**Decision-making behavior of Black Pepper Farmers in Kerala for Climate adaptation– Choice Situation based analysis**

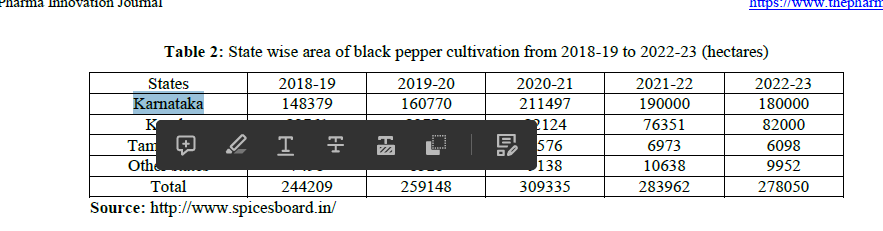
Introduction

Black Pepper (Piper nigrum) is an important spice of trade in India. Black The Black Pepper, otherwise called as Black Gold owes its origin to the South Indian state, of Kerala. The name "Black Gold" for properly dried and stored Black Pepper stems from its remarkable liquidity in the market. Out of the global area of 6.09 lakh ha under black pepper, 42.55% of the area is in India with a production share of 16.76% (Paul, 2023).

Table 1: Yearwise data on total exports of Black pepper from India in terms of quantity and value.

|  |  |  |
| --- | --- | --- |
| Year | Export quantity (Tonnes) | Value( in Lakhs Rs) |
| 2019-20 | 17,000 | 57,370.94 |
| 2020-21 | 199,79.97 | 57,068.74 |
| 2021-22 | 19,979.97 | 57,068.74 |
| 2022-23(advance estimate) | 17,958.26 | 72,686.42 |

The principal pepper-growing states in India are Karnataka, Kerala, and Tamil Nadu with an average production of 54,950 tons from an area of 2.66 lakh hectares. (Paul, 2023)



In Kerala, the area showed a declining trend from 2018-19 (0.83 lakh ha) to 2021-22 (0.76 lakh ha) and thereafter an increasing trend in 2022-23 with an area of 0.82 lakh hectares.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Year | Area (’000 ha) | | Production (’000 MT) | | Productivity (Kg/ha) | |
| India | Kerala | India | Kerala | India | Kerala |
| 2015-16 | 129 | 86 | 55 | 42 | - | - |
| 2016-17 | 132 | 85 | 72 | 34 | - | - |
| 2017-18 | 134 | 85 | 66 | 38 | - | - |
| 2018-19 | 244 | 83 | 48 | 17 | 196.55 | 205 |
| 2019-20 | 258 | 84 | 61 | 20 | 235.39 | 239 |
| 2020 -21 | 309 | 82 | 65 | 22 | 210.13 | 268 |
| 2021 -22 | 284 | 76 | 70 | 21 | 246.51 | 275 |
| 2022-23 | 278 | 82 | 64 | 21 | 230.17 | 256 |

Of all the districts in Kerala, Idukki has the highest area, production and productivity and is the significant contributor to the state's overall production (as much as 59.52 per cent) with 51.12 per cent of area planted with the crop.

District-wise black pepper area, production and productivity in Kerala (2019-20)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sl.No.** | **Name of district** | **Area (ha)** | **Production (tons)** | **Productivity (kg/ha)** |
| 1 | Thiruvananthapuram | 1942 | 604 | 311 |
| 2 | Kollam | 2846 | 849 | 298 |
| 3 | Pathanamthitta | 1617 | 520 | 322 |
| 4 | Alappuzha | 690 | 133 | 193 |
| 5 | Kottayam | 3023 | 1009 | 334 |
| 6 | Idukki | 42822 | 20560 | 480 |
| 7 | Ernakulam | 1895 | 426 | 225 |
| 8 | Thrissur | 1741 | 462 | 265 |
| 9 | Palakkad | 2674 | 1002 | 375 |
| 10 | Malappuram | 2674 | 550 | 206 |
| 11 | Kozhikode | 3432 | 880 | 256 |
| 12 | Wayanad | 10307 | 3694 | 358 |
| 13 | Kannur | 4742 | 2140 | 451 |
| 14 | Kasargod | 3360 | 1716 | 511 |
|  | State total | 83765 | 34545 | 412 |

There has been a remarkable decrease in production from 2019 onwards. Kerala witnessed disastrous floods during the monsoon seasons of two consecutive years, 2018 and 2019. Post-flood assessment of soil quality in Agro-Ecological Unit 9 in Ernakulam district of Kerala revealed that available potassium, available boron, and organic carbon were found to decrease.(Unni & Sreelatha, 2022). Similarly, a study in AEU 16 in the Idukki district shows that there is an increase in soil pH after the flood, and soil fertility is altered in the post-flooded soil.(Sreekutty &Visweswaran , 2020) .

In the year 2023, Kerala received only 877.2 millimeters of rainfall from June 1 to August 16, whereas normal figures recorded during these months is 1572.1 millimeters according to India Meteorological Department(*After 4 Years of High-Intensity Rains, Kerala Inching towards Drought with 45% Deficit Rainfall*, n.d.). Rainfall of 70 mm received in 20 days during May-June is sufficient for triggering flowering process in the plant, but once the process is set off there should be continuous showers until the fruit ripens. The late commencement of the southeast monsoon causes a delay in flower initiation in black pepper(KANDIANNAN et al., 2014)

Most of the black pepper growing areas are experiencing a reduction in rainfall and an increase in temperature. Pollination and development of berries are affected due to the failure of adequate post-blossom rain. (KANDIANNAN et al., 2014).

The global black pepper market faces significant price volatility due to economic factors like currency exchange rates, labor costs, and weather conditions affecting crop yields. Smallholder farmers, a major segment of producers, are especially vulnerable. In similar cropping and climatic conditions, smallholder farmers in the least developed countries in Africa and Asia are affected the most when the climate change impacts are assessed. (Organization: WMO, 2019, n.d.).

Learning to adapt to anticipated changes in climate is crucial for farmers to have a sustainable yield (*Adger2003*, n.d.) . Climate change–relevant decisions (CCRDs), are defined as decisions leading to actions that have consequences for climate change, particularly through mitigation and adaptation. The adaptation decisions and respective choices are framed around cognitive theories.

The adaptive nature of human responses to climate change is studied using multiple theories drawn from different disciplines such as anthropology, geography, cognitive science, political science, psychology, rural sociology, economics, and data science. The empirical pieces of evidence that emerged through decision research have provided reliable extensions of the theories.

Individuals' decision-making patterns and preferences can help in designing interventions or strategies that cater to their needs more effectively, potentially enhancing their ability to cope with challenges and bounce back from setbacks. Resilience-building efforts often involve a combination of psychological support, skill-building, and creating supportive environments.

In this study, we examine two related sub-questions

1. What are the climate change adaptation strategies followed by smallholder Black Pepper farmers in major Black Pepper growing regions of Kerala
2. Which adaptation practices are preferred by smallholder farmers for sustained income from their plantations?

Review of Literature

A bibliometric analysis using R software was done to highlight the scholarly networks propelling innovation in this area. 69 documents were deemed relevant after a search with defined keywords and search range on the Scopus database. The period of the study is from 1999 to 2023 and a substantial increase in annual scientific production was observed from 2019 onwards. unities.

A detailed study of the documents revealed that the frameworks based on protection motivation theory are employed to assess climate change vulnerability while adaptation pathways are analysed using different theories such as the theory of planned behaviour, evolutionary game theory, and prospect theory. Agent-based modelling approach integrates a combination of decision rules based on bounded rationality to test decision-making hypotheses. The real options approach appraises the flexibility level needed in capital investment decisions for climate change adaptation, which will invite more researchers in climate change resilient investment in the future. New forms of decision-making and engagement are emerging within the formal policymaking and planning sphere for creating climate-resilient communities.

H. A. Simon (1978), a Nobel Prize laureate in economics, introduced the concept of "bounded rationality" as a departure from the assumptions underlying rational choice theory. In this model, human decision-makers are constrained by their limited access to information and cognitive capabilities. As a result, they tend to make choices that are satisfactory or "good enough" rather than relentlessly pursuing the absolute highest level of optimisation. He acknowledges the inherent limitations in human decision-making capabilities and suggests a more realistic and flexible approach to decision theory that considers the complexities, uncertainties, and multiple values involved in real-world decision situations (Burns & Roszkowska, 2016a).

Simon’s early choice papers—and also in the larger body of his work—he stressed procedures or algorithms for pursuing, for instance, particular goals and complexes of goals [30]. He contrasted some of his “simplified” rules and procedures with those of what he referred to as “global” models of rationality (see, for example, [30]. Even in his characterization of “classical theory” [30] he refers to “ procedures” of rational choice: “max-min rule,” “probabilistic rule,” and “certainty rule.” Implicitly, as his examples of satisficing indicate, human beings operate with such diverse procedures or algorithms (and not a universal maximization principle). The challenge, as he saw it, is to formulate procedures that approximate what people actually do, e.g., in his satisficing procedure [30]. An example of the type of procedure or algorithm Simon had in mind is that of the “Max-Min Rule,” but much more complex algorithms can be constructed, for example, in complex judgments and choice situations [30](Burns & Roszkowska, 2016b)

30 .Simon, H.A. (1957) Models of Man. Wiley, New York.(Burns & Roszkowska, 2016a)

Nature of climate change risk : decision making under risk

(Kumar & Lazarus, n.d.)

**Consumer Preference for Foxtail and Little Millets in North Eastern Region of Karnataka ( Durgad *et al.,* 2021)**

conjoint analysis, a multivariate technique used in bounded rationality was employed to ascertain the relative importance of different features within a product characterised by multiple dimensions. This method is especially effective for evaluating human perceptions and preferences. The study focused on consumer data pertaining to the consumption of millets, specifically foxtail millet and little millet. A sample of 60 respondents was selected using a random sampling method for data collection.

Top of Form

In this study, profiles describing alternative scenarios were created by combining levels of six attributes like color of foxtail and little millet, taste, nutritional value, grain size, aroma and price. These variables were integrated into the model to assess their impact on the outcomes related to millet consumption.

majority of spice-growing farmers in Kerala being small and marginal, For them, making a significant investment in drip irrigation is still a difficult challenge (Hema et. al., 2007) [1].

Research Methodology

Systematic efforts have been made periodically at RARS Vellayani and RARS Pattambi since January 2022 to conduct surveys on measures to enhance the value chain sustainability of black pepper from Kerala. Documentation and economic evaluation of innovative methods followed by the Black Pepper farmers in managing biodiversity and drought and other productivity enhancement practices was done as a part of the survey.

The survey was conducted in selected farmer plots from AEUs 16,14,15,20 and 21, AEUs 17 and 19. The selection of Panchayats in respective AEUs was done based on a preliminary survey to know the area, production, and number of Black Pepper farmers in the Panchayats. 185 farmers were surveyed during the period. The major adaptation practices followed by farmers to get a sustained income from black pepper farming are

1. Grafting with the rootstock *Piper colubrinum* on Black Pepper scion and mass production of grafts for field planting. Bush Pepper grafts are also produced for selling to homesteads.
2. Application of diluted Cow dung urine which helps in fast establishment and growth of plants both in nursery and main field. The farmers observed that the practice gives resistance to pests and diseases.
3. Maintenance of multiple landraces for combating yield variations and generating additional income through selling of rooted cuttings.
4. Use of standards that protect vines from wind and are resistant to nematodes such as Jack, Mango, and Mahagony.
5. Plastic mulching of the field which reduces fungal infection and nematode population.
6. Shallow planting of Pepper cuttings in the main field and mulching with dried leaves is followed by farmers to reduce the parching of topsoil around the cuttings.
7. Selection of suitable intercrops that suit the location and give a stable income to farmers.
8. Hermetic storage for storing Black Pepper to control pest and fungal infestation during storage.
9. Direct marketing of green pepper to processing units gives a better share to farmers on the consumer’s rupee.
10. Locally assembled innovative threshers that give better berry recovery and enable decortication of Black Pepper.
11. Collectivisation of production and marketing through Farmer interest groups, Pepper Samitis, and Farmer Producer organizations provide better backward and forward production linkages.
12. Adoption of organic farming to get sustainable production and adherence to organic certification systems for getting premium prices.

Based on the adaptation practices identified, a choice experiment was done to assess the decision-making behavior of farmers in adopting climate change adaptation practices. The choice cards were prepared using fractional factorial design and the responses were recorded using Best worst scaling -profile case. BWS ascertains if respondents are better at making their best choices or their worst choices to make them more resilient towards value chain sustainability. Understanding small holder’s choice consistency provides better insights into their underlying thought process.