that Indian sugarcane was less competitive and therefore, the country was comparatively disadvantaged.

Oluyole *et al*. (2017) examined competitiveness and the effects of policies on cocoa marketing in Southern Nigeria using Policy Analysis Matrix (PAM). It was found that cocoa marketing was privately profitable and had comparative advantage. The study recommended the provision of input subsidies to cocoa marketers**.**

Ferede *et al*. (2018) assessed the competitiveness of chickpea production by smallholders' in Ethiopia using DRCR analysis. It was concluded that there was increasing trend in the local prices both in nominal and real terms. The major challenge of chickpea export was the local demand, in spite of which export of chickpea was found to be highly competitive.

Naik and Nethrayini (2018) studied the export competitiveness of Indian coffee and found that coffee was perfectly competitive as the NPC value was less than one.

2.11 IMPLICATIONS OF CHANGES IN PRICE AND TRADE ON PRODUCERS

Chand (1999) studied the effects of trade liberalization on agriculture in India and found that in selected crops like maize and rice, free trade was having positive impact on the net returns from producing export commodities. However, free trade was found to have a small negative impact on net returns from the importable commodities like rapeseed-mustard. Level of input subsidy was high for rice and hence free trade was not sufficient to offset the adverse impact of withdrawal of subsidies on income. It was concluded that liberalization of trade had diverse effects and its impact would vary from commodity to commodity.

Rafeek and Samaratunga (2000) studied the impact of trade intervention policies in rice sector of Sri Lanka. The overall welfare impacts were found to be a gain to the country even though the farmers faced welfare loss.

Chen and Ravallion (2004) studied the welfare impact of China's accession to the World Trade Organization. The results showed that the over-all impacts on inequality and poverty were negligible. It was found that varied impacts emerged across households and regions, which were associated with heterogeneity in consumption and sources of income along with the possible implications for responses on compensatory policy.

Anderson and Valenzuela (2006) estimated the impact of global merchandise trade distortions and services regulations on farmers in various countries. The study suggested that real net farm incomes would rise in developing countries with a move to free trade which in turn would alleviate rural poverty, regardless of the terms of trade deterioration for some developing countries that were net food importers or enjoying preferential access to agricultural markets of high-income countries.

Mittal (2007) studied the impact of OECD agricultural trade reforms on India's prices and producer's welfare and found that the response of domestic price to any change in the international price was considerably smaller for the cereals *viz.*, rice and wheat, while it was comparatively better for cotton and sugar. The impact on welfare of small farmers grounded on these changes ranged from 4 to 18 per cent for cotton and sugarcane.

The impact of price and income in farmers' decision-making process with respect to shift from low-valued food crops to the commercial crops of high value was examined by Mehta (2009). It was found that the farmers were not much responsive to the changes in the food grains prices due to higher income from the high-valued crops, which provided sufficient income for the purchase of food crops. It was also found that the farmers were considering the aggregate returns from the crop in addition to the price of the crop, while making the decision to shift.

Magrini *et al.* (2015) studied the effects of surges and volatility in prices on household welfare by employing household survey data in Bangladesh, Ethiopia, Malawi, Niger and Tanzania. There were variations across the countries for the

similar shocks in the prices due to differences in the portion of expenditure on food in the total consumption, share of cereals in the budget, the substitution effect between the food items and the number of net sellers and buyers who were having access to the market.

Sabu (2015) studied the impact of volatility of black pepper price on producers and found that the vulnerability to price volatility reduced with the factors such as age and education of the farmers and their experience in farming, while the factors such as the family size and income share from black pepper increased their vulnerability to price volatility. The study also showed that the farmers could not be protected from price variations by contractual agreement alone.

Chandy *et al*. (2010) studied the trends in farm income and wages in the era of market uncertainty. The analysis found that growth rate in productivity led to growth in farm income, while the outcome during the post-reforms period was influenced more by the trend in unstable prices which turned out to pose serious policy challenges to the rubber plantation sector in the state.

Rajasenan (2010) assessed the welfare of plantation workers and found that the physical assets of most of the workers remained minimal while the condition of workers in spice plantations was found to be worse when compared to rubber plantations. The land holding capacity of workers was also found to be very low in all the plantation sectors. Most of the workers were having their own houses with the only exception of workers in large scale rubber plantations, where they stayed in plantation quarters as they were migrants from distant places. The study concluded that the livelihood variables that affect the plantation workers were below the standard criteria.

Milian (2014) reported on cardamom in Guatemala that exporters registered the biggest gains while small producers did not gain much and suggested a large inventory to gain huge profit. It was also reported that payment received by selling cardamom in small lots was able to cover only the cost of production leading to

lower level of profit for small and medium producers who were at the bottom of the value chain. The study concluded that the lower profit of small cultivators of cardamom resulted in failure to invest and raise productivity and thus leading to social and economic issues among the farmers.

Methodology

3. METHODOLOGY

The systematic analysis of a research problem and the derivation of meaningful conclusions are possible only with an appropriate design of the research methodology. This chapter deals with the methodology used for achieving the objectives of the present study. Various analytical tools used for analysing the economics of cultivation and marketing, price formation and transmission, supply response, export performance and competitiveness, and the implications of changes in prices and trade on producers of Indian small cardamom are discussed in detail. In order to get a better understanding on how the research was carried out, a brief account on the study area, sampling procedure and the method of data collection followed in the study are also presented in the chapter. The methodology followed in the study is given under the following headings:

3.1 Types of data

3.2 Data sources and period of study

3.3 Area of the study

3.4 Sampling design

3.5 Tools of Analyses

3.1 TYPES OF DATA

The present study used both secondary and primary data. The secondary data on area, production, prices and exports of small cardamom published by various institutions were collected in order to study the price formation and transmission between the international and domestic markets, to find out the export performance and competitiveness of Indian small cardamom and supply response of cardamom to prices. In order to estimate the economics of cultivation and marketing of small cardamom, primary data were collected from selected farm households in Idukki district of Kerala state.

3.2 DATA SOURCES AND PERIOD OF STUDY

The major items of observations included annual and monthly prices of small cardamom in domestic and international markets from 1980-81 to 2017-18, export and import of small cardamom for the period from 1970-71 to 2017-18, state-wise and district-wise area and production of small cardamom from 1980-81 to 2017-18. The major sources of data were the 'Spices Market Weekly' and 'Spice India' published by Spices Board, Kochi and 'Agricultural Statistics' and 'Statistics for Planning' published by Directorate of Economics and Statistics, Thiruvananthapuram, Government of Kerala and the websites of Spices Board and Ministry of Commerce.

3.3 AREA OF THE STUDY

The micro-level study was undertaken in Idukki district of Kerala, as the district accounted for the major share (79.75 per cent) of the total area under small cardamom in the state during 2016-17.

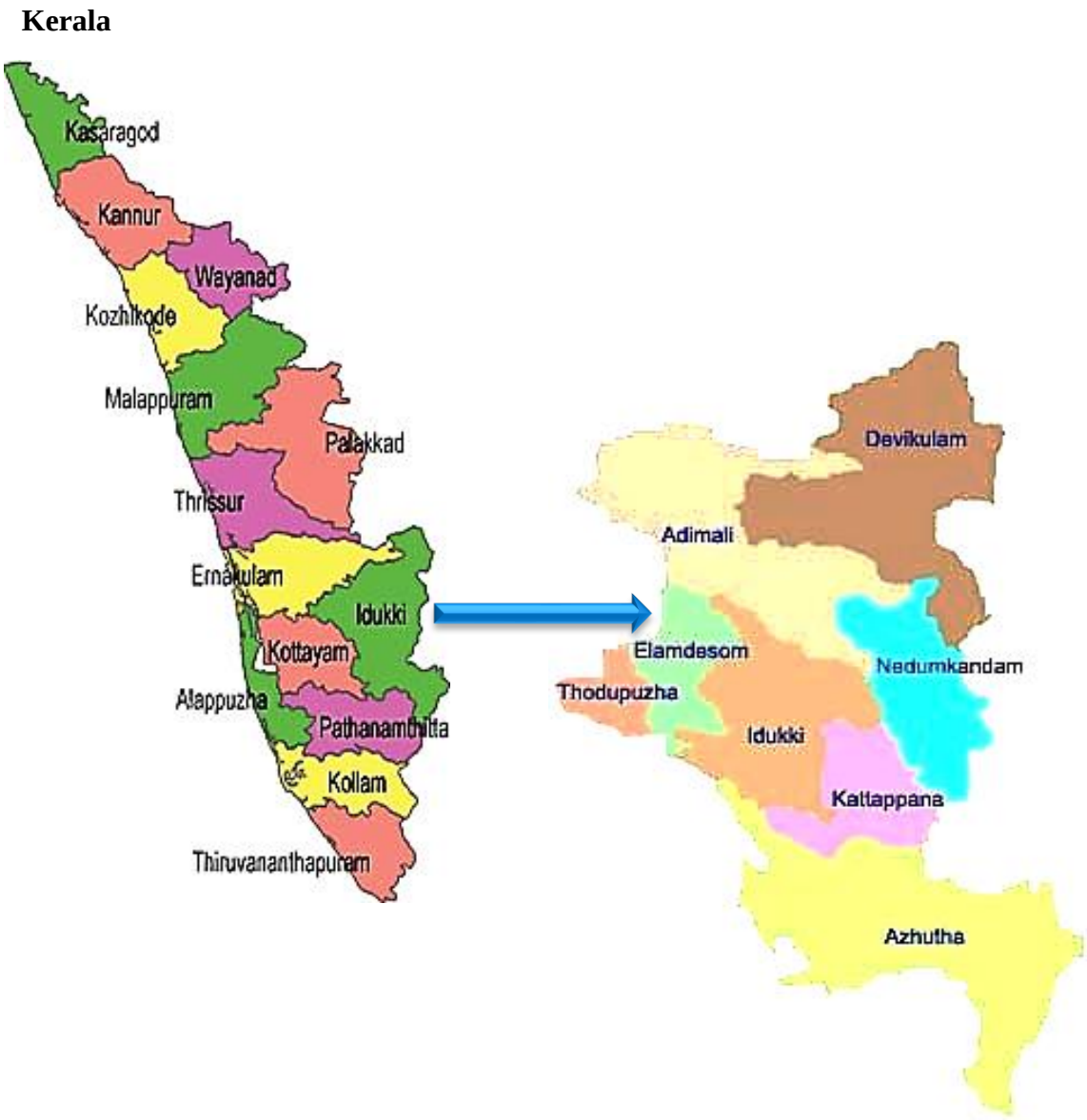
3.3.1 Idukki District

Idukki, the high range district of Kerala, which is geographically known for its mountainous hills and dense forests, is usually referred to as the spice garden of Kerala. As per the 2011 census, population in the district is about 3.32 per cent of the total population in the State. The district is divided into two revenue divisions, four taluks, eight blocks and 64 villages. Agriculture is the main occupation of the people, with dairy being the major supplementary source of income for the farmers. The agro-climatic conditions of the district are suitable for the cultivation of plantation crops and spices. The major crops cultivated in the district are black pepper, cardamom, tea, coffee, natural rubber and coconut.

3.3.1.1 Location

The Idukki district lies between the North latitudes 9° 15′ and 10° 21′ and the East longitudes 76° 37′ and 77° 25′. It is the second largest district of Kerala, with an area of 4,479 km^2. The district is bounded in the north by Mukundapuram Taluk of Thrissur district, Pollachi Taluk of Coimbatore district and Udumalpet Taluk of

Figure 1 Map of the study area



Tiruppur district of Tamil Nadu State, in the west by Muvattupuzha, Kothamangalam and Kunnathunadu Taluks of Ernakulam district and Kanjirappally and Meenachil Taluks of Kottayam district. It is bounded by Pathanamthitta district in the south and Uthamapalayam Taluk of Theni district of Tamil Nadu in the east.

3.3.1.2 Land utilization pattern

The land utilization pattern of Idukki district in 2016-17 is presented in Table 3.1. It could be observed from the table that nearly 45 per cent of land was under forest area and the total cropped area was around 62 per cent of the total geographic area. The net sown area in the district was about 47 per cent of the geographical area, while 3.28 per cent of total geographic area was under non-agricultural uses.

3.3.1.3 Topography and climate

The climate in Idukki varies from the western part to the eastern part of the district. The western part of the district, which comprises the midland area, experiences a moderate climate and the temperature varies between 21°C and 27°C with minimum seasonal variation. The eastern part of the district, which is a highland, experiences a comparatively cold climate and the temperature ranges from minus 1°C to 15°C in November/January and from 5°C to 15°C in March/April. The annual rainfall varies from 2500 to 4250 mm, with the South-West monsoon during June-August period and the North-East monsoon during October-November contributing to the abundant rainfall in the district.

3.3.1.4 Demographic features

As per the census of 2011, the total population in the district was 11,08,974, out of which 10.57 lakhs persons were from rural areas and 0.52 lakhs constituted the urban population. The sex ratio in the district was 1006 females per 1000 males and literacy rate was 92.30 per cent in 2011. The total workers in the district, as categorized together under main workers and marginal workers, were 5,16,363. Number of main workers in the district was 4,15,947 and there were 1,00,416 marginal workers.

Table 3.1 Land utilization pattern in Idukki district in 2016-17

Sl. No.	Particulars	Area (hectares)	Share in total geographical area (per cent)
1	Total geographic area	436328	100.00
2	Forest	198413	45.47
3	Land put to non-agricultural uses	14315	3.28
4	Barren and uncultivable land	1440	0.33
5	Permanent pastures and other grazing land	0	0
6	Land under miscellaneous tree crops	159	0.04
7	Cultivable waste	2197	0.50
8	Fallow land other than current fallow	1157	0.26
9	Current fallow	1481	0.34
10	Marshy land	0	0
11	Still water	10480	2.40
12	Water logged area	0	0
13	Social forestry	1142	0.26
14	Net sown area	205544	47.11
15	Area sown more than once	64812	14.85
16	Total cropped Area	270356	61.96

Source: Agricultural Statistics 2016-17, Directorate of Economics and Statistics, Kerala

3.4 SAMPLING DESIGN

Idukki district was selected purposively for the micro-level study, as the district accounted for 79.75 per cent of the area under small cardamom in Kerala. Two blocks in the district with maximum area under cardamom *viz*., Nedumkandam and Kattapana were purposively selected for the study. From each of the selected block, two Panchayats *viz*., Pampadumpara and Nedumkandam from Nedumkandam block and Vandanmedu and Kanchiyar from Kattapana block were selected randomly. The farmers were randomly selected from the combined list of cardamom farmers obtained from the Krishi bhavans and farmers' societies. From each of the Panchayath, data on production and marketing of cardamom were collected from 40 farmers, making a total sample size of 160. Data on trade and marketing aspects were also collected from randomly selected market functionaries *viz.,* 20 village traders, 20 wholesalers, seven auctioneers and five exporters.

Table 3.2 Distributions of sample farmers in Idukki district

Sl. No.	Block	Panchayat	Number of farmers	Total sample size
1	Nedumkandam	Pampadumpara	40	160
		Nedumkandam	40	
2	Kattapana	Vandanmedu	40	
		Kanchiyar	40	

3.4.1 Description of the Selected Panchayats

The distribution of area according to the types of land in the selected Panchayats is presented in Table 3.2. It could be observed from the table that the dry land formed the major land area in the selected Panchayats.

Table 3.3 Panchayat-wise area according to type of land

Block	Panchayat	Area in Hectares			
		Wetland	Dryland	Others (Plantation)	Total
Nedumkandam	Nedumkandam	3190 (0.18)	1732775 (97.33)	44390 (2.49)	1780355 (100)
	Pampadumpara	-	937207 (84.97)	165775 (15.03)	1102982 (100)
Kattappana	Vandanmedu	88270 (4.96)	1630329 (91.68)	59723 (3.36)	1778322 (100)
	Kanchiyar	18364 (1.25)	1047391 (71.16)	406100 (27.59)	1471855 (100)

Source: Panchayat Level Statistics, 2011, Idukki

Note: Figures in parentheses indicate per cent to row total

3.4.2 Collection of Data

Personal interview method was employed to collect farm level data from the respondents by using a well-structured and pre-tested interview schedule. Information regarding the socio-economic profile of the farmers and data on input use, production, costs of cultivation/production, price of output, income particulars and marketing aspects were collected from the farm households. Data on marketing cost, margin and related aspects were collected from intermediaries and exporters.

3.5 TOOLS OF ANALYSES

3.5.1 Cost of cultivation and marketing

3.5.1.1 Estimation of costs and returns

Small cardamom is a perennial crop and has an economic life span of 25 years, with the yielding phase starting from the third year onwards. The cost of cultivation was estimated by classifying it into two categories *viz*., establishment cost and maintenance cost.

Establishment cost includes the expenses incurred during first and second year of the establishment of cardamom plantation. It is comprised of the cost of land

Plate 1 Survey of small cardamom farmers in Idukki district

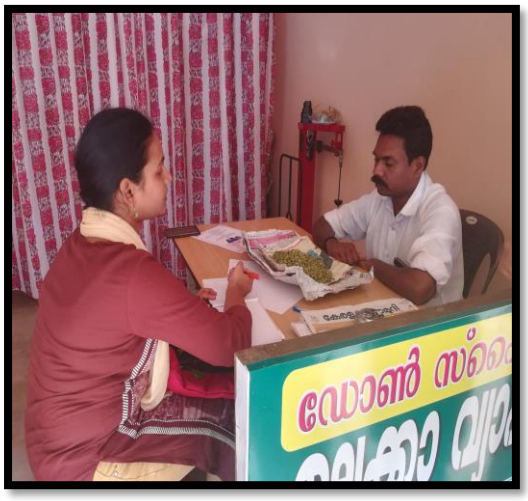


Plate 2 Survey of small cardamom traders

preparation, digging and filling pits, planting material, shade regulation, manures and fertilizers, plant protection chemicals, irrigation and weeding.

The expenses on soil works/conservation practices, FYM and other organic manures, fertilizers, plant protection chemicals and various farm operations such as irrigation, mulching, trashing, shade regulation, weeding, harvesting and curing from the year of bearing to the final year of the economic life span of cardamom were included under the category of maintenance costs.

Weighted mean was calculated for the overall yielding phase of small cardamom. Weightage was given for each of the yielding phase based on the number of farmers cultivating cardamom which were under the particular yielding phase.

In order to calculate the total cost of cultivation, the total establishment cost was amortized to spread it through-out the entire life span of the crop as given below,

$$Ai = [i(1+i)^n]/[(1+i)^n-1]$$

where,

i = rate of interest

n = life span of small cardamom

It was then added to the annual maintenance cost and interest on working capital at seven per cent to arrive at the total cost of cultivation of small cardamom.

3.5.1.2 Economics of small cardamom marketing

The methodologies described by Acharya and Agarwal (1987) were used for the estimation of economics of small cardamom marketing that included marketing cost, marketing margin, price spread and marketing efficiency.

3.5.1.2.1 Marketing channels

The marketing channel is a path traced in the direct or indirect transfer of the title of a commodity, as it moves from a producer to the ultimate consumer or industrial

users. It refers to the chain of intermediaries through whom the commodity is marketed. Intermediaries included were village traders, auction agents, wholesalers, exporters and retailers. The structure of small cardamom market and different marketing channels in Idukki district were identified through the primary survey conducted among the sample farmers and different intermediaries.

3.5.1.2.2 Marketing cost

Marketing costs are the actual expenses incurred in moving the goods and services from the producer to the consumer. It includes the handling charges, assembling charges, transportation costs and others expenses incurred by the producers and intermediaries in the marketing channel.

$$\text{Marketing Cost (MC)} = C_p + C_{m1} + C_{m2} + \ldots + C_{mn} \quad \ldots\ldots (1)$$

where,

C_p = Cost incurred by the producers, and

C_{mi} = Cost incurred by the i^{th} middleman in buying and selling the product.

3.5.1.2.3 Marketing margin

Marketing margin is the actual/net income obtained by the intermediaries in the marketing process.

(i) Absolute margin of i^{th} middleman (Am_i)

$$Am_i = Ps_i - (Pp_i + Cm_i) \quad \ldots\ldots (2)$$

(ii) Percentage margin of i^{th} middleman (Pm_i)

$$Pm_i = ((Ps_i - (Pp_i + Cm_i)/ Ps_i) \times 100 \quad \ldots\ldots (3)$$

where,

Ps = Selling price

Pp = Purchase price

Cm = Marketing cost

3.5.1.2.4 Price spread

The price spread includes the marketing costs and marketing margins, which determine the share of producer in the consumer rupee. The producer's share in the consumer's rupee was estimated using the formula:

$$(P_F / P_R) \times 100 \ldots\ldots (4)$$

where,

P_F = Price received by producer

P_R = Retail price

3.5.1.2.5 Marketing efficiency

Marketing cost, margins and price spread were used to analyse the marketing efficiency using the formula:

$$\text{Marketing efficiency} = (C/M) - 1 \ldots\ldots (5)$$

where,

C = Consumer's price

M = Total marketing cost + Total margin

3.5.2 Price formation and transmission

3.5.2.1 Market Integration

The market integration describes the relationship between prices prevailing in spatially separated markets. When the markets are said to be integrated, it denotes that the markets operate as a single market system. In the present study, cointegration analysis was employed to study the relationship between the prices of small cardamom in domestic and international markets.

3.5.2.1.1 Model of cointegration analysis

The cointegration analysis evaluates the integration between spatially separated markets. Johansen (1988) developed the method of Maximum Likelihood (ML) for cointegration analysis, which was extended by Johansen and Juselius (1990), to examine whether the markets are linked together into a single economic market. This

method was chosen for the current study as it treats all the variables as unambiguously endogenous and also takes care of the problem of endogenity. The current method also allows for the test of multiple co-integrating vectors.

3.5.2.1.2 Analysis of stationarity

Examining the time series characteristics of the data is important to ensure the specification of appropriate model and also to reduce the likelihood of reaching misleading results. Testing the characteristics of time series data involves the tests for the order of integration of the variables. Augmented Dickey Fuller (ADF) tests were used to establish the stationarity of the price series in the present study.

Dickey Fuller (DF) and Augmented Dickey Fuller (ADF) tests were the most widely used tests for identifying the unit roots. Both test the null hypothesis that the time series has a unit root i.e., the time series is non-stationary. The DF test was applied by estimating the following regression,

$$\Delta P_t = \beta_1 + \delta P_{t-1} + u_t \ldots\ldots (6)$$

where,

$\Delta P_t = (P_t - P_{t-1})$

The ADF test was run with the following equation,

$$\Delta P_t = \beta_1 + \delta P_{t-1} + \sum_{i=1}^{P} \alpha_i \Delta P_{t-i} + \in_t \quad \ldots\ldots (7)$$

$$\Delta P_t = \beta_1 + \delta P_{t-1} + \beta_2 t + \sum_{i=1}^{P} \alpha_i \Delta P_{t-i} + \in_t \ldots\ldots (8)$$

where,

$\Delta P_{t-i} = (P_{t-i} - P_{t-i-1})$

P_t is the price at time t and $\in_t$ for t = 1,…., N was assumed to be Gaussian white noise. In ADF test, the equation (7) was with a constant term and no trend, while the equation (8) was with a constant and trend variable. The number of lag (p) was selected to confirm that there was no correlation among the errors.

3.5.2.1.3 Testing for cointegration

Cointegration signifies the presence of a long-run equilibrium to which an economic system converges over the period of time, and the term u_t denotes the disequilibrium error.

Johansen Maximum likelihood procedure (Johansen and Juselius, 1990), which is a multivariate unit root test, is considered to be the most appropriate method to test for cointegration in a system of variables, as it allows for the cointegration between a system of variables without enforcing bias on the estimates. It identifies co-integrating vectors between the non-stationary level variables in the context of a Vector Error Correction Model (VECM) form, which is a Vector Auto Regression model in the form of error correction. VECM treats individual variable as potentially endogenous and links the change in one variable to errors in the past equilibrium and also to past changes in all the variables.

The maximum likelihood method of cointegration is explained as follows (Johansen and Juselius, 1990):

The cointegration was tested based on the ECM representation of P_t (a (nx1) vector of I(1) prices) is given below

$$\Delta P_t = \sum_{i=1}^{J-1} \acute{\Gamma}_i \Delta P_{t-i} + \Pi_i P_{t-j} + \mu + \beta_t + e_t \ldots\ldots (9)$$

where,

$\acute{\Gamma}_i$ = - (1- Π_1 - …… - Π_t); i= 1, 2… J-1; Π= - (1-Π_1-…. – Π_j).

Π_1 = n x n matrix of parameters

e_t = identical n-dimensional vector of residuals

μ = constant

t = trend.

Here, ΔP_t and ΔP_{t-I} variables are I (0). As the equation get balanced when ΠP_{t-j} is 1(0), Π matrix is considered to convey information on the long run relationship between the variables in P_t. The number of co-integrating vectors is determined by the rank of Π, which determines the number of linear combinations of P_t which are to be stationary. When $0< \text{rank } (\Pi) = k<n$, and there exists n x k matrices $\acute{\alpha}$ and β such that $\Pi = \acute{\alpha}\beta$, then it indicates k co-integrating relations. The property of co-integrating vector β is that even if P_t itself is non-stationary, βP_t tends to be stationary. The $\acute{\alpha}$ matrix, which represents the speed of adjustment parameters, indicates the strength of co-integrating vectors in the ECM.

The null hypothesis of at most 'k' co-integrating vectors was tested against the alternative hypothesis of 'more than k' co-integrating vectors by

$$\text{Trace statistic} = -T \sum \ln (1- \lambda_i) \ldots\ldots (10)$$

The null hypothesis of 'k' co-integrating vectors was tested against the alternative hypothesis of k + 1 by

$$\text{Maximum Eigen value statistic} = -T \ln (1- \lambda_{r+1})$$

where,

λ_i = estimated Eigen values obtained from the Π matrix

T = number of usable observations

Any increase in the number of co-integrating vectors indicate an increase in the strength and stability of integration between the price series (Johansen and Juselius, 1990).

3.5.2.2 Granger Causality Test

The cointegration between two price series indicate the presence of causality between them in atleast one direction (Granger, 1980). But cointegration itself cannot indicate the direction of causation. The Granger causality test provides an evidence for

the direction of price transmission between two price series. The Granger causality test estimates the following pair of regressions

$$P_{Dt} = \sum_{i=1}^{n} \alpha_i P_{It-i} + \sum_{j=1}^{n} \beta_j P_{Dt-j} + u_{1t} \quad \ldots\ldots (11)$$

$$P_{It} = \sum_{i=1}^{n} \lambda_i P_{It-i} + \sum_{j=1}^{n} \delta_j P_{Dt-j} + u_{2t} \quad \ldots\ldots (12)$$

Unidirectional causality from P_{It} to P_{Dt} is confirmed when the estimated coefficients of lagged P_{It} in (11) are statistically different from zero, while the estimated coefficients of lagged P_{Dt} in (12) are not statistically different from zero. The unidirectional causality is said to exist from P_{Dt} to P_{It} when the lagged P_{It} in (11) are not statistically different from zero, while the lagged P_{Dt} coefficients in (12) are statistically different from zero. Bilateral causality is concluded between P_{It} and P_{Dt} when the coefficients are statistically different from zero in both (11) and (12). There is independence when both the coefficients are not statistically significant in both the equations.

3.5.3 Supply response of small cardamom production

The supply response of small cardamom in the Idukki district of Kerala was estimated by employing an alternative form of Nerlovian supply response model using Ordinary Least Squares regression (Sadoulet and Janvry, 1995). The specification of supply response model for the small cardamom is as follows:

$$\ln Q_t = b_0 + b_1 \ln Q_{t-2} + b_2 \ln P_{ct} + b_3 \ln P_{ct-2} + b_4 \ln P_{pt-2} + b_5 \ln R_{t-1} + b_6 \ln T_{max\ t-1} + b_7 \ln T_{min\ t-1} + b_8 DUM_t \quad \ldots\ldots (13)$$

where,

Q_t = Production of small cardamom at time t

Q_{t-2} = Production of small cardamom at time t-2

P_{ct} = Price of small cardamom at time t

P_{ct-2} = Price of small cardamom at time t-2

P_{pt-2} = Price of competing crop (pepper) at time t-2

R_{t-1} = Rainfall at time t-1

$T_{max\ t-1}$ = Maximum temperature at time t-1

$T_{min\ t-1}$ = Minimum temperature at time t-1

DUM_t = Dummy for trade liberalisation (0 - pre-liberalisation period and 1 - post-liberalisation period)

3.5.4 Export performance

3.5.4.1 Analysis of growth in export

Growth rates measure how the economic variables performed in the past. In the present study, growth rates were analysed to know the trend in the export of small cardamom from India during the period from 1970-71 to 2017-18. The growth in export in terms of quantity, value and unit value were estimated using exponential growth function as follows (Gujarati and Sangeetha, 2007),

$$E = ab^t e_t \quad \ldots\ldots (14)$$

where,
E= Variable for which growth rate is estimated
a= Intercept
b= Regression co-efficient
t= Time variable
e= Error term

The logarithmic form of the above exponential equation:

$$\ln E = \ln a + t \ln b \quad \ldots\ldots (15)$$

The compound growth rate (r) was computed from the following relationship

$$r = \text{Anti ln of } (b - 1) \times 100 \quad \ldots\ldots (16)$$

Significance of the compound growth rates were tested by the given statistics,

$$t = r / SE(r) \quad \ldots\ldots (17)$$

where,

$$SE(r) = [100\, b * SE(\ln b)] / \ln e \quad \ldots\ldots (18)$$

3.5.4.2 Analysis of instability in export

Instability in the export from a country hinders its development. In the present study, the instability in export of small cardamom from India was analysed for the period from 1970-71 to 2017-18 using Coppock's instability index (Coppock, 1966), which is expressed as,

$$V \log = \frac{1}{N-1} \sum \{\log (\frac{X_{t+1}}{X_t}) - M\}^2 \quad \ldots\ldots (19)$$

$$\text{Instability index} = (\text{antilog } \sqrt{V \log} - 1) \times 100 \quad \ldots\ldots (20)$$

where,

X_t = Value or quantity of exports in year t

N = Number of years considered

M = Arithmetic mean of the difference between the logs of X_t and X_{t+1}

V log = Logarithmic variance of the export

3.5.4.3 Decomposition of sources of growth and variability in export

Hazell's (1982) decomposition model was employed to find out the sources of growth and variability in export of small cardamom from India. As the first step, the quantity and unit value of export were detrended using the following linear relation,

$$z_t = a + b + e_t \quad \ldots\ldots (21)$$

where,

z_t = export quantity or export unit value

t = time variable, and

e_t = residual

The residuals obtained were centered on the mean export quantity and unit value to obtain the detrended data of the form

$$z^*_t = e_t + \bar{z} \quad \ldots\ldots (22)$$

where,

$\bar{z}$ = mean of export quantity or export unit value

Z^*_t = detrended export quantity or export unit value

The average export value was decomposed as,

$$\text{Export Value} = \bar{Q}_I \Delta\bar{P} + \bar{P}_I \Delta\bar{Q} + \Delta\bar{Q}\Delta\bar{P} + \Delta\text{Cov}(Q, P) \text{ (Method I)} \quad \ldots\ldots (23)$$

or

$$= \bar{Q}_{II} \Delta\bar{P} + \bar{P}_{II} \Delta\bar{Q} + (-\Delta\bar{Q}\Delta\bar{P}) + \Delta\text{Cov}(Q, P) \text{ (Method II)} \ldots\ldots (24)$$

where,

$\bar{Q}_I$ = Average export quantity of cardamom in first period,

$\bar{Q}_{II}$ = Average export quantity of cardamom in second period.

$\bar{P}_I$ = Average unit value of export in first period,

$\bar{P}_{II}$ = Average unit value of export in second period,

$\Delta\bar{Q}$ = Change in export quantity ($\bar{Q}_{II} - \bar{Q}_I$), and

$\Delta\bar{P}$ = Change in unit value of export ($\bar{P}_{II} - \bar{P}_I$).

Various components of change in average value of export were estimated as shown in Table 3.4.

There are four sources of change in value of exports between two periods. $\Delta\bar{P}$ and $\Delta\bar{Q}$ are the changes in the export unit value and export quantity. They are the pure effects and arise even in the absence of any other changes. $\Delta\bar{P}.\Delta\bar{Q}$ is the interaction effect, which is due to the occurrence of changes in quantity and unit value of export simultaneously. The term $\Delta\,\text{Cov}(Q, P)$ indicates the changes in variability of export value due to changes in the correlation between export quantity and unit value.

Table 3.4 Components of change in export value of small cardamom

Source of change in export Description	Components of change		
	Symbol	Method I (%)	Method II (%)
Change in mean export unit value	$\Delta\overline{P}$	$\overline{Q}_I\Delta\overline{P}$	$\overline{Q}_{II}\Delta\overline{P}$
Change in mean export quantity	$\Delta\overline{Q}$	$\overline{P}_I\Delta\overline{Q}$	$\overline{P}_{II}\Delta\overline{Q}$
Interaction between change in mean quantity and mean unit value	$\Delta\overline{P}.\Delta\overline{Q}$	$\Delta\overline{Q}\Delta\overline{P}$	$-\Delta\overline{Q}\Delta\overline{P}$
Change in quantity - unit value covariance	$\Delta\mathrm{Cov}\,(Q,P)$	$\Delta\mathrm{Cov}\,(Q,P)$	$\Delta\mathrm{Cov}\,(Q,P)$

3.5.4.4 Geographic Concentration of export

Increased geographic concentration increases the instability and thereby the risks in export earnings. The Hirschman Index (Mikic and Gilbert, 2007) was used to measure the geographic concentration in the export of small cardamom from India.

$$\text{Hirschman Index, HI} = 100\sqrt{\sum_{i=1}^{n}(X_{it}/X_t)^2} \ldots\ldots (25)$$

where,

X_{it} = the value of small cardamom export from India in year t to the i^{th} market,

X_t = the total value of export of small cardamom from India in year t and

n = number of countries importing the commodity from India.

The maximum value of the index is 100, which is obtained only when the country exports to one market. Lower value of HI indicates larger number of export markets.

3.5.4.5 Structural change in exports

Markov-chain model employing transition probability was used to examine the structural changes in the export of small cardamom from India. It identifies the trend in upholding the existing market and the shift in shares from one country to another over the period of time (Lee *et al*., 1970). The analysis involves the estimation of transition probability matrix P. The element P_{ij} denotes the probability of export to shift from country i to country j over the period of time. The diagonal elements in the transition probability matrix indicate the probability of retaining the export share of a

country and thus it helps to identify the loyal importers of a particular country's commodity (Atkin and Blandford, 1982).

The average exports of small cardamom from India to a country is a random variable which depends on its past exports to that country, which is denoted as,

$$E_{jt} = \sum_{i=1}^{r} E_{it} - 1\ P_{ij}\ E_{it-1}\ P_{ij} + e_{jt} \ldots\ldots (26)$$

where,

E_{jt} = Export of small cardamom from India to j^{th} country during the year t

E_{it-1} = Export of small cardamom from India to i^{th} country during the year t-1

P_{ij} = The probability of shift in export from i^{th} country to j^{th} country

e_{jt} = Error term and

r = Total number of countries importing cardamom.

The transition probabilities (P_{ij}) was arranged in a (c x r) matrix and it has the following properties

$$0 \leq P_{ij} \leq 1$$

$$\sum_{i=1}^{r} Pij = 1 \text{ for all i}$$

The share in exports expected from each country in any particular period t was estimated by multiplying the transition probability matrix with the exports to that country in the previous time period (t-1).

Linear programming (LP) framework was employed to estimate the transition probability matrix by using minimisation of Mean Absolute Deviation (MAD).

3.5.4.6 Elasticities of Export Demand and Export Supply

The export demand and export supply elasticities assist in knowing the potential and prospect of small cardamom export from India for a geographic expansion. A simultaneous equation model was employed to analyse the elasticities of export to changes in price and income and a similar set of demand and supply equations for export of horticultural commodities was used by Islam (1990).

Export demand for small cardamom from India is estimated by considering the factors such as export price of small cardamom in India, average export price of cardamom in the international market and the income of the importing countries. The demand equation estimated is specified as follows,

$$\ln X_t^d = a_0 + a_1 \ln [PX_t / PW_t] + a_2 \ln [YW_t] \ldots\ldots (27)$$

where,

X^d = the quantity of exports of small cardamom from India

PX = the export price of small cardamom in India

PW = the average export price in international market

YW = the real income in importing countries

Export supply of small cardamom from India is considered to be influenced by current export price and lagged export price of small cardamom, the domestic price of small cardamom in India and production of small cardamom in India. The supply equation estimated is given as follows,

$$\ln X^s_t = b_0 + b_1 \ln (PX\ ER/P)_t + b_2 \ln (PX\ ER/P)_{t-1} + b_3 \ln (Y)_t \ldots\ldots (28)$$

where,

X^s = The quantity of export of small cardamom from India

PX = The export price of small cardamom in India

ER = Exchange rate (US Dollar – Indian Rupee)

P = Domestic price

Y = Overall production capacity of India

The domestic price of small cardamom in relation to the export price indicates the attractiveness of the domestic market for the traders above the foreign markets, while t-1 denotes one year lagged response of exports to changes in price. The domestic production is included in the supply function as the supply of exports are known to dependent on the production of the commodity.

The normalized supply equation for the export price is as follows,

$$\ln (PX)_t = \beta_0 + \beta_1 \ln (X^s)_t + \beta_2 \ln (ER/P)_t + \beta_3 \ln (PX\ ER/P)_{t-1} + \beta_4 \ln (Y)_t \ldots\ldots (29)$$

The equilibrium relationship is,

$$\ln (Xt) = \ln (X^d)t = \ln (X^s)t \ldots\ldots (30)$$

In the present study, the export demand and supply equations were analysed simultaneously by using the 2SLS technique i.e., the technique of two Stage Least Square**.**

3.5.5 Export competitiveness

Competitive advantage is an inclusive concept that involves market segmentation, differentiated products, differences in technology, economies of scale and other related things. Accordingly, the comparison between price and cost has developed into a preliminary indicator of competitiveness. The competitiveness of small cardamom export from India in the present study was analysed using Policy Analysis Matrix (PAM) and the competitiveness ratios *viz*., Nominal Protection Coefficient (NPC), Effective Protection Coefficient (EPC) and Domestic Resource Cost Ratio (DRCR) (Gotsch *et al*., 2003).

3.5.5.1 Policy Analysis Matrix (PAM)

The Policy Analysis Matrix (PAM) includes two accounting identities namely, profitability identity and divergence identity. In PAM the profitability identity gives the relationship across the columns, while the divergences identity shows the relationship down the rows of the matrix. While the profits are defined as revenues less costs, the entries in the third row of PAM, which is called as the "effects of divergences", indicate the variation between the entries in the first row and the second row i.e., difference between the entries measured in private prices and social prices (Table 3.5).

Table 3.5 Policy Analysis Matrix

	Revenue	Costs		Profits
		Tradable Input	Domestic Factor	
Private	A	B	C	D
Social	E	F	G	H
Divergences	I	J	K	L

The primary motive of a PAM is to help the policy makers in major areas of agricultural policy *viz*., private costs, returns, and profit by providing them with information and analysis. In constructing PAM for the agricultural systems, the privative profitability (D = A-(B+C)) i.e., the measures of competitiveness at prevailing market price, is calculated in the first row, while the calculation of social profitability i.e., the estimation of social opportunity cost is carried out in the second row (H=E-(F+G)). The social profit indicates the comparative advantage and efficiency of the country in utilising scarce resources. In addition to this, PAM also helps in measuring the effects of policy transfers, as the impact of any policy can be known from the difference between revenues in the first row and costs in the second row before and after imposing that particular policy.

The PAM allows for the calculation of important policy analysis indicators namely, Nominal Protection Coefficient (NPC), Effective Protection Coefficient (EPC) and Domestic Resource Cost Ratio (DRCR).

3.5.5.2 Nominal Protection Coefficient (NPC)

The NPC indicates the export competitiveness of a commodity and measures the degree of protection provided to the commodity domestically. In the computation of NPC, wholesale price was considered as the domestic price, while the world price was represented by the international price of the commodity adjusted for the costs incurred in transportation, marketing and processing. The Nominal Protection Coefficient of the i^{th} commodity is calculated as,

$$NPC_i = P_i^d \,/\, P_i^w \ldots\ldots (31)$$

where,

P^d = Domestic price

P^w = World reference price

From the PAM table,

$$NPC = A / E \ldots\ldots (32)$$

NPC value of greater than unity indicates the prevalence of domestic protection to the commodity when compared to the situation of free trade, while a value of less than one indicates that the commodity is not protected. When the domestic price of the commodity is equal to its border price (CIF or FOB), the value of NPC tends to be equal to one. The NPC examines the competitiveness of a commodity from the trader point of view, as the production aspects are taken into account while calculating this competitiveness index (Datta *et al*., 2001).

3.5.5.3 Effective Protection Coefficient (EPC)

From PAM table, EPC is obtained as the ratio of value added in private prices (i.e., A-B) to the value added in social prices (i.e., E-F). The EPC of the i^{th} commodity by considering j^{th} input can be given mathematically as,

$$EPC_i = \frac{Q_i(P_i^d - \sum A_{ij} * P_j^d)}{Q_i(P_i^w - \sum A_{ij} * P_j^w)} \ldots\ldots (33)$$

where,

Q = Output quantity

Aij = Quantity of j^{th} input required to produce a unit of i^{th} commodity

In EPC, the numerator denotes the surplus available with the domestic processor-cum-trader to pay for non-tradable inputs including his own services after meeting the costs of tradable inputs, while the denominator denotes the surplus available to him under free trade conditions (Datta *et al*., 2001). A value of EPC greater than one indicates the presence of positive incentives to the producers as provided by the government policies, while a value of less than one denotes that there is no protection provided to the producers through policy interventions.

3.5.5.3 Domestic Resource Cost Ratio (DRCR)

DRCR measures an economy's resource use efficiency in the production of a commodity and identifies the comparative advantage of the country in producing the commodity. It is the shadow value or shadow price of the non-tradable inputs such as land, labour and capital (non-tradable), which are employed in the activity for one unit of tradable value or price added. From the PAM table,

$$DRCR = G / (E-F) \ldots\ldots (34)$$

DRCR can be defined as the value of domestic resource required to earn or to save a unit of foreign exchange by producing or exporting a commodity. DRCR is given as,

$$DRCR = \frac{\sum A_{ij} P_j^s}{P_i^w - \sum A_{ij} P_j^w} \quad \ldots\ldots (35)$$

where,

A_{ij} = Quantity of j^{th} input required to produce a unit of i^{th} output

P_i^s = Shadow price of j^{th} non-tradable input

The term non-tradable inputs denote the inputs that cannot be traded normally in the international market which include human labour, bullock labour and farm yard manures. Tradable inputs are those which can be traded internationally and this includes fertilizers, plant protection chemicals and seeds. The value of DRCR indicates that the country is having a comparative advantage in producing the commodity domestically, while a value greater than one indicates that the country is not having comparative advantage and it utilizes its inputs inefficiently.

3.5.6 Implications of dynamics in prices and trade

The changes in price of small cardamom have direct impact on the farm households by affecting their income, as the changes in price lead to instability in the income of the producers. Farmers try to compensate the instability in income through dissaving or through borrowings, which in turn have impact on the decision of farmers regarding farm investment. Thus, the dynamics in prices affects the relative prices and

the profitability of small cardamom, which in turn affect the investment decisions and input usage.

3.5.6.1 Variance Decomposition Analysis

The transmission of fluctuations from the world market price to the domestic price and to the producer price commences with the average annual price of exports or export unit value (EUV) which the country receives. It is not necessary for the EUV to follow the world price closely, and any divergence between EUV and world reference price can be due to several factors like the differences in the quality of commodity, distribution of exports and imports based on seasonality, the location of world market and contracts based on forward pricing.

The major factors that determine the transformation from export unit value in terms of US dollar to average wholesale price or producer price in the domestic market in terms of local currency are the exchange rate, interventions by the government, the share of the commodity sold to total production and margins retained by the intermediaries in marketing and processing the commodity. The share of production sold in the domestic market indicates the internal demand or carried forward stocks, especially in the case of existence of any difference in the quality of the product in the domestic market and in the export market. The interventions of government in any form such as taxes on exports or tariff on imports and the attempts to stabilise price in the domestic market cause the movements between domestic market price and EUV to be less than perfectly correlated.

In the present study a simple variance decomposition analysis given by Hazell (1982) was employed to decompose the variability in wholesale prices (as producer prices are not available), which was called as the producer price variance, into different components in order to find out the contribution of different factors to the variability in producer prices or wholesale prices.

The simple variance decomposition analysis can be given as:

$$EUV_{(R)} = EUV_{(\$)} \text{ x } ER \quad \ldots\ldots (36)$$

where,

$EUV_{(\$)}$ = Export unit value in US dollar

$EUV_{(R)}$ = Export unit value in rupee

ER = Exchange rate (US Dollar -Indian Rupee)

The relationship between Producer Price in rupees (PP) and $EUV_{(R)}$ can be given as,

$$PP_t = a + b\ EUV_{(R)} + U_t \text{ ..... (37)}$$

where, U_t is the stochastic residual term

$$PP_t = a + b\ (EUV_{(\$)} \text{ x } ER) + U_t \text{ ..... (38)}$$

Goodman's approximation was used to estimate the role of different components of variance in producer prices (Goodman, 1960), which is given as follows,

$$V(PP) = b^2 [\ \underline{ER}^2 \text{ x } V(EUV_\$) + \underline{EUV_\$}^2 \text{ x } V(ER) + 2 \text{ x } \underline{ER} \text{ x } \underline{EUV_\$} \text{ x } COV(EUV_\$, ER) - COV^2(ER, EUV_\$) + R] + \sigma u^2 \quad \text{..... (39)}$$

where,

V = Variance

COV = Covariance

$\underline{ER}$, $\underline{EUV}$ = Sample means

R = Residual

σu^2 = Variance of u_t

Once the variance of PP is obtained, it can be decomposed into five different variabilty components *viz*., $V(EUV_\$)$, V(ER), $COV(EUV_\$ER)$, R and σu^2.

Results and discussion

4. RESULTS AND DISCUSSION

In the present study, main emphasis was on analysing the dynamics in prices and trade of small cardamom with regard to domestic and international markets and their implications at the producer level. In accordance with the objectives set forth, the analyses were done within the framework of the specified methodologies. The empirical results obtained through various possible models described in the methodology using secondary and primary data are presented in this chapter under the following headings.

4.1 Cost of cultivation and marketing of small cardamom

4.2 Price formation and price transmission in small cardamom

4.3 Supply response of small cardamom

4.4 Export performance for small cardamom

4.5 Export competitiveness of Indian small cardamom

4.6 Welfare implications of changes in price and trade of small cardamom

4.1 COST OF CULTIVATION AND MARKETING OF SMALL CARDAMOM

4.1.1 Economics of small cardamom cultivation

Cost of cultivation and cost of production of small cardamom in Idukki district of Kerala were computed using various concepts like establishment cost and maintenance cost. The economic lifespan of small cardamom was considered as 25 years and the yielding phase starts from the third year onwards. Therefore, in this study, the crop in the fields of the sample farmers was categorized based on its age as in the (i) Establishment phase (1^{st} to 2^{nd} year), (ii) Yield increasing phase (3^{rd} to 7^{th} year), (iii) Yield stabilizing phase (8^{th} to 15^{th} year), and (iv) Yield declining phase (16^{th} to 25^{th} year).

The establishment cost i.e., the expenses incurred during first and second year of planting included the expenditure on land preparation, digging and filling pits,

planting material, shade, manures and fertilizers, plant protection chemicals, irrigation, and weeding.

The maintenance cost which was calculated from the third year to the 25th year included costs on soil works/conservation practices, manures, fertilizers, plant protection chemicals and various farm operations such as irrigation, mulching, trashing, shade regulation, weeding, harvesting and curing.

4.1.1.1 Cost structure during establishment phase of small cardamom

4.1.1.1.1 Operation-wise establishment cost

The total establishment cost per hectare of small cardamom in Idukki district was estimated as ₹4,52,629, while the costs incurred during the first year and second year of establishment were ₹2,79,906 and ₹1,72,723 respectively (Table 4.1). The higher cost incurred in the first year, which was 62 per cent of the total cost of establishment was because of the obvious reason of planting related activities such as land preparation, pit formation and purchase of planting materials, which were absent in the second year of establishment. The cost incurred for manures and fertilizers was high in the first year as they were applied in comparatively larger quantities as basal and for filling the pits. In the second year of the establishment phase, costs were mainly incurred for the maintenance activities and it was incurred for plant protection chemicals, manures and fertilizers, and weeding.

The operation-wise costs incurred for manures and fertilizers, application of plant protection chemicals, digging and filling pits, planting material and planting, weeding, providing shade, land preparation and irrigation during the establishment phase of small cardamom were estimated as ₹1,49,004, ₹1,47,892, ₹38,919, ₹33,359, ₹29,653, ₹24,890, ₹24,463 and ₹4,448 per hectare respectively. Manures and fertilizers and plant protection chemicals accounted for the major share of 32.92 per cent and 32.68 per cent of the total operation-wise cost respectively. This was followed by digging and filling pits (8.60 per cent), planting material (7.37 per cent), weeding (6.55 per cent), shade regulation (5.50 per cent), land preparation (5.40 per cent) and irrigation (0.98 per cent).

Table 4.1 Operation-wise establishment cost of small cardamom in Idukki district

(₹ per hectare)

Sl. No.	Particulars	First year	Second year	Total
1	Land preparation	24463 (8.74)	-	24463 (5.40)
2	Digging and filling pits	38919 (13.90)	-	38919 (8.60)
3	Planting material	33359 (11.92)	-	33359 (7.37)
4	Shade regulation	17480 (6.25)	7410 (4.28)	24890 (5.50)
5	Manure & fertilizers	93405 (33.37)	55599 (32.19)	149004 (32.92)
6	Plant protection chemicals	70054 (25.03)	77838 (45.07)	147892 (32.68)
7	Irrigation	2224 (0.79)	2224 (1.29)	4448 (0.98)
8	Weeding	-	29653 (17.17)	29653 (6.55)
	Total cost	279906 (100.00)	172723 (100.00)	452629 (100.00)

Note: Figures in parentheses indicate per cent to column total

4.1.1.1.2 Input-wise establishment cost

The input-wise establishment cost of small cardamom plantation in Idukki district is presented in Table 4.2. It could be observed from the table that the human labour contributed the major share in the establishment cost, as it included labour cost for land preparation, pit formation, application of fertilizers and pesticides, and weeding. The share of manures and fertilizers was higher than that of plant protection chemicals in the first year of establishment as higher quantity of manure and fertilizers were applied as basal dose during planting.

In the overall establishment phase of small cardamom, human labour accounted for the major share in the total cost incurred (36.93 per cent), followed by manures and fertilizers (30.95 per cent) and plant protection chemicals (20.89 per cent). Cost incurred on irrigation was found to have a minor share among all the inputs (0.49 per cent) as majority of the farmers, especially marginal and small farmers were growing the crop as rainfed.

Table 4.2 Input-wise establishment cost of small cardamom

(₹ per hectare)

Sl. No.	Particulars	First year	Second year	Total
1	Human labour	97853 (34.96)	69310 (40.14)	167162 (36.93)
2	Planting material	33359 (11.92)	-	33359 (7.37)
3	Shade regulation*	15257 (5.45)	-	15257 (3.37)
4	Manure & fertilizers*	88958 (31.78)	51151 (29.61)	140109 (30.95)
5	Plant protection chemicals*	43367 (15.49)	51151 (29.61)	94518 (20.89)
6	Irrigation*	1112 (0.40)	1112 (0.64)	2224 (0.49)
	Total cost	279906 (100.00)	172723 (100.00)	452629 (100.00)

Note: Figures in parentheses indicate per cent to column total
* Exclusive of human labour

4.1.1.2 Maintenance cost incurred during yielding phase of small cardamom

4.1.1.2.1 Operation-wise maintenance cost

The operation-wise annual maintenance cost per hectare of small cardamom was calculated for various periods in the yielding phase and the results are presented in Table 4.3. The cost was higher during the period from the third to seventh year of the crop i.e., the yield increasing phase, as more quantity of fertilizers, plant protection chemicals and irrigation were provided in this period compared to the other periods. Due to high input responsiveness of small cardamom in the yield increasing phase, farmers took better care of the crop by applying comparatively higher amount of chemical fertilizers and pesticides for getting a higher yield. The annual maintenance cost was less in the yield declining phase (from 16th to 25th year of the crop), as fertilizers, plant protection chemicals and irrigation applied were comparatively less, which could be attributed to the lesser care given by the farmers to senile small cardamom plants, which were less responsive to inputs.

The weighted mean of operation-wise annual maintenance cost for the overall yielding phase was worked out as ₹4,00,081 per hectare. The plant protection chemicals contributed the major share of 32.10 per cent in the operation-wise

maintenance cost for the overall yielding phase and was followed by FYM and other organic manures (18.83 per cent), harvesting (13.83 per cent), fertilizers (7.67 per cent), weeding (6.32 per cent), soil works/conservational practices (5.30 per cent), trashing (4.97 per cent), mulching (2.97 per cent), providing shade (2.91 per cent), curing (2.64 per cent) and irrigation (2.46 per cent).

Table 4.3 Operation-wise annual maintenance cost of small cardamom cultivation

(₹ per hectare)

Sl. No.	Particulars	Yield increasing phase	Yield stabilising phase	Yield declining phase	Weighted mean
1	Soil works/conservational practices	8237 (1.70)	39537 (9.82)	-	25191 (5.30)
2	FYM and other organic manures	68448 (14.15)	74626 (18.53)	82368 (25.71)	75319 (18.83)
3	Fertilizers	60201 (12.44)	32124 (7.98)	14085 (4.40)	34690 (7.67)
4	Plant protection chemicals	177280 (36.64)	113668 (28.22)	100819 (31.47)	128822 (32.10)
5	Irrigation	14241 (2.94)	7925 (1.96)	7925 (2.46)	9855 (2.46)
6	Mulching	15979 (3.30)	14826 (3.68)	4942 (1.54)	11884 (2.97)
7	Trashing	17454 (3.61)	19768 (4.91)	22239 (6.94)	19885 (4.97)
8	Shade regulation	5889 (1.22)	15815 (3.93)	12355 (3.86)	11629 (2.91)
9	Weeding	30579 (6.32)	24711 (6.14)	21004 (6.56)	25268 (6.32)
10	Harvesting	74132 (15.32)	49421 (12.27)	44479 (13.88)	55324 (13.83)
11	Curing	11404 (2.36)	10329 (2.56)	10193 (3.18)	10612 (2.64)
	Total	483844 (100.00)	402749 (100.00)	320409 (100.00)	400081 (100.00)

Note: Figures in parentheses indicate per cent to column total

Various plant protection chemicals were sprayed once in a month or at 25 days interval and thus 12 applications each year were given, which obviously led to a higher contribution by the plant protection chemicals, which was 32.1 per cent of the total maintenance cost. The share of FYM and other organic manures (18.83 per cent) was found to be more than that of fertilizers (7.67 per cent), as majority of the farmers preferred more of organic manures which were available at comparatively lower cost than the chemical fertilizers. Being one of the most labour-intensive activity in small cardamom cultivation, the cost incurred for harvesting was nearly 14 per cent of the total maintenance cost. Harvesting of cardamom is done by picking the capsules manually, which requires skilled labour, and it involves five to eight pickings in a year, which makes it much labour intensive.

4.1.1.2.2 Input-wise maintenance cost

The input-wise cost incurred during the yielding phase of small cardamom in Idukki district was computed and the results are presented in Table 4.4. The inputs required for small cardamom were categorised as human labour, FYM and other organic manures, fertilizers, plant protection chemicals, irrigation water and curing. Human labour cost included the expenses spent on labourers for soil works/conservational practices, application of manures, fertilizers and plant protection chemicals and important farm activities such as mulching, trashing, weeding, and harvesting. Irrigation was considered as an input as many farmers purchased irrigation water due to scarcity of water in the study area. The cost structure was more or less similar during all the three stages of the yielding phase, in which human labour accounted for the major share, followed by plant protection chemicals and FYM and other organic manures.

While considering the input-wise maintenance cost for the overall yielding phase, it was found that the cost incurred for human labour was more than 50 per cent. This was followed by plant protection chemicals, FYM and other organic manures fertilizers, curing and irrigation accounting for 24.24 per cent, 15.03 per cent, 6.10 per cent, 2.65 per cent and 1.10 per cent respectively of the total input-wise annual maintenance cost during the overall yielding phase.

Table 4.4 Input-wise annual maintenance cost of small cardamom cultivation

(₹ per hectare)

Sl. No.	Particulars	Yield increasing phase	Yield stabilising phase	Yield declining phase	Weighted mean
1	Human labour	214540 (44.34)	226348 (56.20)	168854 (52.70)	203576 (50.88)
2	FYM and other organic manures	61776 (12.77)	61776 (15.34)	56834 (17.74)	60129 (15.03)
3	Fertilizers	51305 (10.60)	17297 (4.29)	7413 (2.31)	24394 (6.10)
4	Plant protection chemicals	137249 (28.37)	84016 (20.86)	74132 (23.14)	96987 (24.24)
5	Irrigation	7569 (1.56)	2983 (0.75)	2983 (0.93)	4384 (1.10)
6	Curing	11404 (2.36)	10329 (2.56)	10193 (3.18)	10612 (2.65)
	Total	483844 (100.00)	402749 (100.00)	320409 (100.00)	400081 (100.00)

Note: Figures in parentheses indicate per cent to column total

4.1.1.3 Cost of cultivation of small cardamom

Cost of cultivation, which is the total expenditure incurred by the farmers for cultivating one hectare of small cardamom was calculated and the results are presented in Table 4.5. The overall establishment cost incurred in small cardamom cultivation was higher than the maintenance cost, which was in accordance with the findings of Rasmi (2010), John (1993) and Jose (1976). For arriving at the total cost of cultivation, the establishment cost which was estimated as ₹4,52,629 per hectare was amortized to ₹50,953 per hectare per year. It was then added to the annual maintenance cost and interest on working capital at seven per cent and thus, the total cost of cultivation was estimated as ₹4,79,040 per hectare of small cardamom. The cost of cultivation of small cardamom in the study area was found to be high mainly due to higher labour cost and increased usage of plant protection chemicals. On an average, 450 labourers were employed in a hectare of small cardamom plantation per year out of which nearly 250 labourers were hired for harvesting. The scarcity of labour in the area of cultivation and the hiring of labourers from neighbouring state of Tamil Nadu in turn increased the cost of human labour. Susceptibility of small cardamom to pests and diseases and a higher ruling price of the commodity in the market made the farmers to apply the

plant protection chemicals above the recommended level, despite the increasing cost. As per the report of National Institute of Advanced Studies (NIAS), Bengaluru, cardamom farmers used an average of 27 kg of pesticides in one hectare, which was one of the world's highest usage of pesticides. A pesticide monitoring report prepared by the Ministry of Agriculture in 2010 stated that the cardamom samples collected from Pampadumpara panchayat in Idukki district had quinalphos content 25 times the maximum recommended limit (Misra, 2015). This was evident from the presence of high level of residual toxic content, including the presence of residues of banned chemicals in small cardamom capsules (Beevi *et al*., 2014; Raman, 2019).

Table 4.5 Cost of cultivation of small cardamom

(₹ per hectare)

Sl. No	Particulars	Cost (₹ / ha)
1	Establishment cost	4,52,629
2	Amortized value	50,953
3	Annual maintenance cost	4,00,081
4	Interest on working capital @ 7 %	28,006
5	Total cost	4,79,040

4.1.1.4 Cost of production of small cardamom

Cost of production per kilogram of small cardamom in Idukki district of Kerala was calculated by dividing the total cost per hectare by the average productivity of small cardamom in the sample farms in kilograms per hectare and the results are presented in Table 4.6.

The total cost of production was worked out as ₹375 per kg and the production cost was found to be higher during the yield stabilizing period (8-15 years) than the yield increasing period (3-7 years), as the percentage reduction in the crop productivity was higher than the percentage reduction in cost of cultivation in the former phase. This indicates the need for replanting the crops in the middle of the yield stabilizing phase i.e., after 10 to 12 years of age, which will be more beneficial. But the farmers were reluctant to go for replanting due to high expenses incurred and lack of income from the crop during the gestation period. The subsidy provided by the Spices Board

for replanting was also reported to be very low when compared to the actual cost involved.

Table 4.6 Cost of production of small cardamom (₹ per kg)

Sl. No.	Particulars	Yield increasing phase	Yield stabilising phase	Yield declining phase	Average
1	Establishment cost (₹/ha)	-	-	-	452629 (Total)
2	Amortized value (₹/ha)	50953	50953	50953	50953
3	Annual maintenance cost (₹/ha per year)	483844	402749	320409	400081
4	Interest on annual maintenance cost (₹/ha)	33869	28192	22429	28006
5	Total cost (₹/ha per year)	568666	481895	393791	479040
6	Average productivity (kg/ha)	1482	1235	1112	1276
7	Cost of production (₹/kg)	384	390	354	375

4.1.1.5 Gross and net returns from small cardamom cultivation

The estimated gross and net returns earned from small cardamom cultivation in Idukki district is given in Table 4.7. Gross return was estimated based on the average productivity of cardamom in the study area and average price received by the farmers during the survey period. The net return was arrived after deducting the total cost of cultivation per hectare from the gross return per hectare. The gross and net returns were found to be ₹13,97,406 and ₹9,18,366 per hectare respectively.

Table 4.7 Net returns from small cardamom cultivation in Idukki

Sl. No.	Particulars	Quantity/Value
1	Average productivity (kg/ha)	1,276
2	Average price received by farmers (₹/kg)	1,095
3	Gross return (₹ per hectare)	13,97,406
4	Total cost (₹ per hectare)	4,79,040
5	Net return (₹ per hectare)	9,18,366

The total cost of cultivation and the cost of production of small cardamom in Idukki district of Kerala were worked out as ₹4,79,040 per hectare and ₹375 per kg respectively, indicating the need for high initial investment in the cultivation of small

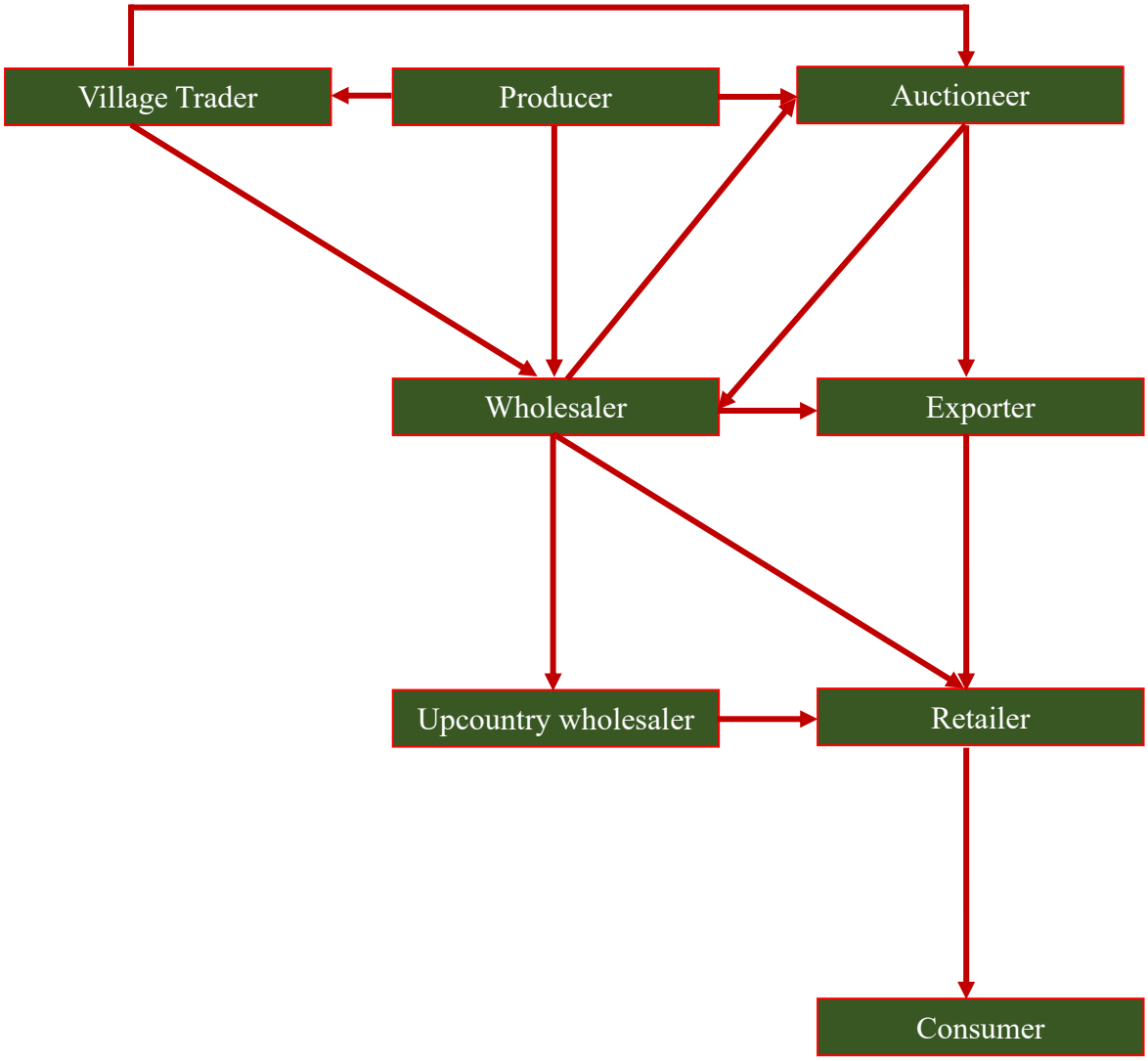
cardamom. The intensive use of inputs, labour requirement throughout the year and the post-harvest operations at the farm level resulted in exorbitant costs. In spite of the higher cost of cultivation, small cardamom cultivation in the Idukki district was found to be profitable in nature, with farmers earning a net return of ₹9,18,366 per hectare, as the commodity was fetching a comparatively higher price during the period of the farm survey. The study has also shown that cardamom required replacement/replanting at the appropriate stage of 8-15 years for better yield and returns (John, 1993), as there was higher cost of cultivation combined with decline in yield in the later stages of the crop.

4.1.2 Marketing of small cardamom

Marketing of small cardamom refers to all the activities involved in the movement of the commodity from the farm to the ultimate consumer through different marketing channels. The marketing process involves many intermediaries like village traders, auction agents, wholesalers, up-country wholesalers, exporters and retailers.

Small cardamom was once grown mainly for export and the export price was dependent on the quality of the capsules. There is significant variation in the quality of the dried capsules as it depends on several external and internal parameters, and due to the quality variations, historically, the small cardamom has been marketed through an auction system (Joseph, 2011), which was a traditional out-cry method. In order to bring transparency in the auction system, Spices Board established the e-auction system in 2007. Currently, small cardamom is marketed through e-auctions, which are conducted during all the working days at the Spices park, situated in Puttady in Idukki district of Kerala state and Spices Board auction centre, located in Bodinayakanur in Tamil Nadu. The auctions are conducted by licensed auctioneers and the purchasers are the dealers who have registered in the auction centre which is under the control of the Spices Board. The overall market structure of small cardamom is given in Figure 2.

Figure 2 Market structure of small cardamom



Auction Centre, Puttady

Auction Centre, Bodinayakkanur

Plate 3 Spices Board auction centres for small cardamom

Grading of small cardamom

Sorting of small cardamom

Packing of small cardamom

Plate 4 Post-harvest activities for small cardamom

Village traders

Village traders purchase the product directly from the farmers at the farm gate and bear the transportation cost. They purchase both cured cardamom and fresh green cardamom, which they cure at their own cost before selling.

Auction agents

The auction agents or auctioneers refer to the companies which are licensed by the Spices Board to conduct auction in the e-auction centres located at Puttady in Idukki district of Kerala and Bodinayakanur in Theni district of Tamil Nadu. Auctioneers are the major actors in the marketing of cardamom who bring together the buyers and sellers of the product (Joseph, 2011). Currently, there are twelve licensed auctioneers in Kerala and Tamil Nadu *viz*., Greenhouse Cardamom Marketing India Pvt. Ltd, South Indian Green Cardamom Co. Ltd, Sugandhagiri Spices Promoters and Traders Pvt. Ltd, Spice More Trading Company, Vandanmedu Green Gold Cardamom Producer Company Limited, Idukki District Traditional Cardamom Producer Company Limited, Cardamom Growers Forever Private Limited, The Kerala Cardamom Processing and Marketing Co. Ltd, Header Systems (India) Limited, Mas Enterprises Limited, The Cardamom Planters' Marketing Co-operative Society Limited and Cardamom Planters' Association. These auctioneers collect the produce from the farmers and village traders and sell it in the auction on behalf of the farmers and traders. Upon sale of the produce, after deducting taxes and other charges, the money is credited to the farmers' accounts. The auction agents also act as wholesalers and exporters.

Wholesalers

Wholesalers usually purchase small cardamom from the farmers, village traders and auction centres. For participating in the auction, they need to register with the Spices Board. They carry out the process of grading and sorting and sell the produce to the retailers, up-country wholesalers and exporters. They sometimes resell the graded small cardamom in the auction. The wholesalers also carry out the business of retailing by directly selling to the consumers. Apart from this, they sell the produce to producers of ayurvedic medicines, spices/masala companies and other food industries.

Up-country wholesalers

Up-country wholesalers are the wholesalers located in Mumbai, Delhi and other major cities of North India and purchase the products from wholesalers in Kerala and Tamil Nadu and sell it to the retailers.

Exporters

Exporters purchase small cardamom from wholesalers or directly from auction. They prefer superior quality cardamom i.e., 7-8 mm bold as it has high demand in many countries around the world.

Retailers

Retailers, the most common and important intermediary in the marketing channels, purchase the products from wholesalers and sell to the ultimate consumers through local markets.

4.1.2.1 Marketing channels

Marketing channels refer to the chain of intermediaries *viz*., village traders, auction agents, wholesalers, exporters and retailers through whom the commodity is marketed. It represents the pathway through which producers are linked to the consumers. The major marketing channels identified for small cardamom in Idukki district were,

Channel I : Producer – Village trader – Auctioneer – Wholesaler – Retailer – Consumer

Channel II : Producer – Auctioneer – Wholesaler – Retailer – Consumer

Channel III : Producer – Village trader – Auctioneer – Exporter – Consumer

Channel IV : Producer – Auctioneer – Wholesaler – Upcountry wholesaler – Retailer – Consumer

Channel I and channel II represented the domestic markets and the farmers in channel I sold the produce to village traders who in turn sold it in the auction, while in channel II, farmers sold directly to the auction agents without the involvement of other intermediaries. The channel III represented the export market for cardamom, in which the exporters purchased the commodity from the auction, while channel IV represented

the upcountry market in which the wholesalers purchased the commodity from the auction and sold it to the upcountry wholesalers.

Table 4.8 presents the distribution of sample farmers in the study area based on their selling behaviour. It could be observed from the table that majority of the farmers (49 per cent) were selling the produce to the village traders. Only 32 per cent of the farmers were selling to auctioneers, though it was reported that farmers received a better price by selling directly to auctioneers rather than to the village traders.

The behaviour of majority of the farmers who sold their produce to the village traders could be attributed to the fact that there was delay in the payment up to 3-6 weeks when sold to auctioneers, while they received immediate payment upon selling to the village traders. Also, those without the title deed of the cultivated land and with low production, which were the cases with many of the marginal and small farmers, were unable to sell their produce to the auctioneers. It was also beneficial for many marginal and small farmers to sell small cardamom to village traders as they collected the produce directly from the farm gate and thus, the farmers did not have to bear any transportation and labour charges for loading and unloading.

It was also found that 19 per cent of the farmers were selling small cardamom to both village traders and auctioneers. They sold small portion of the produce to village traders for getting immediate payment to meet their urgent needs and sold larger quantity to auctioneers for getting better price for their produce.

Table 4.8 Distribution of farmers based on selling behavior

Market functionaries	Distribution of farmers
Village trader	79 (49.38)
Auctioneer	51 (31.87)
Both	30 (18.75)
Total	160 (100.00)

Note: Figures in parentheses indicate per cent to column total

4.1.2.2 Marketing costs

Marketing costs are the actual expenses incurred in bringing the goods and services from the producer to the consumer. The marketing cost for small cardamom included the loading and unloading charges, transportation cost, market charges such as commission and other miscellaneous charges.

The marketing costs were estimated for the identified marketing channels and the results are presented in Table 4.9. In channel I and IV, which involved the village traders, farmers did not incur any marketing cost as the traders themselves procured the produce directly from the farm. The total marketing cost was lowest in channel II (₹128.48 per kg), in which the number of intermediaries involved in marketing was less and there was no involvement of village traders as farmers sold the produce directly to the auctioneers. In channel III, which represents the export market, a higher marketing cost (₹250.38 per kg) was incurred due to high transaction cost and taxes incurred while exporting the commodity.

4.1.2.3 Marketing margin

Marketing margin is the actual/net income obtained by the intermediaries in the marketing process. Marketing margins of various intermediaries in different marketing channels were calculated and are presented in Table 4.10. Exporters (channel III) earned the highest margin of ₹498 per kg of small cardamom followed by retailers, upcountry wholesalers, wholesalers and village traders. Margin earned by wholesalers were high when the commodity was exported (channel III) and sold to upcountry wholesalers (channel IV). The total marketing margin earned by all the intermediaries was high in channel III (₹1271 per kg), followed by channels IV, I and II. The margin varied across the marketing channels according to the number of intermediaries and the kind of functions involved.

Table 4.9 Marketing cost in different channels (₹/kg) of small cardamom

Market functionaries	Items	Channel I	Channel II	Channel III	Channel IV
Farmer	Loading & unloading	-	0.5	-	0.5
	Transportation	-	0.2	-	0.2
	Market charges	10	35	10	35
	Miscellaneous	1	1	1	1
Village trader	Loading & unloading	0.6	-	0.6	-
	Transportation	0.5	-	0.5	-
	Market charges	35	-	35	-
	Miscellaneous	2	-	2	-
Auctioneer	Loading & unloading	0.3	0.3	0.3	0.3
	Transportation	0.2	0.2	0.2	0.2
	Market charges	0.38	0.38	0.38	0.38
	Miscellaneous	36	36	36	36
Wholesaler	Loading & unloading	0.4	0.4	0.4	0.4
	Transportation	0.5	0.5	0.5	0.5
	Market charges	36.5	36.5	36.5	36.5
	Miscellaneous	15	15	25	20
Upcountry wholesaler	Loading & unloading	-	-	-	0.6
	Transportation	-	-	-	10
	Market charges	-	-	-	37
	Miscellaneous	-	-	-	8
Exporter	Loading & unloading	-	-	2	-
	Transportation	-	-	40	-
	Processing	-	-	30	-
	Miscellaneous	-	-	30	-
Retailer	Loading & unloading	0.5	0.5	-	0.5
	Transportation	1	1	-	1
	Miscellaneous	1	1	-	1
	Total cost	140.88	128.48	250.38	189.08

Table 4.10 Price spread in different marketing channels (₹/kg) of small cardamom

Sl. No	Price spread	Channel I	Channel II	Channel III	Channel IV
1	Farmer's selling price	990	1200	990	1200
	Marketing cost	11	36.7	11	36.7
	Net price received by farmer	979	1163.3	979	1163.3
2	Village trader's selling price	1200	-	1200	-
	Marketing cost	38.1	-	38.1	-
	Marketing margin	171.9	-	171.9	-
3	Auction selling price	1250	1250	1700	1450
	Marketing cost	36.88	36.88	36.88	36.88
	Marketing margin	13.12	13.12	463.12	213.12
4	Wholesaler's selling price	1325	1325	1900	1700
	Marketing cost	52.4	52.4	62.4	57.4
	Marketing margin	22.6	22.6	137.6	192.6
5	Upcountry wholesaler's selling price	-	-	-	2000
	Marketing cost	-	-	-	55.6
	Marketing margin	-	-	-	244.4
6	Exporter's sales price	-	-	2500	-
	Marketing cost	-	-	102	-
	Marketing margin	-	-	498	-
7	Retailer's sales price	1600	1600	-	2350
	Marketing cost	2.5	2.5	-	2.5
	Marketing margin	272.5	272.5	-	347.5
8	Consumer's purchase price	1600	1600	3200	2350
	Total marketing cost	140.88	128.48	250.38	189.08
	Total marketing margin	480.12	308.22	1270.62	997.62
	Producer's share in consumer's rupee	61.87	75.00	30.94	51.06

4.1.2.4 Price spread

The price spread consists of the marketing costs and margins which ultimately determine the producer's share in the price paid by the consumer. The marketing channel-wise evaluation of selling price, marketing cost, marketing margin and producer's share in consumer's rupee were done and the results are presented in Table 4.10. Producer's share in consumer's rupee was the highest in channel II (75 per cent), which involved a smaller number of intermediaries than those in the other channels, while the share of producers was only 31 per cent when the commodity was being exported i.e., in channel III.

4.1.2.5 Marketing efficiency

The efficiency in the marketing of small cardamom in different channels was computed based on the marketing costs and margins and the results are presented in Table 4.11. The marketing efficiency was the highest in channel II, while channel III exhibited the lowest efficiency. Higher efficiency of 2.75 in channel II was due to low marketing cost and margin, as it represented the domestic market with comparatively least number of intermediaries. Channel III represented the export market of Indian small cardamom and involved higher marketing cost and margin, which in turn lowered the efficiency (0.57), while channel IV, the upcountry market, was found to be comparatively efficient (1.01).

Table 4.11 Marketing efficiency of small cardamom in different marketing channels

Sl. No.	Particulars	Channel I	Channel II	Channel III	Channel IV
1	Total marketing costs	141	128	250	189
2	Marketing margins	480	308	1471	998
3	Price received by farmers	900	1200	900	1200
4	Marketing efficiency	1.59	2.75	0.57	1.01

The study shows that the higher cost involved in marketing of small cardamom and higher margin earned by the intermediaries led to lower efficiency of the markets. This was mainly due to the lack of proper infrastructure, high concentration of market

power in the hands of very few functionaries and the lack of transparency in price setting. Traders usually keep the auction prices as the base prices, but the small growers claim that the base prices are often manipulated and the traders pay to the producers after reducing on an average about ₹75 to ₹100 from the auction price. But as reported by the traders, they purchase ungraded cardamom from the producers and employ labourers for grading the capsules. The traders are also supposed to pay the taxes while selling the produce in auctions and when transporting the commodity to other states. The process of re-pooling in the auction in which the traders resell the commodity that they have already purchased in earlier auctions from the producers to other traders was found adversely affecting the producers considerably. The re-pooling creates artificial demand in the market and increase the price, because of which the benefits of the increase in price gets transferred only to the traders and not to the producers.

4.2 PRICE FORMATION AND PRICE TRANSMISSION OF SMALL CARDAMOM

Johansen cointegration approach, Error Correction Model and causality tests were employed to analyse the price formation and price transmission between Indian and international markets of small cardamom. The prices of ungraded cardamom and graded cardamom *viz.,* AGEB (Alleppey Green Extra Bold), AGB (Alleppey Green Bold), AGS (Alleppey Green Superior) and AGS1 (Alleppey Green Shipment 1) in the domestic market and the international prices of Indian extra bold in the New York market were considered for the analyses. The study employed the monthly price series from 1983 to 2018, which was classified into pre-WTO period (1983 to 1994) and post-WTO period (1995 to 2018) based on the liberalisation of trade in 1990s and also classified into different decades *viz*., period I (1983 to 1990), period II (1991 to 2000), period III (2001 to 2010) and period IV (2011 to 2018). In the case of graded cardamom, analyses were not carried out for the pre-WTO period and period I due to the non-availability of data in these periods.

4.2.1 Test of stationarity of price series

The price series in rupee and US dollar for different periods were tested for stationarity using Augmented Dickey Fuller (ADF) test at levels and first difference before proceeding to cointegration analysis and the results are presented in Table 4.12 and Table 4.13. The results revealed that for prices in rupee, all the variables were non-stationary at levels and stationary at first difference during all the time periods under consideration (Table 4.12). Non-stationarity at levels indicated the time dependent statistical properties of the price series that may be stochastic or deterministic, while stationarity of the series after first differencing showed that there was no systematic variation of the series with time and it had the tendency to return to its mean value and had a constant finite covariance structure. This indicates that the price series expressed in rupee were suitable for cointegration analysis. When the prices were expressed in dollar, the price of ungraded cardamom during the pre-WTO period, period I, period II and period III, the price of AGEB and AGB during the II and III periods, price series of AGS and AGS1 during the post-WTO period, period II and period III and the price of Indian extra bold in the pre-WTO period, overall time period, period I, period II and period III exhibited non-stationarity at levels and stationarity after first differencing which indicated the appropriateness of these price series for cointegration analysis (Table 4.13). However, for the rest of the time periods, the respective price series were found to be stationary at levels and hence were not considered for the cointegration analysis.

4.2.2 Cointegration analysis

The cointegration between the price series were analysed using Johansen cointegration test and, as the conclusions of trace statistics and maximum eigen value statistics were the same, the results of trace statistics omitting maximum eigen value statistics are presented from Table 4.14 to Table 4.23. The results of the analyses indicated for the small cardamom prices in rupee, there was no cointegration between the price series of Indian ungraded cardamom in the domestic market and Indian extra bold in the New York market during the pre-WTO period and the period II, while there was cointegrating relationship between the price series during the post-WTO period, overall period, period I, period III and period IV (Table 4.14). The prices in US dollars

Table 4.12 Results of the stationarity tests for monthly prices of small cardamom in rupee

Market / Price series	Augmented Dickey-Fuller (ADF)								
	Pre-WTO (1983-1994)			Post-WTO (1995-2018)			Over-all (1983-2018)		
	Level	First difference	Critical value	Level	First difference	Critical value	Level	First difference	Critical value
Ungraded	-1.55 (0.50)	-5.68 (0.00)	-2.88*	-1.96 (0.30)	-6.06 (0.00)	-2.87*	-1.89 (0.33)	-14.66 (0.00)	-2.87*
AGEB	-	-		-1.87 (0.35)	-9.04 (0.00)		-1.83 (0.37)	-12.88 (0.00)	
AGB	-	-		-1.92 (0.32)	-8.85 (0.00)		-2.38 (0.15)	-12.51 (0.00)	
AGS	-	-		-2.07 (0.26)	-8.61 (0.00)		-1.86 (0.35)	-12.64 (0.00)	
AGS1	-	-		-2.05 (0.26)	-8.41 (0.00)		-2.20 (0.20)	-14.06 (0.00)	
Indian extra bold	-1.71 (0.42)	-4.51 (0.00)		-1.81 (0.38)	-7.88 (0.00)		-2.18 (0.21)	-16.07 (0.00)	

Market / Price series	Augmented Dickey-Fuller (ADF)											
	Period I (1983-1990)			Period II (1991-2000)			Period III (2001-2010)			Period IV (2011-2018)		
	Level	First difference	Critical value	Level	First difference	Critical value	Level	First difference	Critical value	Level	First difference	Critical value
Ungraded	-1.70 (0.43)	-5.38 (0.00)	-2.89*	-2.02 (0.28)	-6.64 (0.00)	-2.89*	-0.17 (0.94)	-6.37 (0.00)	-2.89*	-2.08 (0.25)	-4.98 (0.0001)	-2.89*
AGEB	-	-		-1.83 (0.36)	-6.30 (0.00)		-0.11 (0.94)	-6.35 (0.00)		-2.51 (0.12)	-4.29 (0.0008)	
AGB	-	-		-2.09 (0.25)	-5.79 (0.00)		-0.21 (0.93)	-5.76 (0.00)		-2.13 (0.23)	-4.39 (0.0006)	
AGS	-	-		-1.83 (0.36)	-5.39 (0.00)		-0.26 (0.93)	-5.68 (0.00)		-2.15 (0.22)	-4.40 (0.0006)	
AGS1	-	-		-1.95 (0.31)	-5.72 (0.00)		-0.26 (0.93)	-5.77 (0.00)		-2.36 (0.16)	-4.30 (0.0008)	
Indian extra bold	-1.75 (0.40)	-3.87 (0.003)		-1.33 (0.61)	-6.86 (0.00)		-0.57 (0.87)	-5.78 (0.00)		-1.86 (0.35)	-3.94 (0.0027)	

Note: 1.*Critical value at 5% level

2. Figures in parenthesis denote probability

Table 4.13 Results of the stationarity tests for monthly prices of small cardamom in US dollar

Market / Price series	Augmented Dickey-Fuller (ADF)								
	Pre-WTO (1983-1994)			Post-WTO (1995-2018)			Over-all (1983-2018)		
	Level	First difference	Critical value	Level	First difference	Critical value	Level	First difference	Critical value
Ungraded	-2.32 (0.17)	-7.03 (0.00)	-2.88*	-3.07 (0.03)	-12.13 (0.00)	-2.87*	-3.93 (0.002)	-14.55 (0.00)	-2.87*
AGEB	-	-		-3.10 (0.03)	-11.27 (0.00)		-3.47 (0.009)	-12.63 (0.00)	
AGB	-	-		-2.99 (0.04)	-11.04 (0.00)		-3.31 (0.01)	-13.62 (0.00)	
AGS	-	-		-2.55 (0.10)	-11.39 (0.00)		-3.23 (0.02)	-12.49 (0.00)	
AGS1	-	-		-2.85 (0.05)	-11.30 (0.00)		-3.11 (0.03)	-13.92 (0.00)	
Indian extra bold	-1.73 (0.42)	-4.46 (0.00)		-2.98 (0.04)	-12.55 (0.00)		-2.34 (0.16)	-15.55 (0.00)	

Market / Price series	Augmented Dickey-Fuller (ADF)											
	Period I (1983-1990)			Period II (1991-2000)			Period III (2001-2010)			Period IV (2011-2018)		
	Level	First difference	Critical value	Level	First difference	Critical value	Level	First difference	Critical value	Level	First difference	Critical value
Ungraded	-1.94 (0.31)	-5.49 (0.00)	-2.89*	-2.49 (0.12)	-7.04 (0.00)	-2.89*	-0.27 (0.92)	-6.03 (0.00)	-2.89*	-2.99 (0.04)	-5.09 (0.00)	-2.89*
AGEB	-	-		-2.80 (0.06)	-6.75 (0.00)		-0.52 (0.88)	-6.70 (0.00)		-3.17 (0.02)	-4.32 (0.00)	
AGB	-	-		-2.69 (0.08)	-6.09 (0.00)		-0.50 (0.88)	-6.36 (0.00)		-3.19 (0.02)	-4.37 (0.00)	
AGS	-	-		-2.36 (0.15)	-5.73 (0.00)		-0.34 (0.91)	-5.52 (0.00)		-3.05 (0.03)	-4.39 (0.00)	
AGS1	-	-		-2.48 (0.12)	-5.91 (0.00)		-0.36 (0.91)	-5.60 (0.00)		-3.12 (0.03)	-4.27 (0.00)	
Indian extra bold	-1.66 (0.44)	-3.88 (0.00)		-1.74 (0.41)	-4.78 (0.00)		-0.65 (0.85)	-6.01 (0.00)		-2.93 (0.05)	-3.38 (0.01)	

Note: 1. *Critical value at 5% level

2. Figures in parenthesis denote probability

Table 4.14 Results of pair-wise cointegration tests between Indian (ungraded) and international prices of small cardamom in rupee

Pre-WTO (1983-1994)			Post-WTO (1995-2018)			Over-all (1983-2018)		
Eigen value	Trace test		Eigen value	Trace test		Eigen value	Trace test	
	Null	λ-trace		Null	λ-trace		Null	λ-trace
0.0582	r = 0	10.73	0.1549	r = 0	50.4	0.0413	r = 0	20.72
0.0182	r <= 1	2.51	0.0117	r <= 1	3.32	0.0068	r <= 1	2.90

Period I (1983-1990)			Period II (1991-2000)			Period III (2001-2010)			Period IV (2011-2018)		
Eigen value	Trace test		Eigen value	Trace test		Eigen value	Trace test		Eigen value	Trace test	
	Null	λ-trace		Null	λ-trace		Null	λ-trace		Null	λ-trace
0.2705	r = 0	33.96	0.0522	r = 0	8.30	0.2180	r = 0	29.49	0.2133	r = 0	24.27
0.0562	r <= 1	5.26	0.0172	r <= 1	2.03	0.0059	r <= 1	0.69	0.0352	r <= 1	3.16

Note: 1. Critical value for r = 0 is 15.49 and r <= 1 is 3.84

2. Markets and Prices considered: All India Ungraded price and New York Indian Extra Bold

Table 4.15 Results of pair-wise cointegration tests between Indian (ungraded) and international prices of small cardamom in US dollar

Pre-WTO (1983-1994)			Period I (1983-1990)			Period II (1991-2000)			Period III (2001-2010)		
Eigen value	Trace test		Eigen value	Trace test		Eigen value	Trace test		Eigen value	Trace test	
	Null	λ-trace		Null	λ-trace		Null	λ-trace		Null	λ-trace
0.1263	r = 0	21.34	0.2505	r = 0	32.08	0.0901	r = 0	14.27	0.2147	r = 0	29.24
0.0183	r <= 1	2.57	0.0622	r <= 1	5.85	0.0271	r <= 1	3.22	0.0061	r <= 1	0.73

Note: 1. Critical value for r = 0 is 15.49 and r <= 1 is 3.84

2. Markets and Prices considered: All India Ungraded price and New York Indian Extra Bold

were cointegrated during the pre-WTO period, period I and period III, while there was no cointegration during period II (Table 4.15). The multiple cointegration analysis between the domestic prices of graded cardamom (AGEB, AGB, AGS and AGS1) and international prices revealed that the price series were integrated during the post-WTO period, period II, period III, period IV and the overall period for prices in rupee, while when expressed in US dollar, the price series were found to be integrated during period II and period III. The pairwise cointegration between AGEB auction price in rupee in India and international price was analysed for the post-WTO period, period II, period III, period IV and the overall period, and for period II and period III in terms of dollar. The results indicated the presence of integration between the price series in all the periods, with the exception of the period II and the overall period in terms of rupee, while for prices in US dollar, one cointegration relation was found in period III and there was no integration in period II.

Multiple cointegration analysis between the domestic auction prices of graded cardamom (AGEB, AGB, AGS and AGS1) for the post-WTO period, period II, period III, period IV and the overall period in terms of rupee and for period II and period III in US dollar showed that the prices were integrated in all the periods in both rupee and US dollar terms, except for period II for prices in rupee.

The results of the pairwise cointegration analysis between auction prices of AGEB and AGB, AGB and AGS, and AGS and AGS1 proved integration between price series in all the periods considered when expressed in rupee, with the exception of period II for the price series AGEB and AGB and period IV for AGB and AGS prices and AGS and AGS1 price series (Table 4.22), while for prices in US dollar, the price series were integrated in all the periods considered (Table 4.23).

The cointegration analysis for prices of small cardamom in Indian and international markets confirmed the co-movement of prices in the post-WTO period. The transmission of price signals between Indian and international markets was also confirmed for period I, period III and period IV. Thus, the prices of cardamom in one market were found to be having considerable influence on the prices prevailing in the other market, especially after the liberalisation of trade. The transmission of price signals depends on various factors such as presence of tariff barriers, degree of

Table 4.16 Results of the multiple cointegration tests between Indian (graded) and international prices small cardamom in rupee

Post-WTO (1995-2018)			Over-all (1991-2018)		
Eigen value	Trace test		Eigen value	Trace test	
	Null	λ-trace		Null	λ-trace
0.1884	r = 0	148.36	0.1373	r = 0	111.03
0.1296	r <= 1	89.49	0.0845	r <= 1	62.27
0.0916	r <= 2	50.32	0.0643	r <= 2	33.14
0.0641	r <= 3	23.21	0.0245	r <= 3	11.20
0.0159	r <= 4	4.53	0.0091	r <= 4	3.02

Period II (1991-2000)			Period III (2001-2010)			Period IV (2011-2018)		
Eigen value	Trace test		Eigen value	Trace test		Eigen value	Trace test	
	Null	λ-trace		Null	λ-trace		Null	λ-trace
0.2096	r = 0	72.89	0.2929	r = 0	114.01	0.3256	r = 0	74.66
0.1639	r <= 1	45.14	0.2609	r <= 1	73.12	0.2013	r <= 1	39.99
0.1410	r <= 2	24.02	0.1648	r <= 2	37.44	0.1034	r <= 2	20.20
0.0361	r <= 3	6.09	0.1165	r <= 3	16.18	0.0801	r <= 3	10.59
0.0147	r <= 4	1.75	0.0132	r <= 4	1.57	0.0362	r <= 4	3.24

Note: 1. Critical value for r = 0 is 69.82, r <= 1 is 47.86, r <= 2 is 29.80, r <= 3 is 15.49 and r <= 4 is 3.84

2. Markets and Prices considered: AGEB, AGB, AGS, AGS1 and New York Indian Extra Bold

Table 4.17 Results of the multiple cointegration tests between Indian (graded) and international prices small cardamom in US dollar

Period II (1991-2000)			Period III (2001-2010)		
Eigen value	Trace test		Eigen value	Trace test	
	Null	λ-trace		Null	λ-trace
0.2628	r = 0	87.75	0.2952	r = 0	112.91
0.1741	r <= 1	51.77	0.2583	r <= 1	71.63
0.1419	r <= 2	29.20	0.1641	r <= 2	36.37
0.0640	r <= 3	11.14	0.1090	r <= 3	15.20
0.0278	r <= 4	3.33	0.0133	r <= 4	1.58

Note: 1. Critical value for r = 0 is 69.82, r <= 1 is 47.86, r <= 2 is 29.80, r <= 3 is 15.49 and r <= 4 is 3.84

2. Markets and Prices considered: AGEB, AGB, AGS, AGS1 and New York Indian Extra Bold

Table 4.18 Results of the pair-wise cointegration tests between Indian (graded) and international prices small cardamom in rupee

Post-WTO (1995-2018)			Over-all (1991-2018)		
Eigen value	Trace test		Eigen value	Trace test	
	Null	λ-trace		Null	λ-trace
0.0949	r = 0	31.39	0.0262	r = 0	11.82
0.0131	r <= 1	3.66	0.0092	r <= 1	3.05

Period II (1991-2000)			Period III (2001-2010)			Period IV (2011-2018)		
Eigen value	Trace test		Eigen value	Trace test		Eigen value	Trace test	
	Null	λ-trace		Null	λ-trace		Null	λ-trace
0.0460	r = 0	7.35	0.1600	r = 0	21.68	0.2482	r = 0	28.48
0.0151	r <= 1	1.79	0.0093	r <= 1	1.1029	0.0375	r <= 1	3.36

Note: 1. Critical value for r = 0 is 15.49 and r <= 1 is 3.84

2. Markets and Prices considered: AGEB and New York Indian Extra Bold

Table 4.19 Results of the pair-wise cointegration tests between Indian (graded) and international prices small cardamom in US dollar

Period II (1991-2000)			Period III (2001-2010)		
Eigen value	Trace test		Eigen value	Trace test	
	Null	λ-trace		Null	λ-trace
0.096	r = 0	15.06	0.1574	r = 0	21.34
0.0274	r <= 1	3.25	0.0096	r <= 1	1.14

Critical value for r = 0 is 15.49 and r <= 1 is 3.84

Markets and Prices considered: AGEB and New York Indian Extra Bold

Table 4.20 Results of the multiple cointegration tests between Indian small cardamom (graded) prices in rupee

Post-WTO (1995-2018)			Over-all (1991-2018)		
Eigen value	Trace test		Eigen value	Trace test	
	Null	λ-trace		Null	λ-trace
0.1116	r = 0	71.65	0.1345	r = 0	92.03
0.0662	r <= 1	38.15	0.0631	r <= 1	43.64
0.0540	r <= 2	18.76	0.0540	r <= 2	21.8
0.0100	r <= 3	3.03	0.0095	r <= 3	3.19

Period II (1991-2000)			Period III (2001-2010)			Period IV (2011-2018)		
Eigen value	Trace test		Eigen value	Trace test		Eigen value	Trace test	
	Null	λ-trace		Null	λ-trace		Null	λ-trace
0.1844	r = 0	47.85	0.2918	r = 0	92.34	0.2343	r = 0	52.01
0.1153	r <= 1	24.42	0.2611	r <= 1	51.63	0.1405	r <= 1	26.91
0.0553	r <= 2	10.32	0.116	r <= 2	15.92	0.0834	r <= 2	12.67
0.0324	r <= 3	3.79	0.0115	r <= 3	1.37	0.0465	r <= 3	4.48

Note: 1. Critical value for r = 0 is 47.86, r <= 1 is 29.80, r <= 2 is 15.49 and r <= 3 is 3.84

2. Markets and Prices considered: AGEB, AGB, AGS, AGS1

Table 4.21 Results of the multiple cointegration tests between Indian small cardamom (graded) prices in US dollar

Period II (1991-2000)			Period III (2001-2010)		
Eigen value	Trace test		Eigen value	Trace test	
	Null	λ-trace		Null	λ-trace
0.2612	r = 0	75.22	0.2942	r = 0	91.4
0.1470	r <= 1	39.51	0.2584	r <= 1	50.28
0.1149	r <= 2	20.74	0.1093	r <= 2	15.01
0.0522	r <= 3	6.33	0.0114	r <= 3	1.35

Note: 1. Critical value for r = 0 is 47.86, r <= 1 is 29.80, r <= 2 is 15.49 and r <= 3 is 3.84

2. Markets and Prices considered: AGEB, AGB, AGS, AGS1

Table 4.22 Results of the pair-wise cointegration tests between Indian small cardamom (graded) prices in rupee

Price series	Post-WTO (1995-2018)			Over-all (1991-2018)		
	Eigen value	Trace test		Eigen value	Trace test	
		Null	λ-trace		Null	λ-trace
AGEB and AGB	0.0833	r = 0	28.32	0.0575	r = 0	23.21
	0.0123	r <= 1	3.53	0.0010	r <= 1	3.36
AGB and AGS	0.0557	r = 0	19.56	0.0611	r = 0	24.70
	0.0117	r <= 1	3.33	0.0106	r <= 1	3.57
AGS and AGS1	0.1030	r = 0	34.53	0.0980	r = 0	38.00
	0.0131	r <= 1	3.75	0.0102	r <= 1	3.45

Price series	Period II (1991-2000)			Period III (2001-2010)			Period IV (2011-2018)		
	Eigen value	Trace test		Eigen value	Trace test		Eigen value	Trace test	
		Null	λ-trace		Null	λ-trace		Null	λ-trace
AGEB and AGB	0.0985	r = 0	15.32	0.1249	r = 0	17.00	0.1481	r = 0	19.80
	0.0291	r <= 1	3.39	0.0106	r <= 1	1.26	0.0512	r <= 1	4.89
AGB and AGS	0.1167	r = 0	17.56	0.2468	r = 0	34.30	0.0588	r = 0	9.98
	0.0257	r <= 1	3.04	0.0072	r <= 1	0.85	0.0446	r <= 1	4.29
AGS and AGS1	0.1340	r = 0	20.31	0.1625	r = 0	20.91	0.1149	r = 0	14.32
	0.0292	r <= 1	3.47	0.0013	r <= 1	0.15	0.0330	r <= 1	3.08

Note: Critical value for r = 0 is 15.49 and r <= 1 is 3.84

Table 4.23 Results of the pair-wise cointegration tests between Indian small cardamom (graded) prices in US dollar

Price series	Post-WTO (1995-2018)			Period II (1991-2000)			Period III (2001-2010)		
	Eigen value	Trace test		Eigen value	Trace test		Eigen value	Trace test	
		Null	λ-trace		Null	λ-trace		Null	λ-trace
AGEB and AGB	-	-	-	0.150	r = 0	26.78	0.1200	r = 0	16.26
	-	-	-	0.060	r <= 1	7.97	0.0100	r <= 1	1.20
AGB and AGS	-	-	-	0.1479	r = 0	24.03	0.2630	r = 0	36.86
	-	-	-	0.0427	r <= 1	5.15	0.0071	r <= 1	0.85
AGS and AGS1	0.0944	r = 0	34.78	0.1499	r = 0	25.61	0.1670	r = 0	21.66
	0.0234	r <= 1	6.71	0.0532	r <= 1	6.45	0.0024	r <= 1	0.28

Note: Critical value for r = 0 is 15.49 and r <= 1 is 3.84

protection and various border and domestic policies. Reduction in these trade barriers after the liberalisation has led to better integration and transmission of prices between the markets in the post-WTO period. In-spite of a general movement of price between Indian and international markets, the prices did not converge in absolute terms. This could possibly be due to several factors such as non-tariff barriers, transport and transaction costs, extent of market power, scale economies, and extent of exchange rate pass through on output prices (IGIDR, 2011). The price series of cardamom of different grades in the domestic market were found to be moving together in almost all the periods considered. Even though there is price variation among different grades of cardamom, the overall demand for the commodity in the domestic market irrespective of its quality could be the reason for the co-movement of prices of different grades of small cardamom.

4.2.3 Vector Error Correction Model

After confirming the cointegration between two price series indicating the existence of a long-run relationship between them, it is possible to apply the Error Correction Model (ECM) which focuses on the strength of interrelationships and the speed and magnitude of reactions in one price after a price in the system is shocked (Schroeder and Goodwin, 1990) and thus, combining the long-run relationship with the short-run dynamics of the model.

The error correction term was measured for the cointegrated price series for which the optimum lag was selected based on five criteria *viz*., sequential modified Likelihood Ratio (LR) test statistic, Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC) and Hannan-Quinn Information Criterion (HQIC) by fitting unrestricted VAR model. The coefficients of error correction terms denote the percentage of disequilibrium being adjusted and the speed of convergence to the long-run path as a consequence of shock on its own prices.

In the case of the domestic prices of ungraded cardamom and the international market prices, the information flow was more in the international market compared to the domestic market in all the periods considered, with the exception of period III for prices in rupee (Table 4.25) and the pre-WTO period and period III for prices in US

Table 4.24 Co-integration between different price series of Indian small cardamom

In rupee							
Price series	**Pre-WTO period**	**Post-WTO period**	**Period I**	**Period II**	**Period III**	**Period IV**	**Over-all period**
Domestic (ungraded) and international prices	X	C	C	X	C	C	C
Domestic (graded) and international prices	-	C	-	C	C	C	C
Domestic (graded-AGEB) and international prices	-	C	-	-	-	-	X
Domestic graded cardamom prices	-	C	-	X	C	C	C
AGEB and AGB prices	-	C	-	X	C	C	C
AGB and AGS prices	-	C	-	C	C	X	C
AGS and AGS1 prices	-	C	-	C	C	X	C
In US dollar							
Price series	**Pre-WTO period**	**Post-WTO period**	**Period I**	**Period II**	**Period III**	**Period IV**	**Over-all period**
Domestic (ungraded) and international prices	C	-	C	X	C	-	-
Domestic (graded) and international prices	-	-	-	C	C	-	-
Domestic (graded-AGEB) and international prices	-	-	-	X	C	-	-
Domestic graded cardamom prices	-	-	-	C	C	-	-
AGEB and AGB prices	-	-	-	C	C	-	-
AGB and AGS prices	-	-	-	C	C	-	-
AGS and AGS1 prices	-	C	-	C	C	-	-

Note: 1. C denotes the presence of co-integration; X denotes the absence of co-integration

2. '-' denotes that the price series did not satisfy the stationarity test

Table 4.25 Estimates of Error Correction Model for Indian ungraded (UG) and Indian extra bold in New York (IEB) in rupee

Post-WTO	**ECM**	**D(UG(-1))**	**D(UG(-2))**	**D(IEB(-1))**	**D(IEB(-2))**	**C**
D(UG)	-0.0882	0.2480*	-0.1250	0.0919	-0.0498	0.0039
	(0.0549)	(0.0762)	(0.0774)	(0.1040)	(0.0985)	(0.0064)
D(IEB)	0.1729*	0.1242**	-0.1259**	0.2153*	-0.0446	0.0023
	(0.0365)	(0.0507)	(0.0515)	(0.0692)	(0.0656)	(0.0043)
Over-all	**ECM**	**D(UG(-1))**	**D(UG(-2))**	**D(IEB(-1))**	**D(IEB(-2))**	**C**
D(UG)	-0.0016	0.2215*	-0.1220**	0.0621	-0.0244	0.0024
	(0.0167)	(0.0541)	(0.0556)	(0.0804)	(0.0777)	(0.0053)
D(IEB)	0.0420*	0.1593*	-0.0385	0.1559*	0.0049	0.0019
	(0.0110)	(0.0355)	(0.0364)	(0.0527)	(0.0509)	(0.0034)
Period I	**ECM**	**D(UG(-1))**	**D(IEB(-1))**	**C**		
D(UG)	0.0017	0.2423**	-0.1164	-0.0003		
	(0.0504)	(0.1148)	(0.1987)	(0.0124)		
D(IEB)	0.1381*	-0.0047	-0.0029	0.0086		
	(0.0248)	(0.0565)	(0.0977)	(0.0061)		
Period III	**ECM**	**D(UG(-1))**	**D(IEB(-1))**	**C**		
D(UG)	-0.2300**	0.3742*	-0.1670	0.0045		
	(0.1138)	(0.1377)	(0.1636)	(0.0095)		
D(IEB)	0.1893**	0.2220**	0.0635	0.0035		
	(0.0917)	(0.1109)	(0.1318)	(0.0076)		
Period IV	**ECM**	**D(UG(-1))**	**D(UG(-2))**	**D(IEB(-1))**	**D(IEB(-2))**	**C**
D(UG)	0.0119	-0.0523	-0.0619	0.4205	0.1288	-0.0004
	(0.1467)	(0.1877)	(0.1768)	(0.2621)	(0.2405)	(0.0094)
D(IEB)	0.2757*	-0.0497	-0.2225**	0.4980*	0.2208	-0.0011
	(0.0907)	(0.1161)	(0.1094)	(0.1621)	(0.1489)	(0.0058)

Note: 1. * denotes significant at ten per cent level, ** denotes significant at five per cent level, *** denotes significant at one per cent level

2. Figures in parentheses denote Standard Error

3. C denotes constant term

dollar (Table 4.26). These indicate that the price adjustment occurs more quickly in the international market than in the domestic market. The short-run disequilibrium in the domestic price got corrected within two months by changes in its own price and the international market price, while the deviation in the international price got corrected within one month by changes in its own price. But the coefficients of less than 0.5 indicate the slow pace of adjustment towards the equilibrium path.

Considering the integration between domestic price of graded cardamom (AGEB) and the international price, the information flow was more in the international market during the post-WTO period, while the information flow was more in the domestic market during period III and period IV, which can be seen from Table 4.27 and Table 4.28. The short-run disequilibrium in the domestic market price was adjusted within one month by changes in its own price and the speed of adjustment was high.

As seen from Table 4.29 and Table 4.30, the estimates of VECM for integrated price series AGEB and AGB revealed that the speed of adjustment was comparatively high in AGEB in most of the periods considered. The short-run disequilibrium in the prices of AGEB and AGB got adjusted within one month, while AGB took two months for adjustment during period IV.

With regard to the integration between the prices of AGB and AGS (Table 4.31 and Table 4.32), the speed of adjustment was quick in AGB than AGS and the correction of short-run disequilibrium took three months in the post-WTO period, while it was corrected within one month in the over-all period. In case of the prices of AGS and AGS1 (Table 4.33 and Table 4.34), the information flow was more for AGS1 than AGS and the short-run disequilibrium got adjusted within one month.

The error correction model confirmed the presence of short-run disequilibrium in the Indian and international prices of small cardamom and the statistically significant coefficients in most cases imply that once in disequilibrium, the system tries to come back to its equilibrium state with varying speed of adjustment in different time periods. As higher value of error correction term indicates higher rate of adjustment towards equilibrium, the speed of convergence for short-run price

Table 4.26 Estimates of Error Correction Model for Indian ungraded (UG) and Indian extra bold in New York (IEB) in US dollar

Pre-WTO	ECM	D(UG(-1))	D(IEB(-1))	C
D(UG)	-0.0698**	0.2595*	0.0820	-0.0061
	(0.0348)	(0.0858)	(0.1661)	(0.0096)
D(IEB)	0.0609*	0.0754***	0.1286	-0.0034
	(0.0174)	(0.0430)	(0.0832)	(0.0048)
Period I	**ECM**	**D(UG(-1))**	**D(IEB(-1))**	**C**
D(UG)	-0.0125	0.2741**	-0.0084	-0.0062
	(0.0505)	(0.1149)	(0.2106)	(0.0123)
D(IEB)	0.1219*	0.0091	0.0581	0.0019
	(0.0232)	(0.0527)	(0.0967)	(0.0056)
Period III	**ECM**	**D(UG(-1))**	**D(IEB(-1))**	**C**
D(UG)	-0.2418**	0.3507**	-0.1529	0.0048
	(0.1120)	(0.1371)	(0.1657)	(0.0096)
D(IEB)	0.1713***	0.2101***	0.0797	0.0037
	(0.0901)	(0.1103)	(0.1333)	(0.0077)

Note: 1. * denotes significant at ten per cent level, ** denotes significant at five per cent level, *** denotes significant at one per cent level

2. Figures in parentheses denote Standard Error

3. C denotes constant term

Table 4.27 Estimates of Error Correction Model for Indian graded (AGEB) and Indian extra bold in New York (IEB) in rupee

Post-WTO	ECM	D(AGEB(-1))	D(AGEB(-2))	D(AGEB(-3))	D(IEB(-1))	D(IEB(-2))	D(IEB(-3))	C
D(AGEB)	-0.0473	0.3672*	-0.1651***	-0.0397	0.0335	0.0104	-0.0032	0.0034
	(0.0485)	(0.0871)	(0.0869)	(0.0867)	(0.0878)	(0.0854)	(0.0847)	(0.0047)
D(IEB)	0.1411*	0.2086**	-0.0573	-0.0633	0.1643***	-0.1141	0.0920	0.0023
	(0.0469)	(0.0842)	(0.0841)	(0.0839)	(0.0850)	(0.0826)	(0.0819)	(0.0045)
Period III	**ECM**	**D(AEGB(-1))**	**D(IEB(-1))**	**C**				
D(AEGB)	-0.2437	0.4298**	-0.1441	0.0041				
	(0.1664)	(0.2156)	(0.2233)	(0.0077)				
D(IEB)	0.081	0.3718***	-0.1026	0.0035				
	(0.1715)	(0.2223)	(0.2303)	(0.0080)				
Period IV	**ECM**	**D(AEGB(-1))**	**D(AEGB(-2))**	**D(IEB(-1))**	**D(IEB(-2))**	**C**		
D(AEGB)	-0.7003**	0.6565***	-0.1161	-0.2027	0.00003	-0.0020		
	(0.2760)	(0.3589)	(0.3569)	(0.3675)	(0.3502)	(0.0059)		
D(IEB)	-0.3233	0.8341**	-0.0666	-0.3288	-0.0193	-0.0002		
	(0.2836)	(0.3688)	(0.3668)	(0.3776)	(0.3598)	(0.0060)		

Note: 1. * denotes significant at ten per cent level, ** denotes significant at five per cent level, *** denotes significant at one per cent level
2. Figures in parentheses denote Standard Error
3. C denotes constant term

Table 4.28 Estimates of Error Correction Model for Indian graded (AGEB) and Indian extra bold in New York (IEB) in US dollar

Period III	ECM	D(AEGB(-1))	D(IEB(-1))	C
D(AEGB)	-0.2301	0.4091***	-0.1227	0.0043
	(0.1620)	(0.2144)	(0.2214)	(0.0077)
D(IEB)	0.0855	0.3603	-0.0822	0.0036
	(0.1673)	(0.2213)	(0.2286)	(0.0080)

Note: 1. * denotes significant at ten per cent level, ** denotes significant at five per cent level, *** denotes significant at one per cent level
2. Figures in parentheses denote Standard Error
3. C denotes constant term

Table 4.29 Estimates of Error Correction Model for Indian graded cardamom AGEB and AGB in rupee

Post-WTO	ECM	D(AGEB(-1))	D(AGEB(-2))	D(AGB(-1))	D(AGB(-2))	C
D(AGEB)	-0.1138	0.1140	-0.1065	0.2676**	-0.0754	0.0042
	(0.0728)	(0.1515)	(0.1507)	(0.1334)	(0.1351)	(0.0046)
D(AGB)	0.0339	0.0087	-0.1904	0.3946**	-0.0005	0.0042
	(0.0839)	(0.1745)	(0.1735)	(0.1536)	(0.1555)	(0.0052)
Over-all	**ECM**	**D(AGEB(-1))**	**D(AGEB(-2))**	**D(AGB(-1))**	**D(AGB(-2))**	**C**
D(AGEB)	-0.0502	0.0954	-0.1886	0.2269***	0.0167	0.0036
	(0.0613)	(0.1433)	(0.1430)	(0.1285)	(0.1296)	(0.0045)
D(AGB)	0.0631	0.0165	-0.221	0.3310**	0.0463	0.0037
	(0.0688)	(0.1608)	(0.1604)	(0.1442)	(0.1451)	(0.0050)
Period III	**ECM**	**D(AGEB(-1))**	**D(AGB(-1))**	**C**		
D(AGEB)	-0.5228*	0.0476	0.2368	0.0042		
	(0.1663)	(0.2510)	(0.2368)	(0.0073)		
D(AGB)	-0.3705***	-0.0760	0.3602	0.0043		
	(0.1876)	(0.2833)	(0.2679)	(0.0083)		
Period IV	**ECM**	**D(AEGB(-1))**	**D(AEGB(-2))**	**D(AGB(-1))**	**D(AGB(-2))**	**C**
D(AGEB)	-0.3292*	0.6669*	0.3691	-0.1720	-0.3777***	0.0011
	(0.1143)	(0.2433)	(0.2544)	(0.2067)	(0.2139)	(0.0061)
D(AGB)	-0.2159	0.3673	0.3464	0.0914	-0.3711	0.0012
	(0.1430)	(0.2986)	(0.3122)	(0.2537)	(0.2625)	(0.0075)

Note: 1. * denotes significant at ten per cent level, ** denotes significant at five per cent level, *** denotes significant at one per cent level

2. Figures in parentheses denote Standard Error

3. C denotes constant term

Table 4.30 Estimates of Error Correction Model for Indian graded cardamom AGEB and AGB in US dollar

Period II	**ECM**	**D(AGEB(-1))**	**D(AGB(-1))**	**C**
D(AGEB)	-0.3588***	0.1111	0.0995	-0.0010
	(0.1914)	(0.2680)	(0.2357)	(0.0095)
D(AGB)	-0.0872	0.0857	0.1569	-0.0005
	(0.2131)	(0.2985)	(0.2625)	(0.0106)
Period III	ECM	D(AGEB(-1))	D(AGB(-1))	C
D(AGEB)	-0.4943*	0.0609	0.2300	0.0043
	(0.1650)	(0.2521)	(0.2369)	(0.0073)
D(AGB)	-0.3412***	-0.0635	0.3521	0.0045
	(0.1864)	(0.2848)	(0.2676)	(0.0083)

Note: 1. * denotes significant at ten per cent level, ** denotes significant at five per cent level, *** denotes significant at one per cent level
2. Figures in parentheses denote Standard Error
3. C denotes constant term

Table 4.31 Estimates of Error Correction Model for Indian graded cardamom AGB and AGS in rupee

Post-WTO	ECM	D(AGB(-1))	D(AGB(-2))	D(AGB(-3))	D(AGB(-4))	D(AGS(-1))	D(AGS(-2))	D(AGS(-3))	D(AGS(-4))	C
D(AGB)	-0.0744	-0.1114	-0.0602	-0.3338***	-0.1954	0.5172*	-0.1441	0.3734**	0.1109	0.0042
	(0.1040)	(0.2021)	(0.1941)	(0.1954)	(0.1935)	(0.1926)	(0.1940)	(0.1855)	(0.1876)	(0.0052)
D(AGS)	0.0550	-0.0668	-0.0649	-0.4276**	-0.1772	0.5015**	-0.1684	0.4580**	0.1016	0.0049
	(0.1097)	(0.2130)	(0.2116)	(0.2046)	(0.2040)	(0.2030)	(0.2046)	(0.1956)	(0.1978)	(0.0055)
Over-all	**ECM**	**D(AGB(-1))**	**D(AGB(-2))**	**D(AGS(-1))**	**D(AGS(-2))**	**C**				
D(AGB)	-0.2316**	-0.0315	0.0177	0.3825**	-0.1706	0.0036				
	(0.1015)	(0.1862)	(0.1839)	(0.1799)	(0.1795)	(0.0049)				
D(AGS)	-0.1026	-0.0191	0.0403	0.3911**	-0.2103	0.0038				
	(0.1057)	(0.1939)	(0.1915)	(0.1873)	(0.1869)	(0.0051)				
Period II	**ECM**	**D(AGB(-1))**	**D(AGB(-2))**	**D(AGS(-1))**	**D(AGS(-2))**	**C**				
D(AGB)	-0.5760*	-0.0502	0.1628	0.3468	-0.2306	0.0044				
	(0.1777)	(0.2733)	(0.2708)	(0.2687)	(0.2701)	(0.0094)				
D(AGS)	-0.4233**	-0.1312	0.1806	0.4333	-0.2655	0.0050				
	(0.1843)	(0.2834)	(0.2808)	(0.2786)	(0.2801)	(0.0098)				
Period III	**ECM**	**D(AGB(-1))**	**D(AGS(-1))**	**C**						
D(AGB)	-0.6402	0.3647	-0.0290	0.0041						
	(0.5010)	(0.5342)	(0.5197)	(0.0084)						
D(AGS)	-0.1264	0.2282	0.141	0.0041						
	(0.5209)	(0.5554)	(0.5403)	(0.0087)						

Note: 1. * denotes significant at ten per cent level, ** denotes significant at five per cent level, *** denotes significant at one per cent level

2. Figures in parentheses denote Standard Error

3. C denotes constant term

Table 4.32 Estimates of Error Correction Model for Indian graded cardamom AGB and AGS in US dollar

Period III	ECM	D(AGB(-1))	D(AGS(-1))	C
D(AGB)	-0.6927 (0.5199)	0.3328 (0.5385)	-0.0035 (0.5239)	0.0043 (0.0084)
D(AGS)	-0.1430 (0.5411)	0.1797 (0.5605)	0.1836 (0.5453)	0.0042 (0.0087)

Note: 1. * denotes significant at ten per cent level, ** denotes significant at five per cent level, *** denotes significant at one per cent level
2. Figures in parentheses denote Standard Error
3. C denotes constant term

Table 4.33 Estimates of Error Correction Model for Indian graded cardamom AGS and AGS1 in rupee

Post-WTO	ECM	D(AGS(-1))	D(AGS(-2))	D(AGS(-3))	D(AGS(-4))	D(AGS1(-1))	D(AGS1(-2))	D(AGS1(-3))	D(AGS1(-4))	C
D(AGS)	0.0925	0.1910	-0.2377	0.0296	-0.1701	0.2558	-0.0067	0.0471	0.0890	0.0048
	(0.1824)	(0.2060)	(0.1984)	(0.1849)	(0.1639)	(0.1918)	(0.1837)	(0.1715)	(0.1510)	(0.0055)
D(AGS1)	0.4903**	0.3603	-0.1598	0.0666	-0.2042	0.0829	-0.0920	0.0018	0.1245	0.0056
	(0.1936)	(0.2188)	(0.2106)	(0.1963)	(0.1741)	(0.2037)	(0.1951)	(0.1821)	(0.1603)	(0.0058)
Over-all	**ECM**	**D(AGS(-1))**	**D(AGS(-2))**	**D(AGS1(-1))**	**D(AGS1(-2))**	**C**				
D(AGS)	-0.0522	0.3276	-0.2061	0.0544	0.0348	0.0038				
	(0.1135)	(0.1415)	(0.1340)	(0.1308)	(0.1205)	(0.0051)				
D(AGS1)	0.2538	0.4967	-0.1372	-0.0996	-0.0363	0.0038				
	(0.1223)	(0.1524)	(0.1443)	(0.1410)	(0.1298)	(0.0055)				
Period II	**ECM**	**D(AGS(-1))**	**D(AGS(-2))**	**D(AGS1(-1))**	**D(AGS1(-2))**	**C**				
D(AGS)	-0.1082	0.4340**	-0.1433	-0.1085	0.0447	0.0049				
	(0.1732)	(0.2021)	(0.2006)	(0.1860)	(0.1764)	(0.0100)				
D(AGS1)	0.2863	0.4720**	-0.1036	-0.1283	0.0285	0.0034				
	(0.1908)	(0.2227)	(0.2210)	(0.2049)	(0.1944)	(0.0111)				
Period III	**ECM**	**D(AGS(-1))**	**D(AGS(-2))**	**D(AGS1(-1))**	**D(AGS1(-2))**	**C**				
D(AGS)	0.0536	0.4680	-0.3977	-0.0028	0.0899	0.0051				
	(0.4606)	(0.4633)	(0.4528)	(0.4412)	(0.4276)	(0.0084)				
D(AGS1)	0.4879	0.3718	-0.2860	0.0821	-0.0534	0.0054				
	(0.4825)	(0.4853)	(0.4743)	(0.4621)	(0.4479)	(0.0088)				

Note: 1. * denotes significant at ten per cent level, ** denotes significant at five per cent level, *** denotes significant at one per cent level

2. Figures in parentheses denote Standard Error

3. C denotes constant term

Table 4.34 Estimates of Error Correction Model for Indian graded cardamom AGS and AGS1 in US dollar

Period II	ECM	D(AGS(-1))	D(AGS1(-1))	C		
D(AGS)	-0.113 (0.1622)	0.4257** (0.2012)	-0.1553 (0.1837)	-0.0001 (0.0106)		
D(AGS1)	0.2599 (0.1712)	0.4871** (0.2110)	-0.1673 (0.1927)	-0.0013 (0.0111)		
Period III	**ECM**	**D(AGS(-1))**	**D(AGS(-2))**	**D(AGS1(-1))**	**D(AGS1(-2))**	**C**
D(AGS)	0.1541 (0.4631)	0.3532 (0.4710)	-0.4247 (0.4608)	0.0819 (0.4470)	0.1802 (0.4340)	0.0051 (0.0086)
D(AGS1)	0.5899 (0.4850)	0.2566 (0.4934)	-0.3135 (0.4826)	0.1649 (0.4682)	0.0359 (0.4545)	0.0055 (0.0090)

Note: 1. * denotes significant at ten per cent level, ** denotes significant at five per cent level, *** denotes significant at one per cent level

2. Figures in parentheses denote Standard Error

3. C denotes constant term

movements to become stable along the long-run equilibrium path was found to be increasing after the trade liberalisation. This could be attributed to the domestic market orientation of small cardamom during 1980s and higher tariff barriers in the pre-liberalisation period, which were considerably lowered in the post-liberalisation period, leading to better integration of markets. The findings indicate that the reform measures have led to effective transmission of price signals between international and domestic markets, resulting in high integration of the markets (Joseph, 2004).

4.2.4 Granger causality test for monthly prices of small cardamom

The direction of price transmission between price series was studied using Granger causality tests and the results are presented in Table 4.35 and Table 4.36. When the small cardamom prices were expressed in rupee, the international market price was found to Granger cause the price of ungraded cardamom in the domestic market in the post-WTO period, period I, period III and overall period. Price transmission from international market to Indian market was also evident for prices in US dollars in the pre-WTO period, period I and period III. In the post-WTO period and period IV, the prices of Indian extra bold in New York market Granger caused the price of graded cardamom *viz*., AGEB in the domestic market, when considered in rupee terms. For graded cardamom in the domestic market, price transmission between AGEB and AGB was bi-directional in period III, while it was uni-directional from AGB to AGEB in period IV for small cardamom prices in rupee. For prices of small cardamom in US dollar, the price transmission was from AGEB to AGB in period III. The price of AGB cardamom in rupee was found to Granger cause the price of AGS in the post-WTO period and the overall period, while it was bi-directional in period II for prices in both rupee and US dollar. The causality tests for auction prices of AGS and AGS1 showed that the AGS1 Granger caused AGS in the post-WTO period and period II for small cardamom prices expressed in both rupee and US dollar and also in the overall period for the prices expressed in rupee.

The Granger causality test identified that the price transmission was from international market to domestic market for the Indian small cardamom. India, being a major producer and consumer of small cardamom in the world, could have possibly influenced the international price through its decision to export and import. But, the

Table 4.35 Results of the Granger causality test for monthly prices of small cardamom in rupee

Null hypothesis	Post-WTO		Overall	
	F-stat	Probability	F-stat	Probability
Ungraded India does not Granger Cause Indian Extra Bold New York	20.22*	6E-09	18.89*	1E-08
Indian Extra Bold New York does not Granger Cause Ungraded India	1.91	0.1495	0.04	0.9585
AGEB does not Granger Cause Indian Extra Bold New York	10.6*	4E-05	-	-
Indian Extra Bold New York does not Granger Cause AGEB	0.54	0.5856	-	-
AGEB does not Granger Cause AGB	0.09	9.11E-01	0.02	0.8881
AGB does not Granger Cause AGEB	3.5	0.0365	2.06	0.1518
AGB does not Granger Cause AGS	0.11	8.93E-01	1.96	0.1627
AGS does not Granger Cause AGB	4.74*	0.0095	6.84*	0.0093
AGS does not Granger Cause AGS1	9.04*	2E-04	10.16*	0.0016
AGS1 does not Granger Cause AGS	0.9	0.4075	0.002	0.9603

Null hypothesis	Period I		Period II		Period III		Period IV	
	F-stat	Probability	F-stat	Probability	F-stat	Probability	F-stat	Probability
Ungraded India does not Granger Cause Indian Extra Bold New York	17.55*	4.00E-07	-	-	7.13*	0.0012	3.28**	0.0423
Indian Extra Bold New York does not Granger Cause Ungraded India	1.16	0.3194	-	-	2.03	0.1359	2.64***	0.0769
AGEB does not Granger Cause Indian Extra Bold New York	-	-	-	-	2.05	0.1338	2.71***	0.072
Indian Extra Bold New York does not Granger Cause AGEB	-	-	-	-	1.16	0.3182	1.72	0.1847
AGEB does not Granger Cause AGB	-	-	-	-	2.57***	0.081	1.14**	0.0227
AGB does not Granger Cause AGEB	-	-	-	-	7.86*	0.0006	1.36	0.2624
AGB does not Granger Cause AGS	-	-	2.91***	0.0583	0.11	0.8916	-	-
AGS does not Granger Cause AGB	-	-	6.82*	0.0016	1.05	0.3528	-	-
AGS does not Granger Cause AGS1	-	-	5.72*	0.0043	0.52	0.5961	-	-
AGS1 does not Granger Cause AGS	-	-	0.5	0.6065	0.19	0.8279	-	-

Note: * denotes significant at one per cent level, ** denotes significant at five per cent level, *** denotes significant at ten per cent level

Table 4.36 Results of the Granger causality test for monthly prices of small cardamom in US dollar

Null hypothesis	Pre-WTO		Post-WTO		Period I		Period II		Period III	
	F-stat	Probability	F-stat	Probability	F-stat	Probability	F-stat	Probability	F-stat	Probability
Ungraded India does not Granger Cause Indian Extra Bold New York	9.77*	0.0001	-	-	16.16*	1.00E-06	-	-	6.05*	0.0032
Indian Extra Bold New York does not Granger Cause Ungraded India	0.21	0.8112	-	-	0.9	0.4111	-	-	2.22	0.1135
AGEB does not Granger Cause Indian Extra Bold New York	-	-	-	-	-	-	-	-	1.97	0.144
Indian Extra Bold New York does not Granger Cause AGEB	-	-	-	-	-	-	-	-	1.11	0.3332
AGEB does not Granger Cause AGB	-	-	-	-	-	-	0.03	0.9744	2.19	0.1162
AGB does not Granger Cause AGEB	-	-	-	-	-	-	0.86	0.4273	7.07*	0.0013
AGB does not Granger Cause AGS	-	-	-	-	-	-	4.16**	0.0181	0.09	0.915
AGS does not Granger Cause AGB	-	-	-	-	-	-	7.34*	0.001	1.2	0.3038
AGS does not Granger Cause AGS1	-	-	7.31*	0.0008	-	-	6.06*	0.0032	0.63	0.5331
AGS1 does not Granger Cause AGS	-	-	1.1	0.333	-	-	0.32	0.7269	0.08	0.9181

Note: * denotes significant at one per cent level, ** denotes significant at five per cent level

major share of its production is oriented towards the domestic market due to the higher demand in the household, industrial and institutional segments (Narayanan, 2004) and the traders are less motivated to export. Moreover, in the international market, Guatemalan cardamom dominates due to its cheaper price, while the price of small cardamom from India is much higher. This could possibly explain the inefficiency of India to transform price signals from domestic market to the international market.

4.3 SUPPLY RESPONSE OF SMALL CARDAMOM

The supply response of a crop indicates the responsiveness of the production of that crop to changes in its prices and other influential factors. The empirical studies on the supply response of a commodity helps in the formulation of economic policies, especially in generating a proactive agricultural price policy.

Studying the supply response in perennial crops is a great challenge owing to the gestation/pre-bearing period of these crops and also an extended period of output flow, which are almost two years and 25 years respectively for small cardamom. The future output adjustments are actually defined by the present planting decisions of the farmers growing perennial crops. Also, farmers can change their future productive capacity by altering their planting decisions. Any adjustment in the productive capacity of a particular plantation crop during a particular year is the net effect of the plantation decisions that modify both the total cultivated area and the age composition of the stock of trees in the past.

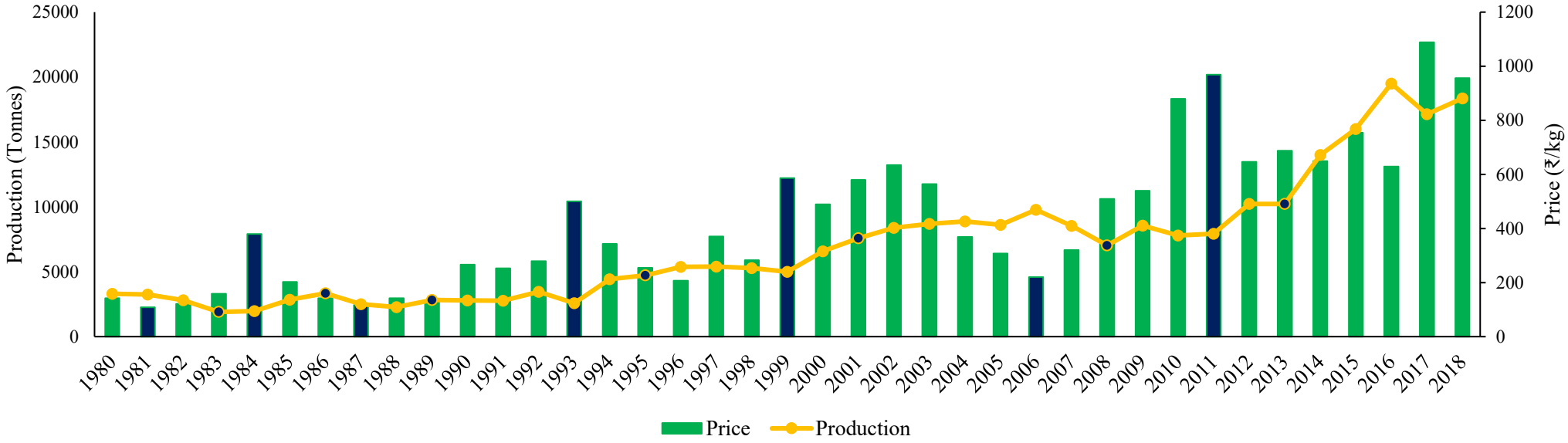
Supply of small cardamom in response to price was estimated using the Nerlovian model. The factors considered for the study included production and price of small cardamom, price of the competitive crop i.e., black pepper, maximum temperature, minimum temperature and average annual rainfall in Idukki district for the period from 1980 to 2018. Apart from these variables, a dummy variable was also included to capture the effect of trade liberalisation on the supply of small cardamom. The results of the analysis of supply response for cardamom are presented in Table 4.37 and Table 4.38.

The coefficient of determination or R^2 value of 96 per cent and probability of F-statistics indicated that the estimated supply response model was a good fit. The estimates from the fitted supply response model showed that the changes in own production, the two-year lagged price and the changes in the one year lagged average annual rainfall had significant influence on the production of small cardamom in Idukki district. The study showed that the effect of changes in the two-year lagged price of the competing crop i.e., black pepper and liberalisation of trade as dummy were not having significant influence on the production of small cardamom.

The short-run and long-run price elasticities of small cardamom were derived from the Nerlovian supply response model. As observed in Table 4.38, the supply elasticity of small cardamom with respect to the two-year lag of its own price was positive and significant in both the short-run (0.39) and long-run (0.96).

It could be inferred from the analysis that the lagged price was a significant factor in explaining the production of small cardamom in Idukki district. When the average annual auction price of small cardamom reduced from ₹142 per kg in 1980 to ₹108 per kg in 1981, the production in Kerala declined gradually from 3300 tonnes in 1980 to 1900 tonnes in 1983 and when the price increased to ₹379 per kg in 1984, the production increased to 3340 tonnes in 1986. As similar trend was observed throughout the study period, especially during the years 1989, 1995, 2001, 2008 and 2013 when the sharp decline/increase in two-year lagged price of small cardamom have significantly affected the production (Figure 3). It was confirmed that the average annual rainfall in the cardamom growing tract had relatively higher influence on the production of the crop. The production of small cardamom in Kerala declined considerably from 2800 tonnes in 1982 to 1900 tonnes in 1983 due to unprecedented drought in the cardamom growing tracts from November 1982 to May 1983. Similarly, the dry spells in 2002 and 2003 have affected the production of small cardamom significantly in the subsequent years. During the years 1998 and 2002, scanty rainfall during the summer months of February and March caused reduction in the yield of small cardamom, even though the total rainfall for those years was normal (Murugan *et al*., 2007).

Figure 3 Annual average auction price and production of small cardamom in Kerala (1980-2018)



The positively significant supply response of small cardamom to lagged domestic price and non-significance of liberalisation could be attributed to the greater inclination of the crop towards the domestic market. The results support the fact that farmers respond to increase in prices by the intensive application of inputs *viz*., fertilizers, pesticides and capital to increase the production. In the long-run, they responded to increase in price by increasing the area under cardamom cultivation and the farmers were found to be more innovative in developing high yielding varieties and post-harvest machineries (Bhadouria *et al*., 2012).

Table 4.37 Estimates of the Nerlovian supply response model for small cardamom

Sl. No.	Variables	Coefficient
1	Intercept	1.82
2	Lagged production of cardamom	0.58*
3	Lagged price of cardamom	0.39*
4	Lagged price of black pepper	0.09
5	Lagged rainfall	0.33**
6	Lagged maximum temperature	-0.16
7	Lagged minimum temperature	0.26
8	Dummy variable	0.07
9	R^2	0.96
10	Adjusted R^2	0.95
11	F-statistic	99.90*

Note: *denotes significance at one per cent level and ** significance at 5 per cent level

Table 4.38 Price elasticities of supply for small cardamom

Components	Short-run elasticity	Long-run elasticity
Lagged price of cardamom	0.39	0.96

4.4 EXPORT PERFORMANCE OF SMALL CARDAMOM

The performance of the export of small cardamom from India was analysed by estimating the growth and instability of export, and the different sources of growth and variance in the value of export of small cardamom. The information on the geographic concentration in exports and stable export markets shows the risk bearing ability of the

Indian small cardamom exporters, while the export demand and supply functions assist in identifying the major factors determining the demand for and supply of small cardamom from India. As the provisions of WTO and globalization intensified the competition faced by Indian spices, the analyses were carried out by dividing the over-all study period into pre-WTO (1970-71 to 1994-95) and post-WTO (1995-96 to 2017-18) periods in addition to the decade-wise (Period I: 1970-71 to 1979-80; Period II: 1980-81 to 1989-90; Period III: 1990-91 to 1999-00; Period IV: 2000-01 to 2009-10; Period V: 2010-11 to 2017-18) analyses.

4.4.1 Growth of small cardamom export

An exponential growth function was used to evaluate the performance of small cardamom export with respect to its growth in terms of quantity, value and unit value for the period from 1970-71 to 2017-18. The results of the analyses of growth in exports are presented in Table 4.39.

Even though both the quantity and value of exports displayed negative growth rates during the pre-WTO period, the rate of decline in export value was lower than that of export quantity as the prices were increasing, which was evident from the positive growth rate of export unit value. The negative growth rate in the pre-WTO period could be attributed to the high cost of production, low quality, effective entry of Guatemala and the inconsistent export policy of the Government of India (Rajesh, 2002). From the table it could be observed that there was a positive growth rate in terms of quantity, value and unit value of export of small cardamom from India during the post-WTO period. Period I recorded higher growth rates of export in terms of value and unit value when compared to the other periods. The lowest and negative growth rate of export was observed in Period II as a result of increased domestic demand for small cardamom in India and flow of cheaper cardamom from Guatemala into the international market. During period III (from 1990-91 to 1999-00) exports started to increase gradually, thus recording a growth which could be attributed to trade and tariff liberalisation policies in India. But the succeeding decade (Period IV) again witnessed a negative growth rate in terms of quantity and value, but still exhibited a growth in price of the commodity.

Table 4.39 Compound Annual Growth Rates (CARG) of small cardamom export from India

(per cent per annum)

Year		Quantity (Kg)	Value (₹)	Value ($)	Unit Value (₹/Kg)	Unit Value ($/kg)
Pre-WTO period	CAGR	-8.61	-2.19	-7.80	7.03	0.88
	SE	4.16	5.38	5.58	2.42	2.67
	Sig	-2.07	-0.41	-1.40	2.90	0.33
Post-WTO period	CAGR	12.82	18.66	15.78	5.18	2.62
	SE	3.97	5.31	4.79	2.07	1.91
	Sig	3.23	3.51	3.29	2.50	1.37
Period I	CAGR	4.64	25.75	24.05	20.18	18.55
	SE	9.25	12.24	12.63	7.36	6.83
	Sig	0.50	2.10	1.90	2.74	2.72
Period II	CAGR	-17.76	-18.37	-24.18	-0.75	-7.81
	SE	19.84	19.92	18.15	6.68	5.51
	Sig	-0.90	-0.92	-1.33	-0.11	-1.42
Period III	CAGR	3.84	9.45	1.08	5.40	-2.66
	SE	11.04	11.78	11.84	5.46	4.89
	Sig	0.35	0.80	0.09	0.99	-0.54
Period IV	CAGR	-1.04	-0.16	0.38	0.89	1.44
	SE	11.24	17.21	16.53	8.49	7.88
	Sig	-0.09	-0.01	0.02	0.10	0.18
Period V	CAGR	16.27	17.89	11.51	1.39	-4.09
	SE	16.21	11.47	11.65	5.83	6.81
	Sig	1.00	1.56	0.99	0.24	-0.60
Over-all period	CAGR	0.59	6.58	0.92	5.95	0.33
	SE	2.30	2.57	2.70	0.81	0.87
	Sig	0.26	2.56	0.34	7.35	0.38

Note: Pre-WTO: 1970-71 to 1994-95; Post-WTO: 1995-96 to 2017-18; Period I: 1970-71 to 1979-80; Period II: 1980-81 to 1989-90; Period III: 1990-91 to 1999-00; Period IV: 2000-01 to 2009-10; Period V: 2010-11 to 2017-18; Over all period: 1970-71 to 2017-18.

One of the major factors that has adversely affected the export of small cardamom from India was the increase in domestic demand, which in turn led to the increase in average annual domestic price. From Figure 4, it could be observed that the quantity of export of small cardamom declined with increase in the average annual domestic price, even though there was an increase in the international price as represented by the increase in unit price and value of export. Thus, the demand and price in the domestic market influenced the export quantity of small cardamom from India, which in turn affected the export value of the commodity.

4.4.2 Instability in export of small cardamom

Instabilities in the export of small cardamom from India in terms of quantity (in kg), value (in US$ and ₹) and unit value (in US$/kg and ₹/kg) were estimated using Coppock's instability index and the results are displayed in Table 4.40.

It could be observed from the table that export of small cardamom from India was more unstable during the pre-WTO period when compared to the post-WTO period, as the restriction for trade in the post-liberalisation period was comparatively low.

Table 4.40 Instability in export of small cardamom from India

Year	Quantity (Kg)	Value (₹)	Value ($)	Unit Value (₹/Kg)	Unit Value ($/kg)
Pre-WTO period	141.87	145.33	145.03	29.99	28.51
Post-WTO period	70.11	62.00	59.93	25.67	25.27
Period I	60.33	57.11	58.73	30.13	28.57
Period II	223.63	223.80	216.16	28.36	25.64
Period III	80.78	65.02	67.28	27.14	24.50
Period IV	51.11	63.39	60.12	25.02	23.92
Period V	76.53	50.30	53.22	19.76	21.08
Over-all period	110.59	108.05	107.26	28.28	27.44

Figure 4 Comparison between domestic market price and export of small cardamom from India

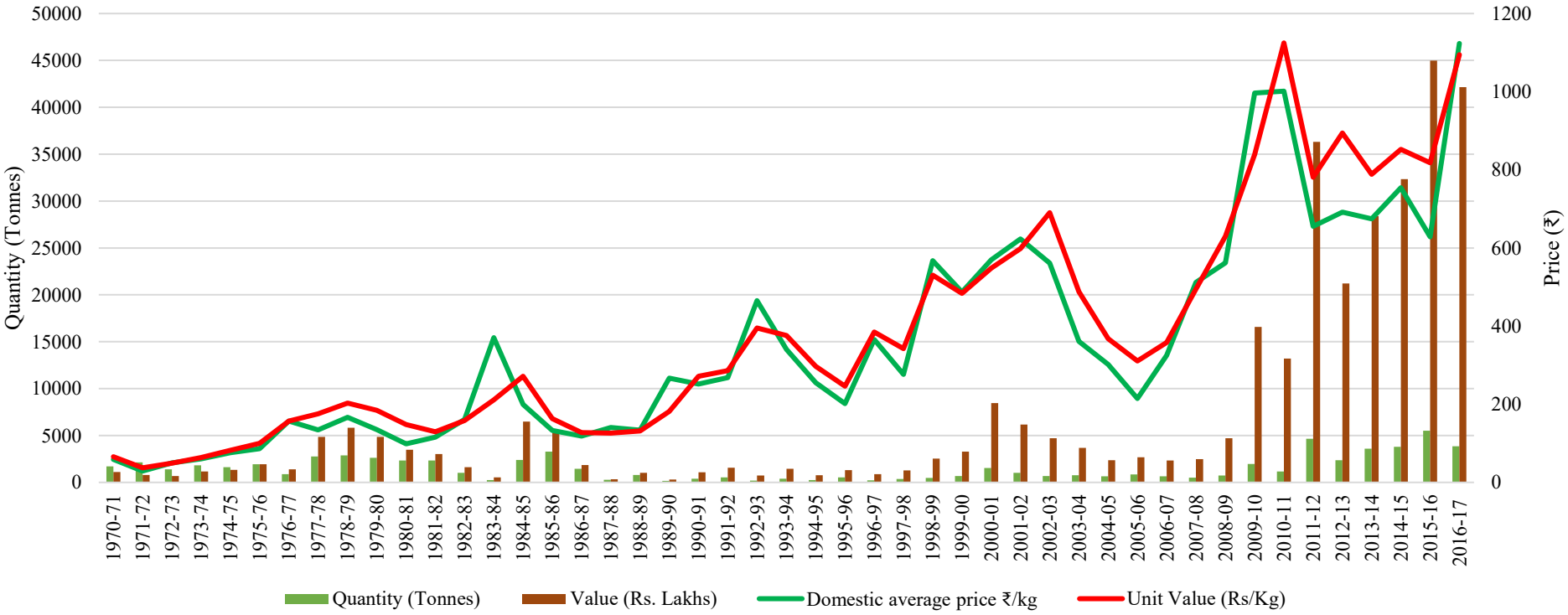
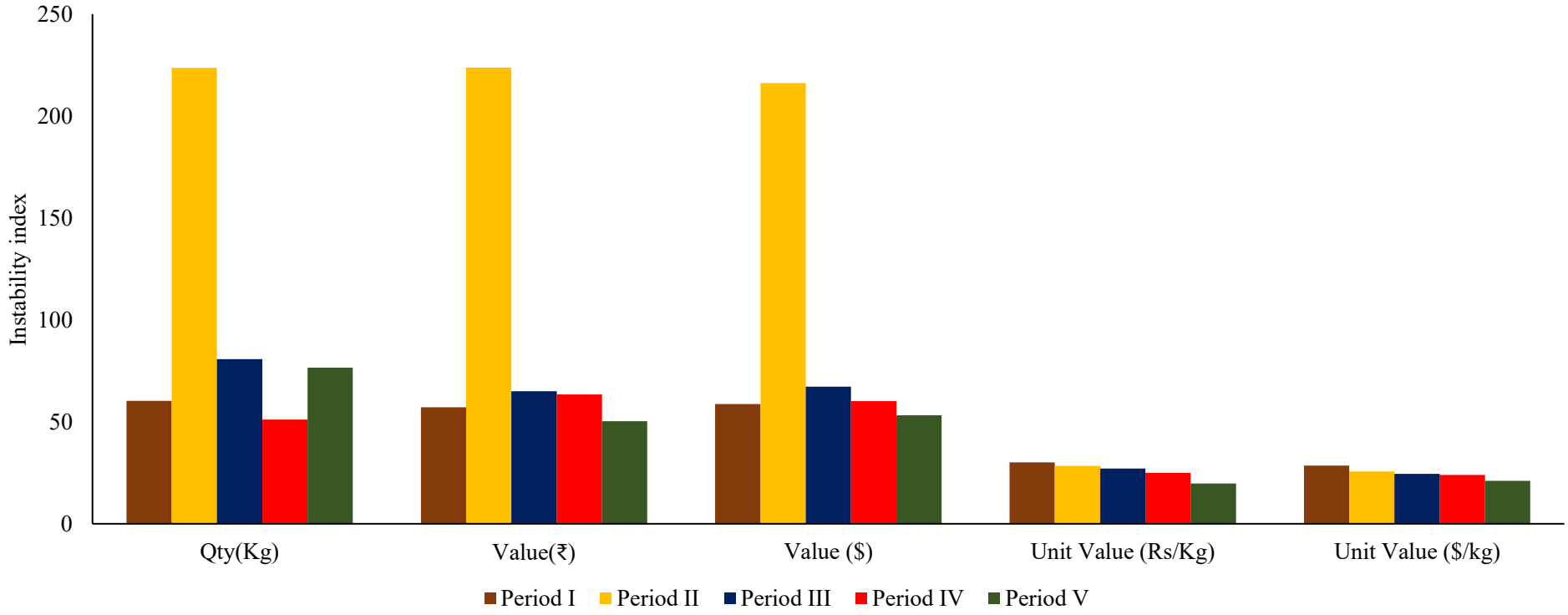


Figure 5 Instability in export of small cardamom



There was a decline in instability of export from period II to period V. It was during period II that the instability in terms of quantity and value of export was very high i.e., 223.63 and 223.80 respectively and notably witnessed lower and negative export growth rate in terms of quantity (-17.76 per cent), value (-18.37) and unit value (-0.75). Thus, the higher instability in period II could be the result of increased domestic demand and stiff competition from Guatemala. Instability in export quantity was the lowest in period IV, while period V recorded the minimum instability for value and unit value of small cardamom export from India. Overall, as compared to the quantity and value of export, instability in unit value of export was less, which could be observed from the trend depicted in Figure 5. From the analysis it could be concluded that the fluctuation in terms of value, quantity and unit value of export of Indian small cardamom had reduced after liberalisation i.e., during the post-WTO period and it was the variations in the export quantity rather than that in price which affected the stability in export earnings from small cardamom.

4.4.3 Decomposition of sources of growth in export value of small cardamom

The change in average export value of small cardamom was attributed to the changes in mean export unit value and quantity, their interaction and the changes in quantity-unit value covariance. Hazell's decomposition model was employed to study the contribution of each component of change and the results are presented in Table 4.41.

Increase in the mean export value of small cardamom in the post-WTO period compared to the pre-WTO period was mainly due to changes in mean export quantity (79.58 per cent), while the changes in the mean export unit value contributed 20.93 per cent to the growth in export value. The contributions of the interaction between changes in mean export quantity and unit value and the changes in export quantity – unit vale covariance to the growth in export value of small cardamom were negligible.

Figure 6 Decomposition of sources of growth in small cardamom export value

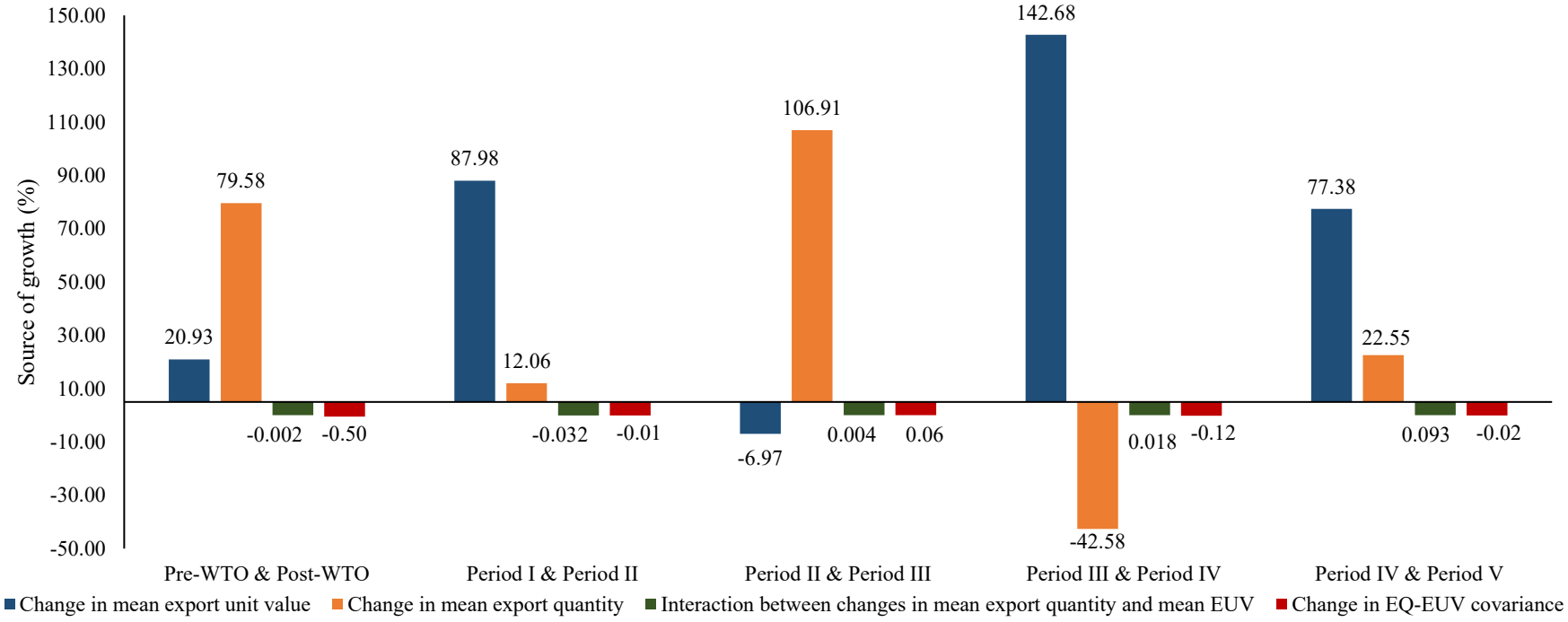


Table 4.41 Decomposition of components of change in average export value of small cardamom

Period	Change in mean export unit value	Change in mean export quantity	Interaction between changes in mean export quantity and mean export unit value	Change in export quantity-export unit value covariance
Pre-WTO & Post-WTO	20.93	79.58	-0.002	-0.50
Period I & Period II	87.98	12.06	-0.032	-0.01
Period II & Period III	-6.97	106.91	0.004	0.06
Period III & Period IV	142.68	-42.58	0.018	-0.12
Period IV & Period V	77.38	22.55	0.093	-0.02

When different decades were considered, the changes in mean export unit value played a major role in bringing about changes in the mean export value in all the periods, except between period II and period III. It was the change in the mean export quantity that contributed more to the change in mean value of export between period II and period III, while the export unit value had a negative influence on the export value.

4.4.3.1 Sources of variance in export value of small cardamom

The stability in the export value of small cardamom was assumed to be affected by ten components of change as shown in Table 4.42. Nearly 85 per cent of increase in the variance of export value in the post-WTO period compared to the pre-WTO was attributed to the changes in variability of export unit value, followed by a contribution of 12 per cent by changes in the covariance between export quantity and export unit value.

The changes in the variance of export unit value was the major factor that contributed to the changes in variance of value of export between period I and period II (69 per cent) and between period III and period IV (90 per cent), while the changes

Table 4.42 Components of change in variance of export value (%)

	Pre-WTO & Post-WTO	Period I & Period II	Period II & Period III	Period III & Period IV	Period IV & Period V
Change in mean export unit value	-0.0004	-0.02	-0.003	3.03E-05	-0.07
Change in mean export quantity	-0.006	-0.005	0.20	0.005	-0.48
Change in export unit value variance	84.65	69.12	30.59	90.13	52.71
Change in export quantity variance	3.03	6.75	18.26	0.46	-7.77
Interaction between changes in mean EUV and mean EQ	2E-08	8E-07	1E-06	1E-08	-8E-05
Change in export quantity - export unit value covariance	12.36	24.32	51.04	9.37	55.16
Interaction between changes in mean EQ and EUV variance	-0.01	-0.05	-0.04	0.02	0.13
Interaction between changes in mean EUV and EQ variance	-0.0001	-0.04	0.001	-0.0004	-0.06
Interaction between changes in mean EQ and EUV and changes in EQ-EUV covariance	-0.001	-0.07	-0.03	-0.003	0.29
Change in residual	-0.01	-0.02	-0.03	0.009	0.10

in the covariance between export quantity and export unit value was the major contributor to the changes in variance of export value between period II and period III (51 per cent) and between period IV and period V (55 per cent). The changes in the variance of export quantity was the third major contributor to the changes in the variance in export value and it was found to cause a stabilising effect between period IV and period V, as it reduced the variability in export value to an extent of 7.77 per cent. The influence of other factors on the changes in variability of value of export of small cardamom was found to be minimum i.e., less than one per cent.

The results of the decomposition analyses implied that the price of small cardamom was more influential in bringing about changes in the variability of export value and contributed a major role in destabilising the value of small cardamom export from India.

The value of small cardamom export from India exhibited higher growth rate and lower instability in the post-WTO period compared to the pre-WTO period and the export quantity was found to be the major factor that influenced the export value. Prior to 1980s, the productivity of small cardamom was very low, as the crop was vulnerable to pest attacks and the occurrence of drought in early 1980s made the situation worse (Krishna, 2014). Adding to this, the economic upswing in relation to the oil boom in West Asia and Europe during 1970s led to the increase in demand for cardamom in the Middle East countries, inducing the prices to surge to higher levels. This encouraged Guatemala to focus on exporting its cardamom to the Middle East countries (Soundarapandian, 2012) and subsequently, the country emerged to be the largest exporter of small cardamom in the world. These issues led to the lower production and export of small cardamom from India during the pre-liberalisation period (from 1970-71 to 1994-95). Since mid-1980s, the production and profitability of small cardamom was moving positively due to the introduction of high yielding variety and the increasing price in the international market (Krishna, 2014).

4.4.4 Geographic concentration in Indian small cardamom export

The geographic concentration in the export of small cardamom from India was measured using Hirschman Index and the results are presented in Table 4.43. Much

variation could not be observed in the geographic concentration of small cardamom export from India and the value of the index always remained above 50, denoting a higher level of concentration and uneven distribution, which could result in higher instability and risks in export earnings. Geographic concentration was found to be more in the post-WTO period (63.20) in comparison to the pre-WTO period, which was about 53. The post-WTO period exhibited wide variation as well as an increasing trend in the geographic concentration index when compared to the pre-WTO period (Figure 7, 8 and 9). It could be observed that during the years from period I to period V, there was a steady and gradual increase in the geographic concentration of small cardamom export from India. In period I and period II, the geographic concentration index was around 51, and since period III it increased steadily from 58 to 67 in period V. This increase in geographic concentration index could be mainly due to the increase in the concentration of small cardamom export from Indian to the Middle-East countries (Figure 10), especially Saudi Arabia which is the major consumer of small cardamom in the world.

Table 4.43 Geographic concentration of Indian small cardamom export

Year	Hirschman Index
Pre-WTO period	52.62
Post-WTO period	63.20
Period I	51.12
Period II	51.34
Period III	57.90
Period IV	62.82
Period V	67.19
Over-all period	57.69

It could be observed from Figure 10 that during TE 1992-93, the major share of small cardamom export from India was to Japan which considerably reduced in TE 2017-18. Nearly 84 per cent of India's small cardamom export in TE 2017-18 was to Middle-East countries and it was reflected in the higher geographic concentration index, which in turn indicated the higher instability and risks in export earnings. The

Figure 7 Trend in geographic concentration of small cardamom export from India during pre-WTO period

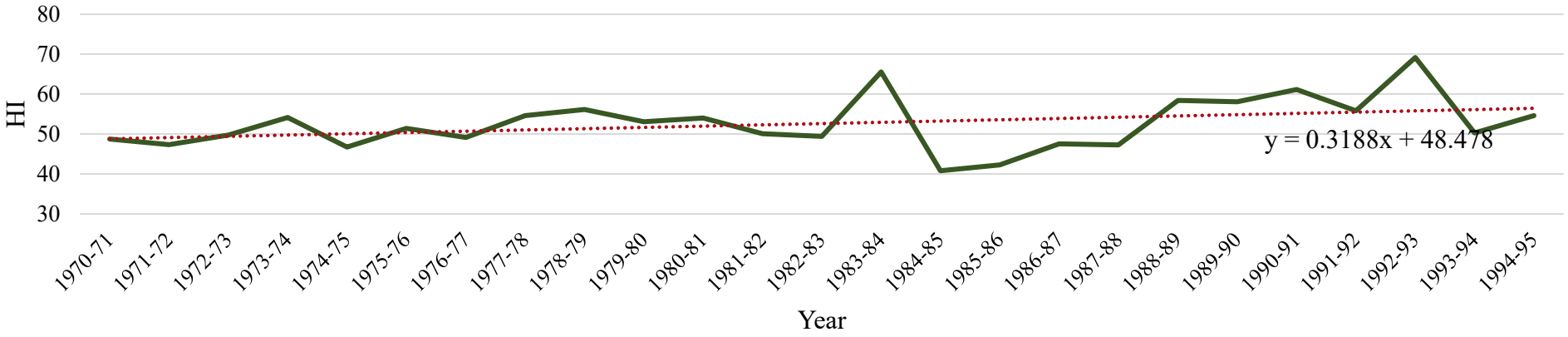


Figure 8 Trend in geographic concentration of small cardamom export from India during post-WTO period

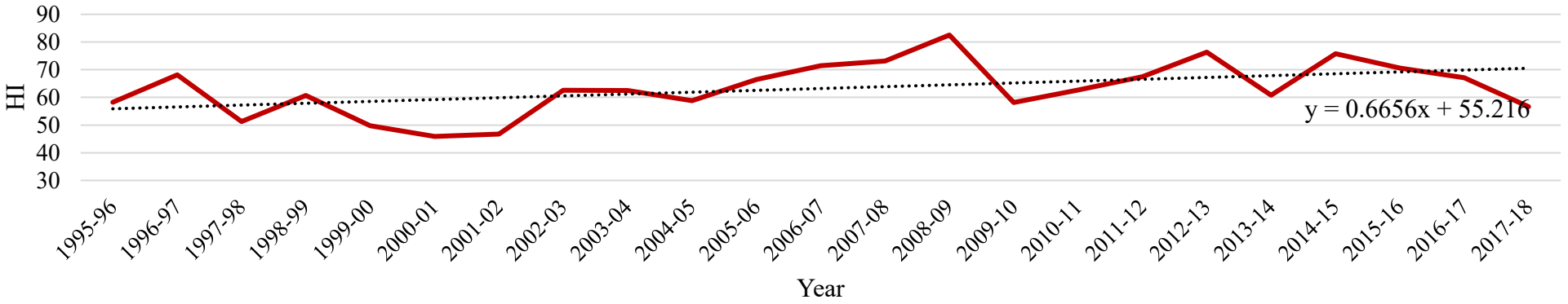


Figure 9 Trend in geographic concentration of small cardamom export from India the period from 1970-71 to 2017-18

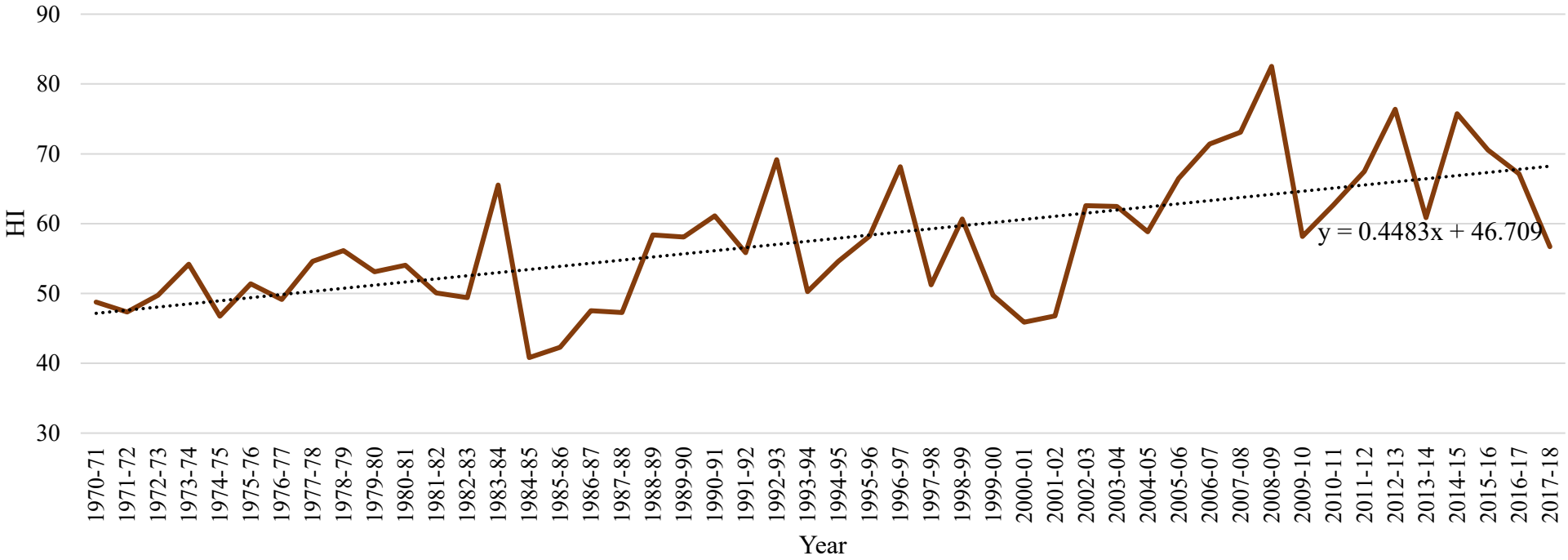
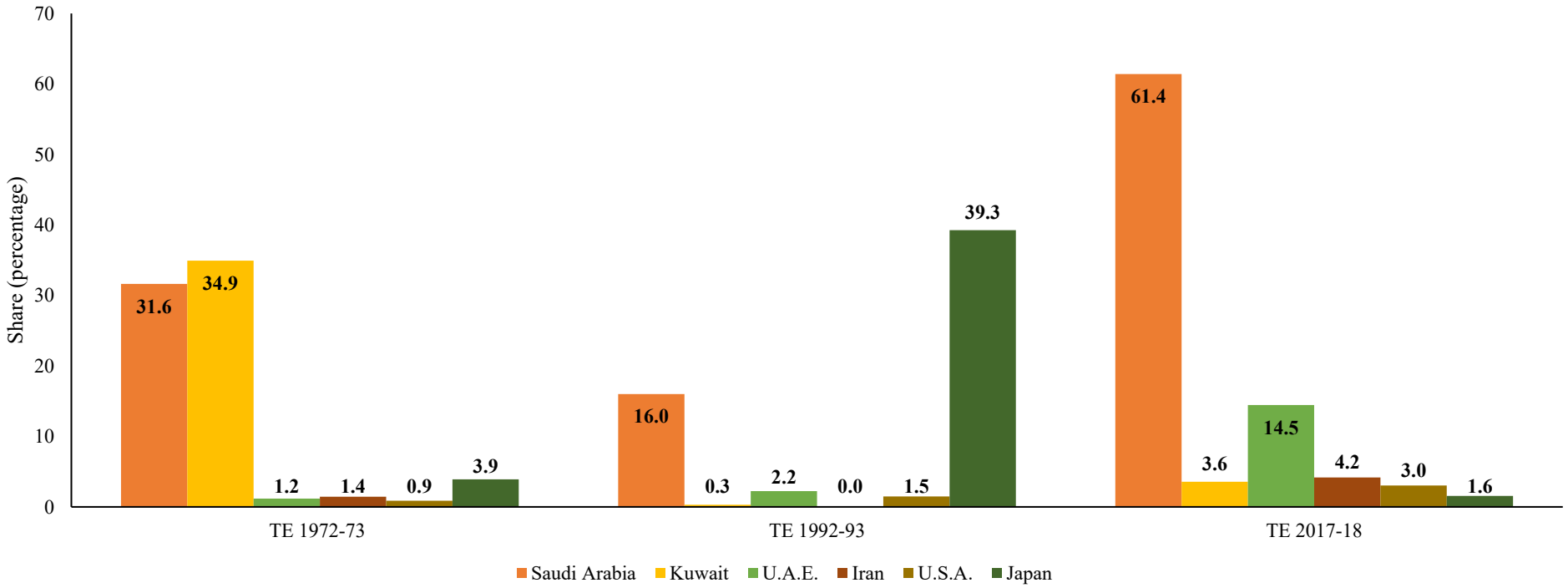


Figure 10 Change in the share of different countries in Indian small cardamom export



ban on the imports of small cardamom from India by Saudi Arabia, which accounted for 61 per cent of the exports from India in TE 2017-18, due to the presence of higher levels of residual toxic content of pesticides has adversely affected the Indian exporters.

4.4.5 Structural changes in the export of small cardamom from India

The structural change in the export of small cardamom from India in relation to the dynamics in the direction of export and the changing pattern of export to different destinations were analysed using the Markov chain model. The analysis for the country-wise exports of small cardamom from India for the period from 1970-71 to 2017-18 was carried out by considering eighteen major exports markets of Indian small cardamom *viz.,* Australia, Bahrain, Bangladesh, Canada, Iran, Iraq, Japan, Jordan, Kuwait, Malaysia, Qatar, Russia, Saudi Arabia, Singapore, South Africa, UAE, UK and USA and the exports to all the remaining countries were categorised under 'Others'.

The stable export markets were identified using the diagonal elements of transition probability matrix from the Markov chain analysis and the results for different time periods are presented from Table 4.44 to Table 4.51. In the pre-WTO period, Malaysia was found to be the most stable market for Indian small cardamom, as its probability of retaining the previous period's market share was 75 per cent, while Kuwait was the second most stable market with 73 per cent probability of retention, followed by Saudi Arabia, Qatar, Japan, Bahrain, Russia and UAE.

Compared to the pre-WTO period, a major change in the group of stable markets was observed in the post-WTO period. Iran emerged as the most stable market with 83 per cent probability of retention, while in the pre-WTO period the retention probability for Iran was zero per cent. Saudi Arabia was the second most stable market with 81 per cent probability of retaining the previous year's market share, which considerably improved over the period of time. It was found that Saudi Arabia gained considerable probability of transfer from other countries i.e. 0.80, 0.66 and 0.65 from 'Others', Russia and Singapore respectively. Japan, USA, Malaysia, Bangladesh, UAE, South Africa and Canada were the other reliable importers of Indian small cardamom in the

post-WTO period. Compared to the pre-WTO period, India lost the export markets of Kuwait, Qatar, Bahrain and Russia in the post-WTO period. Kuwait, which was the second most stable export market in the pre-WTO period (0.73), lost its share to UAE (0.56) and 'Others' (0.41) in the post-WTO period. The major export markets of small cardamom gained by India in the post-WTO period were Iran, USA, Bangladesh, South Africa and Canada.

UAE was the most stable market for Indian small cardamom in period I (1970-71 to 1979-80) with 82 per cent probability of retention, but it lost to Saudi Arabia to the tune of 97 per cent and had zero probability of retention in period II (1980-81 to 1989-90). In period II, the stable export markets for small cardamom from India were Kuwait, Qatar, Japan, Russia and Malaysia, while India lost the major markets of UAE, Saudi Arabia, USA and Canada. Kuwait, which was the most stable market in period II, lost completely to Japan, while Qatar lost 91 per cent of its share to UAE in period III. Iraq emerged as the most stable market in period III (1990-91 to 1999-00) by completely retaining its previous period's share (1.00), followed by Japan (0.20) and UAE (0.20).

Iraq remained as the most stable market in period IV (2000-01 to 2009-10) with 100 per cent probability of retention. The retention probability of UAE and Japan increased from 0.20 in period III to 0.77 and 0.65 respectively in period IV, while Saudi Arabia (0.70) and Bangladesh (0.42) emerged as the new stable markets for Indian small cardamom in period IV.

In period V (2010-11 to 2017-18), Saudi Arabia (0.73) became the most stable market, while Iraq and UAE, the most stable markets in period IV, turned out to be unstable with zero probability of retention. The probability of retaining previous year's market share declined from 0.65 and 0.42 in period IV to 0.04 and 0.18 in period V for Japan and Bangladesh respectively. Even though India lost the export markets of Iraq and UAE, it gained the markets of UK (0.42), Iran (0.40) and USA (0.26) in period V.

When the country-wise export data for the overall study period from 1970-71 to 2017-18 was analysed, Saudi Arabia and Kuwait, each with 83 per cent probability of retention, were found to be the most stable markets for the export of small cardamom

Table 4.44 Transition probability matrix for small cardamom export from India for overall period (1970-71 to 2017-18)

Country	AUS	BAH	BAN	CAN	IRN	IRQ	JAP	JOR	KUW	MAL	QAT	RUS	SAU	SIN	SOA	UAE	UK	USA	OTH
AUS	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.78
BAH	0.00	**0.36**	0.00	0.00	0.00	0.00	0.00	0.00	0.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13
BAN	0.00	0.00	**0.23**	0.00	0.00	0.00	0.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.01	0.00
CAN	0.00	0.00	0.00	**0.19**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81	0.00
IRN	0.00	0.00	0.00	0.00	**0.37**	0.07	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
IRQ	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
JAP	0.00	0.00	0.00	0.00	0.00	0.00	**0.70**	0.00	0.00	0.04	0.00	0.00	0.21	0.00	0.00	0.00	0.01	0.00	0.04
JOR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.66	0.00	0.00	0.00	0.00	0.00	0.00	0.34
KUW	0.00	0.02	0.00	0.00	0.01	0.02	0.00	0.00	**0.83**	0.00	0.02	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.06
MAL	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	**0.55**	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.32
QAT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.00	**0.48**	0.00	0.00	0.24	0.00	0.00	0.00	0.00	0.02
RUS	0.00	0.01	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.00	**0.51**	0.10	0.04	0.00	0.00	0.00	0.01	0.00
SAU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	**0.83**	0.00	0.00	0.04	0.02	0.00	0.09
SIN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.48	0.00	**0.13**	0.00	0.20	0.00	0.00	0.09
SOA	0.00	0.00	0.00	0.00	0.00	0.00	0.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.26**	0.00	0.00	0.00	0.00
UAE	0.02	0.00	0.04	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.08	0.00	0.29	0.00	0.03	**0.44**	0.00	0.02	0.07
UK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	**0.00**	0.00	0.00
USA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.27	0.00	**0.59**	0.00
OTH	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.04	0.00	0.00	0.00	0.68	0.00	0.00	0.00	0.03	0.00	**0.23**

Note: Derived from Markov Chain Analysis

Table 4.45 Transition probability matrix for small cardamom export from India in the pre-WTO period (1970-71 to 1994-95)

Country	AUS	BAH	BAN	CAN	IRN	IRQ	JAP	JOR	KUW	MAL	QAT	RUS	SAU	SIN	SOA	UAE	UK	USA	OTH
AUS	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BAH	0.00	**0.32**	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40
BAN	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CAN	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
IRN	0.00	0.00	0.00	0.00	**0.00**	0.09	0.00	0.00	0.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.43
IRQ	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.84	0.00	0.00	0.16	0.00	0.00	0.00
JAP	0.00	0.00	0.00	0.00	0.00	0.00	**0.46**	0.00	0.00	0.00	0.00	0.47	0.00	0.07	0.00	0.00	0.00	0.00	0.00
JOR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.21	0.01	0.12	0.00	0.00	0.00	0.00	0.65
KUW	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	**0.73**	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00
MAL	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00	**0.75**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
QAT	0.00	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.29	0.00	**0.49**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RUS	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.00	0.00	0.00	0.00	**0.28**	0.34	0.00	0.00	0.00	0.00	0.02	0.02
SAU	0.00	0.00	0.00	0.00	0.01	0.00	0.02	0.00	0.00	0.00	0.02	0.20	**0.53**	0.03	0.00	0.00	0.01	0.00	0.17
SIN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.78	0.00	**0.00**	0.00	0.07	0.00	0.03	0.13
SOA	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00
UAE	0.00	0.34	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.06	0.00	0.00	0.00	0.18	0.00	**0.17**	0.00	0.00	0.00
UK	0.00	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00
USA	0.00	0.00	0.00	0.00	0.00	0.00	0.93	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	**0.00**	0.00
OTH	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.46	0.00	0.02	0.00	0.19	0.00	0.00	0.07	0.06	0.00	**0.13**

Note: Derived from Markov Chain Analysis

Table 4.46 Transition probability matrix for small cardamom export from India in the post-WTO period (1995-96 to 2017-18)

Country	AUS	BAH	BAN	CAN	IRN	IRQ	JAP	JOR	KUW	MAL	QAT	RUS	SAU	SIN	SOA	UAE	UK	USA	OTH
AUS	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.45
BAH	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.96	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BAN	0.00	0.04	**0.34**	0.00	0.00	0.00	0.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00
CAN	0.00	0.00	0.00	**0.20**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.00
IRN	0.00	0.00	0.00	0.17	**0.83**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IRQ	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
JAP	0.00	0.00	0.00	0.00	0.00	0.00	**0.73**	0.00	0.00	0.04	0.00	0.00	0.22	0.00	0.00	0.00	0.00	0.00	0.00
JOR	0.00	0.24	0.00	0.00	0.00	0.00	0.00	**0.00**	0.13	0.00	0.00	0.00	0.00	0.46	0.00	0.00	0.00	0.17	0.00
KUW	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	0.41
MAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.41**	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.34
QAT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.20	0.00	0.80	0.00	0.00	0.00
RUS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.00	0.00	**0.00**	0.66	0.00	0.00	0.00	0.00	0.00	0.00
SAU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	**0.81**	0.00	0.00	0.07	0.02	0.00	0.06
SIN	0.00	0.00	0.00	0.01	0.29	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.65	**0.00**	0.00	0.00	0.00	0.00	0.00
SOA	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.00	0.32	0.04	0.00	0.00	0.00	0.01	**0.23**	0.00	0.00	0.00	0.00
UAE	0.04	0.00	0.07	0.00	0.00	0.00	0.00	0.02	0.11	0.00	0.09	0.00	0.24	0.01	0.04	**0.24**	0.00	0.02	0.12
UK	0.20	0.00	0.00	0.00	0.00	0.00	0.30	0.00	0.00	0.20	0.00	0.00	0.25	0.00	0.04	0.00	**0.01**	0.00	0.00
USA	0.00	0.00	0.00	0.15	0.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.59**	0.00
OTH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.80	0.00	0.00	0.00	0.00	0.00	**0.19**

Note: Derived from Markov Chain Analysis

Table 4.47 Transition probability matrix for small cardamom export from India in period I (1970-71 to 1979-80)

Country	AUS	BAH	BAN	CAN	IRN	IRQ	JAP	JOR	KUW	MAL	QAT	RUS	SAU	SIN	SOA	UAE	UK	USA	OTH
AUS	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BAH	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39
BAN	0.00	0.00	**0.00**	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CAN	0.00	0.00	0.00	**0.11**	0.00	0.00	0.00	0.00	0.00	0.00	0.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IRN	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.00
IRQ	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.76	0.00	0.00	0.00	0.24	0.00	0.00
JAP	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.01	0.00	0.00	0.08	0.00	0.42	0.07	0.00	0.00	0.09	0.01	0.32
JOR	0.00	0.00	0.00	0.03	0.00	0.00	0.00	**0.00**	0.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
KUW	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	**0.58**	0.00	0.02	0.00	0.38	0.00	0.00	0.00	0.00	0.00	0.01
MAL	0.00	0.00	0.00	0.34	0.66	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
QAT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RUS	0.00	0.24	0.00	0.01	0.00	0.00	0.00	0.01	0.55	0.00	0.00	**0.00**	0.19	0.00	0.00	0.00	0.00	0.00	0.00
SAU	0.00	0.05	0.00	0.00	0.01	0.00	0.03	0.00	0.07	0.00	0.06	0.25	**0.40**	0.02	0.00	0.00	0.00	0.00	0.12
SIN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.85	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.15	0.00
SOA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00
UAE	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.82**	0.08	0.01	0.00
UK	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.89	0.02	0.00	0.00	**0.00**	0.00	0.00
USA	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.23	**0.23**	0.00
OTH	0.00	0.01	0.00	0.00	0.06	0.05	0.25	0.00	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.27**

Note: Derived from Markov Chain Analysis

Table 4.48 Transition probability matrix for small cardamom export from India in period II (1980-81 to 1989-90)

Country	AUS	BAH	BAN	CAN	IRN	IRQ	JAP	JOR	KUW	MAL	QAT	RUS	SAU	SIN	SOA	UAE	UK	USA	OTH
AUS	**0.00**	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BAH	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
BAN	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
CAN	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
IRN	0.00	0.00	0.00	0.00	**0.00**	0.09	0.00	0.00	0.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IRQ	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.95	0.00	0.00	0.05	0.00	0.00	0.00
JAP	0.00	0.00	0.00	0.00	0.00	0.00	**0.15**	0.00	0.00	0.02	0.00	0.76	0.07	0.00	0.00	0.00	0.00	0.00	0.00
JOR	0.00	0.03	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.00	0.79
KUW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.53**	0.00	0.00	0.03	0.37	0.00	0.00	0.00	0.01	0.00	0.07
MAL	0.00	0.00	0.00	0.00	0.00	0.00	0.96	0.00	0.00	**0.04**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
QAT	0.00	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	**0.35**	0.00	0.48	0.00	0.00	0.00	0.00	0.00	0.00
RUS	0.00	0.02	0.00	0.00	0.01	0.00	0.29	0.00	0.07	0.00	0.10	**0.09**	0.31	0.01	0.00	0.03	0.01	0.01	0.07
SAU	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.01	0.00	0.69	**0.00**	0.10	0.00	0.00	0.00	0.01	0.06
SIN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	**0.00**	0.00	0.00	0.00	0.00	0.00
SOA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00
UAE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.97	0.00	0.00	**0.00**	0.00	0.00	0.00
UK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00
USA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	**0.00**	0.00
OTH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.41	0.00	0.03	0.29	0.13	0.00	0.00	0.14	0.00	0.00	**0.00**

Note: Derived from Markov Chain Analysis

Table 4.49 Transition probability matrix for small cardamom export from India in period III (1990-91 to 1999-00)

Country	AUS	BAH	BAN	CAN	IRN	IRQ	JAP	JOR	KUW	MAL	QAT	RUS	SAU	SIN	SOA	UAE	UK	USA	OTH
AUS	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00
BAH	1.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BAN	0.00	0.00	**0.00**	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CAN	0.16	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.84	0.00	0.00	0.00	0.00	0.00
IRN	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
IRQ	0.00	0.00	0.00	0.00	0.00	**1.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
JAP	0.00	0.00	0.00	0.00	0.00	0.00	**0.20**	0.00	0.00	0.07	0.00	0.00	0.56	0.00	0.00	0.05	0.01	0.00	0.10
JOR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00
KUW	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.05**	0.00	0.00	0.00	0.20	0.09	0.66	0.00	0.00	0.00
QAT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.91	0.00	0.09	0.00
RUS	0.00	0.00	0.00	0.00	0.00	0.00	0.74	0.00	0.00	0.00	0.00	**0.00**	0.23	0.00	0.00	0.00	0.00	0.03	0.00
SAU	0.00	0.00	0.00	0.00	0.00	0.00	0.87	0.00	0.00	0.00	0.00	0.00	**0.00**	0.01	0.00	0.04	0.00	0.00	0.08
SIN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.08	0.00	0.58	0.00	**0.06**	0.17	0.00	0.00	0.00	0.05
SOA	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00
UAE	0.00	0.08	0.16	0.00	0.00	0.00	0.09	0.02	0.02	0.00	0.09	0.00	0.27	0.00	0.04	**0.20**	0.00	0.02	0.02
UK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	**0.00**	0.00	0.00
USA	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.97	0.00	0.00	0.00	**0.00**	0.00
OTH	0.00	0.00	0.00	0.00	0.00	0.00	0.84	0.00	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**

Note: Derived from Markov Chain Analysis

Table 4.50 Transition probability matrix for small cardamom export from India in period IV (2000-01 to 2009-10)

Country	AUS	BAH	BAN	CAN	IRN	IRQ	JAP	JOR	KUW	MAL	QAT	RUS	SAU	SIN	SOA	UAE	UK	USA	OTH
AUS	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BAH	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.98	0.00	0.00	0.00
BAN	0.00	0.05	**0.42**	0.00	0.00	0.00	0.45	0.03	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.03	0.00
CAN	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
IRN	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IRQ	0.00	0.00	0.00	0.00	0.00	**1.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
JAP	0.00	0.00	0.00	0.00	0.00	0.00	**0.65**	0.00	0.00	0.04	0.00	0.00	0.30	0.00	0.00	0.00	0.00	0.00	0.00
JOR	0.00	0.00	0.00	0.00	0.00	0.00	0.83	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.00
KUW	0.00	0.00	0.00	0.00	0.00	0.00	0.51	0.00	**0.00**	0.00	0.00	0.00	0.49	0.00	0.00	0.00	0.00	0.00	0.00
MAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
QAT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RUS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.03	0.00	0.00	0.97	0.00	0.00
SAU	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.02	0.00	0.00	**0.70**	0.00	0.01	0.02	0.03	0.00	0.17
SIN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.94	0.00	0.00	0.00	0.00	**0.00**	0.06	0.00	0.00	0.00	0.00
SOA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00
UAE	0.06	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	**0.77**	0.04	0.00	0.00
UK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	**0.00**	0.00	0.00
USA	0.00	0.00	0.00	0.00	0.00	0.00	0.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.19	0.00	**0.00**	0.00
OTH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.11	0.00	0.00	0.77	0.00	0.03	0.00	0.07	0.00	**0.00**

Note: Derived from Markov Chain Analysis

Table 4.51 Transition probability matrix for small cardamom export from India in period V (2010-11 to 2017-18)

Country	AUS	BAH	BAN	CAN	IRN	IRQ	JAP	JOR	KUW	MAL	QAT	RUS	SAU	SIN	SOA	UAE	UK	USA	OTH
AUS	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
BAH	0.00	**0.00**	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BAN	0.00	0.00	**0.18**	0.00	0.66	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.06	0.00	0.00	0.00	0.00
CAN	0.00	0.00	0.00	**0.00**	0.09	0.00	0.00	0.00	0.00	0.00	0.36	0.00	0.00	0.00	0.00	0.00	0.00	0.55	0.00
IRN	0.09	0.00	0.00	0.14	**0.40**	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.21	0.00
IRQ	0.00	1.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
JAP	0.16	0.00	0.00	0.00	0.00	0.00	**0.04**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.40	0.00	0.00
JOR	0.00	0.00	0.00	0.00	0.00	0.00	0.24	**0.00**	0.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19
KUW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.00	0.00	0.81
MAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
QAT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.85	0.00	0.15	0.00
RUS	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SAU	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.05	0.00	0.01	0.00	**0.73**	0.00	0.01	0.15	0.00	0.01	0.04
SIN	0.00	0.00	0.00	0.00	0.51	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.41	**0.00**	0.01	0.00	0.00	0.00	0.00
SOA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.38	0.00	0.31	0.31
UAE	0.02	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.94	0.00	0.00	**0.00**	0.00	0.00	0.00
UK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.43	0.13	0.01	0.00	0.00	0.00	0.00	0.00	**0.42**	0.00	0.00
USA	0.00	0.00	0.22	0.07	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00	**0.26**	0.00
OTH	0.02	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.92	0.00	0.00	0.04	0.00	0.00	**0.00**

Note: Derived from Markov Chain Analysis

Table 4.52 Major importing countries of small cardamom from India in the order of stability

Period	Countries
Overall period (1970-71 to 2017-18)	Saudi Arabia > Kuwait > Japan > USA > Malaysia > Russia > Qatar > UAE > Iran > Bahrain > South Africa > Others > Bangladesh > Canada > Singapore
Pre-WTO period (1970-71 to 1994-95)	Malaysia > Kuwait > Saudi Arabia > Qatar > Japan > Bahrain > Russia > UAE > Others
Post-WTO period (1995-96 to 2017-18)	Iran > Saudi Arabia > Japan > USA > Malaysia > Bangladesh > UAE > South Africa > Canada > Others > UK
Period I (1970-71 to 1979-80)	UAE > Kuwait > Saudi Arabia > Others > USA > Canada
Period II (1980-81 to 1989-90)	Kuwait > Qatar > Japan > Russia > Malaysia
Period III (1990-91 to 1999-00)	Iraq > Japan > UAE > Singapore > Malaysia
Period IV (2000-01 to 2009-10)	Iraq > UAE > Saudi Arabia > Japan > Bangladesh
Period V (2010-11 to 2017-18)	Saudi Arabia > UK > Iran > USA > Bangladesh > Japan

Table 4.53 Dynamics in export of small cardamom from India

Period	Stable markets						Markets gained	Markets lost
Overall period (1970-71 to 2017-18)	Saudi Arabia (0.83)	Kuwait (0.83)	Japan (0.70)	USA (0.59)	Malaysia (0.55)	Russia (0.51)		
Pre-WTO period (1970-71 to 1994-95)	Malaysia (0.75)	Kuwait (0.73)	Saudi Arabia (0.53)	Qatar (0.49)				
Post-WTO period (1995-96 to 2017-18)	Iran (0.83)	Saudi Arabia (0.81)	Japan (0.73)	USA (0.59)			Iran, USA, Bangladesh, South Africa, Canada	Kuwait, Qatar, Bahrain, Russia
Period I (1970-71 to 1979-80)	UAE (0.82)	Kuwait (0.58)						
Period II (1980-81 to 1989-90)	Kuwait (0.53)						Qatar, Japan, Russia, Malaysia	UAE, Saudi Arabia, USA, Canada, Others
Period III (1990-91 to 1999-00)	Iraq (1.00)						Iran, UAE, Singapore	Kuwait, Qatar, Russia
Period IV (2000-01 to 2009-10)	Iraq (1.00)	UAE (0.77)	Saudi Arabia (0.70)	Japan (0.65)			Saudi Arabia, Bangladesh, USA	Singapore, Malaysia
Period V (2010-11 to 2017-18)	Saudi Arabia (0.73)						UK, Iran	Iraq, UAE

Note: Figures in parenthesis indicate retention probabilities of the respective countries

from India. Japan was the second most stable market (0.70), followed by USA (0.59), Malaysia (0.55) and Russia (0.51). The other stables markets identified in the overall period were Qatar, UAE, Iran, Bahrain, South Africa, Bangladesh, Canada, Singapore and 'Others'.

The results of the Markov chain analysis indicated the changing pattern in the stability of export markets of Indian small cardamom and the declining probability of retention of major countries over the period of time, with the exception of Saudi Arabia. It was found that Saudi Arabia, Malaysia, Japan and UAE were the stable markets for Indian small cardamom in both pre-WTO and post-WTO periods. Even though India gained considerable market share of new markets *viz*., UK, Iran and Bangladesh, it lost some of the traditional export markets *viz.,* Kuwait, UAE and Qatar. This could be attributed to the higher price of Indian small cardamom and the increase in supply of low-priced cardamom from Guatemala (Rajesh, 2002) and also the quality issues faced by Indian cardamom with regard to the presence of residual content of pesticides.

4.4.6 Demand and supply elasticities of small cardamom exports from India

The demand and supply elasticities for the export of small cardamom from India was estimated using simultaneous equation model (2SLS) for the pre-WTO period (1983-84 to 1994-95), post-WTO period (1995-96 to 2017-18) and the overall period (1983-84 to 2017-18) and the results are presented in Table 4.54.

In the estimate of demand function, the significance of GDP per capita in the importing countries indicated the influence of the income in the importing countries on the demand for Indian small cardamom in the pre-WTO period, post-WTO period and overall period. The significant but positive elasticity coefficient of export price ratio in the post-WTO period and the insignificant value obtained in the pre-WTO and overall periods revealed the influence of the non-price factors such as quality of the commodity on the export demand (Sengupta and Roy, 2011).

Table 4.54 Estimates of demand and supply elasticities for small cardamom exports from India

Variables	Pre-WTO period		Post-WTO period		Overall period	
	Demand	Supply	Demand	Supply	Demand	Supply
R^2	0.44	0.82	0.47	0.85	0.26	0.40
Intercept	39.09*	57.79*	-1.11	-32.27*	4.59	-5.50
Export Price Ratio	0.87	-	3.75***	-	0.22	-
GDP per capita of importing countries	-2.84**	-	1.65*	-	0.98***	-
Domestic Price to Export Price Ratio	-	6.66*	-	-2.23**	-	-0.48
Lagged Domestic Price to Export Price Ratio	-	1.08	-	-0.19	-	-0.56
Production	-	-2.92*	-	2.86*	-	1.21*

*Significant at 10 per cent level
**Significant at five per cent level
***Significant at one per cent level

High R-square values of 82 per cent in the pre-WTO period and 85 per cent in the post-WTO period, for the estimated export supply functions indicated that the fitted models provided good estimates of elasticity of export supply. While both the price and production elasticities of export supply were statistically significant in the pre-WTO period and the post-WTO period, the export supply was found to be influenced by production in the overall period. There was a shift from the positive price elasticity in the pre-WTO period to the negative elasticity in the post-WTO period and from negative production elasticity of export supply in the pre-WTO period to positive elasticity in the post-WTO period.

The negative relationship between the income in importing countries and demand for small cardamom from India in the pre-WTO could be possibly due to the increase in supply of cardamom from Guatemala, which emerged as the major exporter

in the world after 1980s. But in the post-WTO period, the supply from Guatemala declined, especially after 2000s, due to the adverse climatic conditions that prevailed in the country.

While there was a positive and significant relationship between the export price ratio i.e., the ratio of export price in India to average export price of cardamom in international market, and the export demand for Indian small cardamom, the relationship between domestic price to export price ratio and export supply from India was negatively significant in the post-WTO period. This could be attributed to the increased integration between the international and domestic markets, and increased domestic demand after liberalisation. Due to the integration of markets and transmission of price signals from international market to domestic market, any increase in the international market prices of small cardamom increased the domestic market price. This increased price in the domestic market along with higher domestic demand encouraged the traders to divert the commodity towards the domestic market and reduce the supply to the international market. This in turn created a shortage of superior quality cardamom from India in the international market, especially in the Middle-East countries, which increased the demand for Indian cardamom.

There was a negative and significant relationship between production and export supply of small cardamom from India in the pre-WTO period, which could be attributed to the low productivity of small cardamom in India during 1980s because of which there was only a marginal increase in the production, which in turn restricted the export supply. Since 1990s, due to the introduction of high yielding varieties, there was a drastic increase in the production and supply of small cardamom from India that resulted in a positive and significant relation between the production and export supply in the post-WTO period.

4.5 EXPORT COMPETITIVENESS OF INDIAN SMALL CARDAMOM

The export competitiveness of Indian small cardamom for 2017-18 was analysed using the Policy Analysis Matrix (PAM) and competitiveness indices *viz*., Nominal Protection Coefficient (NPC), Effective Protection Coefficient (EPC) and Domestic

Resource Cost Ratio (DRCR) and the results are presented in Table 4.55 and Table 4.56.

The profit from the cultivation of small cardamom calculated at private prices measures the competitiveness at actual market prices, while the efficiency and comparative advantage of Indian small cardamom was measured by the social profit. A positive value for the social profit (Table 4.55) implies the efficient use of scarce resources in India and also the country's static comparative advantage in the production of small cardamom at the margin.

Table 4.55 Policy Analysis Matrix

	Tradable		Domestic Resources	Profits
	Output	**Inputs**		
Private	1397406	6263.35	231026	1160117
Social	1048948	7290.77	231098	810559.2
Divergences	348458.2	-1027.42	-71.92	349557.6

The policy interventions in the international trade of small cardamom could be explained by the divergence between private and social values. Based on these values, the competitiveness indices *viz*., NPC, EPC and DRCR were estimated.

NPC measures the divergence between domestic price and international price of the commodity, while EPC incorporates the distortions in the prices of inputs in addition to the distortions in the prices of output. Compared to the NPC, EPC is considered to be a more reliable indicator of effective incentive as it indicates the combined effects of policies in the markets of tradable commodities which include both output and inputs.

An EPC value very similar to the NPC value indicates that the tradable inputs accounted only for a relatively small fraction of the total value of output i.e., the ratio of the value of inputs purchased to the gross value of output was much lower. This is very relevant for small cardamom since the gross revenue earned from the crop is usually higher than the cost of cultivation.

Both NPC and EPC values for small cardamom were found to be greater than one i.e., 1.33. The higher values of NPC and EPC implied higher protection for the commodity and greater incentives for production. A value greater than one also indicates a higher price of small cardamom in the domestic market compared to the international market, implying the inefficiency of Indian small cardamom as an export competitive crop. Thus, the values of NPC and EPC signified that the small cardamom from India was not competitive in the international market, which could rightly be attributed to the high cost of cultivation, high domestic demand and stiff competition from Guatemalan cardamom. High cost of plant protection chemicals, fertilizers and manures, and higher wage rates increased the cost of cultivation of small cardamom in India, which in turn resulted in a higher price of the commodity. Moreover, traders preferred the domestic market over the international market due to growing demand and increasing price of small cardamom in India. But in the case of Guatemala, the major competitor in the international market, the country has the benefit of disposing its entire production in the international market at a very low price, as the crop is grown in natural conditions entailing a low cost of production and a negligible domestic consumption of cardamom. The inefficiency of Indian small cardamom as an import substitute also led to the import of cheap Guatemalan cardamom into India, which was being mixed with the Indian cardamom, pooled in the auctions and sold at higher rates.

As both the EPC and NPC estimates failed to consider the effects of transfers in the factor market, they are ineffective in reflecting the incentives to farmers to the full extent (Gotsch *et al*., 2003). Hence, these values do not indicate the comparative advantage of domestic producers in the international market.

DRCR helps to know the comparative advantage of India in the production of small cardamom. It shows how much of an economy's domestic resources are being spent to earn or save a dollar of foreign exchange. DRCR, which measures the efficiency of production, was found to be less than one (0.22) for small cardamom, indicating India's comparative advantage in producing the commodity, as it implies the efficient utilisation of domestic resources. A DRCR value of less than one also implies that the cost of domestic resources for producing a unit quantity of cardamom was less than the net foreign exchange earned through its export (Meena *et al*., 2018)

i.e., one rupee of foreign exchange could be earned by using domestic resource worth only 0.22 rupee (22 paise).

The analysis of competitiveness of small cardamom from India using PAM revealed that the commodity was less competitive in the international market, but the country was having comparative advantage in production. India lost its competitiveness in small cardamom export as the commodity became more concentrated in the domestic market and its share in the world export declined drastically due to the stiff competition from Guatemala, which offered its commodity at much lower price (Rajesh, 2002). The higher price of Indian cardamom and lower price of Guatemalan cardamom have also resulted in the increasing supply of the latter into the Indian market (Narayanan, 2004).

Table 4.56 Competitive measures for small cardamom

Indicators	Coefficients
NPC	1.33
EPC	1.33
DRC	0.22

4.6 WELFARE IMPLICATIONS OF CHANGES IN PRICE AND TRADE OF SMALL CARDAMOM

The instability in the income earned by the farmers will have a direct impact on their welfare. The income instability depends mainly on the variance in producer prices (PP), which is in turn affected by the fluctuation in international price of the commodity. As there is transmission of fluctuations from the world market price to the domestic price, the variance of the producer price (PP) can be decomposed into five variability components *viz*., variance of export unit value in dollars ($EUV_{\$}$),variance of exchange rate (ER), covariance between export unit value and exchange rate ($COV(EUV_{\$}$ ER)), residual (R) and variance of the error term (σu^2).

The variance in exchange rate was found to be the major source of variation in the domestic auction prices (PP) in the pre-WTO period, as it accounted for more than two-third of the V(PP), but its role reduced substantially to sixteen per cent in the post-

WTO period (Table 4.57). In period II, the share of V(ER) increased three times over the share in the period I and declined considerably to one per cent during period III. The V(EUV$) was the major contributor to the variation in auction prices in the post-WTO period as well as period I, period III and period IV. The major component of the V(PP) in the overall period was the V(ER) followed by the V(EUV$). The contribution of σu^2 to the variation in auction prices decreased in the post-WTO period, while it accounted for about one-third of variation in the domestic ungraded prices in the period I and period II. In the case of auction prices of graded cardamom, AGEB and AGB, as well as the average auction price of all grades *viz*., AGEB, AGB, AGS and AGS1, the major share in the variance was V(EUV$) in the post-WTO period. The contribution of V(ER) to variance in auction prices was above 50 per cent in the period II, which reduced significantly to two per cent in period III, but increased above 30 per cent in period IV.

Uncertainty in the exchange rate during the pre-WTO period led to uncertainty in the effective prices received by the exporters, which in turn affected the wholesale prices and then the producer prices, ultimately resulting in uncertain profits. In the post-WTO period, export prices emerged to be the major determinant of domestic price variation due to high market integration and concentration of market power in the hands of a few traders at all levels of marketing of cardamom in India. Only a few auctioneers and dealers account for a bulk of the sale and purchase through auctions and also, most of the quantity of cardamom exported was controlled by a handful of exporters. The high value of $\sigma^2 u$ indicate the effect of domestic demand and behaviour of intermediaries in the small cardamom market in India.

Table 4.57 Decomposition of price variance for small cardamom

Components	Pre-WTO period	Post-WTO period	Period I	Period II	Period III	Period IV	Over-all period
Ungraded Auction Price (India) and Indian Export Unit Value							
V(EUV$)	33.66	41.41	76.94	42.95	60.48	71.77	20.90
V(ER)	82.94	15.78	26.49	70.23	1.87	34.41	91.70
COV(EUV$,ER)	-21.15	12.13	-24.38	-21.81	3.41	-29.89	-3.30
σ^2u	15.15	5.02	34.03	20.84	7.41	21.98	5.38
R	-10.60	25.66	-13.08	-12.21	26.83	1.73	-14.68
Graded Auction Price* and Indian Export Unit Value							
V(EUV$)	-	54.92	-	55.17	83.34	110.71	43.35
V(ER)	-	20.93	-	90.20	2.58	53.08	47.88
COV(EUV$,ER)	-	16.09	-	-28.01	4.70	-46.11	10.83
σ^2u	-	3.72	-	9.47	5.25	20.16	3.94
R	-	4.34	-	-26.83	4.13	-37.84	-6.00
Graded Auction Price and Indian Export Unit Value**							
V(EUV$)	-	46.10	-	46.71	53.82	75.04	39.32
V(ER)	-	17.57	-	76.38	1.66	35.98	43.43
COV(EUV$,ER)	-	13.50	-	-23.72	3.04	-31.25	9.82
σ^2u	-	7.03	-	14.62	10.38	25.37	8.47
R	-	15.80	-	-13.99	31.10	-5.14	-1.03
Average Graded Auction Price* and Indian Export Unit Value**							
V(EUV$)	-	44.47	-	42.50	57.59	77.54	37.13
V(ER)	-	16.95	-	69.48	1.78	37.19	41.01
COV(EUV$,ER)	-	13.03	-	-21.58	3.25	-32.30	9.28
σ^2u	-	5.31	-	13.46	7.73	23.85	6.33
R	-	20.24	-	-3.86	29.65	-6.28	6.25

Note: 1. V(EUV$) denotes Variance of Export Unit value in US Dollar, V(ER) Variance of Exchange Rate, COV (EUV$, ER) covariance between EUV$ and exchange rate, σ^2u variance of the error term u and R the residual

2. Graded cardamom auction prices: *corresponds to AGEB, ** AGB and *** average of prices for four grades, AGEB, AGB. AGS1 and AGS

Summary and Conclusion

5. SUMMARY AND CONCLUSION

The study on "Dynamics in prices and trade of Indian small cardamom and its implications on producers" envisioned to estimate the economics of cultivation and marketing of small cardamom in Idukki district of Kerala, examine the price formation and transmission between the domestic and international markets and analyse the supply response of small cardamom. The study also aimed at analysing the trade performance and export competitiveness of the commodity followed by analysing the implications of changes in prices and trade on producers.

The study on the economics of small cardamom cultivation revealed that the total cost of cultivation and production in Idukki district were ₹4,79,040 per hectare and ₹375 per kg respectively. The cost of establishment for first two years of the crop was found to be ₹4,52,629 per hectare, while the annual maintenance cost was ₹4,00,081 per hectare. The intensive use of inputs, labour requirement throughout the year and the post-harvest operations at the farm level resulted in the higher costs. In spite of the higher cost of cultivation, small cardamom cultivation in Idukki district was found to be profitable in nature, with farmers earning a net return of ₹9,18,366 per hectare, as the commodity was fetching a comparatively higher price. The study also revealed that small cardamom required replacement/replanting at an appropriate time of 8-15 years for better yield and returns, as there was increase in cost of cultivation with decline in yield in the later stages of the crop. But the farmers were reluctant to go for replanting due to high expense incurred and lack of income from the crop during the gestation period and also, the subsidy provided by Spices Board for replanting was very low compared to the actual cost involved.

To study the economics of small cardamom marketing, various marketing channels were identified and the marketing costs, margins, price spread and efficiency for each channel were estimated. The major marketing channels identified for small cardamom were, Channel I: Producer-Village trader-Auctioneer-Wholesaler-Retailer-Consumer; Channel II: Producer-Auctioneer-Wholesaler-Retailer-Consumer; Channel III: Producer-Village trader-Auctioneer-

Exporter-Consumer and Channel IV: Producer-Auctioneer-Wholesaler-Upcountry wholesaler-Retailer-Consumer. Majority of the farmers (49 per cent) were selling their produce to the village traders, while 32 per cent of the farmers were selling to the auctioneers. Channel II exhibited the highest marketing efficiency of 2.75 because of low marketing cost and margin, and high producer's share in consumer's rupee. The marketing efficiency was found to be the lowest in channel III, which was 0.57. The study shows that the higher cost involved in cardamom marketing and higher margin earned by the intermediaries led to lower efficiency of the markets. This was mainly due to the lack of proper infrastructure, high concentration of market power in the hands of very few functionaries and the problem of transparency in price setting. The process of re-pooling in the auctions in which traders resell the commodity that they have already purchased in earlier auctions from the producers to other traders, was found to be adversely affecting the producers considerably.

The co-integration analysis was conducted for the monthly domestic prices of ungraded cardamom and graded cardamom *viz.*, AGEB (Alleppey Green Extra Bold), AGB (Alleppey Green Bold), AGS (Alleppey Green Superior) and AGS1 (Alleppey Green Shipment 1) and the international price of Indian extra bold in the New York market from 1983 to 2018. Prior to co-integration analysis, stationarity of the price series in rupee and US dollar were tested using Augmented Dickey Fuller (ADF) test at levels and first difference. The results revealed that for prices in rupee, all the variables were non-stationary at levels and stationary at first difference during all the time periods under consideration indicating their suitability for cointegration analysis. When expressed in US dollar, the prices of ungraded cardamom during the pre-WTO period, period I, period II and period III, the prices of AGEB and AGB during the II and III periods, price series of AGS and AGS1 during the post-WTO period, period II and period III, and the prices of Indian extra bold in the pre-WTO period, overall time period, period I, period II and period III were found to be appropriate for cointegration analysis. However, for the rest of the

time periods, the respective price series were found to be stationary at levels and hence were not considered for the cointegration analysis.

The cointegration analysis for prices of small cardamom in Indian and international markets confirmed the co-movement of prices in the post-WTO period. The transmission of price signals between Indian and international markets was also confirmed for period I, period III and period IV. Thus, the prices of cardamom in one market were found to be having considerable influence on the prices prevailing in the other market, especially after the liberalisation of trade. The transmission of price signals depends on various factors such as presence of tariff barriers, degree of protection and various border and domestic policies. Reduction in these trade barriers after the liberalisation has led to better integration and transmission of prices between the markets in the post-WTO period. The price series of cardamom of different grades in the domestic market were found to be moving together in almost all the periods considered. Even though there is price variation among different grades of cardamom, the overall demand for the commodity in the domestic market, irrespective of its quality, could be the reason for the co-movement of prices of different grades of small cardamom. The Error Correction Model confirmed the presence of short-run disequilibrium in the Indian and international prices of small cardamom and the statistically significant coefficients in most of the cases imply that once in disequilibrium, the system tries to come back to its equilibrium state with varying speed of adjustment in different time periods. The Granger causality test identified that the price transmission was from international market to domestic market for the Indian small cardamom. The inefficiency of India to transform price signals to the international market could be due to the orientation of production towards the domestic market and the domination of Guatemalan cardamom in the international market due to its cheaper price, while the price of small cardamom from India was much higher.

Supply of small cardamom in response to price was estimated using the Nerlovian model for the period from 1980 to 2018. The coefficient of determination or R^2 value of 97 per cent and probability of F-statistics indicated that the estimated

supply response model was a good fit. The estimates from the fitted supply response model showed that the changes in own production, the two-year lagged price and the changes in the one year lagged average annual rainfall had significant influence on the production of small cardamom in Idukki district. The study showed that the effect of changes in the two-year lagged price of the competing crop i.e., black pepper and liberalisation of trade were not having significant influence on the production of small cardamom. The short-run and long-run price elasticities of small cardamom derived from the Nerlovian supply response model were 0.39 and 0.96 respectively. The results supported the fact that farmers responded to the increase in price by intensive application of inputs *viz*., fertilizers, pesticides and capital to increase the production. In the long-run, they responded to increase in price by increasing the area under cardamom cultivation and the farmers were found to be more innovative in developing high yielding varieties and post-harvest machineries.

The performance of small cardamom export from India was analysed by estimating the growth and instability in export, sources of growth and variance in the value of export, geographic diversification and stability of export markets for Indian small cardamom, and the factors determining the export demand and supply. The rate of growth in small cardamom export from India increased, while the instability in the export declined in the post-WTO period as compared to the pre-WTO period. Among different periods, period I (1970-71 to 1979-80) recorded the highest growth rate of 25.75 and 24.05 per cent for value and unit value of export expressed in rupee and 20.18 and 18.55 per cent for value and unit value expressed in dollar, while period V (2010-11 to 2017-18) recorded the highest growth rate of 16.27 in export quantity and minimum instability in value and unit value of export. Period II (1980-81 to 1989-90) witnessed the lowest and negative growth rate and high instability in export. The export of Indian small cardamom was adversely affected by the increase in domestic demand, which led to the increase in the average annual domestic price. Thus, the demand and price in the domestic market influenced the export quantity of small cardamom from India, which in turn affected

the export value of the commodity. The decomposition analysis revealed that the export quantity played a major role in the growth of export value of small cardamom. Change in mean export quantity contributed about 80 per cent to the changes in average export value of small cardamom in the post-WTO period in relation to the per-WTO period. Change in the variance of export value was mainly due to the change in variability in the export unit value, which contributed about 85 per cent in the post-WTO period compared to the pre-WTO period.

Geographic concentration of small cardamom export from India always remained high above 50 and it further increased from 53 in the pre-WTO period to 63 in the post-WTO period. From period I to period V, there was a steady and gradual increase in the geographic concentration index from 51 to 97. This denoted the higher level of concentration and uneven distribution of Indian small cardamom export that could result in higher instability and risks in export earnings.

The results of Markov chain analysis indicated the changing pattern in the stability of export markets of Indian small cardamom and the declining probability of retention of major countries over the period of time with the exception of Saudi Arabia. In the pre-WTO period, Malaysia was the most stable market for Indian small cardamom, with 75 per cent probability of retaining the previous period's market share, while Iran emerged as the most stable market with 83 per cent probability of retention in the post-WTO period. It was found that Saudi Arabia, Malaysia, Japan and UAE were the stable markets in both pre-WTO and post-WTO periods. UAE was the most stable market for Indian small cardamom in period I (1970-71 to 1979-80) with 82 per cent probability of retention, but it lost to Saudi Arabia to the tune of 97 per cent and had zero per cent probability of retention in period II (1980-81 to 1989-90). Kuwait emerged as the most stable market in period II, but lost completely to Japan in period III (1990-91 to 1999-00). Iraq became the most stable market in period III by completely retaining its previous period's share and remained as the most stable market in period IV. In period V (2010-11 to 2017-18), Saudi Arabia (0.73) became the most stable market, while Iraq and UAE, the most stable markets in period IV, turned out to be unstable with zero probability of

retention. Even though India gained considerable market share of new markets *viz*., UK, Iran and Bangladesh, it lost some of the traditional export markets *viz.,* Kuwait, UAE and Qatar. This could be attributed to the higher price of Indian cardamom and the increase in supply of low-priced small cardamom from Guatemala and also the quality issues faced by Indian cardamom due to the presence of residual content of pesticides.

The export demand for Indian small cardamom was found to be influenced by the GDP per capita in the importing countries. The R-square value of less than 0.50 revealed the influence of the non-price factors such as quality of the commodity on export demand. The export supply was found to be determined by the ratio of domestic price to export price and the domestic production. The factors such as increase in the demand and price for small cardamom in the domestic market and the drastic increase in the yield as a result of changes in the technology of production during the post-liberalisation period influenced the export supply of cardamom from India.

The analysis of competitiveness of small cardamom from India using PAM revealed that the commodity was less competitive in the international market as the values of Nominal Protection Coefficient (NPC) and Effective Protection Coefficient (EPC) were greater than one (1.33), but the country was having comparative advantage in production as the Domestic Resource Cost Ratio (DRCR) was less than one (0.22). India lost its competitiveness in small cardamom export as the commodity became more concentrated in the domestic market and its share in the world export declined drastically due to the stiff competition from Guatemala, which offered its commodity at much lower price.

Implications of dynamics in prices and trade of small cardamom on producers were analysed using the variance decomposition analysis. The export price was found to be the major determinant of variation in the domestic price of small cardamom, which in turn has significant influence on the welfare of the farmers by affecting their income. This could be due to the increased market integration and

concentration of market power in the hands of a few traders at all levels in the marketing of small cardamom in India.

Policy implications

The policy recommendations based on the present study are as follows:

- Good Agricultural Practices (GAP) in combination with the introduction of varieties that are both pest resistant and high yielding and formulation of effective organic inputs could help in reducing the usage of toxic chemical inputs without affecting the yield. This would inturn help in improving the quality of the commodity and reduce the cost of cultivation.
- Providing replanting subsidy at a reasonable rate to the farmers would help them to carry out timely replanting and thus increasing the yield and reducing the cost of production.
- The problem of price variations and inefficient marketing could be overcome by price stabilization measures and transparency in the e-auctions. Crop specific price stabilization mechanism is needed to tackle the excessive volatility in the cardamom prices and ensure a stable income to the farmers. More transparency should be brought into the e-auction system to reduce re-pooling by the traders and ensure faster payment to the farmers.
- In addition to GAP, effective ban on toxic chemicals at national level is necessary to keep the residual toxic content within the permissible limit. Branding of Indian small cardamom which is of superior quality could help in promotion of the commodity in the international market.

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DYNAMICS IN PRICES AND TRADE OF INDIAN SMALL CARDAMOM AND ITS IMPLICATIONS ON PRODUCERS

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ABSTRACT OF THE THESIS

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ABSTRACT

Indian small cardamom is known worldwide for its quality and is exported to many countries around the world. Formerly, India enjoyed a monopoly in the production and export of small cardamom in the world. Since 1980s, the country lost its share in the international market to Guatemala due to comparatively higher price and increasing domestic demand for the commodity.

The present study on "Dynamics in prices and trade of Indian small cardamom and its implications on producers" was undertaken with the objectives, to study the economics of small cardamom cultivation and marketing, analyse the price formation and transmission between Indian and international markets, study the supply response of cardamom, analyse India's export performance and competitiveness and assess the implications of changes in price and trade at the farm level.

The study was based on both primary and secondary data. In order to estimate the economics of cultivation and marketing of small cardamom, primary data were collected from 160 selected farm households in Idukki district of Kerala and from 52 market intermediaries in Kerala and Tamil Nadu. The secondary data on area, production, prices and exports of small cardamom published by various institutions for the period from 1970-71 to 2017-18 were collected in order to study the price formation and transmission between the international and domestic markets, to find out the export performance and competitiveness of Indian small cardamom and supply response of cardamom to prices.

The economics of small cardamom cultivation in Idukki district of Kerala was estimated using the concepts of establishment cost and maintenance cost. The total cost of cultivation and production of small cardamom in Idukki district were estimated as ₹4,79,040 per hectare and ₹375 per kg respectively, while the net returns earned by the farmers was ₹9,18,366 per hectare.

The major marketing channels identified for small cardamom were, Channel I: Producer-Village trader-Auctioneer-Wholesaler-Retailer-Consumer; Channel II: Producer-Auctioneer-Wholesaler-Retailer-Consumer; Channel III: Producer-Village trader-Auctioneer-Exporter-Consumer and Channel IV: Producer-Auctioneer-Wholesaler-Upcountry wholesaler-Retailer-Consumer. Majority of the farmers (49 per cent) were selling their produce to the village traders, while 32 per

cent of the farmers were selling to auctioneers. The marketing efficiency was found to be highest in channel II because of the low marketing cost and margin, and high producer's share in consumer's rupee. The marketing efficiency was found to be lowest in channel III.

The co-movement between the cardamom prices in the Indian and international markets was confirmed in the post-WTO period, while there was no integration in the pre-WTO period. The transmission of price signals between Indian and international markets was also established for period I, period III and period IV. The price series of different grades of cardamom in the domestic market were found to be moving together in almost all the periods considered. Thus, the price of cardamom in one market was found to be having considerable influence on the price prevailing in the other market after the liberalisation of trade. The Error Correction Model (ECM) indicated the presence of short-run disequilibrium between the Indian and international prices, and between the prices of different grades of cardamom, which got corrected with varying speed of adjustment. Granger causality test confirmed that the price transmission was from the international market to the Indian market in the long-run. The elasticity of supply of small cardamom with respect to its own price lagged by two years was positive and significant in both the short-run (0.39) and long-run (0.96).

The rate of growth in the export of small cardamom from India increased, while the instability in export declined in the post-WTO period as compared to the pre-WTO period. The export quantity contributed to about 80 per cent growth in the export value of small cardamom in the post-WTO period. Nearly 85 per cent of change in the variance of export value in the post-WTO period was due to the change in the variability of export unit value of small cardamom. Among the different periods considered for the study, period I recorded a higher growth rate of export and lower instability in terms of value and unit value, while period II witnessed the lowest and negative growth rate with high instability in the export of small cardamom.

Geographic concentration of small cardamom export from India always remained high and it further increased in the post-WTO period. Over the years from period I to period V, there was a steady and gradual increase in the geographic concentration of export. There was a changing pattern in the stability of export markets for Indian small cardamom, and the probability of retention of major countries was

declining over the years with the exception of Saudi Arabia. It was found that Saudi Arabia, Malaysia, Japan and UAE were the stable markets in both pre-WTO and post-WTO periods. Even though India gained considerable market share of new markets *viz*., UK, Iran and Bangladesh, it lost some of the traditional export markets *viz.*, Kuwait, UAE and Qatar.

The export demand for Indian small cardamom was determined by the GDP per capita in the importing countries in both pre-WTO and post-WTO periods, while the export supply was influenced by the ratio of export price to domestic price and the domestic production.

The indices of export competitiveness *viz.,* the Nominal Protection Coefficient (NPC) and Effective Protection Coefficient (EPC) values were greater than one (1.33) indicating lower export competitiveness of Indian small cardamom. Domestic Resource Cost Ratio (DRCR) was less than one (0.22) which indicated India's comparative advantage in the production of small cardamom.

Variance in producer prices influences the welfare of the farmers by affecting their income. The variance in exchange rate was found to be the major source of variation in producer prices in the pre-WTO period and period II, while the variance in export unit value was the major determinant in the post-WTO period, period I and period III.

The challenges in small cardamom cultivation need to be addressed by introducing varieties that are both pest resistant and high yielding, formulating effective organic inputs and providing replanting subsidy at a reasonable rate to the farmers. Regarding the price and trade of cardamom, crop specific price stabilization mechanism is needed to tackle the excessive volatility in cardamom prices. More transparency is required in the e-auction system to reduce re-pooling by traders and ensure faster payment to the farmers. In order to promote export and improve India's competitiveness, farmers should be encouraged to follow Good Agricultural Practises (GAP) that will help to reduce the input usage, which will in turn improve the quality of the commodity and reduce the cost of production. Effective ban on toxic chemicals at the national level is necessary to keep the residual toxic content in small cardamom within the permissible limits. Branding of Indian small cardamom which is of superior quality could also help in promotion of the commodity in the international market.

Appendices

APPENDIX I

Survey questionnaire

KERALA AGRICULTURAL UNIVERSITY (KAU)
COLLEGE OF HORTICULTURE
KAU P.O
Vellanikkara, Thrissur 680656
Department of Agricultural Economics

Dynamics in prices and trade of Indian small cardamom and its implications on producers

(Indhushree, A. 2016-21-027)

This information is gathered for the purpose of research work of the PhD programme in KAU and the data will be kept strictly confidential

Interview Schedule

Block: **Panchayath:**

1 Name of the respondent :

2 Address & Contact Number :

3 Age :

4 Experience in farming (Years) and experience in cardamom cultivation :

5 Family details and consumption :

Sl No	Member (code)	Age	Education (code)	Occupation (code)		Annual Income	
				Primary	Secondary	Primary	Secondary

Code for member	**Codes for education**	**Codes for occupation**
1 Head of the HH 2. Spouse 3. Unmarried child 4. Married child 5. Son/Daughter in law 6. Grand child 7. Parents 8. Father/Mother/ in laws 9. Others	1. Primary or less 2. Upper primary up to secondary 3. Secondary passed but have no Degree 4. Degree holders general 5. Degree agriculture 6. Other Professional degree (specify)	1. Farming 2. Employed in State /Central Govt. 3. Employed in Semi Govt. Aided school/college, co-operative /local administrative bodies 4. Employed in Private sector 5. Self employed 6. Unpaid family work 7. Agricultural labour 8 Animal husbandry/diary/poultry/ fishing/ 9. Labourers in non-agric. Sector 10. Job seekers 11. Student 12. Pensioners, too old to work/ handicapped 13. Employed abroad

Consumption expenditure and recent changes

Sl No	Particulars	Quantity	Amount	Remarks

6. Details of the Land Holding:

Area of Operational Holding (ha)

Total area	Owned – with title deed (pattayam)	Owned – without title deed	Leased-in (From which year)	Leased-out (From which year)	Monocrop cardamom			Mixed crops	Other monocrop
					Total area	Mature plants (Nos.)	Immature plants (Nos.)		

7. Details of non-crop/Allied activities:

Sl No	Activities	Area/No	Annual maintenance expenses	Gross returns
1	Dairy			
2	Poultry			
3	Fish farming			
4	Self-employment			
5	Others			

8. Cropping Pattern:

Sl.No.	Crop	Variety - Local/HYV	Area
I	Perennial Crops		
Mono-crop – Specify Pre-bearing / Peak-bearing / Over-aged – denote age			
Mixed –crop			
II Annual Crops			

If replanting of over-aged plants not done, reasons for that

9. Production and Price of Cardamom

Year / Crop	**2018**	**2017**	**2016**
Quantity Produced / Sold			
Average Price			
Peak Price			
Lowest Price			

10. Cost of Cultivation of Cardamom

Fixed inputs	Year of purchase	Initial cost (Rs)	Present cost (Rs)	Useful life (years)
Land value				
Farm building				

Machinery and equipment's	Quantities	Year of purchase	Initial cost	Subsidy (if any)	Maintenance cost	Useful life (years)

Rental value of land	
Land revenue	
Interest on fixed capital	
Interest on working	

Age of plantation: Start of commercial year:

Wage Rates (Rs./day): Male…….. Female……. Special wages: ……

Change in wages in last few years:

Change in input prices in last few years:

Changes in cultivation cost:

2016 2017 2018

Area: **Production** (Qtls)**:**

Price (Rs/ Qtl)**:**

By product:

Particulars	Input			Human labour					
				Hired labour		Family Labour		Total labour cost	
	Nos.	Cost/unit	Total Cost	No.	Amount	No.	Amount	No.	Amount
Land preparation									
Digging of pits, Filling up of pits									
Planting material									
Planting/staking/mulching									
Shade regulation									
Farm Yard Manure									
Fertilizers									
Plant protection chemicals									
Irrigation									
Intercultural operation (weeding, gap filling)									
Others/Intercropping									
Harvesting & processing									
Trashing									
Land tax/cess									
Other expenses									
Total									
Establishment cost **Total**									
Total cost									

* Establishment cost: For total establishment to be converted to annual share

11. Details of credit:

Have you availed any credit? Yes / No (Specify year)

Sl. No.	Sources of Finance	Type of Loan			Loan Amount		Rate of interest (per year)
		ST	MT	LT	Taken	Outstanding	
1	Nationalised bank						
2	Co-operative bank						
3	Gold Loan						
4	Money lender						
5	Friends & relatives						
6	Others						

12. Replanting, land improvement and others (last five years)

Activity	Extent of coverage	Total expenditure	Amount of subsidy & Source	Year
Replanting (number of plants)				
Replanting (No. of plants) – Shift to other crops				
Land improvement (area)				
Irrigation (area)				
Farm machinery				
Any other investment				

13. Details on Marketing:

Farm Level Details		
1	Main mode of Disposal	
2	Total Marketed Quantity	
3	When do you sell the produce? (Code 1. During harvest 2. Later)	
4 a.	To whom/where do you sell the produce?	
b.	Reason	
5	Distance to the market and auction centre	
6	Any market charges (commission/brokerage)	
7	Mode of Transport and cost incurred	
8	Do you sort/grade produce? (Code: 1. Yes 2. No) If yes, where do you get it done?	
9	Do you own a cardamom curing/polishing facility? (Code: 1. Yes 2. No) If no, distance to curing house	
10	Cost incurred in curing	
11	Price received per kg	
12	Mode of Payment	
13	Storage	
(i)	Time period of storage	
(ii)	Method of storage	
(iii)	Cost of Storage	
(iv)	Other remarks	
14	Loading and unloading charges	
15	Transport charges	
16	Other charges if any	
17	Source of information on price	

14. Known marketing channel through which produce reach ultimate consumer

15. Marketing Constraints

Ranking of Constraints		
Sl No	**Problems**	**Rank**
1	Low price of produce/price fluctuation	
2	Distress sale to traders	
3	Labour problems (loading and unloading)	
4	Transport charges	
5	Transportation losses	
6	Distance to markets/ Co-operative Marketing Society	
7	Non - availability of storage facilities	
8	Others (specify)	

16. Constraints in Cardamom Action System

S.No.	**Constraint**	**Rank**
1	Payment delay	
2	Distance	
3	Advance taken from local dealer	
4	Sample deduction	
5	Others	

17. Other details:

a. Are you member of any producer organization / Cooperative / SHG

b. Any contractual agreement of selling of the produce. If yes, since which year?

c. How the price is determined

d. Is there any incentive/bonus

e. Details on contact with developmental agencies:

Sl.No	Agencies	Type of Assistance			
		Pl. materials	Technology	Subsidy	Marketing
1	Agrl.Department				
2	Spices Board				
3	KAU				
4	Co-operatives				
5	NGO				
6	Others				

18. Suggestions for Improvement of Cultivation of this crop

19. What support do you expect from the institutions to withstand price volatility?

20. Strategies employed to cope up with any loss/ price variation

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INTERVIEW SCHEDULE FOR INTERMEDIARIES

1. Name and address of respondent:
2. Age:
3. Sex:
4. Type of market intermediary:

   Village merchant/ auction agents/wholesaler/ retailer/ exporter

5. No of years of experience in cardamom trading:
6. Main product(s) dealt with:
7. Quantity (volume) of transaction/year:
8. Do you have any shop or stall for marketing the produce?
9. Place of operation:
10. From whom you mostly purchase?
11. Mode of purchase:
12. Quantity purchased/ year:
13. Average price paid/unit:
14. Purchase place and distance from market:

15. Mode of transport:

16. Transporting charges:

    Details (in case of export: fright charges, tariffs etc.)

17. Loading and unloading charges:

18. Processing charges if any (Mention the processing done) :

19. Packaging cost:

20. Storage cost:

21. Average loss in handling:

22. Brokerage:

23. Other expenses:

24. Average retention time:

25. To whom the product sold:

26. Mode of sales:

27. Market fee:

28. Other charges:

29. Price received /kg:

30. Known marketing channel through which produce reach ultimate consumer:

31. Challenges faced:

APPENDIX II

Details of secondary data with source and duration

Particulars	Period	Sources
Annual and monthly domestic and international price of small cardamom	1970-71 to 2017-18	Spices Board (www.indianspices.com)
Country wise export of small cardamom	1980-81 to 2017-18	Spices Board
State and district wise area, production and productivity of small cardamom in India and Kerala	1980-81 to 2017-18	Spices Board Directorate of economics and statistics, Kerala