ECONOMICS AND RISK MITIGATION MEASURES FOR NENDRAN BANANA CULTIVATION IN THIRUVANANTHAPURAM DISTRICT.

by

STEPHY.M.A.

(2016-11-054)

THESIS

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2018

DECLARATION

I, hereby declare that this thesis entitled "**ECONOMICS AND RISK MITIGATION MEASURES FOR NENDRAN BANANA CULTIVATION IN THIRUVANANTHAPURAM DISTRICT**" is a bonafide record of research work done by me during the course of research and thesis has not previously formed the basis for the award to me of any degree, diploma, fellowship or other similar title, of any other university or society.

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Stephy M.A.

TABLE CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVATION

AIC	Agricultural Insurance Company of India
APEDA	Agricultural and Processed Food Products Export Development Authority
B:C	Benefit cost ratio
CCIS	Comprehensive Crop Insurance Scheme
CSO	Central Statistics Office
et al.,	Co workers
FAO	Food and Agricultural Organization
Fig.	Figure
FYM	Farm Yard Manure
GDP	Gross Domestic Income
GOI	Government of India
GOK	Government of Kerala
KAU	Kerala Agricultural University
MFC	Marginal Factor Cost
MVP	Marginal Value product
MNAIS	Modified National Agricultural Insurance Scheme

NAIS	National Agricultural Insurance Scheme
PMFBY	Pradhan Mantri Fasal Bima Yojana
SCIS	State Crop Insurance Scheme
TCB	Tissue Culture Banana
VFPCK	Vegetable and Fruit Promotion Council of Kerala
VIF	Variable Inflation Factor
WBCIS	Weather Based Crop Insurance Scheme

LIST OF SYMBOLS

ha	Hectare
ha^{-1}	Per Hectare
Kg	Kilo gram
Kg^{-1}	Per Kilogram
Km	Kilo meter
mm	Millimeter
q^{-1}	Quintal per hectare
%	Per cent
₹	Rupees
R^2	Coefficient of determination
Σb_i	Coefficient of regression
Yr. $^{-1}$	Per year

LIST OF APPENDICES

Introduction

1. INTRODUCTION

Agriculture is the most important sector in the Indian economy which contributes 18 per cent of India's gross domestic product in the year 2017 (GoI, 2018). Around 70 per cent of its population is directly or indirectly depended on agricultural sector for their livelihood. India is the largest producer of many fresh fruits and vegetables, milk, major spices and jute (FAO, 2010). India's diverse climatic condition favours the cultivation of all varieties of fresh fruits and vegetables. India ranks second in the production of fruits and vegetables after China. According to the National Horticultural Board, India produced 86.602 million metric tonnes of fruits in the year 2014-2015 (NHB, 2015).

Among the fruits, India is the largest producer of bananas (26.04 per cent) with an annual production of 30 million tons in an area of 0.8 million hectares. Banana (*Musa paradisiaca)* is commonly known as "Apple of paradise" or "Fruit of the wise men". It is the fifth largest agricultural commodity in world trade after cereals, sugar, coffee and cocoa. Banana is normally grown in the tropical humid lowlands and optimum temperature requirement is 27° C. Tamil Nadu is the largest banana producing state in India. Even though Cavendish bananas are most demanded in the world trade, South East Asia and West Asia region people prefer traditional bananas like Nendran, Poovan and Red banana (APEDA, 2017).

Nendran is a commercial plantain variety in the southern states Kerala, Tamil Nadu and Karnataka which occupied 50 per cent of total area under plantain in India. This variety is grown for both the fruit and culinary purpose and the cultivation is also deeply connected with the traditional culture and festivals of Kerala. In Kerala almost 40 to 50 per cent of cultivated banana is of this variety. Nendran variety is commonly used for making chips and several Kerala dishes like Olan, Avial, Erisseri etc. which are popular dishes in the southern state of Kerala.

The agricultural economy of Kerala has undergone a structural transformation from the mid-seventies since there was a remarkable shift of the traditional crop area, from area under subsistence crops like rice and tapioca to more remunerative crops like banana and other plantations. In the last decade, the southern districts especially Thiruvananthapuram, Kollam and Pathanamthitta in Kerala have witnessed the revolution of banana cultivation and its value addition. For Nendran there is a state wide domestic market. The average Nendran exports is 700 tonnes in a year which is worth ₹ 1.25 crore.

Table 1. Year wise distribution of area, production and productivity of banana in Kerala

Sl .No	**Year**	**Area (ha)**	**Production (tonnes)**	**Productivity**
1	2002-03	55668	421809	7577
2	2003-04	55906	442220	7910
3	2004-05	58866	475371	8075
4	2005-06	61400	491823	8010
5	2006-07	59143	463766	7841
6	2007-08	59341	439803	7411
7	2008-09	54739	435979	7965
8	2009-10	51275	406242	7923
9	2010-11	58671	483667	8244
10	2011-12	59069	514054	8703
11	2012-13	61011	515606	8451
12	2013-14	62261	531299	8533
13	2014-15	61936	545431	8806
14	2015-16	59835	536155	8960
15	2016-17	57140	489322	8563
AAGR		0.33	1.29	0.94
CAGR		0.17	0.99	0.81

Source: Government of Kerala, 2018

Area, production and productivity of banana of Kerala provided in Table 1. shows that area and production increased from 2002 to 2006 but after 2006 area and production had been decreasing for few years. Production of banana in the year 2009-

2010 was only 4,062,42 tonnes. In the period 2012 to 2014 a marginal increase in area and production was noticed as compared to previous years. Productivity of banana was maximum in the year of 2014-2015. The average annual growth rate was 0.33, 1.29 and 0.94 respectively for area, production and productivity. Compound annual growth rate of area, production and productivity were respectively 0.17, 0.99 and 0.81.

1.1 RISK AND RISK MITIGATION IN BANANA PRODUCTION

There are various kinds of risks that are encountered in banana production and marketing. The production risk is the major one which adversely affects the yield parameters. Farmers cultivating this crop suffered huge loss from natural disasters, pest and disease outbreaks and fluctuation in prices. This has even led to suicides because of less income and deprivation. Therefore, farmers adopt different risk mitigating strategies to overcome such situations. Crop insurance is the best risk management tool that producers purchase to protect against the loss of their crops.

1.1.1 History of crop insurance in India

In 1976 Dhandaker recommended the area approach crop insurance scheme in India. But this policy had suffered various kind of problems like adverse selection and moral hazards and high administrative cost. From this experience, the pilot crop insurance scheme was implemented in the year of 1979. In this scheme agricultural insurance was linked with short term crop loan and all crop loans were insured compulsory and the premium was deducted from the loan advance. In 1985 a systematic crop insurance scheme was implemented as Comprehensive Crop Insurance Scheme (CCIS), it was the expansion of the Pilot Crop Insurance Scheme. The main aim was to protect all the loanee farmers from risk. Comprehensive Crop Insurance Scheme couldn't achieve intended targets due to problems like limited crop coverage, capping of sum insured and limited availability to loanee farmers (Aditya and Parveen, 2016). To overcome the deficiencies in the CCIS a new scheme was introduced as

National Agriculture Insurance Scheme from Rabi 1999-2000. The main objective was to provide the financial support to the farmers for the yield loss of crops due to natural calamities, pest and diseases as a part of risk management in agriculture (Anusha and Roopini, 2016). The scheme had covered most of the crops and all states in the country to both loanee and non loanee farmers.

NAIS protects the farmers only from the production risk. But price risk is not considered in this scheme. Due to the price fluctuation in the markets farmers fail to maintain their farm income, to take care of such conditions government introduced Farm Income Insurance Scheme during 2003-2004. In order to address some of the problems of NAIS, Agriculture Insurance Company of India (AIC) developed a pilot weather risk index based insurance scheme in 2004. In 2007 government of India and AIC designed the Weather Based Crop Insurance Scheme (WBCIS) on pilot basis in a few states. PMFBY (Pradhan Manthri Fasal Bheema Yojana) is the new insurance scheme implemented by Indian government in 2016.

1.1.2 Insurance schemes available in Kerala for Nendran

1.1.2.1 Kerala State Crop Insurance Scheme

Kerala State Crop Insurance was introduced in the year 2011-12 and ₹ 570 lakhs was deposited towards state share in the crop insurance fund. The scheme was implemented through Department of Agriculture and the Krishi Bhavan at village level. The main objective of the insurance scheme was to provide crop loss compensation against the loss due to natural calamities and wild animal attack. Under this insurance scheme, farmer will be benefited which may lead to better utilization of resources and to increasing the production and productivity.

1.1.2.2 Vegetable and Fruit Promotion Council of Kerala Crop Insurance Scheme

VFPCK has designed a crop insurance package for its participating farmers for protecting as well as the banker from uncertainties that arises during the cultivation period. VFPCK had made a tie up with National Insurance Company Ltd. for insurance coverage of banana, vegetables and tuber crops. Crops covered are all banana varieties, vegetables (pandal and non-pandal) and tuber crops (amorphophallus, colocasia, yams and tapioca) cultivated by participant farmers of VFPCK.

1.1.3 Risk Mitigation

Apart from production risk, farmers also considered the price risk and credit risk. Price fluctuation in the agricultural commodity create a wide depletion in farm income. The perishable nature of banana is a constraint for the farmers in Kerala because there is lack of proper cold storage systems and proper processing methods. In Kerala, farmers also join VFPCK, Sangamythri and Kudumbasree for assured marketing and realising better price for the produce. The farmers borrow the funds from different formal and informal institution to meet various costs which involves credit risk.

1.2 OBJECTIVE OF STUDY

- To study the economics of banana cultivation
- Identification of risks and relative advantages of risk mitigation measures
- To identify constraints in the adoption of risk mitigation measures in Thiruvananthapuram district.

1.3 SCOPE OF THE STUDY

Farming is more hazardous than any other enterprise or business. Every year, in our country large area under food crops are affected by different natural calamities and weather parameters. The estimated total annual crop loss per annum due to natural calamity was ₹ 1000 crore. The farmer behind the farm has to be assured and he should

be compensated for such crop loss. Farmers were adopting different strategies to overcome such situation. Crop insurance is a financial instrument which make up the loss and helps the farmers to stabilize the farm income when crop loss occurs. Hence this study was taken up with expectation to provide an insight into the relative advantage of farmers who were adopting formal risk mitigation measures.

1.4 LIMITATIONS OF THE STUDY

Memory based recall method of data collection from the respondents was a major limitation. Efforts were taken to minimize the error. As the study was taken up as a part of M. Sc programme, it was limited by time and resource constraints. A clear picture would have been obtained, if the study was done after the classification of farmers in to three groups such as small, marginal and large. The non-availability of recorded secondary data in the past was also a limitation for the analysis of performance of insurance schemes. The study was based on primary data collected from the farmers which often had recall bias and is considered to be a major limitation. However, care was taken to reduce such errors by resorting to realistic estimates with cross check.

1.5 ORGANIZATION OF THE THESIS

The thesis is organized into chapters, the first chapter is "Introduction", which helps to understand the background, scope and limitation of the study. The second chapter includes the review of the past studies and findings related to research topic. Materials and methods is the third chapter which consists of sampling procedure for selection of respondents, description of study area, different statistical tool used for the data analysis and different variables and measurements. Result and discussion are presented in fourth chapter which contain the findings and interpretation of the study according to the objectives. Summary is the last chapter which highlighted the major findings and policy implications.

Review of literature

2. REVIEW OF LITERATURE

An appraisal of the previous works relating to the research problem is a requisite to determine the appropriate research methodology for the present study. The research problem in thesis deals with the objectives of economics of banana cultivation and relative advantage of risk mitigation measures and constraints in their adoption. An exhaustive literature review was done to identify similar studies, which are in support of this specific research topic and are relevant to the objectives of present study. Further the studies related to the research topic are presented under the following sub headings.

2.1. Economics of Banana cultivation

2.2. Risks in agriculture

2.3. Risk mitigation measures in agriculture

2.4. Constraints in the adoption of risk mitigation measures

2.1 ECONOMICS OF BANANA CULTIVATION

The Cobb Douglas production function was used by Venkatesh Reddy (1982) to examine the resource use efficiency and productivity for plantain and ratoon crops of Robusta and dwarf Cavendish varieties. Plant population, land, labour, manures and fertilizers and chemicals which are used for the plant protection were considered as independent variables and gross return as dependent variable. The analysis revealed that 95 per cent variation in gross return was explained by the selected independent variables.

Arputhraj and Nair (1986) reported that on an average, an amount of ₹ 36,252 ha^{-1} was incurred towards cost of cultivation of plantain, with human labour as the highest item of expenditure accounting to 23 per cent of total cost. The average output was 14,991 kg ha^{-1} valued at ₹ 56,205. The benefit cost ratios at Cost A_1, Cost A_2, Cost B and Cost C were 2.16, 2.10, 1.84 and 1.64 respectively.

Bastine and Radhakrishnan (1988) found that the cost of cultivation was ₹.36, 249 ha^{-1} for plantain cultivation. The gross returns worked out to ₹ 45, 068 and the net income was ₹ 8, 819 with BC ratio 1.55. The main items of expenditure were the cost of both family and hired labour and manure for plantain cultivation. The study showed that the contribution of family labour was 30.50 per cent of the total expenditure for labour and contribution of family labour showed a decreasing trend with an increase in holding sizes and 42.50 per cent of expenditure on manuring and manuring operations. Crop protection cost was less than one (0.92) per cent of total cost of cultivation.

Thomas *et al.* (1989) worked out the cost of production of Nendran and Robusta varieties of banana from the data of Kalliyoor panchayat. The results showed that Robusta was more economical than Nendran even though it was more susceptible to pests and diseases.

The study by Senthilan and Srinivasan (1994) on the economics of Poovan cultivar of banana in Thiruchirapilly district of Tamil Nadu, observed that cost of cultivation was ₹ 1,24,668.11 ha^{-1} with the net income of ₹ 62,235.69 ha^{-1}. Benefit cost ratio was 2.3:1 indicating that Poovan banana is a highly profitable crop.

Natarajan (1995) studied production and marketing of banana in Tirunelveli district of Tamil Nadu, found out that human labour, manure, fertilizer and sucker influenced the revenue at 1 per cent significant level. The MVP (Marginal Product Value) of factor cost of hired labour, sucker, manure and fertilizer was greater than one which indicated the under utilization of the production resources.

Calderon (2003) studied the benefit cost analysis of commercial banana production in the Philippines and found that demand for banana is high in developed countries and the export premises are good, more than 5.6 million small scale famers depend on it and contribute around 7 per cent of total value of agricultural products in the country. It creates more benefit in terms of income and employment. In banana cultivation more than 50 per cent of production cost was spent for fertilizers and manures.

Manojkumar *et al.* (2003) conducted a case study of crop insurance on banana in Wayanad district and reported that due to the labour shortage, and high labour cost in Padinarathara panchayat cost of cultivation was high (₹ 71.31 per plant) compared to Ambalavayal (₹ 57.96 per plant) and Panamaram (₹ 52.62 per plant).

According to Alagumani (2005) tissue-cultured banana (TCB) was more profitable than sucker-propagated banana (SPB). Also, the resources could be used more efficiently in TCB. Through Probit model analysis, it was found that gross income and bunch weight are the major factors influencing the adoption of tissue cultured banana. Since the performance of TCB was better than SPB and the risk is lower, farmers may be encouraged to adopt tissue-cultured banana to get higher profits and increased production of banana.

Kathirvel (2007) studied the effect of fixed cost and variable cost on banana production and calculated the scale of returns in Karur district of Tamil Nadu. Large farmers (₹ 66,404.37) have higher cost of cultivation compared to small, (₹ 60,132.75) and medium (₹ 62,521.443) farmers. The returns to scale was less than one (0.944- decreasing returns to scale) for small scale farmers and increasing returns to scale for marginal (1.02) and large scale (1.03) farmer. He revealed that cost of production of banana was high. Among the cost, the cost of labour and fertilizer was more. The output of banana much depended upon maintenance of plants, timely application of fertilizers, manures, pesticides and water availability.

Naduvinmani (2007) studied economics of red banana production under contract farming in Karnataka and estimated the total expenditure for production as ₹ 97,976.2 ha^{-1}. From which 88.55 per cent was incurred for the variable cost and only 11.45 per cent was the fixed cost. Expenditure on purchase of sucker (28.35 per cent) has accounted the largest share in variable cost followed by labour (19.36 per cent) and protection chemicals (13.46 per cent). The imputed value of family labour was ₹ 7908.50. BC ratio of red banana under contract farming was 3.28.

Wanda (2009) conducted a study on Production risk and input use in banana production in Uganda and reported that fertilizer had a positive and significant effect on yield of banana and fertilizer had the maximum marginal productivity (1,262.03) in the banana production and farmers were using on average 87 Kg ha^{-1} fertilizer and 161.4 bundles of green manures ha^{-1} as a mulch.

Sarkar *et al.* (2010) conducted a study on adoption of recommended banana production technology among the famers of Durg district of Chhattisgarh and found that in multiple regression analysis, out of thirteen independent variables only three variables namely education, annual income and knowledge had positive and significant contribution towards adoption at 1 per cent significant level. Seven variables namely social participation, land holding, credit acquisition, contact with extension agencies, source of information, scientific orientation and irrigation methods had a positive significant towards adoption of production technology at 5 per cent level.

Kaushikbhai (2011) revealed that under drip irrigation method total cost of cultivation (Cost C_2) of banana ha^{-1} was ₹ 1,50,098 whereas under conventional irrigation method it was ₹ 1,51,735. Compared to non-drip irrigated farm the value of gross output ha^{-1} was high in drip irrigated banana farm, which were respectively ₹ 2, 59,870 and ₹ 315283. For drip irrigated banana farms net profit was ₹ 1, 65,184.89 ha^{-1} whereas it was ₹ 1, 08,135.13 ha^{-1} for non-drip banana farms. The increased the net profit on drip banana farms was due to high yield and high price (good quality) obtained under drip banana cultivation and the reduced use of important resources such as human and bullock labour, irrigation, manures, fertilizers and plant protection chemicals etc.

Kumar (2012) conducted a study on analysis of banana production in Khangra district of Bihar and revealed that the cost of cultivation of sucker banana was ₹ 86, 635 ha^{-1} and tissue culture banana was ₹ 1, 06, 958.09 in first crop. The gross returns of sucker banana and tissue culture banana was ₹ 1,70,320 and ₹ 2,01,952 respectively. The technical, allocative and economic efficiency of

sucker banana were 79.40, 69.30 and 55.02, and respectively tissue culture banana, these efficiencies 75.80, 55.60 and 42.14.

Naveen (2013) conducted a study on economics of production and marketing of banana in chikkaballapur district and found that farm yard manure and fertilizer was significant at 5 percent level with regression coefficient of 0.33 and MVP (Marginal Value Product) to MFC (Marginal Fixed Cost) ratio was 1.39. The regression coefficient of hired labour was 0.81 and it was significant at 1 per cent level. The coefficient of multiple determination value was 0.83 and returns to scale was 1.60 (increasing returns to scale). The total cost per hectare was estimated ₹ 1,32,363.30 with average variable cost of banana production was ₹ 45,958.14 (34.72 per cent).

Bondar *et al.* (2015) conducted a study on economics of banana production in Kolhapur district of Maharashtra and revealed that there was 6.85 per cent increase of average annual production of banana with respect to area in India and average compound growth rate of production increased at the rate of 10.08 per cent and productivity 3 per cent which was significant at 1 per cent level. He classified farmers into three groups as small, marginal and large. The gross average return from banana was ₹ 5,64,283.57 with BC ratio of 2.07 at cost C. BC ratio of small, medium and large were 2.01, 2.08 and 2.12 respectively.

Hossain (2014) estimated the frontier production function and found that all estimated output elasticities for all inputs deviated from zero at 5 per cent significant level. Land for cultivation was more elastic (0.349) than the other factors, indicating 10 per cent increase in land area for cultivation which leads to 3.498 per cent increase in the production of banana. Compared to other factors, labour factor was very less elastic. Farmers age and education level had a positive effect on technical efficiency but experience of farmer showed a negative effect on technical efficiency.

According to Noor *et al.* (2015) the average production cost of banana was ₹ 1,58,581 per acre which included fixed costs, labour cost, capital inputs and

marketing costs which were ₹ 88, 300, ₹ 20, 100, ₹ 28,847 and ₹ 21,334 respectively. Gross returns per acre was estimated ₹ 2,50,250 with net income ₹ 91,669. The cost benefit ratio under contract farming of banana in Sindh Pakistan region was 1.57.

Balaganesh *et al.* (2016) conducted a study on resource use efficiency and constraints in adoption of precision farming in banana in Teni district of Tamil Nadu and reported that R^2 value of precision farming and conventional farming were 0.752 and 0.790 respectively which implies the 75 per cent and 79 per cent of variations in dependent variable (gross returns) was caused by the influence of independent variables like human labour, manures, fertilizers and sucker plants. In precision farming and conventional farming, labour cost showed a positive regression coefficient with value 0.468 and 0.352 which implies 1 per cent increase in labour cost per acre will cause an increment of 0.468 per cent in gross return but in case of conventional farming its only 0.352 per cent.

A study conducted by Kumar (2016) on an economic analysis of production and marketing of banana conducted in Durg district of Chhattisgarh. The 60 respondents were categorized in to three small, marginal and large according to the farm holding size. Gross average income of small farmers was found to be higher (₹. 3, 92,000 ha^{-1}) than large size holdings. The net benefit cost ratio is higher in small group (1.96) followed by marginal (1.89) and large (1.84).

Mahalakhmi *et al.* (2016) conducted a study of cost of cultivation of banana in Theni district of Tamil Nadu and reported that among the cost component, the cultivation cost was accounted 64.15 per cent followed by cost on instruments, irrigation cost, interest on investment and imputed land cost which were respectively 12.08 per cent, 9.69 per cent, 7.43 per cent and 6.64 per cent. Eighty-eight per cent respondents reported that fluctuation in price is a major economic factor which affected the production of banana.

According to Krishna (2017) there is a direct relationship between farm holding size and gross return from banana production. He conducted a study in Kurnool district of AP and total respondents were classified into three category based on the landholding size marginal (<1 ha), small (1-2 ha) and others (>2 ha). The total cost of cultivation was marginal, small and others were respectively ₹ 3,27,531 , ₹ 3,13,337 and ₹ 2,47,989. The gross returns of marginal, small and others were ₹ 4,47,592, ₹ 4,78,306 and ₹ 4,91,516 respectively. Other's group had higher (1.98) BC ratio compared to marginal (1.37) and small (1.53) farm.

Patel (2017) conducted a study on production and marketing of banana in Bemetara district of Chhattisgarh and worked out the overall cost of cultivation of banana as ₹ 2,30,536 ha^{-1}. The total cost varied from ₹ 2,11,410/ha for small farmers to ₹ 2,34,821.4 ha^{-1} for large farmers. The overall marketable surplus was 698.54 quintals per farm. 82.14 per cent farmers were feeling high cost of planting material as a constraint in the production of banana.

2.2 RISKS IN AGRICULTURE

Risk is an inherent factor of the farm business. The uncertainties like weather, yield, price, government policies, global market and some other factors affect farming and cause a wide swing in the farm income. Risk management is an alternative solution, which reduces the financial effects (USDA, 2016).

2.2.1. Production risk

Production risk is the possibility of lower output or yield levels than predicted or projected. Major reason for production risk is adverse weather condition like freeze, excess rainfall, drought, and storm. Pest, disease and technological failures can also be the reason of production risk.

Bardsley and Harris (1987) conducted a study for estimating risk aversion parameter and attitude to risk. They compared the farmers financing decision with

production decision and found that partial coefficient aversion increased with income and decreased with wealth.

Basuaraju *et al.* (2009) conducted a study on yield reduction in potato in two different regions of Karnataka and reported that aphids, *Spodoptura litura and* mites caused an yield reduction of 6 per cent, 9 per cent and 26.80 per cent in the Madanoor region and 4 per cent, 6 per cent, 4 per cent in Buckhanahally respectively.

A study by Kiran (2010) on impact of crop insurance on resource use efficiency in potato production in Hassan district of Karnataka, reported that the insured farmers used resource more efficiently than non-insured farmers. They used 6.25 and 20.89 per cent more of seeds and FYM respectively than non-insured farmer, which resulted in 9.08 percent more yield to insured farmers.

Singh (2010) revealed that production and income of the individual farms will be adversely affected when there is deviation in the weather variable from the normal condition. This fluctuation in income due to changes in the yield is production risk and due to changes in price is marketing risk.

An analysis by Van Asten *et al.* (2011) to quantify the effect of drought stress on banana production in central and southwest Uganda, reported that 100 mm decline in rainfall caused a maximum bunch loss of 1.5- 3.1 kg or 8-10 per cent and the severity ranged from 20- 65 per cent.

"Weather Based Crop Insurance Scheme (WBCIS) offers substantial opportunities to understand how to increase demand, particularly from the most vulnerable farmers. A rigorous monitoring and evaluation could be integrated into these programs to ensure that at the end of the pilot period government and states

have the information they need to make decisions about the future of agricultural insurance in India." (Clarke, 2012)

Rajasivarangan, (2015) found that severe drought in Hariyana caused deterious reduction in rice productivity in the districts of Jhajjar (51 per cent), Rewari (27 per cent), Rohkk (26 per cent) and Gurgon (22 per cent).

Production risk is the possibility that yield or output levels will be lower than the expected or projected. Adverse weather conditions such as drought, freezes or excessive rainfall at harvest or planting will leads to production risk. It may be also due to insect pest or disease damage and from failure of technology adoption. (Sciabarrasi, 2018)

2.2.2. Market risk/ Price Risk

Market risk is the condition when price of product will go down than expected level due to the increased number of competitors in that field or product fails to maintain the standard in the market.

Wanjari (2004) stated that marketing efficiency was very low (0.35 per cent) in Jargon local market due to high margin (63.1 per cent) of retailers. However, the efficiency was found to be 0.41 per cent when marketed through cooperative society. The total loss was estimated to be 11.73 per cent of banana when it reaches retailer from farmer.

Sarode (2009) conducted a study on economics of banana marketing in Jalgaon district and revealed that producer's share in consumer rupee was very less (46.41 per cent) while the share of intermediaries like wholesaler (7.46 per cent) and retailers (11.35 per cent) were considerably high. We can increase the consumer share in producer rupees by reducing the middle man between the producer and consumer.

The major constraints faced by the farmers in Raipur district of Chhattisgarh were non availability of regulated market and cooperative society for marketing produce which forced the farmer to sell the product to private intermediaries who exploited the poor farmers. More than 60 per cent of farmers lack the awareness of market information which was a major threat for farming community. Labour shortage in planting and harvesting will increase the wage rate of hired labour and affect the net return of the farmer producer (Dhurandher, 2010).

Producers were not able to get 40 per cent of consumer rupee due to the intervention of market intermediaries. Producer farmer can do direct sale to avoid such intermediaries, already such markets are functioning in Tamil Nadu (Uzhavar Sandai) and other parts of country, which encourages farmers to produce more. (Moorthy, 2013).

2.2.3. Credit risk/ financial risk

It is a condition where farmer does not have sufficient money or liquid assets to meet the obligations, generating lower income than expected one. Financial risk can be influenced by several factors like higher interest rate, excess borrowing and increased family demands. Low income of agriculturist leads to low investment, low productivity and low savings and keep such people in poverty. It will be a limiting factor to increased savings and investments.

Mohanthy and Kesarwani (2012) stated that yield uncertainty prevents farmers from maximizing production and credit institution from advancing loans for agricultural production purpose. The risk bearing capacity of majority of farmers was limited due to scare resources and smallholdings. A serious crop failure not only leads to the loss of the farm income but also loss of investment for next crop season.

Mattthew and Uchechukkavu (2014) found that 53.3 per cent of people didn't have access to credit and they borrowing credit from friends and relatives for the agricultural purpose. The possible way to improving credit access was making the interest rate low and affordable.

2.3 RISK MITIGATION MEASURES IN AGRICULTURE

Jodha and Walker (1986) observed that farmers were practicing own measures to reduce risk due to drought and scarcity in semi- arid tropical India which were costly and relatively ineffective. He also found that official credit institutions are ill equipped to reduce the exposure of Indian farmers to risks because consumption loans were not given to drought-affected farmers.

Private crop insurance has tended to cover more specific risks and not cover management-related risks. These insurance policies offered must fit the needs of farmers and be beneficial--otherwise they would not exist. Private insurance works in a wide range of countries for a wide range of agricultural activities (Gudger, 1991).

Mishra (1994) observed that insured people invested more on agricultural inputs leading to higher output and income from agriculture than non-insured farmers in Tamil Nadu. Small farms had more increase in investment and income and increase in income to the insured farmer was computed as 29 per cent.

Besley (1995) stated that many non-market institutions were functioning effectively for risk reduction where formal institution fails, because they have greater ability to monitor each one other than do formal institution.

Gommes (1998) stated that diversification is one of the most basic risk management approaches used at the subsistence level as well. Structural measures like irrigation, water harvesting, wind breaks, frost protection, artificial and controlled climates (green house), microclimate manipulation were needed high cost to reduce the risk for which government participation is required.

Harwood *et al.*, (1999) conducted a study and found that farmers were more concerned about price risk and yield risk. They were practicing a combination of crop insurance and forward pricing of a close substitute for revenue insurance in risk reduction.

Jonathan and Rajendran (2000) reported that application of carbofuran at 4 Kg active ingredient ha^{-1} avoided an yield loss of 30 per cent caused by *Melodogyne incognita* in banana cultivar Poovan.

Coble and Knight (2002) stated that agricultural production is facing uncertainty due to events like drought, insect, disease, frost and rain. The farmers need some risk management tool to protect farmer from the production risk. Insurance stands the most appropriate risk mitigating tool for agricultural yield risk.

Hanson (2004) conducted a study on risk and risk management in organic farming and observed that they managed risk by diversifying their marketing plans. Organic vegetable and fruit farmers marketed their crops through more than one channel for reducing the risk factor, like community supported agriculture (CSA) arrangements, farmer's markets, small-scale markets and wholesale markets. Some farmer added value with a food processing enterprise. The crop diversity involved in meeting organic rotation requirements also provided marketing advantages.

Jerry *et al.* (2006) stated that farmers were trying to address the risk by risk mitigation, risk transfer and management of retained risk. They were practicing integrated pest management, irrigation, risk-reducing technologies to mitigate the risk in production. In developed countries risk transfer mechanism was taking place through future marketing contracts.

Jennifer (2008) stated that income from crop production can be low even when yields are not, revenue protection guarantees a certain level of revenue rather than just production. It protects farmers from declines in both crop prices and yields. The guarantee is based on market prices and the farm's actual yield.

Chuku and Okoye (2009) stated that technological development is one of the most effective and sustainable ways of mitigating risk in agriculture. Developed technologies helped to reduce the vulnerability to shock in agricultural farms by forecasting the weather, climate and market condition related with agricultural production.

Aimin (2010) found that farmers were trying to manage risk factor by increasing intercropping of farm products and reducing the production of agricultural commodities for which price fluctuate greatly and also by adopting new technology.

Kumar *et al.* (2010) reported the need for large-scale promotion of stabilization measures like crop insurance to face the consequences of yield and production variability. Though crop insurance is likely to be largely demand driven in future, the efforts of the government to support and finance insurance products and/or facilitate congenial environment as meaningful risk management tool would further enhance the potential and credibility of crop insurance.

Kumar *et al.* (2011) conducted a study on farmer's perception and awareness towards crop insurance in entire state of Tamil Nadu, and reported that drought caused a yield reduction ranging from 27 per cent (rice) to 50 per cent (banana). Two third of the respondents, were aware about risk mitigation measures but only half of the people were aware about the crop insurance scheme. It was also observed that 38 per cent of farmers were practising their own measures to mitigate the risk like crop diversification and better marketing.

Theuvsen (2013) conducted a survey on risk management and reported that farmers ranked external market and political risks as the highest and they reacted to these risks by applying various risk management strategies. The latter often comprised of a mix of management (such as diversification, liquidity management) and agronomic instruments (for instance, choice of robust varieties, irrigation).

Aidoo *et al.* (2014) suggested that periodic training and education of farmer improve their knowledge about crop insurance as a risk mitigating tool and helps the farmers in order to enhance the uptake of crop insurance. Educational level, age of the farmer, land tenure system practiced were found to be key factors of crop insurance uptake.

Risk management should focus on making the available systems more efficient rather than creating new institutions. They should build on existing information and institutional arrangements, and enforcing access to information. The risk management system has to be understood as a long-term investment in a clear arrangement that defines the responsibilities of farmers, government and markets, and allows the evolution and development of appropriate solutions in different risk layers (Barros, 2014).

Varalakshmi (2014) studied the impact of weather based crop insurance scheme among chilli farmers in Guntur district of Andhra Pradesh and found that net returns obtained by the insured farmers (₹.202978.9 ha^{-1}) were higher than uninsured farmers (₹.178951.67 ha^{-1}). The total output of chilli under the insured farmers was 68.42 q ha^{-1} while it was 62.97q per ha for uninsured farmers. This shows an optimized use of inputs by the insured farmers than uninsured farmers.

Krishnan (2015) found that VFPCK was helping farmers by designing an effective programme to achieve income stability and efficiency by facilitating movements of products from farmers to market. Under VFPCK, 254 markets were established which are farmers oriented. It will allow farmers to receive a large share of profit and to reduce risk in marketing of perishable commodities.

Ullah *et al.*, (2016) stated that agribusiness risk includes production risk, market risk, institutional risk and personal risk. The adoption of risk management structure is influenced by farmer's risk perceptions, their attitude towards risk, farm and farm household characteristics and farm access to publically provided services including agricultural credit and information.

Hamada (2017) explained that risk is an unavoidable part of a farm business. The promising crop or plant can suddenly fall due to variation to weather, insects and disease. People were adopting to new technologies, high yielding crop varieties and breeds to overcome such risks. Smart agriculture is also practiced to cope up with risk factor.

1.4 Constraints in the adoption of risk mitigation

Hazell (1992) reported that many of the risks insured under public insurance programme are essentially uninsurable risks. Moreover, they occur frequently and hence are expensive to insure. The financial performance of most of the public crop insurance has been ruinous in both developed and developing countries. The multi-peril crop insurance thus is very expensive and has to be heavily subsidized

A study by Horowitz and Lichtenberg (1993) found that in the US Midwest, crop insurance exerted considerable influence on maize farmer's decision on chemical use. Those purchasing insurance applied significantly more nitrogen $acre^{-1}$ (19 per cent), spend more on pesticides (21 per cent), and treated more acreage with both herbicides and insecticides (7 per cent and 63 per cent) than those who do not adopt insurance. These results suggest that both fertilizer and pesticides may be risk-increasing inputs.

According to Skees *et al.* (1999) the link between risk and credit market is important. If risks are not mitigated, then credit will be more expensive and may not be readily available. Credit is one key to development, and producers generally borrow to invest in new technology

Manojkumar *et al.* (2003) found that farmers faced difficulty to pay premium amount during the pre- gestation period of cultivation and suggested that linking of a credit facility with crop insurance programme will be inevitable for its success.

Raju and Chand (2008) stated that farmers didn't have in-depth awareness about crop insurance scheme. The insurance coverage of non-loanee farmers was only less than 18 per cent in Andhra Pradesh when compared to loanee farmers which was more than 70 per cent. More than 60 per cent of insured farmers felt that the existing premium rate was high while 32 per cent felt it was reasonable. The financial viability of National Agricultural Insurance Scheme (NAIS) was very poor in entire West Godavari district but it is considerably good in Guntur district of Andhra Pradesh.

Nandwani (2010) pointed out several factors such as pest and diseases, weeds, soil fertility, lack of availability of planting material, limited genetic diversity, natural disaster, annual charge of sea water intrusion in to the basal water layers are the major yield reduction factors in banana cultivation.

The spatial variations in weather parameters are high in a country like India and basic risk can only be minimized if climate structures for these products are worked out a smaller unit. Weather data is often recorded at taluka level, which may result in the actual impact of adverse weather conditions at the farm location being significantly different from recorded by the RWS (Nair, 2010).

According to Mathiyalagan (2012) production problem was a major constrain faced by the banana farmers in Kanyakumari district of Tamil Nadu followed by loan interest and repayment, irrigation problem and transportation problem. He accounted point score for each constraints and computed the coefficients for each problem which was 4.38 for production, 4.13 for loan interest, 4.05 for irrigation and 3.91 for transportation

Kasyoka (2013) conducted a study on banana production, constraints and propagation methods and stated that sufficient and surplus fresh fruit availability throughout the year in the market keeps banana price low.

Fusarium wilt and sigatoka leaf spot disease were found to be major diseases to limit production of 'Gros Michel', the export cultivar in America. Virus disease and mosaic disease caused less damage but more widespread (Jones, 2013).

Kamal *et al*, (2014) reported a number of problems of banana growers by his study on socio-economic status and problems of banana growers in Bangladesh. Among them problems of credit, non-availability or insufficiency of credit, high interest rate and loan transaction cost, low prices of output, high prices of inputs, lack of sucker/seed of banana, high prices of fertilizer and insecticides, lack of storage facilities were the major problem faced by the farmers in the study areas.

According Naveen (2013) markets were far away from villages was the major constraint in the production of banana with highest mean score 72.33 followed by fluctuation in the market price with score of 72.30. In the case of production inadequate facilities of irrigation was found to be the major constraint in banana cultivation with highest garret score 76.73.

Hossain (2014) found that large reduction in the cultivated area caused drastic production change from 10, 04,520 tonnes to 8, 00,840 tonnes with in the period of 2006 to 2011 in Bangladesh. Pest-disease-insects also acting as biological constraints in yield loss of banana in Bangladesh.

Shivaram (2014) conducted a study on banana production technology and found that several constrains like lack of proper knowledge about value addition (84.16 per cent), heavy loss during the post-harvest handling (83.33 per cent), lack of assured market (80 per cent) damage of crop due to heavy wind (75 per cent), no benefit from fruit crop loan (20.83 per cent) and fruit crop insurance scheme (15.83 per cent).

High temperature and non-availability of electricity, lack of improved varieties for cultivation were the major constraints in banana production in Raipur

district of Chhattisgarh. In supply chain management lack of processing industry, storage facilities, fluctuation of price are reported as major obstacles (Chandrakar *et al.,* 2015).

Gunasekaran (2016) pointed out that the major problem faced by the banana farmers in production were heavy damage by wind and pest attack in Karur district. They also faced some marketing problems due to indebtedness of the traders and fluctuations in the market price.

According to Kumar (2016) higher amount of human labour input cost due to lack of management and high rate of human labour per day was the major constraints related to human labour. Price fluctuation, lack of storage facilities, lack of processing facilities also acted as constraints in the supply chain of banana.

Mahalakshmi *et al.,* (2016) found that natural factors affecting banana crop production included water storage, soil fertility, insects, weeds and crop variety. Among economic factors, 88 per cent of the loss was due to price fluctuations.

Materials and methods

3.MATERIALS AND METHODS

In the previous chapter review of literature of studies related to the research topic was done in order to identify appropriate methods and tools for data analysis to bring out meaningful conclusions. Data collection methods and different statistical tools used for analysis of data are discussed in this chapter under following headings.

3.1 Description of the study area

3.2 Selection of sample

3.3 Method of data collection

3.4 Variables and their measurement

3.5 Tools for analysis

3.1 DESCRIPTION OF THE STUDY AREA

A brief description of study area is essential to understand the research background and importance of study. Description of study area includes different aspects like topography, climate and rainfall, soil types, land utilization pattern, land holding pattern, agriculture and major crops grown, demography, occupation and administration. It will definitely help in understanding the physical and economic environment of selected region which have a policy implication.

3.1.1 Location

Kerala

The Southern most state in India spreads over 38863 km^2 bordered by Karnataka to North and North East, Tamil Nadu to South East, embraced by the coast of Arabian Sea in the West and is bounded by the Western Ghats in the East. God's

own country comprises of 1.18 per cent area of unique flora and fauna of India and lies between East longitudes 74° 52' and 72° 22' and North latitudes 8° 18' and 12° 48'. Kerala is blessed with tranquil stretch of emerald backwaters, lush hill stations and exotic wild life. The state's history is closely related with spice trade, renowned as spice coast of India. Major spices like black pepper, cardamom, turmeric, ginger, nutmeg, all spice, cumin, coriander etc. are extensively cultivated in Kerala. Among the spices, black pepper accommodates maximum area and contributing a lion's share to the economy of Kerala (History of Modern Kerala, 1987).

3.1.2 Thiruvananthapuram – topography

It lies between 8° 17′ and 8° 54′ of North latitude and 76° 41′ and 77° 17′ of East longitude. It is the southernmost district of coastal state of Kerala and southern most extremity, Kaliyikkavila is only 56 Km away from Kanyakumari. It came into existence in the year 1956. Thiruvananthapuram is the capital city and the largest metropolitan city of Kerala, consists of 6 tehsils. The district has an area of 2192 square kilometers with 3 major rivers Neyyar, Vamanapuram River and Karamanayar and also have several fresh water lakes and more than 300 ponds. The Neyyar irrigation project started in 1959 for irrigating an area of 116.65 Km, Neyyar reservoir is the major source for irrigation project. Mahatma Gandhi referred this city as "Evergreen city of India". The city is ranked among best cities to live in India. (GOK, 2015)

3.1.3 Climate and Rainfall

Generally, Thiruvananthapuram district has a hot tropical climate. The large forest area reserve affects the climate which favorably induces rains. The total annual average rainfall in the district is about 1827.7 mm (72 in) per annum. The South West monsoon (Edavappathy), from June to September is the principal rainy season.

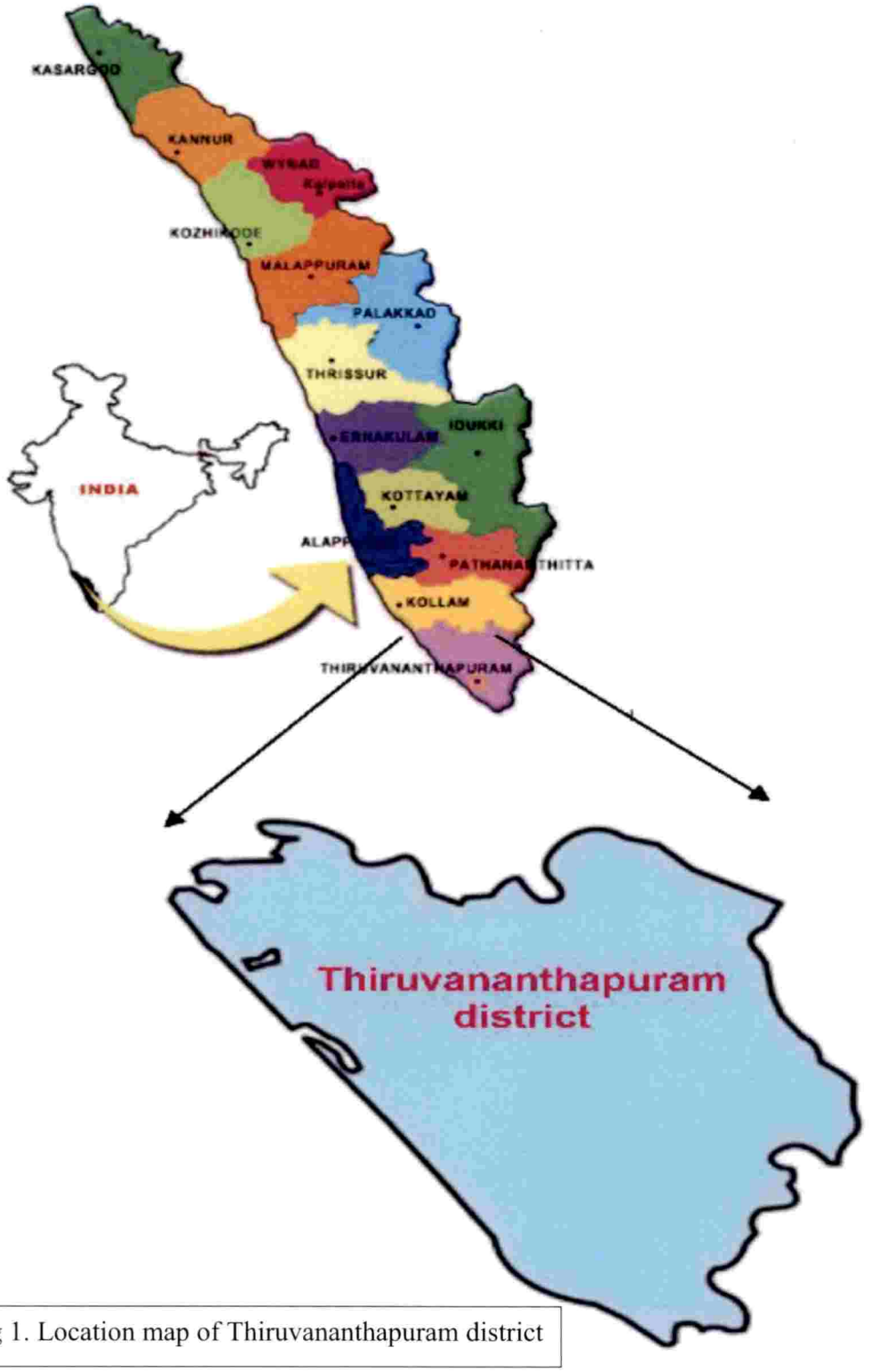

Fig 1. Location map of Thiruvananthapuram district

Thiruvananthapuram is the first district along the path of S-W monsoons and its first shower will be on early days of June. The district receives most of its annual rainfall from South West monsoon. The second rainy season is North East monsoon. The receding N-E monsoon hit the district during the October (Thulavarsham). The summer season starts in February and continues until May. The average temperature goes up to 95° F (35° C) in the summer months. The humidity will reach up to 90 per cent during the monsoon season (IMD, 2014).

3.1.4 Soil types

The district has 3 types of soils which constitute brown laterite (middle part of district), sandy loam (western coastal region) and dark brown loamy soil (eastern hilly region).

3.1.5 Land utilization pattern

Total geographical area of the district is 218.9 ha which comprises of 23 per cent (49.8 ha) forest area, 128.2 ha (58.6 per cent) area under cultivation (net sown area), 31.8 ha (14 .5 per cent) land put under the nonagricultural use and 4 per cent as cultivable waste land (GOK, 2015).

3.1.6 Agriculture

The net sown area in the district was 1, 28, 290 hectares. Out of this 34,458 hectares area was sown more than once in the year. Gross cropped area is 162748 hectares with a cropping intensity is 126.7 per cent.

3.1.7 Major crops

Agriculture of Kerala is characterized by diversity of crops. The major crops in the state can classified in to three – food grains (rice, jower, ragi and pulses), plantation crops (rubber, tea, coffee, cardamom) and garden crops (coconut, cashew, Arecanut, pepper, tapioca, banana, tobacco, sugar cane, ginger). Homestead farming is predominant in Kerala. Tapioca, banana, rice, pepper and vegetable crops are cultivated in most of the area. Principal crop cultivated in the district is coconut (71700 ha) followed by rubber (30000 ha), tapioca (20300 ha), banana (8300 ha), pepper (5500 ha), jack (5400 ha), mango (3600 ha), papaya (1300 ha) and other vegetable crops (GOK-Kerala Agri View, 2015).

3.1.8 Demography

Thiruvananthapuram district has a population of roughly 3,307,284 according to 2011 census. The district has the population density of 1509 inhabitants per square kilometer. The population growth rate over the past decade was 2.25 per cent and with a literacy rate of 92.66 per cent and sex ratio of 1088 women for every 1000 men (GOK, 2015).

3.1.9 Occupation

Presently most of the people are working in service sector either public or private followed by agricultural workers and house hold industries. From the last decade, there is a shortage of agricultural labourers due to switching over to non-agricultural labour and service sector. Among the total population 1,81,383 are non-workers. Thiruvananthapuram district contributes 10.31 per cent to state GDP (GOK-Kerala Economic Review, 2018).

3.1.10 Administration

The headquarters of Thiruvananthapuram district is situated at kudappanakunnu. The district administration is headed by district collector. There are six taluks: Neyyattinkara, Thiruvananthapuram, Chirayinkeezhu, Nedumangadu, Varkkala and Kattakkada each headed by a Tahsildar. There are two parliamentary constituencies Attingal and Thiruvananthapuram.

3.2 SELECTION OF SAMPLE

The study was conducted in Thiruvananthapuram district which has the maximum area under cultivation of banana in southern Kerala. From the six taluks, Neyyatinkara taluk was selected which have maximum area under banana cultivation (GOK, 2015). From the taluk, four panchayats namely Parassala, Karode, Kulathoor and Chenkal were selected randomly. From the respective Krishi Bhavans, list of banana growers was collected and 20 farmers were randomly chosen from each panchayat. Thus the sample size was 80 (20 persons from each panchayat).

3.2.1 Neyyatinkara

Neyyatinkara is the southernmost municipal town of the Thiruvananthapuram district and the taluk spread over an area of 16.21^2 km on the river banks of Neyyar River. The Taluk located on 8° 24' North and 77° 05' East and 20 km way from town. It comprises one municipal town and 21 small villages. During the period of Marthanda Varma, the land was known as 'Thenganad'. The average annual precipitation was recorded as 1700 mm and annual temperature is 27.2° C. The area is located in between the Western Ghats and Arabian sea. According to 2011 census the population of taluk was 70,850. Taluk is famous for many cottage industries and handlooms; Balaramapuram Handloom industry is worldwide famous for its fine hosiery.

Figure 2. Political Map of Thiruvananthapuram district

Figure 3. Political Map of Neyyatinkara Taluk

3.2.1.1 Parassala

Parassala is the southern end of Kerala, bordering Tamil Nadu situated at 8 °44′ North and 77° 02′ East. Parassala has heavy rains during June – August due to the south west monsoon. Winter starts from December continues up to February. Annual average rainfall is 3100 mm and average maximum temperature is 32° C. The literacy per cent of panchayat is 82 per cent.

3.2.1.2 Kulathoor

Kulathoor is the one of panchayat in Neyyatinkara tehsil where agriculture is the major occupation. Total cropped area in the panchayat was 863 ha. Coconut, tuber, banana and vegetable are the major crops. Most of the soil was laterite soil with average pH was 4.5. Total population of the area is 32,978 according to 2011 census. Total area of village is 11.24 km^2.

3.2.1.3 Karode

Karode panchayat is comprised of three villages Pozhiyoor, Plamootukada and Karode, coconut is a major cultivated crop in the area followed by tuber and banana. Most of the farmers were doing leased in land farming in this area. Population of the panchayat is 31,506.

3.2.1.4 Chenkal

Chenkal is situated 9 Km way from Neyyatinkara town. One of the leading banana producing panchayat in Neyyatinkara tehsil. During the last decade, most of reclaimed fallow lands were converted for banana cultivation. Before the land reforms

act in 1950, the major part of the village was under the estate of the jenmi of Kadamath. The average population is 35,999.

3.3 METHODS OF DATA COLLECTION

3.3.1 Sampling Framework

Economics and risk mitigation measures of Nendran banana study was conducted in Neyyatinkara taluk in Thiruvananthapuram district. According to the agricultural statistics 2014-2015, Neyyatinkara taluk has maximum area under banana cultivation. From the 21 panchayats, four panchayats were selected randomly.

3.3.2 Sampling Design

Random sampling design was adopted to select the banana growers from each panchayat. Lists of banana cultivators were collected from Krishibhavan in four panchayats, from which 20 farmers were selected at random from each panchayat. Total sample size was 80.

3.3.3 Sampling frame: Flow chart showing sample selection Sampling Frame

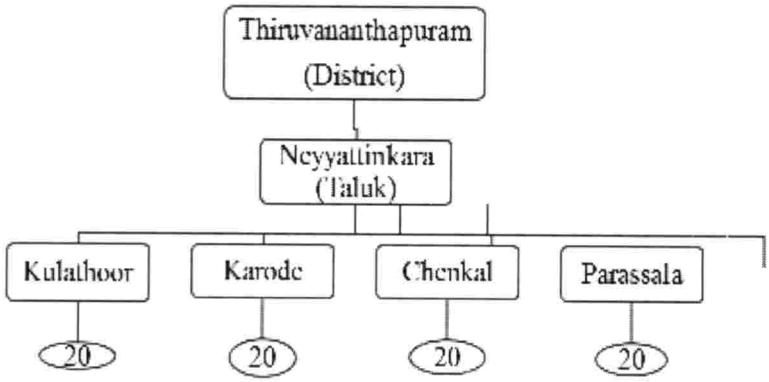

Figure 4. Diagrammatic representation of sampling frame.

3.4 VARIABLES AND THEIR MEASUREMENT

Data on various operations and practices in the cultivation of Nendran banana was collected from farmers through personal interview using pre-tested and structured interview schedule. All details on yield, costs and returns from the crop, different risk factors, mitigation measures and constraints faced by the farmers were collected. The survey was conducted during March 2018 to April 2018.

3.4.1 Socioeconomic status of the selected farmers

Socio-economic characteristics such as age, educational status, gender, family size, land holding, standard of living, annual income, annual expenditure, experience in banana farming etc. of the respondents were collected. According to each socio economic feature, the farmers were categorized into different groups for finding the socio economic status of the sample.

3.4.2 Quantity of inputs

Quantity of inputs like sucker, farm yard manure, poultry manure, fertilizers, insecticides, pesticides, fungicides, liming material, propping material etc. were collected and the cost of cultivation and annual returns from the crop was computed.

3.4.3 Cost of inputs

3.4.3.1. Cost of Manures, Fertilizers and plant protection chemicals

Farm produced manure was evaluated as per the prevailing market rates in the study area and fertilizers, liming material and non-farm produced manures were evaluated at their purchase price. Purchased price of pesticides, insecticides and fungicides were used to worked out cost of inputs.

3.4.3.2. Cost of labour

i. Family labour

The cost of family labour was imputed based on the prevailing wage rates paid to hired labour in the area according to number of man hours used.

ii. Hired labour

The wages paid to labourers engaged in crop production was considered as cost of hired human labour. The prevailing wage rate in the area was Rs. 750 for men and women labourers in banana cultivation. Male labourers are preferred for banana cultivation because of the need of physical strength to do cultivation practices.

iii. Machine labour

Hired machine labour cost was calculated on the basis of the prevailing rent for machine on hour basis, which is 650/hr.

3.4.3.3. Land Revenue

This was taken as the actual rate paid to the revenue department which was calculated as ₹ 150 – 200 ha^{-1} Yr^{-1}.

3.4.3.4. Interest on Working Capital

It is a common practice among farmers to avail short term loans to pay for supplies, labour, and purchased inputs. To account for this, interest on operating capital was included as an item in the cost of cultivation. The paid out cost constitutes the working capital. Interest on working capital was worked out for the crop period at the

rate of 7 per cent per annum, since it is the rate at which farmers take crop loans from financial institutions.

3.4.3.5. Interest on Fixed Capital

The present value of assets and equipment form the fixed capital. Interest on this can be calculated in the same way as in the case of interest on working capital. Interest on fixed investments (excluding land) was estimated at rate of 11 per cent per annum, it being the lending rate of commercial banks for long term loans.

3.4.3.6. Rental Value of Leased in Land

It is evaluated on the basis of rent paid on leased in land. Since the selected crop is standing throughout the year, the rental value of leased in land was computed as the rent paid once in a year.

3.4.3.7. *Rental Value of Owned Land*

Rental value of owned land was computed by taking the rent of land prevaling in the study area.

3.4.3.8. Depreciation

This was worked out to account the wear and tear of the implements and machinery used in banana cultivation. The annual rate of depreciation was worked out on each item using straight line method and then aggregated to get the total annual depreciation allowance.

$$\text{Depreciation} = \frac{\text{Purchased value} - \text{Present value}}{\text{Expected Value}}$$

3.4.3.9. Insurance premium

This was the amount paid to the insurance authority to insure the crop. In Kerala state crop insurance, the premium was Rs. 3 per plant and VFPCK charging Rs. 3 per plant.

3.4.3.10. Miscellaneous Expenses

The cost involved in replacing damaged, pest infested and disease infected suckers and charge for transportation were included as all miscellaneous charges.

3.4.4 Indemnity obtained

This is the amount obtained as compensation for the yield loss or production loss due to natural calamities, vulnerable weather condition or pest and disease outbreak in the case of insured crop of the farmers. Under state crop insurance non bunched banana will get ₹ 150 and bunched banana will get ₹ 300 as a compensation for Nendran, in VFPCK Rs. 50 and Rs. 85 will be given as compensation respectively for non-bunched and bunched.

3.4.5 Quantity of output

Quantity of Nendran banana purchased is given in kg / ha.

3.5 TOOLS FOR ANALYSIS

Analytical tools employed for the primary data analysis are given below

3.5.1 Percentages and Averages

Socio - economic characteristics of the farmers such as age, educational status, gender, family size, land holding, annual income was analyzed by the use of percentages and averages.

3.5.2 Cost of Cultivation

Cost of cultivation of Nendran banana was worked out as the sum total of cost incurred on various inputs that were used in the production. In this study ABC cost concept was used to work out the cost of cultivation and returns.

A B C Cost Concept

ABC cost concept (CSO, 2008) was used for working out cost of cultivation of Nendran banana.

The **Cost A_1** includes

a) Cost of sucker plant
b) Cost of hired labour
c) Cost of manures, fertilizers and soil ameliorants
d) Cost of plant protection chemicals
e) Cost of propping material and irrigation
f) Land revenue
g) Depreciation
h) Interest on working capital
i) Miscellaneous cost & insurance premium

Cost A_2

Cost A_1 + rent paid for leased-in land.

Cost B

Cost A_2 + rental value of owned land & interest on owned fixed capital excluding land.

Cost C

Cost B + imputed value of family labour.

3.5.3. Returns

3.5.3.1. Gross returns

Gross returns was worked out as the total value of products at the prevailing market price.

Gross returns = Quantity of product * unit price

3.5.3.2. Net returns

Net returns was derived by deducting the total cost from the gross returns.

Net returns= Gross returns- cost of cultivation

3.5.4 Benefit-Cost Ratio

It was calculated as the ratio of the total benefits to total expenditure incurred for production of Nendran banana.

BC ratio = Gross returns/cost of cultivation

3.5.5 Resource Use Efficiency

Resource use efficiency is used to determine how efficiently the available resources are allocated by farmers. An efficient farmer allocates scarce farm resources in a judicious manner. The main objective of the farmer is to maximize the net returns with minimum production cost.

To describe the relationship between the output and various inputs used in production, Cobb-Douglas production function was used. From the production function, elasticities of production of inputs were worked out as follows

Cobb- Douglas production function in algebraic form

$$Y = a\prod_{i=1}^{5}(X_i^{b_i})e$$

The functional form of production function fitted for the study is

$$Y = a.\ X_1^{b1}\ X_2^{b2}\ X_3^{b3} X_4^{b4} X_5^{b5}\ e$$

This is modified into a log linear model by the application of logarithm

$$\log Y = \log a + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + \log e$$

Where,

Y = Quantity of output (kg / ha)

X_1 = Quantity of manures and fertilizer (kg/ha)

X_2 = Hired labour /ha

X_3 = Family labour /ha

X_4 = Quantity of plant protection materials/ha

a = Intercept

$b_1 \ldots b_5$ = Regression coefficients of explanatory variables.

Cobb-Douglas production function is estimated by using ordinary least square method by assuming that error term (e) is normally and independently distributed. Coefficient of multiple determination (R^2) was tested for its significance by applying F test. The regression coefficients (b_i) were tested for their significance using t- test at chosen level of significance.

3.5.6 Estimation of Marginal Products and Marginal Value Products

In the present study marginal product (MP) and marginal value product (MVP) were calculated by comparing the MVP of each resource with marginal factor cost (MFC).

The marginal products were calculated at the geometric mean levels of variables by using following formula.

$$MPi = bi \frac{\overline{Y}}{\overline{X}}$$

Where

$\overline{Y}$ = geometric mean of quantity of output

$\overline{X_i}$ = geometric mean of i^{th} independent variable.

b_i = the regression coefficient of the i^{th} independent variable.

The marginal value product of each resource was calculated by multiplying the marginal product of the resource by the price of that product.

The formula used for calculating the MVP was;

Marginal value productivity of $X_i = P_Y \times MP_i$

Where

P_Y = Price of Nendran banana (₹ /kg)

The comparison of ratios (MVP/MFC= k) for judging efficiencies are

k> 1 indicating under use or sub optimal use of resources

k = 1 optimum use of resources (allocative efficiency)

k< 1 indicating excess use of resources.

3.5.7 Extent of adoption of fertilizers

There was wide acceptance in the adoption of package of practices in the district of Thiruvananthapuram. The extent of adoption of NPK fertilizers by Nendran banana farmers was measured using the package of practices and recommendation published by Kerala Agricultural university in 2016.

Extent of adoption =

$$\frac{\text{Adopted level}}{\text{Recommended level}} X\ 100$$

(Ganapathy, 1998)

Total extent of adoption of farmers = $\frac{1}{3} X \left[\frac{X_1}{F_1} + \frac{X_2}{F_2} + \frac{X_3}{F_3}\right]$ X 100

(Dhondyal, 1997)

Here

X_1, X_2 and X_3 are adopted level of fertilizer dose

F_1, F_2 and F_3 are the recommended dose of corresponding fertilizer according to the KAU

3.5.8 Constraint analysis - Garret's Ranking Technique

To identify the major constraints faced by the farmers in the adoption of risk mitigation measures, respondents were asked to rank the constraints related to production risk, price risk and credit risk. These ranks were converted into percentage position by the following formula

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

R_{ij} = Rank given for i^{th} factor by j^{th} farmer.

N_j = Number of factors ranked by the j^{th} farmer (Garret, 1969)

Garret's table is used to convert the estimated percentage position to garret score. Thus for each constraint identified, the scores of various respondents were added and the mean value was calculated. Then obtained mean scores for each of the constraint were arranged in descending order and the major constraint would be the attribute with highest mean value.

Results and discussion

4. RESULTS AND DISCUSSION

A scientific study is essential to disclose the facts behind the problem. In the previous chapters, the review of previous works, appropriate methodology and characteristics of the study area were discussed. The data collected for the study has aimed to bring out the economics of banana cultivation, identification of risks and relative advantages of risk mitigation measures and constraints in their adoption. From the study area, 80 farmers growing banana were selected randomly and were divided into two categories, insured farmers and uninsured farmers. The farmers who adopted crop insurance as risk mitigation measure were considered as insured farmers and other farmers were considered as uninsured farmers. The data collected was analysed by different statistical tools and the results are presented in this chapter under following headings.

4.1 Socio economic characters of sample farmers

4.2 Risk and risk mitigation measures

4.3Economics of banana cultivation

4.4 Resource use efficiency

4.5 Constraints in the adoption of risk mitigation measures

4.1 SOCIO ECONOMIC CHARACTERS OF SAMPLE FARMERS

Socio economic status reveals the sociological and economical position of the selected group in the society. From the primary data collected, the socio economic status of the farmers was analyzed. Analysis was based on the characteristics such as age, educational status, family size, gender, occupational status, experience in farming, size of land holdings and average annual net income. The results of the analysis are presented and discussed below.

4.1.1 Age

The respondents were categorized into five groups according to their age, less than 30 years, between 30 - 40 years, between 40 - 50 years, between 50 to 60 years and above 60 years and results are given in Table 2. In the case of uninsured farmer's majority were in the age group of between 40 and 50 years (44.19 per cent) followed by the age group of 50 to 60 (32.56 per cent). In the case uninsured farmers more farmers were concentrated in the age group of 50 to 60 years (35.10 per cent) followed by 40 to50 years (32.50 per cent). Majority of the farmers belonged to the middle age group. Overall only 5 per cent of farmers were in the category of below 30 years. The average age of selected respondents was 48.7 years. A study conducted by Naveen (2013) showed the average age of the banana growers to be 47.91 years, which indicated that most of the banana growers belong to the middle age group.

Table 2. Age wise distribution of selected respondents

Particulars	**Below 30 years**	**30-40 years**	**40-50 years**	**50-60 years**	**Above 60 years**	**Mean age**
Insured (43)	1(2.33)	5(11.62)	19(44.19)	14(32.56)	4(9.30)	48.8
Uninsured (37)	3(8.10)	5(13.50)	12 (32.50)	13(35.10)	4(10.80)	48.7
Total (80)	4 (5)	10 (12.5)	31 (38.75)	27 (33.75)	8 (10)	48.7

Figures in parentheses denote percentage to total

4.1.2 Educational Status

The respondents were classified into 4 groups according to their educational status as shown in Table 3. Illiterate, primary and upper primary, secondary and higher secondary and graduation. Majority of the farmers had educational status of primary and upper primary education in case of both insured and uninsured farmers which was 53.50 per cent and 48.70 per cent respectively. About 32.50 per cent insured farmers have secondary level of education and 4.6 per cent are graduates. 9.40 per cent farmers

were illiterate. Among the uninsured farmers 35.10 per cent have secondary education and 2.70 per cent farmers are graduates. Illiteracy was noticed in the sample and it was more in the case of uninsured category (13.50 per cent) than in the insured category (9.4 per cent). 90 per cent of insured farmers had formal education, in the case of uninsured farmers the per cent was 86.

Table 3. Educational status of selected respondents

Particulars	Insured		Uninsured		Overall	
	Number	per cent	Number	per cent	Number	per cent
Illiterate	4	9.40	5	13.50	9	11.25
Primary and upper primary	23	53.50	18	48.70	41	51.25
Secondary & Higher secondary	14	32.50	13	35.10	27	33.75
Graduation	2	4.60	1	2.70	3	3.75
Total	43	100.00	37	100.00	80	100

4.1.3 Family size

Respondents were categorized into three groups according to their family size as small family (less than 4 members), medium family (4 to 6 members) and large family (more than 6 members) and results are shown in Table 4. Majority of the farmers belonged to medium size family. 60 per cent of insured farmers belonged to medium size family with four to six members. In the case of uninsured farmers 43.3 per cent people came under this category. 37.8 per cent of uninsured farmers and 34.8 per cent of insured farmers belonged to small family with less than four members. Large family size consisted of 18.9 per cent of uninsured farmers and 4.7 per cent of insured farmers.

Table 4. Distribution of respondents according to family size

Size of the family	Insured farmers		Uninsured farmers		Overall	
	Number	per cent	Number	per cent	Number	per cent
Small (<4)	15	34.80	14	37.80	29	36.25
Medium (4-6)	26	60.50	16	43.30	42	52.50
Large (> 6)	2	4.70	7	18.90	9	11.25
Total	43	100	37	100	80	100

4.1.4 Gender

Gender wise distribution of the farmers is presented in Table 5. More than 90 per cent of farmers were males in both insured and uninsured categories, only 9.4 per cent of insured farmer and 2.8 per cent of uninsured famers were females. Out of 5 female respondents, 4 of them were adopting crop insurance.

Table 5. Distribution of respondents according to gender

Gender	Insured farmers		Uninsured farmers		overall	
	Number	per cent	Number	per cent	Number	per cent
Male	39	90.6	36	97.2	75	93.75
Female	4	9.4	1	2.8	5	6.25
Total	43	100	37	100	80	100

4.1.5 Occupational status

The respondents were grouped into two categories, one with agriculture as main occupation and other who considered agriculture as a secondary source of income, which was again sub divided into service sector and own business. Results are

presented in Table 6. Considering the total sample, majority (88.75 per cent) of the farmers had agriculture as main occupation and 88.4 per cent of insured farmers and 89.2 per cent uninsured farmers belonged in this group. Respondents who considered agriculture as subsidiary source of income were doing either their own business or service sector jobs such as lab assistant, agricultural field worker, teacher etc. In insured category 7 per cent was working in the service sector and around 5 per cent was engaged in own business. Only below 3 per cent of uninsured farmers were working in the service sector.

Table 6. Distribution of respondents according to occupational status

Particulars	Agriculture as main		Agriculture as secondary			
			Service		Own business	
	Number	Per cent	Number	Per cent	Number	Per cent
Insured	38	88.40	3	6.90	2	4.70
Uninsured	33	89.20	1	2.70	3	8.10
Total	71	88.75	4	5	5	6.25

4.1.6 Size of land holdings

Farmers were categorised into 4 groups based on their size of land holdings and presented in Table 7. Land holding size was classified as less than 50 cents (0.2 ha), 50 to 100 cents (0.2 to 0.4 ha), 100 to 250 cents (0.4 to1 ha) and more than 1 ha. Fifty four per cent of uninsured farmers and 48.83 per cent of insured farmers had less than 50 cents. The land holding of 27 per cent uninsured farmers and 39 per cent insured farmers ranged from 50 to 100 cents which revealed that more than 80 per cent of farmers had area below 100 cents. Only 5.40 per cent uninsured farmers and 2.30 per cent insured farmer had more than 250 cents of land holdings. Average land

holding of uninsured farmers was 76.08 cents and 71.09 cents for insured farmers. The overall land holding size of farmers was found to be 73.58 cents.

Table 7. Distribution of respondents according to size of land holdings

Size of holding	Insured farmers		Uninsured farmers		Overall	
	Number	Per cent	Number	Per cent	Number	Per cent
Less than 50 cents	21	48.83	20	54.05	41	51.25
50 -100 cents	17	39.53	10	27.03	27	33.75
100 – 250 cents	4	9.30	5	13.52	9	11.25
More than 250 cents	1	2.30	2	5.40	3	3.75
Total	43	100	37	100	80	100
Average (cents)	71.09		76.08		73.58	

4.1.7 Cropping pattern

The cropping pattern was analyzed and cropping intensity was estimated and is presented in Table 8. Mono-cropping as well as mixed cropping was observed among the respondents. It was found that banana occupied the first position in area under cultivation with a total area of cultivation 9.53 ha area in the case of insured and 8.12 ha for uninsured farmers. Crop rotation and crop diversification were the other methods practiced by farmers to cope up with the risk factor and to reduce the level of burden. Second highest position was occupied by cucumber for both insured (2.38 ha) and uninsured (2.46 ha) farmers. In the study area, most of the people were cultivating cucumber as an intercrop at an early stage of banana cultivation, due to sufficient availability of sunlight. Crop period of cucumber was on an average 60-70 days. After the harvest plant residues were used as green manure as well as mulch. Third position was occupied by other banana varieties like Robusta, Poovan, Rasthali in that area. Most of the farmers cultivated tuber crops like Colacasia, Elephant Foot Yam etc. as intercrops, three months after planting. Urd, Groundnut and Bush cow pea cultivation

were also grown in that study area for the purpose of green manuring. Net cropped area was found to be 12.22 ha for insured farmers and 11.26 ha for uninsured farmers. Gross cropped area of insured farmers was 17.59 ha and 16.55 ha for uninsured farmers. The total cropping intensity was found to be 147 per cent and 144 per cent for uninsured and insured farmers respectively. Uninsured farmers have given more stress to crop diversification than insured farmers, they were practicing crop diversification as risk mitigation technique.

Table 8. Cropping pattern and cropping intensity of sample farmers

Sl. No	Crops	Insured (in ha)	Uninsured (in ha)
1	Nendran banana	9.53	8.36
2	other banana varieties	0.65	0.96
3	Cucumber	2.38	2.46
4	Tuber	1.66	0.74
5	Ginger	0.1	0
6	Groundnut	0.26	0.24
7	Urd	0.35	0.38
8	Arrow root	0.88	0
9	Bush cowpea	1.31	1.07
10	Pineapple	0	0.9
11	Mulch crop	0.22	0.484
12	Vegetable	1.03	1.01
13	Total cropped area	17.59	16.55
14	Net cropped area	12.22	11.26
15	Cropping intensity (%)	144	147

4.1.8 Experience in banana farming

Based on experience, the farmers in banana cultivation was classified into four categories, less than five years of experience, between five and ten, between ten and fifteen, more than fifteen years (Table 9). In the case of insured farmers, majority (45 per cent) of farmers had experience in range of ten to fifteen years followed by farmers having experience of more than 15 years (30.23 per cent). The uninsured farmers were found to be less experienced compared to the insured farmers. The majority of the uninsured farmers were in the category of 5 to 10 years (35.14 per cent) followed by the categories of less than 5 years and more than 15 years' experience equally (24.32 per cent). The average farming experience was relatively higher for insured farmers than the uninsured farmers which was 11.64 year and 14.2 years respectively. The overall farming experience of respondents was 13.05 years.

Table 9. Distribution of respondents according to experience in banana farming

Particulars	Insured farmers		Uninsured farmers		Overall	
	Number	per cent	Number	per cent	Number	per cent
Less than 5	4	9.30	9	24.32	13	16.25
5-10	7	16.28	13	35.14	20	25
10-15	19	44.19	9	24.32	28	35
More than 15	13	30.23	6	16.22	19	23.75
Total	43	100	37	100	80	100
Average	14.20		11.64		13.05	

4.1.9 Annual income

Annual income of insured and uninsured farmers were collected and presented in Table 10. Based on annual income farmers were classified into three, below 1.5 lakh, between ₹ 1.5 to 3 lakhs and above ₹ 3 lakhs. Eighty-one per cent of uninsured farmers and 76.7 per cent of insured farmers had annual income of less than ₹ 1.5 lakhs. About

19 per cent of uninsured farmers and 16.2 per cent of insured farmers belonged to the annual income range of ₹ 1.5 to 3 lakh. It is understanding to note that only insured farmers (6.5 per cent) had an annual income more than ₹ 3 lakhs. The annual average income of insured farmer was ₹ 1,39,955 and for uninsured farmers it was ₹ 96,007.80. The overall average annual income was accounted to be ₹ 1, 16,758.60.

Table 10. Distribution of respondents according to average annual income

	Insured		Uninsured		Overall	
Income (Rs)	**Number**	**Per cent**	**Number**	**Per cent**	**Number**	**Per cent**
Below 1.5 lakhs	33	76.7	30	81.1	63	78.75
1.5- 3 lakhs	7	16.2	7	18.9	14	17.5
Above 3 lakhs	3	6.9	0	0	3	3.75
Total	43	100	37	100	80	100
Average	1,39,955.08		96007.80		1,16,758.60	

4.2 RISK AND RISK MITIGATION MEASURES

Farming community faces various kinds of risks in crop production due to natural calamities, price deprivation and government policies. The risk factor prevents farmers from maximizing the production and discourages them from investing more on crop production. Risk in agriculture can't be avoided completely, but it can be prevented or reduced with the help of various measures or adoption of risk management strategies. Some production risk can be reduced by either decreasing the cost of production or transferring the risk factor by the adoption of crop insurance. In this section farmer's perceptions about the risk and risk mitigation measures were analyzed and presented in following tables.

4.2.1 Mitigation measure against production risk

The respondents were classified into two sections as insured and uninsured farmers. Insured farmers were again classified into two sub divisions, people who adopted insurance alone as a risk mitigation tool and second one was practicing crop diversification along with crop insurance. Uninsured farmers were subdivided into two categories, one with under taking crop protection measures and other one is crop diversification. In the insured category 32.5 per cent of respondents confirmed only to crop insurance whereas 67 per cent of people were practicing crop diversification along with crop insurance. Uninsured farmers were giving more importance for adoption of crop protection measures like irrigation, propping, plant protection chemicals and the extent of adoption of crop protection was 64. 8 per cent and only 35.2 per cent were practising crop diversification (Table 11).

Table 11. Distribution of respondent according to mitigation measures against production risk

Particular	Adopted measures	Number	Per cent	
Insured farmers (43)	Crop insurance alone	14	32.5	100
	Insurance +crop diversification	29	67.5	
Uninsured farmers (37)	Crop protection measures	24	64.8	100
	Crop diversification	13	13.2	

4.2.2 Awareness about crop insurance

The analysis on the awareness about crop insurance scheme is given in Table 12. On the whole 83.7 per cent of the respondents were aware about crop insurance scheme. Among the uninsured farmers 64.8 per cent were aware about crop insurance but they were not interested to insure the crop. The remaining 35.2 per cent of uninsured farmers were totally unaware about crop insurance scheme. The uninsured farmers suffered huge loss during okchi, some of the farmers left their land as barren

due to financial burden and some other farmers are cultivating intercrops in banana garden for reducing the level of risk.

Table 12. Distribution of respondents according to awareness about crop insurance

Aware of CI	Insured		Uninsured		Overall	
	Number	Per cent	Number	Per cent	Number	Per cent
Aware	43	100	24	64.8	67	83.75
Not aware	-	0	13	35.2	13	16.25
Total	43	100	37	100	80	100

4.2.3 Reasons for non-adoption of crop insurance

Farmers had different reasons for non-adoption of crop insurance as a risk mitigation tool, which are given in Table 13. It is already mentioned that 35.2 per cent of farmers in the uninsured category lacked the proper knowledge about crop insurance and 24.3 per cent felt that the procedure for crop insurance was difficult due to complicated nature. About 19 per cent weren't adopting because the claim for crop insurance (indemnity) have disappointed them in previous occasions. Sixteen per cent of the farmers was considered the crop insurance as unnecessary expenditure. But the remaining 5.4 per cent farmers felt the premium amount was high.

Table 13. Distribution of respondents according to reasons for non-adoption of crop insurance

Sl .No	Reasons	Number of farmers	Per cent
1	Not aware	13	35.2
2	Not necessary	6	16.2
3	High premium	2	5.4
4	Complicated procedure	9	24.3
5	Indemnity problems	7	18.9
Total		37	100

4.2.4 Source of information about crop insurance

In Thiruvananthapuram district, the banana farmers have insured their crop either with Kerala state crop insurance and or VFPCK. According to the insurance scheme, the farmers were categorised into two groups and the details are given in Table 14. Majority of insured farmers (93.10 per cent) adopted Kerala state crop insurance because it is linked with Krishi Bhavan at village level, farmers can easily access the information from the agricultural officers and field officers. Remaining 6.9 per cent farmers adopted insurance from VFPCK, with the help of local VFPCK outlets, which facilitates marketing of products.

Table 14. Distribution of respondents according to source of crop insurance

Insurance source	Number	Per cent
Kerala State crop insurance	38	93.10
VFPCK insurance	3	6.90
Total	43	100

4.2.5 Farmers' perception about insurance premium

Farmers' perception about premium was categorized into three categories- high, reasonable and low which was presented in Table 15. Forty-four per cent of the insured farmers felt that the premium rate was reasonable, 39.2 per cent of the insured farmers felt that it was very low while 16.2 per cent of the farmers felt that the premium was high. Around 80 per cent of the farmers were ready to pay the current level of premium without any objection.

Table 15. Distribution of respondents according to their perception about premium rate

Sl. No	Perception about premium rate	Number of farmers	Per cent
1	High	7	16.2
2	Reasonable	19	44.2
3	Low	17	39.6
4	Total	43	100

4.2.6 Farmers' perception on the level of convictions

Most of the farmers were benefited from crop insurance in the previous year. The weather calamity Okchi caused a huge loss in the study area in the month of November 2017. Level of conviction of crop insurance was analyzed according to farmers' perception and was presented in Table 16. The results revealed that 34.9 per cent of the insured farmers were highly convinced about the crop insurance scheme and 44.2 per cent respondents said that it was medium and indicated that 80 per cent of farmers had medium to high level of convictions. For 20 per cent farmers the level was low and opined that the insurance claim was not even sufficient to meet the payment of rent on leased in land.

Table 16. Distribution of respondents according to perception of satisfaction level about crop insurance

Sl .No	Particular	Number of farmers	Per cent
1	Low	9	20.9
2	Medium	19	44.2
3	High	15	34.9
4	Total	43	100

4.2.7 Basic information about different crop insurance scheme

4.2.7.1 Kerala State Crop Insurance

The scheme is being implemented by the Department of Agriculture and the Krishi Bhavans at the panchayat level. The insurance coverage available for 25 major cultivable crops in Kerala. The crops covered in this scheme are paddy, coconut, arecanut, banana, rubber, cashew, vegetables, nutmeg, clove, betel vine etc. The premium amount should be paid in the District Cooperative Bank of the concerned area. Premium rate was ₹ 3 per banana plant and in case of calamity, the compensation for bunched banana was ₹ 300 per plant and for unbunched it was ₹ 150 per plant, at the time of survey in April 2017 (Table 17).

4.2.7.2 VFPCK Crop insurance

VFPCK has set up a crop insurance package for protecting the farmers from uncertainties during crop production period, with a tie up with National Insurance Company Ltd. Under this scheme banana, vegetables and tuber crops were included and insurance claim can be obtained on the basis of total loss or damage to banana plants due to natural calamities, damage by wild animals, Kokkan disease and Pseudostem weevil attack. The premium rate was ₹ 5.50 per banana plant, and the share of insured farmer was ₹ 3. The compensation for banana was ₹ 60 per plant for unbunched and ₹ 85 per plant for bunched. In the case of vegetable and tuber crops premium rate was ₹ 6/cent and compensation ranged from 350 to 400 per cent in a season.

Table 17. Premium and compensation of Kerala state crop insurance scheme and VFPCK crop insurance for banana.

Insurance scheme	Premium (₹/plant)	Compensation (₹/plant)		Eligibility for joining the scheme
		Before bunching	After bunching	
Kerala State crop insurance	3	150	300	After 1 month of planting to 5 months
VFPCK crop insurance	5.50	60	85	2 months after planting and above

4.2.7.3 Performance of Kerala State Crop Insurance

4.2.7.3.1. Proportion of farmers indemnified to farmers enrolled

The performance was analyzed in terms of proportion of farmers indemnified to farmers enrolled, and indemnity premium ratio was also calculated.

The year wise details of the number of farmers enrolled and number of farmers who received indemnity from KSCIS during 2012 to 2016 were given in the Table 18. The proportion of farmers indemnified to total farmers enrolled was highest in the year 2011-12 which was 25.04 per cent followed by 2012-13 (12.83 per cent). The average proportion for the period 2012 -16 was 6.12 per cent. The lowest of 3.3 per cent was recorded in 2014-15.

Table 18. Year wise distribution of farmers enrolled and farmers indemnified of Kerala

Sl. No	Year	No. of farmers		Percentage of farmers indemnified to enrolled
		Enrolled	Indemnified	
1	2011-12	53442	13382	25.04
2	2012-13	36260	4653	12.83
3	2013-14	141776	13697	9.67
4	2014-15	131950	4369	3.31
5	2015-16	733485	30995	4.22
Total		1096913	67096	6.12

Source: Directorate of Agriculture, 2017

4.2.7.3.2 Indemnity- premium ratio

The ratio of indemnity paid to premium collected for the period of 2012 to 2016 was given in Table 19. The ratio was the highest (8.41) in the year of 2011 -2012, where only 60.38 lakhs was collected as premium while the indemnity disbursed was ₹ 526.32 lakhs. In 2012-13 the ratio was the lowest (1.67), collected premium was ₹ 50.95 lakhs and indemnified amount was ₹ 184.75. At the overall level it was 4.2. Hence it can be understood that the KSCIS was incurring losses continuously for the last five years.

Table 19. Ratio of indemnity disbursed and premium collected

Sl. No	Year	Premium collected (₹ in lakhs)	Indemnity paid (₹ in lakhs)	Ratio of indemnity to premium
1	2011-12	60.38	526.32	8.71
2	2012-13	50.95	184.75	1.67
3	2013-14	107.28	918.84	8.56
4	2014-15	125.68	305.38	2.43
5	2015-16	598.65	2018.96	3.38
Total		942.94	3954.25	4.20

Source: Directorate of Agriculture, 2017

4.2.7.3.3 Indemnity – premium ratio of the respondents

The indemnity premium ratio of the insured respondents was worked out for the selected panchayat and presented in Table 20. Out of the 43 insured respondents, 83. 72 per cent have received indemnity at least once in the last 3 years due to natural calamity. At the overall level the indemnity premium ratio was worked out to be 17.21. Ratio of indemnity to premium was highest for Karode (27.96) followed by Chenkal (21.88). Chenkal panchayat ranked first in terms of extent of insured farmers (40 per cent) and extent of indemnity (51.6 per cent). while comparing the no of farmers who received the indemnity to number of insured farmers and it was hundred per cent for kulathoor and Karode but it was 64.7 and 92.3 per cent respectively for Chenkal and Parassala which highlight the significance of crop insurance.

Table 20. indemnity premium ratio of respondents

Sl .No	Panchayat	No of insured farmers selected	No of farmers received indemnity during the last three years	No of times indemnity was received	Premium paid by the farmers	Indemnity obtained	Ratio of indemnity to premium
1	Kulathoor	8	8	3	31700	2,79,000	8.80
2	Karode	5	5	1	5750	1,60,800	27.96
3	Chenkal	17	11	2	39540	8,65,500	21.88
4	Parassala	13	12	2	20375	3,71,100	18.21
5	Total	43	36	-	97365	16,76,400	17.21

4.2.7 Marketing methods adopted by the farmers against price risk

Price risk or marketing risk is another important risk faced by the farmers. Price of agricultural products is mainly dependent on market demand and supply. Many factors influence the market price and unexpected change in the market price compels the farmers to go for distress sale. According to the marketing agency to which the farmers sold their produce, respondents were categorized into three groups, VFPCK/ Farmers' market, direct marketing and contract farming as shown in Table 21. For reducing the price risk, majority of the farmers dependent on more than one marketing agency at a time. Twenty per cent of the farmers adopted pre harvest contract marketing to reduce the risk from price fluctuation. The produce was marketed through farmers' markets or VFPCK by 15 per cent of the farmers which helped the farmers to reduce the transportation charge and other marginal costs. Around 18 per cent of farmers sold their produce directly in the whole sale markets. Farmers got more profit and relatively more returns by the adoption of more than one channel. If reasonable price was not obtained from one agency, then they switch over to alternative channel.

Table 21. Distribution of respondents according to the marketing agency

Marketing agency	No. of farmers	Per cent
Farmers market /VFPCK only	12	15.00
Direct marketing only	15	18.75
Contract marketing only	16	20.00
More than one marketing channel	37	46.25
Total	80	100.00

4.2.8 Source of credit for production purpose

Credit risk is a condition faced by the farmers which arises when there is problem in the potential cash flow of the farmer. It is referred to as the interruption of the cash flows and increased cost of cultivation. Banana is a crop of nine-months duration and it needs more investment for cultivation than many annual crops. High rent for leased in land, labour cost and input cost forced the farmers to borrow money from different sources.

The respondent farmers were classified into four categories according to source of credit for production purpose as from bank, private money lenders, own money and borrowed from relatives which is presented in Table 22. More than 42 per cent of the respondents were borrowing credit from different banks. About 22.50 per cent of the farmers have borrowed money from relatives and 8 per cent of the respondents used own money for production, remaining 26.25 per cent of the farmers depended on private money lenders as credit source. While comparing it can be noted that the insured farmers had better access to institutional agencies (48.8 per cent) than uninsured farmers (35.10 per cent) for credit. The second important source was private money lenders for uninsured (32.5 per cent) and borrowing from relatives for uninsured farmers (23.3 per cent).

. Banks provide agricultural loans to farmers for cultivation. More number of farmers prefer the banking institution for mitigating the credit risk because of low interest rate and trustworthy transactions. Agricultural loans are available only to those

who have owned land or some collateral security like gold. Farmers who ever cultivate on leased in land were more prone to credit risk because of lack of collateral security.

Table 22. Distribution of respondents according to source of credit for production

Source	Insured farmers		Uninsured farmers		Overall	
	Number	Per cent	Number	Per cent	Number	Per cent
Bank loan	21	48.80	13	35.10	34	42.50
Private money lenders	9	20.90	12	32.50	21	26.25
Own money	3	7.0	4	10.80	7	8.75
Borrowed from relatives	10	23.30	8	21.60	18	22.50
Total	43	100	37	100	80	100

4.2.9 Reasons for avoiding of formal credit institution

Farmers who do not avail loans from formal credit institutions had several reasons to avoid them. Complicated and time consuming procedures for loan sanction was the major reason (37 per cent). Twenty eight per cent of the farmers felt that bank loan will be a burden for them when crop loss occurs. Around 20 per cent of the respondents had a feeling that interest rate charged was higher than that by local private money lenders and 15 per cent of the farmers had the capacity to arise own funds (Table 23).

Table 23. Distribution of farmers according to reasons for avoiding formal credit institutions.

Sl .No	Reasons	Number	Per cent
1	Interest rate on loans is high	9	19.56
2	Complicated and time consuming procedure	17	36.94
3	Own funds	7	15.20
4	Burden to repay in times of crops loss	13	28.30
Total		46	100

4.2.10 Sources of information for mitigating risk

Farmers need right suggestions and support to mitigate risk in production, marketing and credit transactions. Several formal and informal institutions are giving guidance to farmers to overcome such risks. According to the farmers' opinion, Krishi Bhavan (60 per cent) was the major helping institution to reduce the risk by offering their guidance and support followed by the VFPCK (17.5 per cent). About 14 per cent of farmers considered that banking institutions as a major source of help to mitigate their risk. Remaining 8.75 per cent farmers seek help from the College of Agriculture to mitigate their risk (Table 24).

Table 24. Source of information centers to overcome risk

Sl .No	Institution	Number	Per cent
1	Krishi Bhavan	48	60.0
2	VFPCK	14	17.5
3	Banking institutions	11	13.75
4	COA, Vellayani	7	8.75
5	Total	80	100

4.3 ECONOMICS OF PRODUCTION

The study on cost of cultivation and return are important as they reveal the profitability of the farm business. Economics of Nendran banana was an important tool used to compare the relative performance of insured and uninsured farmers. In this study, cost ABC Concept was used to estimate the cost of cultivation of Nendran banana and tables are given below.

4.3.1 Cost of Cultivation of Nendran Banana

The total cost of cultivation per hectare banana of insured and uninsured farmers was worked out and is presented in the Table 25 and Table 26.

The cost of cultivation (Cost C) of Nendran banana of insured farmers (Table 25) was ₹ 4, 28, 086 ha^{-1}. Cost A_1 was ₹ 2, 58, 582 ha^{-1}, of which cost of inputs such as manures, fertilizers and soil ameliorants accounted for the highest, about 31.49 per cent. It was followed by cost of hired labour (28.95 per cent), and cost for propping and irrigation (15.34 per cent). Cost A_2, includes cost A_1 and rent paid for leased in land. Average rent (₹ 75, 116. 28 ha^{-1}) was too high in this particular area which increased the cost of cultivation. Cost A_2 for insured farmers was ₹ 3, 33, 628 ha^{-1}. Total labour cost per hectare was found to be ₹ 1,18, 078, including both hired and family labour. Family labour contribution was 36.60 per cent of total labour cost. Labour wage was ₹ 750 / day.

Family labour contribution was 36.60 per cent of total labour cost which is higher than the value of Bastine and Radakrishnan (30.50 per cent) calculated in the year of 1988. Premium amount paid by the farmers for insurance per hectare was only 1.38 per cent of cost A_1. Most of the famers (80 per cent) were cultivating the crops in leased land. High input cost indicates more risk which are forced the farmers to adopt crop insurance.

Table 25. Cost of Nendran banana cultivation of insured farmers

Sl. No	Item	Cost (₹/ha)	Percentage
1	Sucker	31,569.76	12.21
2	Cost of manures, fertilizers and soil ameliorants	81,433.13	31.49
3	Cost for plant protection	3589.53	1.38
4	Cost of hired labour	74,857.12	28.95
5	Cost for propping and irrigation	39,662.79	15.34
6	Depreciation	1718.91	0.66
7	Land revenue	252.79	0.09
8	Premium for insurance	5009.31	1.38
9	Miscellaneous cost	3572.09	1.93
10	Interest on working capital	16,916.58	6.54
11	**Cost A1**	2,58,582.05	100
12	Rent of leased land	75,116.28	-
13	**Cost A2**	3,33,698.20	-
14	Rental value of own land and interest on fixed capital	51,167.44	-
15	**Cost B**	3,84,865.80	-
16	Imputed value of family labour	43,220.93	-
17	**Cost C**	4,28,086.70	-

For uninsured farmers (Table 26) cost A_1 was estimated to be ₹ 2,34,058 ha^{-1}, cost of manures, fertilizers and soil ameliorants contributed around 32.01 per cent and hired labour occupied the second highest position (28.69 per cent). Total cost of cultivation per hectare at Cost C was ₹ 3, 99, 796 ha^{-1}. Hired labour cost was lesser and family labour cost was higher than that of insured farmers. Total labour cost was found to be ₹ 1,11,290 ha^{-1} out of which 39 per cent was contributed by family labour.

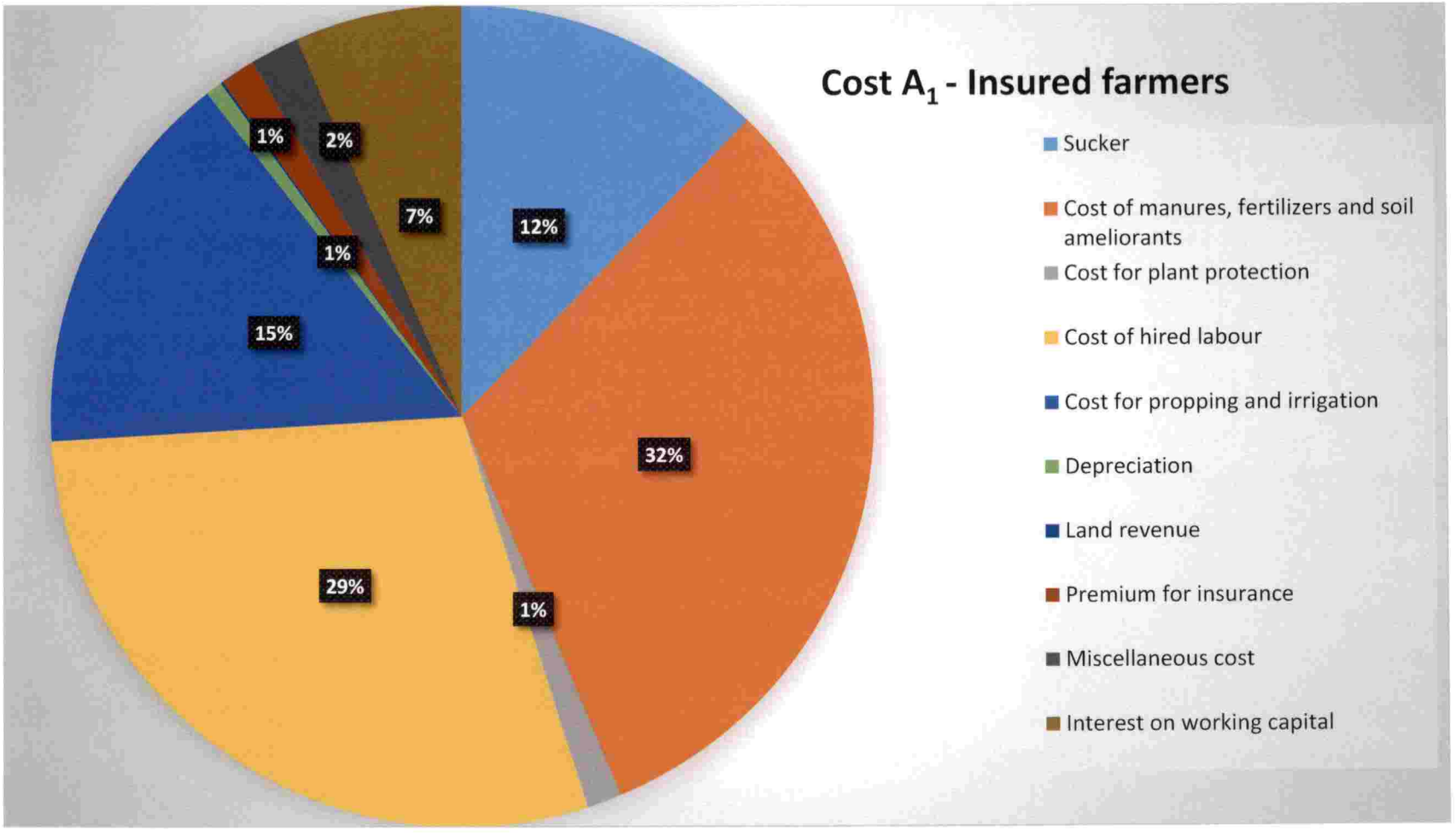

Figure 5 . Cost A_1 of banana cultivation for insured farmers

The cost of manures, fertilizers and soil ameliorants was less than that of insured farmers which indicated that uninsured farmers used less quantity of fertilizers than insured farmers. The average rent paid for leased in land was also lesser for uninsured farmers. Cost A_2 was ₹ 2, 95, 964 ha^{-1}.

Table 26. Cost of Nendran banana cultivation of uninsured farmers

Sl. No	Item	Cost (₹/ha)	Percentage
1	Sucker	28,716.22	12.27
2	Cost of manures, fertilizers and soil ameliorants	74,915.74	32.01
3	Cost of hired labour	67,155.23	28.69
4	Cost for plant protection	3,483.78	1.488
5	Cost for propping and irrigation	39,540.54	16.89
6	Depreciation	1855.96	0.79
7	Land revenue	303.24	0.13
8	Miscellaneous cost	2852.77	1.21
9	Interest on working capital	15,312.25	6.54
10	**Cost A1**	2,34,058.70	100.00
11	Rent of leased in land	61,905.41	-
12	**Cost A2**	2,95,964.10	-
13	Rental value of own land and interest on fixed capital	59,697.30	-
14	**Cost B**	3,55,661.40	-
15	Imputed value of family labour	44,135.13	-
16	**Cost C**	3,99,796.50	-

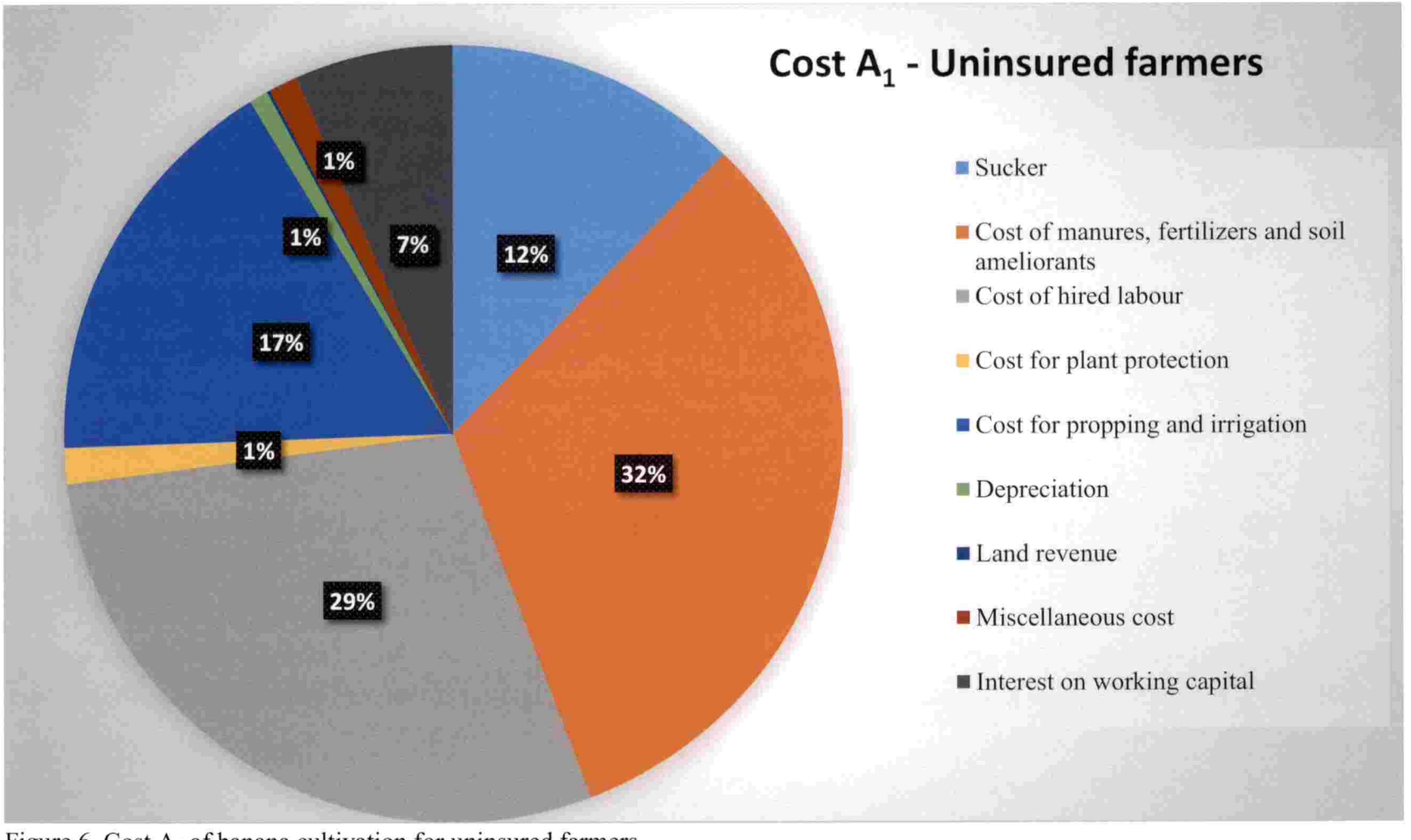

Figure 6. Cost A_1 of banana cultivation for uninsured farmers

4.3.2 Net Returns

Net returns is a concept of farm business analysis which is used to find out profit and efficiency of farm business. Average yield was 259.7 q ha^{-1} and 220.9 q ha^{-1} for insured and uninsured farmers respectively. The price of banana was ₹ 37/kg during April 2018. Using the average yield and unit cost, gross returns from banana were worked out. Gross return from banana was higher for insured farmers (₹ 9,61, 569.76 ha^{-1}) than that of uninsured farmers (₹ 8,18,000 ha^{-1}). Net returns at cost A_1 was ₹ 7,02, 987.71 ha^{-1} for insured farmers and ₹ 5,83,941.34 ha^{-1} for uninsured farmers. At Cost C, net returns of insured famers was ₹.1,14,364.45 ha^{-1} which was more than that of uninsured farmers. It shows that insured farmers were making more profit than uninsured farmers. The net returns of insured farmers at Cost A_2, Cost B and Cost C were ₹ 6,27,871 , ₹ 5,76,703 and ₹ 5,33,483 respectively. For uninsured farmers the net returns at Cost A2, Cost B and Cost C were ₹ 5,22,035.94, ₹ 4,62,338.64 and ₹ 4,18,203.51 respectively (Table 27).

Table 27. Gross returns and net returns of insured and uninsured banana farmers

Sl. No	Particulars	Returns	
		Insured farmers	Uninsured farmers
1	Yield (q/ha)	259.7	220. 9
2	Price (₹ /kg)	37	37
3	Gross return (₹/ha)	9,61,569.76	8,18,000
4	Net returns at cost A_1 (₹ /ha)	7,02,987.71	5,83,941.34
5	Net returns at cost A_2 (₹ /ha)	6,27,871.43	5,22,035.94
6	Net returns at cost B (₹ /ha)	5,76,703.99	4,62,338.64
7	Net returns at cost C (₹ /ha)	5,33,483.06	4,18,203.51

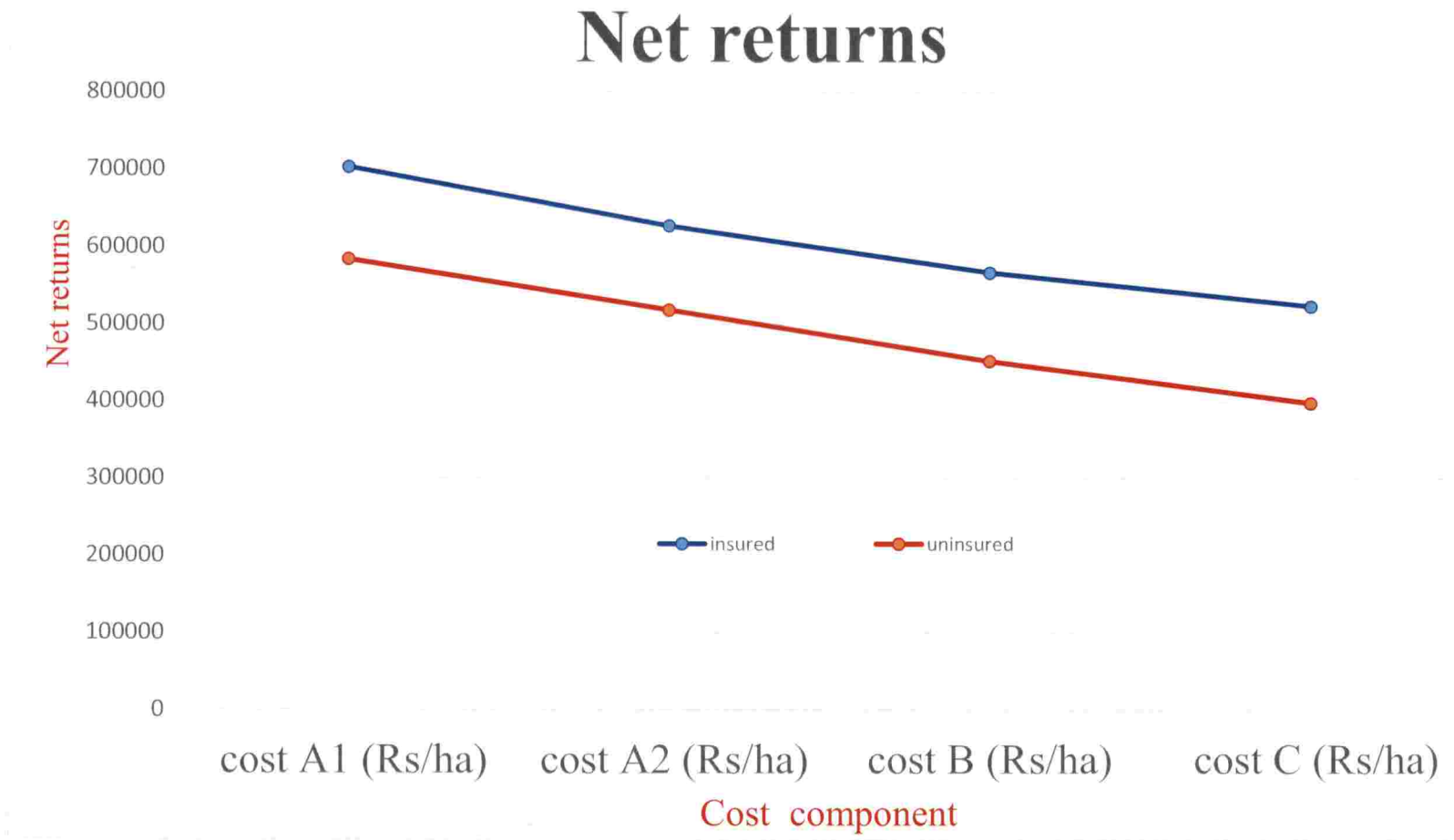

Figure 7. Net returns of insured and uninsured banana farmers

4.3.3 B C ratio

Benefit cost ratio which is a concept of profitability was complicated for insured and uninsured farmers and presented in Table 28. The higher value indicates more profit. Insured farmers have higher BC ratio than the uninsured farmers at various costs. Uninsured and insured farmers had a BC ratio of 2.04 and 2.25 respectively by spending one rupee for cultivation, at cost C. on the whole, the input- output ratio was higher for insured farmers which indicates that insured farmers are benefited more than uninsured famers. This can be attributed to higher yield on the basis assurance on income on account of crop loss.

The BC ratio of uninsured farmers (2.04) at cost C was almost equal to the BC ratio of banana farmers (2.07) in Kolhapur district of Maharashtra, study conducted by Bondar (2015).

Table 28. Benefit Cost ratio of insured and uninsured Banana farmers

Cost	Insured farmers	Uninsured farmers
Cost A1	3.71	3.49
Cost A2	2.88	2.76
Cost B	2.49	2.29
Cost C	2.25	2.04

4.3.4 Resource Use Efficiency

Cobb Douglas production function was fitted separately for insured and uninsured farmers to find the resource use efficiency in production of Nendran cultivation. In this study four variables were considered as independent variable namely quantity of fertilizer and manure, quantity of propping material, hired labour days and family labour days. Yield was considered as the dependent variable. VIF was calculated to check the existence of multicollinearity between the independent variables in the analysis.

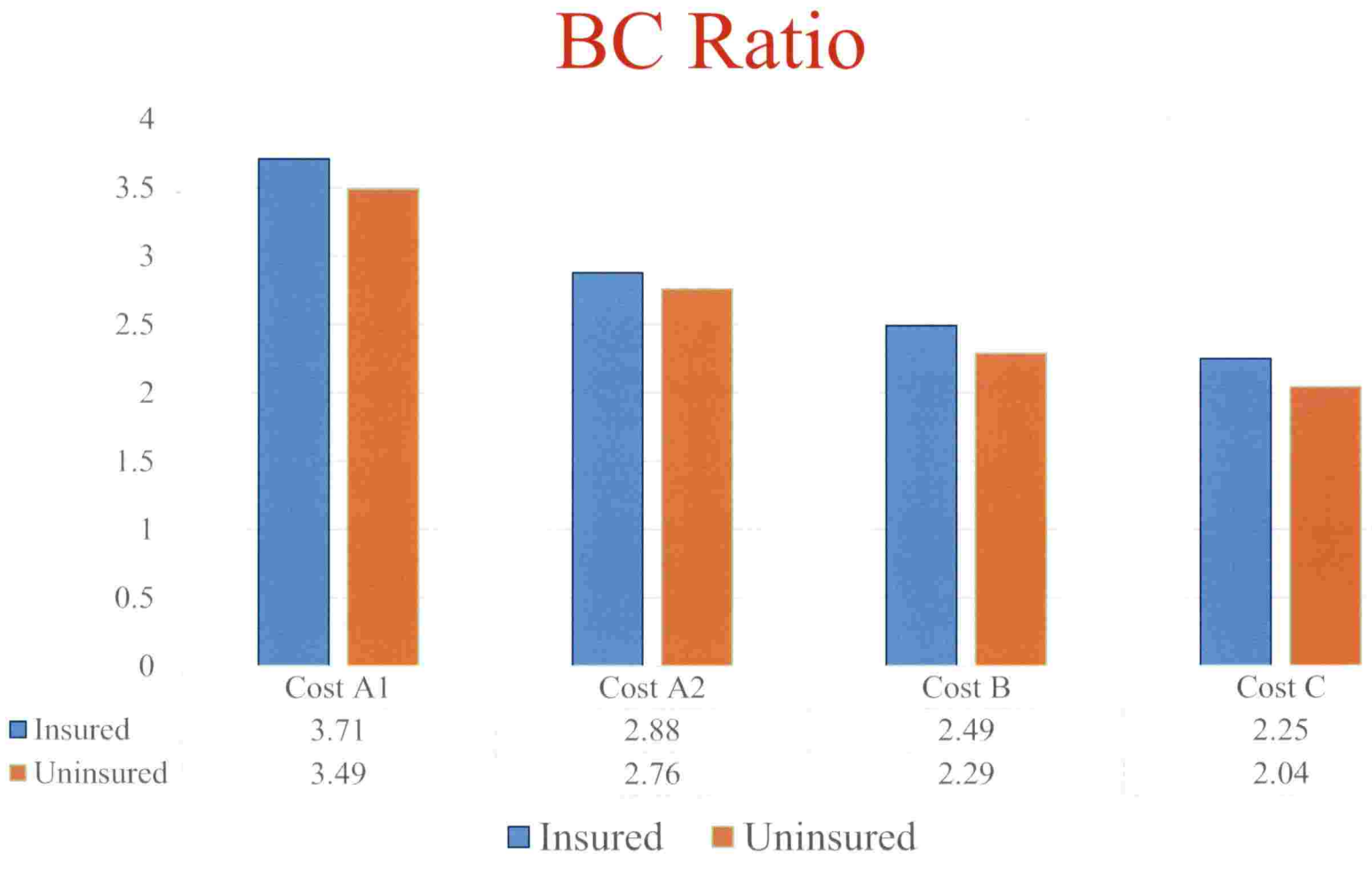

Figure 8. comparison of ABC Cost of banana cultivation for insured and uninsured banana farmers.

The coefficient of determination (adjusted R^2) for insured farmers was 0.77 which indicated that 77 per cent of variation in the yield was explained by the selected independent variables (Table 29).

Quantity of manure and hired labour days were the two variables which had a significant impact on yield at 1 per cent and 5 per cent level of significance respectively. The elasticity coefficient of manures and hired labour was respectively 0.57 and 0.28 and found to be significant. This revealed that one unit increase in quantity of manures and fertilizers led to 0.57 units increase in the output and one unit increase in labour days would increase yield by 0.28 units. The returns to scale was found to be 0.84 which that means one percent increase in the all independent variable will increase the yield by 0.84 per cent which in turn shows decreasing returns to scale (<1). The VIF value of all independent variable range between 1 and 2 indicated that there was no multicollinearity present in the selected variables.

Table 29. Estimated production function for insured farmers

Particulars	Coefficients	Standard Error	P value	VIF
Intercept	2.755	0.761	0.0008	-
Quantity of manures and fertilizers	0.576**	0.093	0.0003	1.75
Hired labour	0.208*	0.092	0.0299	1.47
Family labour	-0.056	0.080	0.489	1.04
Quantity of plant protection materials	0.112	0.067	0.106	1.55
R^2	0.77			
$\bar{R}^2$	0.74			
F	31.85			
Σb_i	0.84			
No. of observations	43			

* significant at 5 per cent level

** significant at 1 per cent level

Note: coefficients were obtained with log values

In the case of uninsured farmers, the explanatory variables were able to explain only 57 per cent of change in dependent variable (Table 30). Quantity of manures and fertilizers was the only variable which was statistically significant at one per cent level. Elasticity of coefficient for manures and fertilizers was 0.40 which means that one unit increase in quantity of manures and fertilizers will result in 0.40 unit increase in quantity of output. The coefficient of elasticity of this function was 0.79 which indicates decreasing returns to scale. There was no problem of multicollinearity because of all VIF values of independent variables were found to be less than five.

Table 30. Estimated production function for uninsured farmers

Particulars	Coefficients	Standard error	P value	VIF
Intercept	4.001	1.029	0.00048	-
Quantity of manures and fertilizers	0.406*	0.108	0.0007	1.35
Hired labour	0.236	0.178	0.1937	2.04
Family labour	0.078	0.121	0.5215	1.64
Quantity of plant protection materials	0.077	0.040	0.0620	1.19
R^2	0.57			
$\bar{R}^2$	0.54			
F	10.84			
Σb_i	0.79			
No. of observations	37			

*significant at 5 per cent level

Note: coefficients were obtained with log values

Allocative efficiency is used to detect how the farm uses production inputs optimally in right quantity and right combination to achieve maximum profit. Two economic aspects were used to find out resource use efficiency, which are marginal value product (MVP) and marginal factor cost (MFC). For finding out marginal value products, geometric mean of quantity of manures and fertilizers, plant protection materials, hired labour days and family labour days were used. The price was taken as ₹ 37 Kg^{-1} for Nendran banana. The ratio K (MVP/MFC) was used to assess the allocative efficiency.

The allocative efficiency of insured farmers is presented in Table 31. The K (MVP/MFC) ratio of quantity of manures and fertilizer, quantity of protection material and hired labour days is more than one which indicated the underutilization of resources and it can be increased to enhance the allocative efficiency in production.

Table 31. Allocative efficiency of insured farmers

Particular	Geometric mean	MVP	MFC	K=MVP/MFC
Yield of Nendran (Y)	25881.65	_	-	-
Quantity of manures and fertilizers (x_1)	23730.97	23.276	3.41	6.825
Hired labour (x_2)	99.38	2006.831	749	2.679
Family labour (x_3)	57.40	-934.617	749	-1.247
Quantity of plant protection materials (x_4)	2214.01	48.482	17.76	2.729

A perusal of Table 32 revealed that the K ratio of insured farmers was more than one for quantity of manures, quantity of plant protection materials and hired labour days. These values indicate the underutilization of these resources for Nendran production. The use of these resource are increased to enhance the production of banana.

Table 32. Allocative efficiency of uninsured farmers

Particular	Geometric mean	MVP	MFC	K=MVP/MFC
Yield of Nendran (Y)	22081.48	-	-	-
Quantity of manures and fertilizers (x_1)	19824.87	16.74	3.77	4.44
Hired labour (x_2)	94.48	2046.23	792	2.58
Family labour (x_3)	60.09	1069.78	735	1.45
Quantity of plant protection materials (x_4)	1771.84	35.82	22.05	1.62

4.2.11 Recommended fertilizer dose of Nendran

Application of fertilizer is a major cultivation practice in banana production. Kerala Agricultural University has standardized the recommended dose of fertilizer at the rate of 190:115:300 (N: P_2O_5: K_2O) g/plant. Among the farmers, split application of fertilizers is common, but most of the farmers didn't adopt the recommended level of fertilizer. The recommended dose and time of application of fertilizer is presented in the Table 33.

Table 33. Recommended dose of fertilizer for Nendran banana

Time of application	**N: P_2O_5:K_2O (g /plant)**
One month after planting	40:65:60
Two months after planting	30:50:60
Three months after planting	30:00:60
Four months after planting	30:00:60
Five months after planting	30:00:60
Just after complete emergence of bunch	30:00:60

Source: KAU Package of Practices Recommendations, 2016

4.2.12. Extent of adoption of NPK fertilizers

The extent of adoption of fertilizers shown is in Table 34. All the farmers were applying NPK fertilizer in varying splits. The average use of fertilizer was calculated separately for insured (224: 80 :300 g /plant) and uninsured farmers (140: 80: 240 g/plant). The overall adoption rate of insured farmers was 93.3 per cent and the extent of adoption by insured farmers was less than recommended dose except the N where we could see excess adoption (117.89 per cent).

Varghese (2012) observed the excessive adoption rate of N fertilizer in black pepper (116.90 per cent).

Among the uninsured farmers also the adoption rate was less than recommended dose. Overall the adoption rate was found to be 74.41 per cent which is comparatively less than the adoption of insured farmers. under adoption was seen for N, P, K fertilizer which for uninsured farmers was 73.68 per cent, 69. 56 per cent and 80 per cent respectively which throws light to the lower yield obtained by the farmer.

Table 34. Extent of adoption of NPK fertilizer

Particular	**N**	**P**	**K**	**Total (%)**
Recommended level (g/plant)	190	115	300	100
Average adoption by insured farmers (g/plant)	224	83	270	93.3
Extent of adoption of insured farmers (%)	117.89	72.17	90.00	
Average adoption by uninsured farmers (g/plant)	140	80	240	74.41
Extent of adoption of uninsured farmers (%)	73.68	69.56	80.00	

4.2.12 Fertilizer use by farmers

Based on the fertilizer utilization pattern farmers were grouped into three categories higher, recommended and lesser which was shown in Table 35. About 60 per cent of the insured farmers utilized the recommended dose of fertilizer, 25 per cent utilized higher than recommended dose and remaining 14 per cent were utilizing lesser than the recommended dose. In the case of uninsured farmers most of the farmers fell into less category this is a major reason in the yield variation. In the uninsured category most of the respondents were skipped one dose of fertilizer.

Table 35. Distribution of farmers according to use of recommended dosage of fertilizer

Particular	Insured farmers						Uninsured farmers					
	N		P		K		N		P		K	
	Number	Per cent	Number	Number	Per cent	Number	Number	Per cent	Number	Per cent	Number	Per cent
Low	6	13.95	22	6	13.95	22	24	64.86	28	75.68	21	56.76
Recommended	27	62.79	13	27	62.79	13	9	24.32	6	16.22	13	35.14
Higher	10	23.26	8	10	23.26	8	4	10.82	3	8.10	3	8.10
Total	43	100	43	43	100	43	37	100	37	100	37	100

4.5 Constraints in the adoption of risk mitigation measures

Any study focuses on formulating new policies which help the farmers to improve their production, productivity and profitability. Identification of the constraints of the farming community will help to make suitable policy recommendations which will improve the current status of production by the incorporation of suitable suggestions according to policy implementation.

There are various constraints faced by the banana farmers while adopting different risk mitigation measures. For each risk mitigation measure, constraints in adoption are different and each category of constraints were separately given for ranking using the Garret's ranking technique.

The constraints faced by farmers while adopting production risk management are given in the Table 36. Complicated procedure of crop insurance was ranked the highest with Garret's score of 59. The main problem was that the Kerala State Crop Insurance is available to farmers through Krishi Bhavan but the premium payment is through the banking institution, and also the procedure was complicated because of rules and regulations. It was followed by high cost of measures such as propping and irrigation (55.1), weather uncertainties (52.2) and incidence of pest and disease (51.7).

Table 36. Constraints faced by farmers while mitigating production risk

Sl. No	Constraint	Garret score	Rank
1	Unavailability of suitable insurance scheme	38.6	7
2	Lack of proper knowledge about insurance	46.5	5
3	High incidence of pests and diseases	51.7	4
4	Unavailability of inputs and planting materials	44.0	6
5	High cost of protection measures such as propping and irrigation	55.1	2
6	Complicated procedure of crop insurance	59.0	1
7	Weather uncertainties	52.2	3

Price variation of banana is a serious risk faced by the farmers. Farmers resort to different marketing channels for reducing the price risk and obtaining maximum profit from produce. Farmers face different problems while adopting price risk mitigation, major constraints were found to be low price due to glut of output in the market (Garret score59), dumping from the neighbouring state Tamil Nadu during the festival seasons followed by high price of inputs (56.43) shown in Table 37.

Table 37. Constraints faced by the farmers while mitigating price risk

Sl No	Constraint	Garret's score	Rank
1	Lack of proper rules and regulations in the market	34.38	6
2	High cost for marketing and transportation	47.79	5
3	High price of inputs	56.43	2
4	Low price fixed in contract farming	48.41	4
5	Low price due to glut of output in market.	59.00	1
6	Multiplicity of intermediaries	54.00	3

Majority (more than 70 per cent) of the farmers were practising leased land farming. High rental value of leased in land was found out to be the major constraint in credit risk. Bidding system was there, which makes farmers to compete for more fertile land. Farmers should pay the full amount before signing the lease contract (59.41) which was also a burden for the farmer. Complicated procedure for approval of bank loan is considered as the second highest constraint (57.48). Most of the farmers sought help from banking institution and private money lenders for investment (Table 38).

Table 38. Constraints faced by the farmers while mitigating credit risk

Sl. No	Constraint	Garret score	Rank
1	High interest rate	36.13	5
2	Complicated procedure for loan sanctioning	57.48	2
3	Payment of rent in advance for leased in land	59.41	1
4	Unavailability of credit in time	52.92	3
5	Difficulty in repayment due to crop loss.	43.03	4

Summary

5. SUMMARY

Nendran is a major cultivable banana variety in Kerala. It is highly remunerative as well as a risk prone crop. Risk is a product of hazard and vulnerability, in other words probability of loss due to damaging event. Unexpected change in the farm income causes heavy debt for the farmers. Risk can reduce by the adoption of alternative solution to the problem. This study entitled "Economics and risk mitigation measures for Nendran banana cultivation in Thiruvananthapuram district" was carried out in order to understand the economics of banana cultivation, identification of risks and relative advantages of risk mitigation measures and constraints in their adoption.

The study is confined to four panchayats of Neyyatinkara taluk in Thiruvananthapuram district. Primary data on socio economic characteristics, cost of cultivation, mitigation measures were collected from 80 banana farmers. Percentage and average were used to study the socio economic characteristics of the farmers. Cost ABC concept was used to find out the cost of cultivation of Nendran. Cost of cultivation was worked out for insured as well as uninsured farmers. The profitability of banana cultivation was computed using BC ratio. The resource use efficiency was tested by Cobb- Douglas production function and allocative efficiency also worked out by using MVP and MFC. The extent of adoption of fertilizers in relation to KAU package of practices was worked out to understand the level of adoption.

Salient features

The average age of selected respondents was 48.7 years. For insured farmers' maximum concentration of farmers was observed in the lower age group of 40-50 years (44.19 per cent) than uninsured farmers in the age group of 50-60 years (35.10 per cent). Overall more than 70 per cent of farmers were in the age group of 40-60 years.

Maximum number of insured farmers and uninsured farmers had primary level education which was respectively 53.50 per cent and 48.70 per cent followed by upto higher secondary education (32.50 per cent and 35.10 per cent). Formal education was not noticed among 11 per cent, and 3.75 per cent farmers were graduates.

Distribution of farmers according to family size showed that 60.50 per cent of insured farmers and 43.50 per cent of uninsured farmers had medium size family with 4 to 6 members. More than 50 per cent of respondents belonged to medium size family.

Most of the farmers were males (93.75 per cent) and the females were only 9.8 per cent of insured farmers and 2.8 per cent of uninsured.

About 89 per cent of farmers considered agriculture as the main occupation. The remaining 11 per cent considered agriculture as a secondary source of income, of which 5 per cent farmers were working in service sector and 6 per cent were doing their own business.

The average land holding for insured and uninsured farmers were 71.09 cents and 76.08 cents respectively. More number of the insured (48.83 per cent) and uninsured (54.04) farmers had the land holding size less than 50 cents. On the whole, more than 80 per cent of farmers had the area below 100 cents.

The total cropped area of insured and uninsured farmers were respectively 17.59 ha and 16.55 ha. The area under Nendran banana cultivation was 9.53 ha and 8.36 ha respectively for insured and uninsured farmers. The cropping intensity of uninsured (147 per cent) farmers were higher than insured farmers (144 per cent).

Respondents with a farming experience of 10 to 15 years were found to be more among the insured farmers (44.19 per cent) than uninsured farmers, while it was 24.32 per cent. The average experience of insured farmers was 14 years and it was 11 years for uninsured farmers. For sample as a whole it was 13 years.

The maximum number of insured and uninsured farmers falls under the income category of less than ₹ 1.5 lakhs. The average annual income of insured farmers was ₹ 1,39,955.08 and it was ₹ 96,007.80 for uninsured farmers. It can be noted that only the insured farmers had an annual net income of more than 3 lakhs (6.9 per cent).

Farmers were mainly facing three kinds of risk such as production risk, price risk and credit risk. Among these production risk was comparatively high.

On the whole 83.75 per cent of farmers were aware about crop insurance scheme. In the uninsured category the awareness was around 65 per cent, remaining 35 per cent of farmers were totally unaware about crop insurance.

So many reasons are there for non-adoption of crop insurance, maximum number of farmers (24.3 per cent) had problem with complicated procedure of the crop insurance scheme.

Majority of the farmers (93.10 per cent) had adopted Kerala state Crop insurance and remaining 6.90 per cent had taken crop insurance from VFPCK. Indemnity for bunched banana was ₹ 300 and ₹ 85 respectively for SCIS and VFPCK.

Maximum number (46.25 per cent) of farmers adopted more than one marketing outlet to reduce the price risk. By this method they were profited than other farmers who ever sold their product in a single outlet. Farmers markets is the second highest outlet used by the farmers which may be the reason for the preference of SCIS.

For tackling the credit risk maximum farmers (42.50 per cent) depended on formal banking institutions. More than 50 per cent of farmers didn't want to avail loans from banking institution. Around 26 per cent of farmers had borrowed credit from private money lenders. They were switching to other informal institution because of complicated procedure and lack of collateral security.

Total cost of cultivation (Cost C) of Nendran banana of insured farmers was ₹ 4, 28, 086 ha^{-1} . Cost A_1 was ₹ 2, 58, 582 ha^{-1} , of which cost of inputs such as

manures, fertilizers and soil ameliorants accounted for the highest, about 31.49 per cent. It was followed by cost of hired labour (28.95 per cent), and cost for propping and irrigation (15.34 per cent). Cost A_2 for insured farmers was ₹ 3, 33, 628 ha^{-1}. Total labour cost per hectare was found to be ₹ 1,18, 078, including both hired and family labour. Family labour contribution was 36.60 per cent of total labour cost. Labour wage was ₹ 750 / day. Most of the famers (80 per cent) were practicing leased land farming.

For uninsured farmers, cost A_1 was estimated to be ₹ 2,34,058 ha^{-1}, cost of manures, fertilizers and soil ameliorants contributed around 32.01 per cent and hired labour occupied the second highest position (28.69 per cent). Total cost of cultivation per hectare at Cost C was ₹ 3, 99, 796 ha^{-1}. Hired labour cost was lesser and family labour cost was higher than that of insured farmers. Total labour cost was found to be ₹ 1,11,290 ha^{-1} for uninsured farmers, out of which 39 per cent was contributed by family labour. The cost of manures, fertilizers and soil ameliorants was less than that of insured farmers which indicted that uninsured farmers used less quantity of fertilizers than insured farmers.

Net returns is a concept of farm business analysis which is used to find out profit and efficiency of farm business. Average yield was 259.7 q ha^{-1} and 220.9 q ha^{-1} for insured and uninsured farmers respectively. The price of banana was ₹ 37 kg^{-1} during April 2018. Using the average yield and unit cost, gross returns from banana was worked out. Gross return from banana was higher for insured farmers (₹ 9,61, 569.76 ha^{-1}) than that of uninsured farmers (₹ 8,18,000 ha^{-1}). Net returns at cost A_1 was ₹ 7,02, 987.71 ha^{-1} for insured farmers and ₹ 5,83,941.34 ha^{-1} for uninsured farmers. At Cost C, net returns of insured famers was ₹ 1,14,364.45 ha^{-1} which was more than that of uninsured farmers. It can be seen that insured farmers were making more profit than uninsured farmers.

Insured farmers have higher BC ratio than the uninsured farmers at various costs. Uninsured and insured farmers get a BC ratio of 2.04 and 2.25 respectively by

spending one rupee for cultivation, at cost C. At the overall level, input- output ratio is higher for insured farmers which indicates that insured farmers are benefited more than uninsured famers.

Four variables namely quantity of manures fertilizers and soil ameliorant, number of hired labour days, imputed family labour days and quantity of propping material were taken for the computation of resource use efficiency. The coefficient of determination (R^2) was 0.77 and 0.54 for insured and uninsured farmers respectively. The Σb_i (coefficient of regression) value obtained for insured famers and uninsured farmers were 0.84 and 0.79 respectively which indicated decreasing returns to scale for both.

Two variables, quantity of manures, fertilizers and soil ameliorants and hired labour were significantly influencing the production of the insured farmers and only quantity of manures and fertilizer was significant for uninsured farmers.

Allocative efficiency analysis revealed that both insured and uninsured farmers have a greater scope for better utilization resources, because K value was greater than one for many resources which indicated the underutilization of the resources.

Excess adoption of N fertilizer was noticed for insured farmers, and the average extent of adoption of fertilizers was 93.3 per cent and 74.41 per cent for insured farmers and uninsured farmers respectively.

Policy option

Nendran is a very popular banana variety in Kerala, known for its nutritive value and multi-purpose use. There is an ample scope for increasing production, processing and export earnings. Even though it is a very remunerative crop, the production risk is a major constraint for such farmers. Kerala is still depending neighboring states for Nendran banana, who are targeting our festival seasons and

making more profit than native farmers. So appropriate steps should be taken in the initiative of government to encourage the farmers in Kerala to meet the demand of the state.

Efforts should be taken to simplify the procedure of crop insurance, such that all transactions are made through Krishi Bhavan and creation of awareness and conviction about the benefits of crop insurance should be given to the farmers.

The village level procurement agencies can be set up to avoid forced sales and to obtain reasonable price for the procedure at the time of glut in the market.

While formulating credit schemes provision should be given for providing adequate credit for leased land farmers who lacks collateral security.

In Kerala, most of the banana processing units are under the control of private entrepreneurs. Government should initiate a model like HPMC for Nendran banana processing with the collaboration of private entrepreneurs in different locations. Government can purchase the commodity directly from farmer for processing, which will generate more employment and income in our state.

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Appendices

Appendix I

APPENDIX - I

Kerala Agricultural University

College of Agriculture, Vellayani

Department of Agricultural Economics

Economics and risk mitigation measures for Nendran banana cultivation in Thiruvananthapuram district

1. Name of the Krishibhavan & Taluk:
2. Name of the respondent:
3. Address:

House: Village: Block:

Taluk: Pin: Phone:

4. Household Information

Sl. No.	Name	Relation with head (code)	Sex	Age in years	Education	Occupation		Income	
						Primary	Secondary	Primary	Secondary
1									
2									
3									
4									
5									

Relation with head: 1. Head, 2. Wife, 3. Son, 4. Daughter, 5. Son in law, 6. Daughter in law, 7. Sister, 8. Brother, 9 Grand child

Sex: 1. Male, 2. Female

Education: 1. No formal education, 2 lower and upper primary, 3. High school and higher secondary, 4. Graduation.

Occupation: Agricultural only, 2. Govt. Service, 3. Private job, 4. Own business, 5. Agricultural labour, 6. House wife

5. Land particulars

Sl. No.	Particulars (Cents)	Wet land (Cents)	Garden land (Cents)	Rain fed (Cents)	Irrigated (Cents)	Total (Cents)
1	Area owned					
2	Area leased in					
3	Area leased out					
4	Net cropped area					
5	Area under Nendran					
6	Land value (Rs.)					

6. 1mpliments

Sl. No.	Particulars	Number	Year of purchase	Purchase price(Rs)	Expected life (Years)
1	Manvetties				
2	Pickaxe				
3	Spades				
4	Sprayers				
5	Vaakathi/ Knife				
6	Ladder				
7	Others 1. 2.				

7. Buildings and machineries owned by farmer

Sl. No.	Particulars	Number	Year of purchase	Purchased/ constructed value	Expected life (Years)	Maintenance cost (Rs)
1	House					
2	Store house					
3	Tractor/tiller					
4	Weed cutter					
5	Pump set					
6	Household particles					

7.cropping pattern

i. Cropping pattern – (sole cropping / mixed cropping/ relay cropping/ crop rotation)
ii. Variety with area
iii. Other crops in the banana field
iv. Years of experience in banana farming (below 5 years /5-10 years/10-15/ above 15 years)

Sl. No.	Crops	Variety	Area (Cents)/ No.	Irrigated /rainfed	Yield (kg)	Income (Rs)
1	Banana					
2						
3						
4						
5						

8. Cost of cultivation

Labour cost

Wage rate: Men (Rs/ day) _____ Women (Rs/ day) _____

Machinery rent (Rs/ hour) _____ Total cost (Rs) _____

Cost of cultivation							
Sl.no	Input used	Quantity applied		Price	Labour		Total expenses (Rs)
		Unit	Quantity		M	F	
1	Banana sucker						
2	Clearing land						
3	Digging pits						
4	Props (types)						
5	Fertilizer Application 1. Urea 2. DAP 3. MOP 4. Complex 5. Others						
6	Manures 1. Cow dung 2. Green Manure 3. Sheep Manure 4. Poultry Manure						
7	Soil ameliorants 1. Lime						

	2. Others					
8	Weedicides 1. 2. 3.					
9	Pesticides 1. 2. 3.					
10	Fungicides 1. 2. 3.					
11	Biocontrol agent 1. 2. 3.					
12	Irrigation					
13.	Harvesting					
14	Post-harvest operation					
15	Transport					
16						

9. Yield and returns

Yield	Quantity		Unit Price received		Total price received	Marketing agency
	Main product	By product	Main product	By product		

2) Information on Risk mitigation strategies

1. Do you have any risk during cultivation? If yes, mention the type of risk
   Production risk/ Price risk/ Credit risk
2. What are the mitigation measures adopting to mitigate risk?
   a) Against production risk
   b) Against price risk
   c) Against credit risk

3. Do you have awareness about crop insurance? Yes/No

4. Have you adopted any crop insurance? Yes/No

5. Do you practising any risk mitigation measures against production risk?

   (Yes/ No)

   If yes

a) Crop insurance alone
b) Crop diversification + insurance
c) Plant protection alone
d) Crop diversification alone

6. Which scheme?
State crop insurance scheme / VFPCK

7. Perception about premium Rate
High/ medium/ low

8. Reason for nonadaptation
   a. No awareness
   b. Not necessary
   c. High premium
   d. Complicated procedure
   e. Difficulty in receiving indemnity

9. Area under insurance scheme .....

10. Premium paid .....

11. Indemnified or not (yes/No)
How much .....

12. Satisfaction level of farmers by adoption of crop insurance
High/ medium/low

13. Source of credit for agricultural production

Sl no	Type of credit	Source of credit	Purpose	Amount taken	Amount utilized	Interest rate %	Repaid	Period	Amount overdue

14. Why not approaching banking institution?
    a. Interest is high
    b. Complicated procedure
    c. Not necessary
    d. Burden for farmers

15. Marketing outlets for reducing price risk
    a. VFPCK/farmers market
    b. Direct marketing
    c. Contract marketing
    d. More than one marketing channel

16. Do you practice KAU Package of practice (yes/ No)

    Low /recommended/ high

17. Which institution is helping to reduce your risk (according to farmer perception)
    a) Krishi Bhavan
    b) VFPCK
    c) Credit institution
    d) COA

3) Constraints faced by the farmer for adopting risk mitigation measures

1. Related to production risk

Production risk	Rank
o Unavailability of suitable insurance scheme	
o Lack of proper knowledge about insurance	
o High incidence of pest and disease	
o Unavailability of suitable inputs &planting material	
o High cost of protection measures	
o Complicated procedure of crop insurance	
o Weather uncertainties	

Price risk / market risk	Rank
○ Lack of précised rules and regulation in markets ○ High cost for marketing & transportation ○ High price of inputs ○ Decreased price due to glut of output in market ○ Low price fixed in Contract farming ○ Intermediaries are earning profit	

Credit risk	Rank
○ Rate of interest is high ○ Complicated procedures for sanctioning loans ○ Payment of rent in advance for leased in land ○ Unavailability of credit on time ○ Repayment is difficult when loss occurs	

Appendix II

GARRETT RANKING CONVERSION TABLE

The conversion of orders of merits into units of amount of "socres"

Percent	Score	Percent	Score	Percent	Score
0.09	99	22.32	65	83.31	31
0.20	98	23.88	64	84.56	30
0.32	97	25.48	63	85.75	29
0.45	96	27.15	62	86.89	28
0.61	95	28.86	61	87.96	27
0.78	94	30.61	60	88.97	26
0.97	93	32.42	59	89.94	25
1.18	92	34.25	58	90.83	24
1.42	91	36.15	57	91.67	23
1.68	90	38.06	56	92.45	22
1.96	89	40.01	55	93.19	21
2.28	88	41.97	54	93.86	20
2.69	87	43.97	53	94.49	19
3.01	86	45.97	52	95.08	18
3.43	85	47.98	51	95.62	17
3.89	84	50.00	50	96.11	16
4.38	83	52.02	49	96.57	15
4.92	82	54.03	48	96.99	14
5.51	81	56.03	47	97.37	13
6.14	80	58.03	46	97.72	12
6.81	79	59.99	45	98.04	11
7.55	78	61.94	44	98.32	10
8.33	77	63.85	43	98.58	9
9.17	76	65.75	42	98.82	8
10.06	75	67.48	41	99.03	7
11.03	74	69.39	40	99.22	6
12.04	73	71.14	39	99.39	5
13.11	72	72.85	38	99.55	4
14.25	71	74.52	37	99.68	3
15.44	70	76.12	36	99.80	2
16.69	69	77.68	35	99.91	1
18.01	68	79.17	34	100.00	0
19.39	67	80.61	33		
20.93	66	81.99	32		

Abstract

ECONOMICS AND RISK MITIGATION MEASURES FOR NENDRAN BANANA CULTIVATION IN THIRUVANANTHAPURAM DISTRICT.

by

STEPHY.M.A.

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Abstract of Thesis
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ABSTRACT

The research entitled " Economics and risk mitigation measures for Nendran banana cultivation in Thiruvananthapuram district" was conducted in Neyyatinkara taluk of Thiruvananthapuram district. Risks are inherent in farming business and it can be explained in terms of production risk, price risk and credit risk. The risks are there with regards to weather parameters, yield, price, government policies, global markets and several other factors that can cause a wide swing in farm income. Risk mitigation includes a series of techniques that can eliminate or reduce the negative impact of risk. In this context, the main objectives were to study the economics of banana cultivation, identification of risks and relative advantages of risk mitigation measures and constraints in their adoption. Neyyatinkara taluk was purposively selected which is having the maximum area under banana, from which four panchayats were selected at random. From each panchayat 20 respondents were taken randomly. Thus the total sample size was 80. Further the farmers were classified into insured and uninsured by considering crop insurance as a formal risk mitigation measure.

Percentage analysis was done to analyze the socio economic variables and extent of adoption of crop insurance. Cost ABC concept was used to compute the cost of cultivation of insured farmers and uninsured farmers. Resource use efficiency was calculated using Cobb Douglas production function and constraints were ranked by Garret's ranking technique.

Majority (72.5 per cent) of farmers belonged to the middle age group and the average age of the selected respondents was 48.7 years. Considering the educational status, 90 per cent of insured farmers had formal education whereas in case of uninsured farmers the per cent was 86.

More than 50 per cent of farmers belonged to medium size family with 4 to 6 members. The average size of land holding was 71.09 cents for insured farmers and

76.08 cents for uninsured farmers. Area under cultivation of banana was 9.53 ha (area under insurance scheme) for insured farmers and 8.12 for uninsured farmers. The average annual income of insured farmers was ₹ 1,39,955.08 and it was ₹ 96,007.80 for uninsured farmers.

Out of 80 respondents, 53.75 per cent of the farmers adopted crop insurance as a risk mitigation tool. Most of the insured farmers (88.3 per cent) adopted Kerala state crop insurance scheme and only few farmers resorted to VFPCK scheme. Comparatively high indemnity (₹ 300/ plant) was the reason to attract farmers towards the Kerala state crop insurance scheme. Among the uninsured farmers 35.2 per cent were not aware about crop insurance scheme. The premium per plant was ₹ 3 for SCIS and ₹ 5.50 for VFPCK.

Apart from production risk, farmers also considered the price risk and credit risk. For mitigating the price risk, the farmers sold their products through more than one marketing agency (46.25 per cent). The respondents used the institutional agencies (42.5 per cent) as the major source to overcome credit risk.

The cost of cultivation of Nendran banana of insured farmers was ₹ 4, 28, 086.70 ha^{-1} and for uninsured farmers it was ₹ 3, 99, 796.5 ha^{-1} at Cost C. In both cases, the manures and fertilizers cost accounted the highest share followed by hired labour in the variable cost. The average yield was 259.7 q ha^{-1} and 220. 9 q ha^{-1} for insured and uninsured farmers respectively. The price of Nendran banana was ₹ 37 Kg^{-1} at the time of the survey. BC ratio was more for insured farmers (2.25) than uninsured farmers (2.04) at Cost C. The family labour contribution to total labour cost was 36 per cent for insured farmers and 39 per cent for uninsured farmers.

The results of Cobb Douglas production function analysis showed positive and significant co efficient for quantity of manures and fertilizers on yield for both insured and uninsured farmers. Hired labour days was also positive and statistically significant for insured farmers. The estimated allocative efficiency was more than one for quantity

of manures and fertilizer, quantity of propping and hired labour for both type of farmers indicating underutilization of these resources and it can be increased to enhance the allocative efficiency in production.

There are various constraints faced by the banana growers while adopting different risk mitigation measures. Complicated procedure of crop insurance was the major constraint for mitigation of production risk. For mitigating price risk glut of product in the market scored the highest and payment of rent in advance for leased in land scored the highest in the case of constraints for mitigation of credit risk.

To conclude, the farmers adopting crop insurance had incurred higher cost of cultivation and obtained better yield and BC ratio from Nendran banana. The analysis revealed that there is scope for efficient utilization of the resources. Lack of awareness was prevalent among the uninsured farmers and complicated procedure of crop insurance was cited as the major constraints for mitigation of production risk by insured farmers. Crop insurance acted as a tool for enhancing the risk taking capacity of farmers for investing more to increase the profitability.