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The Evolving Landscape of Paddy Cultivation in Kerala

Dr. Basheer K K[1*],
[1*]Assistant Professor of Economics, Dept. of Economics, N.M.S.M. Government College Kalpetta, Wayanad-673122. Email: basheerkkw@gmail.com

Dr. Muneer Babu M.[2]
[2]Assistant Professor of Economics, Dept. of Economics, Dr. John Matthai Centre, University of Calicut. Aranattukara, Thrissur - 680 618, Email: mkmmuneerbabu@gmail.com

Mr. Biju Abraham[3]
[3]Assistant Professor of Economics, Dept. of Economics, N.M.S.M. Government College Kalpetta, Wayanad-673122. Email: kbiju2@gmail.com

***Corresponding author: Dr. Basheer K K.**
*Email: basheerkkw@gmail.com

Abstract

This study explores the evolving landscape of paddy cultivation in Kerala, focusing on the socioeconomic, technological, and environmental changes that have shaped this sector. The study based on both secondary and primary data sources, investigates the role of collective farming initiatives such as Padashekhara Samithies and Joint Liability Groups (JLGs) of Kudumbashree in addressing challenges like labour shortages, climate change, and technological changes. The study also examines the shift towards commercial crops, technology adoption in terms of the use of High Yielding Varieties seeds (HYVs) and implications for food security and sustainability. The study observes that despite the support from initiatives like Padashekhara Samithies and JLGs of Neighbourhood Groups (NHGs), paddy cultivation in Kerala faces labour shortages, climatic uncertainties, and declining profitability, emphasizing the need for sustainable and climate-resilient practices, conservation of traditional paddy varieties, and adoption of modern machinery. Future research, therefore, should focus on developing innovative solutions to labour shortages, enhancing climate-resilient practices, and promoting the conservation and use of traditional paddy varieties to ensure the sustainability of paddy cultivation in Kerala.

Keywords: Paddy cultivation, collective farming, climate change, labour shortage, technology adoption, commercialisation.
JEL: Q10, Q13, Q18.
UDC: 63, 631.11,631.16, 338.43

1. Introduction

The agriculture sector in Kerala occupies a significant role in the Kerala economy. According to the Kerala State Economic Review for 2021, however, the agriculture economy faces challenges on account of decelerating growth, risks from climatic uncertainties and variabilities, variations in commodity prices, and marketing of agricultural produce. Thomas (2011) observes that paddy cultivation in Kerala faces numerous challenges, including long-term policy, technological, and environmental issues that necessitate attention and addressing. There are several other research

highlights numerous challenges faced by paddy cultivation in Kerala, including declining profitability (Raj, 2009), labour shortages (Thomas, 1996), and climate change (Subramanyam et al., 2018). These factors have led to a decline in paddy production, making Kerala a rice-deficient state (Karunakaran, 2014). To address these challenges, sustainable and climate-resilient agriculture practices need to be promoted and scaled up in paddy cultivation in Kerala (Hari et al., 2016).

Collective farming initiatives, such as Padashekhara Samithies and Joint Liability Groups (JLGs) of Kudumbashree, play a crucial role in addressing challenges faced by paddy farmers in Kerala, including labour shortages (Thomas, 2011), climate change (Subramanyam et al., 2018), and technological changes (Hari et al., 2016). These initiatives promote collective action among farmers, enhance their bargaining power, and provide access to resources, technology, and markets (Boumara et al., 2015). The shift towards commercial crops and technology adoption, particularly the use of High-Yielding Varieties (HYVs) seeds, has significant implications for food security and sustainability in Kerala (Gopi et al., 2018). While HYVs have increased productivity, they have also led to a decline in traditional crop diversity and increased dependence on external inputs (Vishnudas, 2003). Furthermore, the shift towards commercial crops has resulted in the marginalization of smallscale farmers and the degradation of natural resources (Karunakaran, 2014).

The present study highlights the need for a sustainable and equitable approach to paddy cultivation in Kerala, one that balances productivity with environmental and social sustainability. Collective farming initiatives and technology adoption must be aligned with the principles of agroecology and food sovereignty to ensure that the benefits of technological progress are shared equitably among all stakeholders (Rasheed et al., 2021). By adopting a holistic approach, Kerala can ensure food security, sustainability, and the well-being of its farming communities. It is against this broad background that present study aims to understand the changing context of paddy cultivation in Kerala, Wayanad and Palakkad. Based on primary data collected from Wayanad and Palakkad, and secondary data from Kerala Agriculture Statices published by DES and Kerala Economic Reviews by State's Planning Borad, changing context of paddy cultivation in Kerala attempted to narrate under three sections. Following the introduction section, Section two examines the efficacy of collective farming initiatives, namely Padashekhara Samithies and Kudumbashree's Joint Liability Groups (JLGs), in mitigating emerging challenges such as labor shortages and climate variability. Section three investigates the adaptive strategies employed by paddy farmers in response to changes in cropping patterns, commercialization. The fourth section investigate role of technological changes in terms of farmers adoption of high yielding varieties of seeds in paddy cultivation, followed by the conclusion and suggestion of the study.

2. Collective Paddy Farming by Padashekhara Samithies.

The Kerala state launched an initiative known as Padashekhara Samithi for paddy production in the late 1980s. Padashekhara Samithi is the cooperative of the paddy farmers' locality registered to promote the cultivation of paddy and allied crops. These collectives of paddy farmers are an institution that arose as a result of cooperative farming efforts. It organises farmers in rice-growing villages, and the members democratically elect their leaders. Padasekkara Samithis and Krishi Bhavans[1] play a crucial part in the revival of rice farming in Kerala. Through Padasekhara Samithis, Krishi Bhavans provide farmers with subsidised seeds and fertilisers. Smithies were also entrusted with the responsibility and management of machinery like harvesters, threshers, crushers, and tractors acquired with panchayath funds and made available to paddy farmers. The State's financial aid for ensuring

[1] Agriculture support institutions run by the state's Agriculture Department and operated by panchayats

food security for paddy cultivators is channelled through Samithies. Block wise details of Samithies, number of farmers registered and total area of paddy cultivation under Samithes have given in table-1.

Interactions with paddy farmers and experts in the Wayanad and Palakkad study area reveal concerns regarding the limited reach of Padashekhara Samithies, with only a small proportion of paddy farmers participating in these organizations. Additionally, the dominance of larger farmers within these smithies was noted as a concern, potentially perpetuating existing power imbalances and marginalizing smaller farmers. Furthermore, observation from the study area suggest that Padashekhara Samithies tend to focus primarily on production-related issues, neglecting crucial aspects such as marketing, processing, and social welfare. These oversights can have important implications for the livelihoods of paddy farmers, highlighting the need for a more comprehensive approach to addressing their needs.

Padashekhara Smithies' establishment in the State, however, can be viewed as an important institutional change in paddy cultivation to adjust the climate change issues. It has been observed in the study area that adaptation and coping practices to climate change, such as applying for crop insurance, selecting specific improved seed varieties, the decision to go for delaying in sowing and switching between direct sowing and transplanting methods of cultivation, are only possible through farmers' membership in group farming, such as Smithies. The majority of members in the Samithi of Wayanad and Palakkad, for example, have chosen the Valichoori or Uma[2] seed varieties of paddy.

Table 1, Padashekhara Samithies in the Study Area.

	Community Development Block Kuzhalmandam		
Gram Panchayath	No Padashekhara Samithies	No of Farmers	Area(Ha)
Kuzhalmandam	44	2236	1187.95
Peringottukurrish	28	2129	1803.8
Kuthannur	25	2137	880.39
Kannadi	28	1695	853.08
Koyttayi	33	1899	660.951
Mathure	34	2005	925.49
Thenkurissi	26	1737	904.09
	Community Development Block Alathur		
Gram Panchayath	No of Padashekhara Samithies	No of Farmers	Area(Ha)
Alathur	17	1202	483.89
Puthukkode	10	886	326.52
Kannambra	13	1206	425
Kavassery	19	1782	718.64
Erimayur	27	2483	1180.81
Kizhakkanchery	24	1558	519.3

[2] Uma and Valichoori have maturity periods of 120 and 140 days, respectively, and are improved seed varieties of paddy discovered by the regional research station to respond to early and late arrival of rainfall.

Tharur	22	1486	576.97
Vadakanchery	22	1256	46
	Community Development Block Panamaram		
Gram Panchayath	No of Padashekhara Samithies	No of Farmers	Area(Ha)
Panamaram	40	1800	890
Kaniyambetta	15	759	508
Poothadi	21	1275	450
Pulpally	10	971	357.4
Mullamkolly	16	371	140

Source: Field Survey, 2021

If a member does not choose Uma; an early maturing seed variety preferred by the majority of Samithi members, the farmer has to face the brunt of consequences, such as production loss owing to pest and pathogen outbreaks, late maturing, and harvesting. Therefore, it can argued that the introduction of collective farming in paddy cultivation was also able to address technological and climate change constraints by disseminating information among farmers about the timing of water availability through canal irrigation, crop selection, seed and fertilizer availability with Krishi bhavan, availability of machinery for various farm operations, and early climate warning.

2.1 Leased Cultivation of Paddy by Joint Liability Group (JLGs)

Another important changing background of paddy cultivation in the study area may be women's collective farming of paddy on lease land under the Kudumbashree initiative[3]. In the Kerala Action Plan on Climate Change 2014, collective farming through Kudumbashree was highlighted as a key programme in the agriculture sector relevant in the context of climate change. Over a long period, a growing number of small, medium, and large parcels of cultivable land were left fallow in the State (Abraham, 2019), due to labour shortages, high costs of cultivation, commercial crops' export prospects, growth in the number of absentee landowners, and low profitability (Thomas, 1996). In 2008, the Kerala Government passed the “Kerala Conservation of Paddy Land and Wetland Act”, which prevented rice fields from being left fallow or used for other purposes without authorisation from a district/state level monitoring committee. One of the main implications of the act is the resurgence of paddy farming through Joint Liability Groups (JLG), where landless women operating under the Kudubashree banner across the State have exhibited an increased presence in leased paddy cultivation.

However, existing studies have identified some issues with Joint Liability Group (JLG) cultivation of paddy in Kerala, including a lack of technical expertise, which can lead to suboptimal farming practices and lower yields (Suma et al., 2017). Furthermore, JLGs have limited market access, and heavy reliance on local markets for procuring inputs and selling outputs make the products less competitive, questioning the sustainability of microenterprise model (Deepika et al., 2014). These challenges can hinder the effectiveness of JLGs in promoting sustainable paddy farming practices and improving the livelihoods of paddy farmers in Kerala. Nonetheless, while JLGs face challenges in

[3] Collective farming by State Poverty Eradication Mission through Kudumbashree is known as Harithashree.

selling products, generating revenue, and attracting additional sources of income, their formation empowers women and strengthens village economies (Sreeni, 2021).

Table 2, Leased in Area of Paddy in the Study Area

	Palakkad		Wayanad	
	Area (Acere)	No of Farmers	Area (Acere)	No of Farmers
Leased in cultivation	29.07	19(9.9)	230.78	57(41.3)
Owned Cultivation	288.10	173(90.1)	389.82	81((58.7)
Total	317.17	192(100)	620.6	138(100)

Source: Field Survey, 2021.

In Kerala, Kudumbashree helps landless women in agriculture by providing food security and improving the livelihoods in Kerala through JLG collective farming in paddy. Paddy (27 per cent of the area) is the main crop cultivated by the Kudumbashree group during 2009-10 on a lease land farming, followed by plantation and vegetables (KSAPCC, 2014). The reduced area under fallow and other cultivable wastelands at the state level (DES Agristat, 2020) perhaps be attributed to the advent of Kudumbashree-supported paddy cultivation through JLGs. In 2016, the Joint Liability Group (JLG) of the Kudumbashree program cultivated paddy on 11337 hectares in Kerala, with Palakkad cultivating 1444.05 ha (12.7 per cent) and Wayanad cultivating 476.6 ha (4.2 per cent) (Kudumashree report, 2017). However, present study found from the field survey that 41.3 per cent of paddy farmers in Wayanad and 9.9 per cent of Palakkad were engaged in leased paddy cultivation (Table 2).

2.2 Labour Shortage

Demographic changes in work participation, with reference to agricultural labourers and cultivators, have been seen in the study area, in line with the changing background of Kerala state's demography during the last two decades (table 4). Labor shortages in paddy cultivation in Kerala are mainly caused by out-migration, disinterest in farming, wage differentials, and alternative employment opportunities like MGNREGA, leading to a scarcity of skilled labor, especially during critical operations like harvesting (Prasad, 2017). Labour shortages in paddy cultivation is also caused by other factors such as, changes in land use pattern and cropping pattern (Viswanathan 2016), and gulf migration (Zachariah, 2005) have resulted in acute labour shortage and higher wages. The implementation of the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) in Kerala has in particular resulted in higher wage rates for laborers, reduced availability of labor during peak agricultural seasons, and a decline in labor productivity, in paddy cultivation (Lakshmi, 2019). It can be inferred from the figure 1 that agriculture work participation, mainly among cultivators and agriculture labourers, is declining changing in Kerala, Wayanad and Palakkad between 2001 and 2011. This decline of cultivators and agricultural labour will affect paddy cultivation. The seasonal shortage of agricultural labour is widely acknowledged as a serious difficulty facing rice farming in Kerala today. Kerala has been moving its workforce away from agriculture and into various nonagricultural occupations at a significantly higher rate than the rest of India. According to the National Sample Survey (NSS), only 35.5 per cent of Kerala's workforce was employed in agriculture, fishery, or forestry in 2004–05, compared to 56.5 per cent in India. In recent years, Kerala's occupational

diversification has been helped by the massive spread of mass education and the rapid development of construction and service-sector incomes (Thomas, 2011).

Figure 1, Category of Workers in Kerala, Palakkad & Wayanad

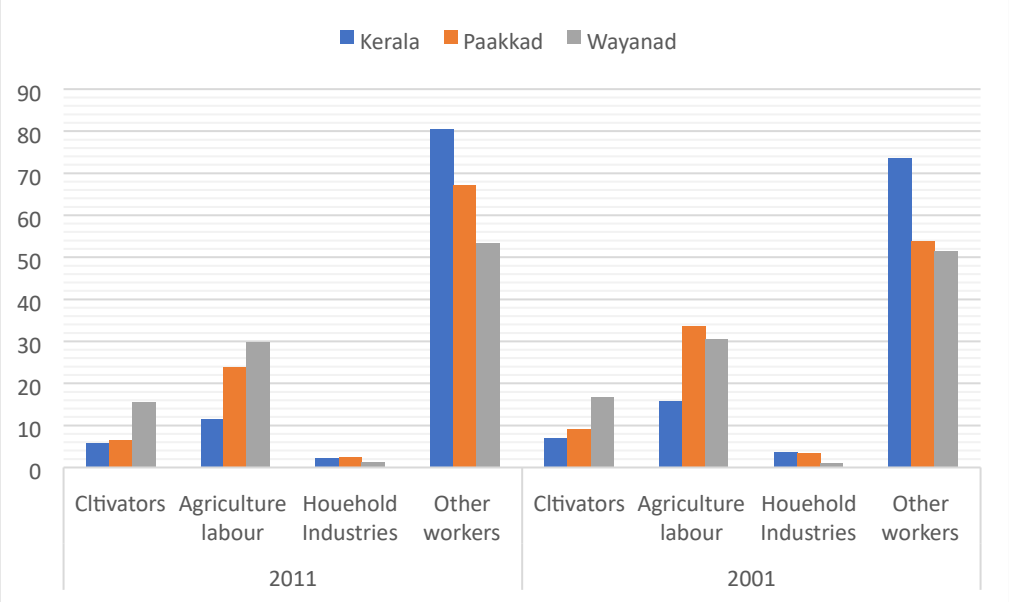
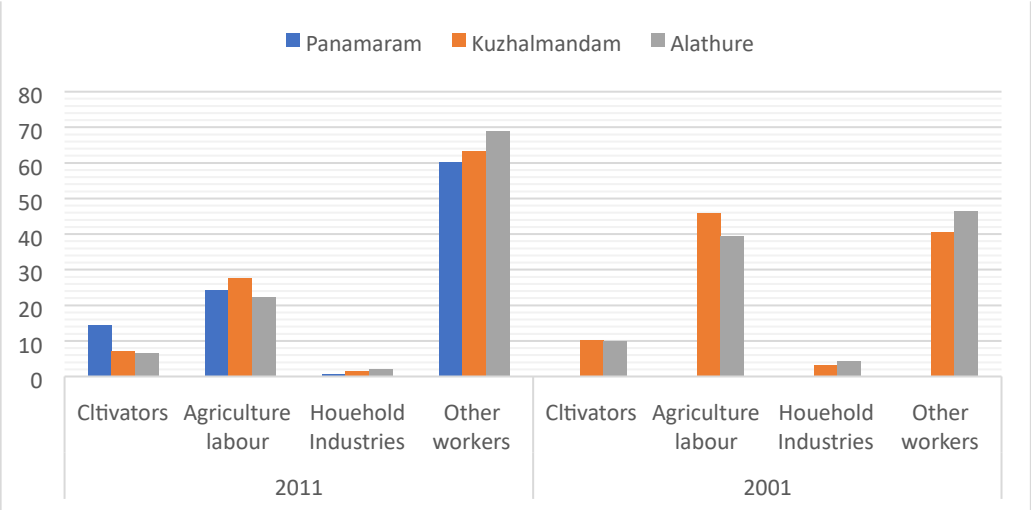


Figure 2, Category of Workers in Kuzhalmandam, Alathur & Panamaram



Labour shortages as such have significantly impacted paddy cultivation in the study area, with farmers in Wayanad and Palakkad attributing the scarcity to the availability of alternative local employment opportunities offering higher wages (Table 3). Notably, non-farm occupations provide daily wages

ranging from Rs 1000 to 1100, while agricultural labourers receive barely sufficient subsistence wages, with male labourers earning between Rs 550 and 750 per day and female labourers earning between Rs 450 and 650 per day in the Wayanad-Palakkad paddy growing region (Field Survey, 2021). Additionally, farmers perceive other factors contributing to labour shortages, including the emergence of MGNREG, the seasonal nature of agriculture jobs, shifting to permanent occupations, perceived low esteem of agriculture occupations, higher educational attainment and occupational mobility, and migration to other cities and foreign countries. These factors collectively exacerbate the labour shortage, hindering paddy production in the region.

Table 3, Reasons for Labour Shortage.

Reasons for labour Shortages	No of Famers perceived in Palakkad (%)	No of Famers perceived in Wayanad (%)
The availability of other local jobs with higher wage	75	81
The emergence of MGNREGA	63	71
Seasonal nature of agriculture jobs	42	57
The transition to a full-time job	36	50
Perception of agriculture occupation as low esteem	27	31
Migration to other cities	10	19
Higher educational attainment and occupational mobility	7	14
International migration	2	6

Source: Field Survey, 2021

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Table 4, Category of Workers

	Variable	Kerala		Palakkad		Kuzhalmandam		Alathur		Wayanad		Panamaram	
2011	Population variable	33406061	(2.76)	2809934	(8.41)	1,74,611	(6.21)	2,68,098	(9.54)	817420	(2.45)	45,627	(5.58)
	Main workers	9329747	(27.93)	875540	(31.16)	62,665	(35.89)	93,303	(34.80	263445	(32.23)	14,414	(31.59)
	Marginal workers	2289316	(6.85)	166800	(5.94)	5,317	(3.05)	15,853	(5.91)	76632	(9.37)	4317	(9.46)
	Total workers	11619063	(34.78)	1042340	(37.09)	73,891	(42.32)	1,09,156	(40.71)	340077	(41.60)	18,731	(41.05)
	Cultivators	670253	(5.77)	67,805	(6.50)	5,317	(7.20)	7,051	(6.46)	52759	(15.51)	2,732	(14.59)
	Agriculture labour	1322850	(11.39)	249949	(23.98)	20,436	(27.66)	24,469	(22.42)	101630	(29.88)	4,558	(24.33)
	Household Industries	273022	(2.35)	25035	(2.40)	1,206	(1.63)	2,384	(2.18)	4574	(1.34)	148	(0.79)
	Other workers	9352938	(80.50)	699551	(67.11)	46932	(63.51)	75252	(68.94)	181114	(53.27)	11293	(60.29)
2001	Population variable	31841374	(30.10)	2617428	(8.22)	1,66,029	(6.34)	253385	(8.49)	780619	(2.45)	**	
	Main workers	8236973	(25.87)	768620	(29.37)	55,086	(33.18)	82530	(32.57)	219789	(28.16)	-	
	Marginal workers	2046914	(6.43)	176432	(6.74)	15,776	(9.50)	18020	(7.11)	88824	(11.38)	-	
	Total workers	10283887	(32.30)	945052	(36.11)	70,862	(42.68)	100550	(39.68)	308613	(39.53)	-	
	Cultivators	724155	(7.04)	85638	(9.06)	7,205	(10.17)	9997	(9.94)	51751	(16.77)	-	
	Agriculture labour	1620851	(15.85)	317192	(33.56)	32,506	(45.87)	39607	(39.39)	94139	(30.50)	-	
	Household industries	369667	(3.59)	32832	(3.47)	2,341	(3.30)	4257	(4.23)	3600	(1.17)	-	
	Other workers	7569214	(73.60)	509390	(53.91)	28,810	(40.66)	46689	(46.43)	159123	(51.56)	-	

Source: District Census HandBook Wayanad 2001, 2011, District Census HandBook Palakkad 2001, 2011, Note: Values in the paranthesis for main workers and marginal workers expresess per cent to total population of India, Kerala, Palakkad and Wayanad. Values in the bracket for other category of workers expressed in per cent to total workers ** Data related to the variable for Panamaram block became available after 2011 census onwards as Panamaram Community Development Block formed in 2010 after the amalgamation of gram panchayats Pulpally, Mullankolly, Puthadi, Panamarm, and Kaniyambetta Gram Panchayath from Kalpetta, Mananthawady and SulthanBathery blocks.

3. Changes in the Cropping and Commercialisation

The transition from food crops to non-food crops has been the most noticeable change in Kerala's cropping pattern from 1954-55 to 2016-17 (Johnson D, 2018). During this time, there was a shift away from rice farming and toward more lucrative crops like coconut, areca nut, banana, tea, coffee, and rubber. Between the 1970s and 1996, rice had the "smallest increase in average farm prices among key agricultural commodities in Kerala" (George et al 1986). Changes in land use and cropping patterns away from paddy-based food crops hurt food security and the environment in the State (Kanampath, 2015). However, price volatility especially among cash crops grew as a result of the adoption of new multilateral trade agreements during the 1990s, and given the limited capacity of the state government to protect cultivating farmers due to quantitative limits (Joseph 2005, Johnson D, 2018).

The present study attempted to measure the extent of commercialisation in the Palakkad and Wayanad study areas using the Herfindahl Index (HI) as specified in the following formula.

$$\mathbf{HI} = \sum_{i=1} \mathbf{P}i^2$$

The HI is the measure of concentration, where the index is calculated"by taking the sum of area proportion of each crop in the total cropped area". In the formula, "n is the total number of crops, P*i* represents acreage proportion of i^{th} crop in the total cropped" area."With the increase in diversification, the index value decreases", HI take the value of one when there is complete specialisation and tends to zero when N becomes large.

Available block-level data since 2009 for the study area, for the area under important food crops like paddy and tapioca as well as non-food crops like pepper, ginger, turmeric, areca nut, banana, plantain, cashew, and coconut, were used to calculate the index.

Table 5, Crop Diversification in Palakkad, Wayanad and Panamaram

Crops	Kuzhalmandam	Alathur	Panamaram
Paddy	0.41581	0.23238	0.02111
Tapioca	0.00002	0.00026	0.00066
Pepper	0.00001	0.00018	0.03796
Ginger	0.00003	0.00001	0.00118
Turmeric	0.00003	0.00003	0.00001
Areca Nut	0.00001	0.00025	0.03139
Banana	0.00012	0.00013	0.01087
Plantain	0.00006	0.00045	0.00026
Cashew	0.00002	0.00004	0.00001
Coconut	0.0083	0.03297	0.03422
Total Non-food	0.01603	0.06667	0.51425

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Source: Agriculture Statistics, DES, Govt. of Kerala, note: Values are calculated HI

Climate change impact may have an impact on cropping pattern changes (Duku, 2018). Crop diversification reduces risks involved in crop production due to climatic variability, whereas commercialization assists farmers in reducing the high costs of cultivation and the high labour shortage in paddy cultivation. However, crop diversification as an adaptation to climate change requires changing crop mix which is climate resilient which is lacking in the study area. It has been observed in the study area that although a majority of the farmers of Wayanad and Palakkad

Table 6, Cropping Pattern Changes in Palakkad and Wayanad.

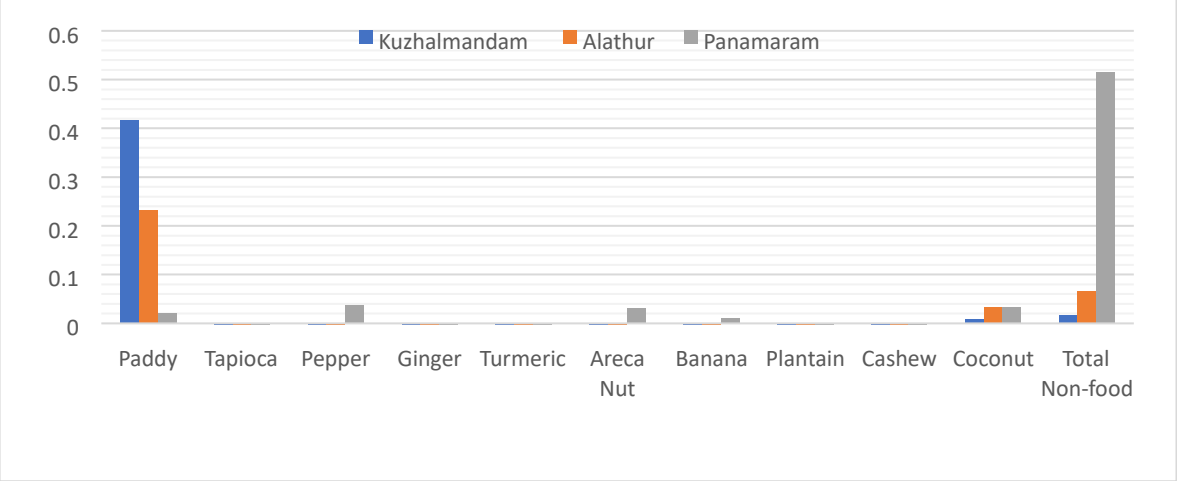
Kuzhalmandam	**Paddy**	5.33					5.66	5.46	5.37	4.76			
	Tapioca	0.11	0.07	0.08	0.08	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01
	Areca Nut	0.01	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.02	0.02	0.02	0.03
	Banana	0.019	0.021	0.012	0.025	0.02	0.009	0.013	0.012	0.009	0.01	0.004	0.004
	Coconut	0.73	0.72	0.83	0.82	0.77	0.78	0.75	0.81	0.7	0.71	0.72	0.76
	Non food	1.09	1.05	1.22	1.27	1.04	1.01	1.03	1.1	0.97	0.96	0.93	0.99
Alathur	**Paddy**	4.31	4.45	4.3	3.65	4.02	3.79	4.02	3.71	3.47	3.91	4.21	4.36
	Tapioca	0.17	0.18	0.18	0.17	0.16	0.14	0.17	0.11	0.1	0.1	0.07	0.06
	Areca Nut	0.11	0.34	0.17	0.14	0.13	0.12	0.07	0.1	0.1	0.11	0.09	0.09
	Banana	0.16	0.18	0.16	0.1	0.09	0.07	0.07	0.08	0.06	0.09	0.04	0.05
	Coconut	1.58	1.71	1.76	1.54	1.62	1.43	1.42	1.46	1.43	1.4	1.41	1.39
	Non food	2.41	2.9	2.63	2.22	2.25	1.98	1.9	1.99	1.92	1.94	1.87	1.82
Panamaram	**Paddy**	-	-	-	1.62	1.72	2.4	1.55	1.5	1.35	1.56	1.48	1.35
	Tapioca	-	-	-	0.43	0.4	0.24	0.33	0.27	0.24	0.26	0.21	0.2
	Areca Nut	-	-	-	1.67	1.84	2.04	1.89	2.39	1.97	1.99	2	1.92
	Banana	-	-	-	1.32	1.09	2.05	1.1	0.99	0.95	1	0.81	1.12
	Coconut	-	-	-	1.97	1.96	1.89	1.93	2.84	2.08	1.99	2.03	1.79
	Non food	-	-	-	7.37	7.28	8.61	7.76	10.02	7.98	8.05	7.44	7.21

Blocks Crops	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
		5.35	5.45	5.15	5.57					5.49	5.51	5.38

Source: Agriculture statistics, Directorate of Economics and tatistics, Govt of Kerala, Values expressed in percent to the district total cropped area.

adapted to commercial crops or other tree crops, few number of farmers are found to adapt to resilient climate practices such as altering cropping patterns toward less water-required crops(Table 7).

Figure 3, Crop Diversification in Palakkad and Wayanad



Note: values in the y axis is HI

Table 7, Adaptation to Climate Change by the Paddy Farmers.

Adaptation Practices	*No of Farmers in Wayanad*	*Per centage*	*No of Farmers in Palakkad*	*Per centage*
Change in Cropping Pattern towards commercial crops Mixed farming	84	43.8	127	66.1
Altering cropping patterns to less	79	41.1	51	26.6
waterintensive or rained crops	59	30.7	69	35.9
Increase in the number of livestock				
Shifting from crops to trees crops	67	34.9	46	24
	73	38	30	15.6

Source: Field Survey, 2021.

Changes in cropping patterns towards commercial crops and crop diversification (Table 5& 6) in the study area may also be attributed to farmers' adaptation to climate change. This could explain why paddy fields in Wayanad and Palakkad are increasingly being used to grow other crops such as coconut, areca nut, pepper, and banana crops. Although farmers switching to the cropping pattern towards perennial and thermal resistant crops like coconut and areca nut help to better adapt to climate change in the study area, however, crop switching results in the large-scale filling of paddy fields and hill levelling, on the other hand, has had an impact on the environment of the Wayanad in particular. As a result, there is more drinking water scarcity throughout the summer, as well as declining water tables, land erosion, and climate change (District HDI Report, 2010). Farmers are increasingly shifting away from wet rice fields and toward drier, permanent crops such as coconut, areca nut, and rubber as a result of growing apathy toward paddy farming.

4. Technological Changes in Paddy Cultivation in Study Area

According to Anja et al., (2014), the Wayanad region has transitioned from an agrarian economy based on staple food production to one based on cash crops and plantations. Now, coffee, tea, pepper, cardamom, and rubber are important plantation crops cultivated in Wayanad. In the case of paddy

cultivation, While Kerala has three rice seasons, Wayanad follows two paddy seasons known as Nanja and Punja[4]; however, the majority of the paddy farmers cultivate and harvest paddy only in the Nanja season. The majority of the rice fields remained fallow during the autumn season and Punja season due to inadequate irrigation facilities. There is no autumn paddy cultivation in the district.
Whereas, Palakkad district "is known as the rice bowl of Kerala". Palakkad follows three paddy seasons, known as Virippu, Mundakan and Puncha[5] . From table 8, it is clear that, Palakkad district has 27.8 % area under paddy cultivation to the gross cropped area of the state and 42.3 % share in rice production in the state rice production. In Palakkad, there have not been any appreciable improvements in the area under paddy cultivation after reaching its highest level of 34.6 % in 200506. According to surveys, in the last four decades, the District used a significant portion of cultivable land for growing food crops. It accounts for 80 % of the gross cropped area. Coconut, groundnut, sugarcane, pepper, and banana are the other important crops grown. In addition, oranges, coffee, cardamom, mango and vegetables are cultivated in Nelliyambathy in 325 ha. Even though the paddy acreage increase is low, higher production and intensive paddy cultivation have played a part in the higher productivity in Palakkad. Productivity of the Palakkad increased from 2230 kg/ha in 1990-91 to 2648 kg/ha in 2011-12 and further to an all-time high at 3224 kg /ha in 2019-20. The district has lost 1,03,980 hectares of rice fields. However, Paddy production in Palakkad registered an increase from 29.9 % in 1990-91 to 42.3 in 2019-20.

Table 8, Area and Production of Paddy in Study Area

Year	Area and Production of Paddy			
	Palakkad		Wayanad	
	Area	Production	Area	Production
1990-91	26.0	29.9	3.6	3.9
1995-96	28.8	29.4	4.3	4.9
2000-01	34.2	34.9	4.3	4.5
2005-06	34.6	42.3	4.2	4.5
2015-16	27.6	41.6	4.7	4.3
2019-20	27.8	42.3	3.7	3.3

Source: Agriculture Statistics, Eco Stat, DES, Govt. of Kerala.
Note: Values indicate proportions to the state gross cropped area and total state production of paddy

4.1 Area Covered under Traditional and Modern Varieties.

When new agricultural technology, popularly known as the New Agriculture Strategy (NAS), was introduced in India in the 1960s, the extent of technology adoption in southern states in particular was relatively low. In Kerala, the adoption of (HYV) began only in 1968-69 and was mostly limited to rice. In Kerala, high-yielding varieties accounted for 28.8% of the total paddy area, while traditional

[4] Paddy seasons of Wayanad known in local name as Nanja and Punja. Nanja paddy season occure in winter starts in September-October and harvest in December-January, where asPunja is summer paddy season begin in December-January and ends in March-April.
[5] As per agriculture climate, Kerala has three paddy season known in local name as Virippu, Mundakan and Puncha. Virippu (Autumn-paddy) is the first crop season occure in April-May and harvest in September-October. Mundakan(Winter paddy) is the second crop season starts in September-October and end in December-January. Puncha (Summer paddy) is the third crop season starts in Decemcer-January and harvest in March-April.

paddy varieties accounted for 71.2 per cent of the total paddy area in 1990-91. Over 30 years, the area under modern verities increased significantly to 97.1 per cent, while the area under modern verities decreased dramatically to 2.9 per cent of the total area under paddy in 1990-91in the state.

With declining paddy area and production, intensive cultivation with high-yielding varieties of seeds could maintain higher paddy productivity in the state. The expansion of area under high-yielding seed varieties in the future depends on how far new seed varieties can address climatic stress in the future. Similar to the state pattern, area expansion of new paddy seed varieties in Wayanad and Palakkad follow the same trends. Wayanad district is famous for its traditional rice varieties. Wayanad used to cultivate almost 105 indigenous rice varieties by the farming community just a few decades ago, it has, however, been reduced to 20 throughout the years (MSSRF, 2008). The few surviving traditional rice varieties in Wayanad are "Adukkan, Veliyan, Chenellu, Chomala, Chenthadi, Thondi, Gandhakasala, Jeerakasala Mullankaima, and Kalladiaryan". Wayanad has experienced an apparent reversal in the changes in paddy productivity since 2004-05, and at present, Wayanad has 3.7 % and 3.3 % state's area and production of paddy. The productivity of paddy in Wayanad stood at 2663 kg/ha in 2019-20. The inability of the traditional verities to withstand harsh climates[6] coupled with low profitability perhaps forces farmers to shift towards high-yielding verities (Blakeney et al., 2020).

Table 9, Productivity of Paddy in Study Area (Yield in kgs /ha)

Year	Palakkad	Wayanad	Year	Palakkad	Wayanad
1990-91	2230	2063	**2005-06**	2341	2468
1991-92	2344	2186	**2006-07**	2473	2597
1992-93	2297	2382	**2007-08**	2463	2585
1993-94	2337	2225	**2008-09**	2499	2657
1994-95	2240	2124	**2009-10**	2648	2552
1995-96	2067	2288	**2010-11**	2493	2525
1996-97	2291	2199	**2011-12**	2672	2615
1997-98	2173	2217	**2012-13**	2389	2742
1998-99	2213	2218	**2013-14**	2872	2679
1999-00	2287	2587	**2014-15**	2851	2701
2000-01	2209	2253	**2015-16**	2816	2575
2001-02	2323	2495	**2016-17**	2202	2640
2002-03	2104	2412	**2017-18**	2634	2715
2003-04	1802	2303	**2018-19**	2792	2878
2004-05	2343	2578	**2019-20**	3224	2663

Source: Agriculture Statistics, Eco Stat, DES, Govt. of Kerala. Note: Values indicate kilogram per hectare

[6] Traditional rice verities are exposed to grains falling down and bending due to the higher length of grass stand.

Figure 4, Area under Modern and Traditional Paddy Varieties in Kerala

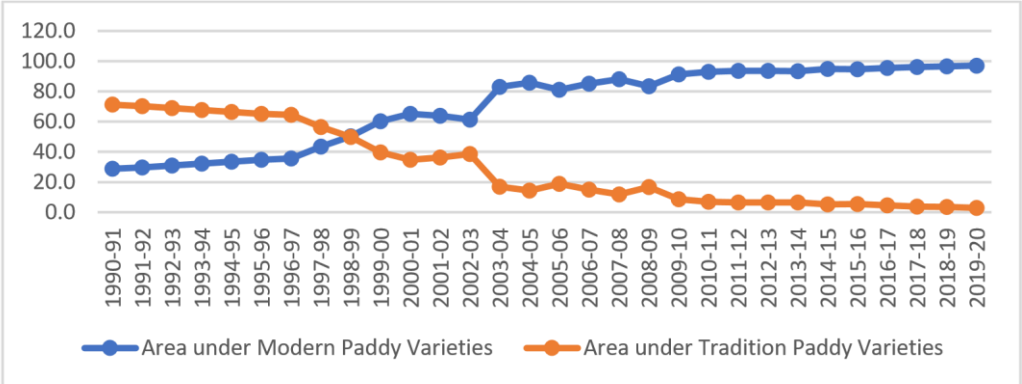


Figure 5, Area under Modern and Traditional Paddy Varieties in Wayanad

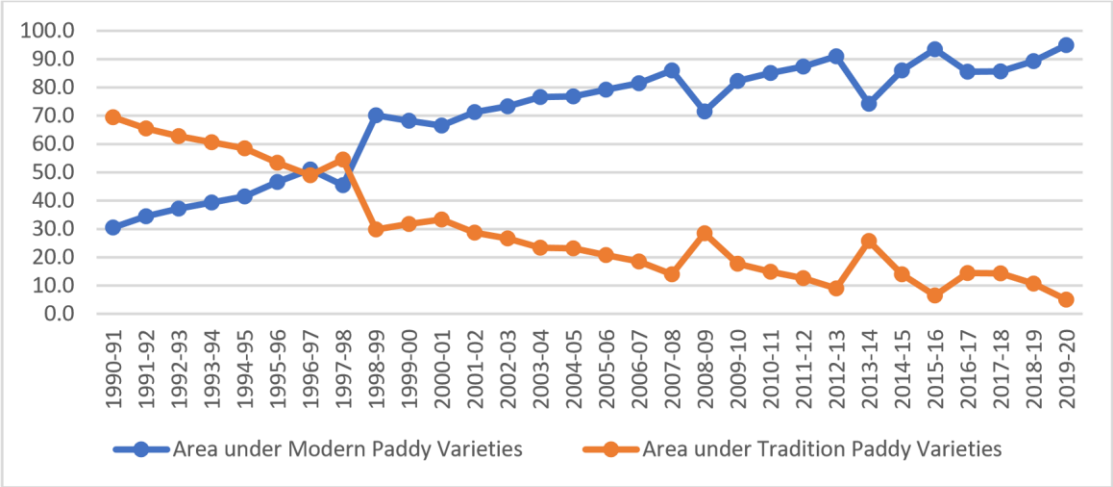
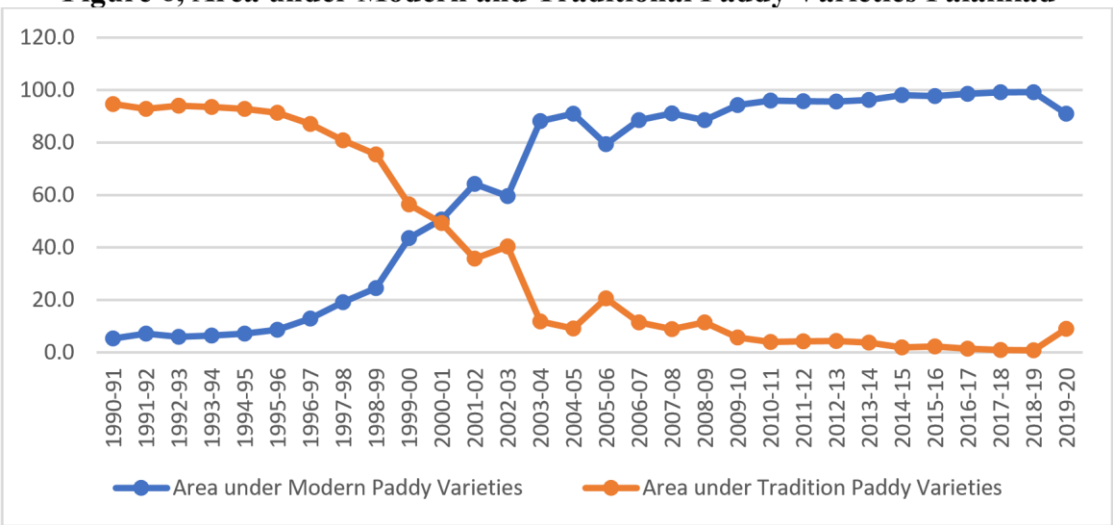


Figure 6, Area under Modern and Traditional Paddy Varieties Palakkad



It has been observed from the field that still few farmers cultivate traditional seeds verities along with modern verities. It can be inferred from table 10, the status of technological adoption in the study area. It was found in the study area that the majority of paddy farmers from Wayanad and Palakkad switched to new high-yielding paddy seed varieties. More than 95 per cent of the paddy cultivation area is found to have been converted to high-yielding seed varieties, with only 4.8 per cent of the area covered by

traditional seed varieties. Paddy farmers' favourite high-yielding paddy seeds include Uma, Jaya, Athira, Valichoori, Palakkadan Matta, Cherumatta, Masoori, 1000 kana, Rosematta, Vyshakh, IR 20, Navara, Sigappi, AST, Jyothi, and Kanjana. Although high-yielding is the most common reason given by 90% of paddy farmers for choosing these varieties in the field, 78 per cent of farmers choose high-yielding paddy seeds for cultivation due to group farming. Farmers who adopt specific seed varieties

Table 10, Extend of Traditional and Modern Varieties in the Study area.

Paddy Seeds	Wayanad Area	No of Farmers	Palakkad Area	No of Farmers	Total no farmers	Total area
Traditional	5.2 (1.67)	10 (7.2)	3.49 (0.61)	6 (3.2)	16 (4.8)	8.69 (0.98)
Modern	309.65(98.32)	128(92.8)	569.144(99.39)	186(96.8)	314(95.2)	878.794(99.02)
Total	314.85 (100)	138 (100)	572.634 (100)	192 (100)	330 (100)	887.484 (100)

Source: Field Survey. Note: Area is in acers, and values in the parenthesis are expressed as per cent.

through group farming in paddy cultivation can overcome a variety of challenges, including pest and pathogen outbreaks, labour shortages, and machine shortages, besides the attainment of higher paddy productivity. Traditional seed varieties are more popular only among more experienced paddy farmers because they believe they can better withstand adverse weather conditions than modern varieties. Few farmers cultivate traditional seed varieties solely for their consumption, while many cultivate modern varieties solely for marketing.

5. Conclusions and Suggestions

The agriculture sector in Kerala is integral to the state's economy. Despite its importance, the sector faces significant challenges, including decelerating growth, climatic uncertainties, price fluctuations, and marketing issues. Various studies have highlighted the specific problems in paddy cultivation, such as long-term policy inadequacies, technological constraints, environmental concerns, declining profitability, labor shortages, and the impacts of climate change. These factors have contributed to a decline in paddy production, rendering Kerala a rice-deficient state. Addressing these challenges requires promoting sustainable and climate-resilient agricultural practices and conserving traditional paddy varieties and their genetic diversity.

Paddy cultivation in Kerala has also seen significant shifts due to socioeconomic and demographic changes. Initiatives like Padashekhara Samithies have been established to promote cooperative farming, offering subsidized seeds, fertilizers, and machinery to farmers. These collectives have played an important role in reviving rice farming in Kerala by providing essential resources and support. However, labour shortages remain a persistent issue, driven by demographic changes, alternative employment opportunities, and migration. Technological adoption in terms of adoption of modern variety has influenced paddy farming in Kerala.

Padashekhara Samithies, established in the late 1980s, are cooperatives of local paddy farmers aimed at promoting paddy cultivation and allied crops. These collectives organize farmers in rice-growing villages and provide them with subsidized seeds, fertilizers, and machinery. The financial aid from the state for food security is channelled through these Smithies. This initiative has been instrumental in reviving paddy farming and addressing challenges related to climate change by facilitating the adoption of improved farming practices and technologies. Padashekhara Samithies facilitate the dissemination of information on improved seed varieties, water availability, and early climate warnings. However, there is a need for greater adoption of climate-resilient practices and crop diversification to mitigate the impacts of climate change. The use of modern machinery and improved cultivation techniques has also been promoted to enhance productivity and sustainability.

Climate change poses a significant threat to paddy cultivation in Kerala. Farmers have adopted different coping strategies, such as crop insurance, selecting improved seed varieties, and altering

sowing and transplanting methods. Collective farming through initiatives like Padashekhara Samithies has enabled farmers to implement these practices effectively. Additionally, the conservation of traditional paddy varieties, which are more resilient to climate change and have higher nutritional value, is crucial for sustainable agriculture.

The Kudumbashree initiative promotes women's collective farming of paddy on leased land through Joint Liability Groups (JLGs). This approach has helped address issues like labour shortages, high cultivation costs, and absentee landowners. The Kerala Conservation of Paddy Land and Wetland Act of 2008 has further encouraged paddy farming by preventing the conversion of rice fields for other purposes. The resurgence of paddy farming through JLGs has contributed to reduced fallow land and improved food security in the state.

Labour shortages have significantly impacted paddy cultivation in Kerala. The emergence of alternative employment opportunities, the MGNREG program, and migration have reduced the availability of agricultural labour. This has led to higher wages and increased cultivation costs. The study highlights the demographic changes in work participation and the seasonal nature of agricultural jobs as key factors contributing to labour shortages. Furthermore, there has been a noticeable shift from food crops to non-food crops in Kerala's cropping pattern over the past few decades. This transition, driven by the pursuit of more lucrative crops, has implications for food security and environmental sustainability. Crop diversification and commercialization are seen as strategies to mitigate the high costs of cultivation and labour shortages in paddy farming. However, the study emphasizes the need for climate-resilient crop choices and sustainable agricultural practices. Farmers in Kerala have adopted various strategies to adapt to climate change, including changing cropping patterns, mixed farming, and increasing livestock. These practices help mitigate the risks associated with climatic variability and enhance the resilience of the agricultural sector. The study underscores the importance of promoting climate-resilient practices and providing support to farmers to facilitate their adaptation efforts. In short, The changing context of paddy cultivation in Kerala is shaped by a combination of socioeconomic, technological, and environmental factors. Initiatives like Padashekhara Samithies and Kudumbashree's JLGs have played a pivotal role in addressing the challenges faced by paddy farmers. However, continued efforts are needed to promote sustainable and climate-resilient practices, conserve traditional paddy varieties, and address labor shortages to ensure the long-term viability of paddy cultivation in Kerala.

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