Who cultivates traditional paddy varieties and why? Findings from Kerala, India

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Traditional paddy varieties are climate resilient, local stress-tolerant, low-input intensive and valuable sources of genetic diversity that have been under the threat of extinction from rising preferences for high yielding varieties. However, farmers in few pockets of the globe continue to cultivate traditional paddy varieties. This study therefore is an attempt at investigating who cultivates them and why they do so, through the survey of 225 paddy farmers in Wayanad district of Kerala. Results revealed that traditional paddy varieties were grown mainly by marginal and tribal farmers for chief purposes of self-consumption, and for associated traditional values and conservation. Farmers' varietal selection decisions were found to be influenced by varietal traits related to consumption aspects, consumer demand, pest and disease resistance. Therefore, by cultivating traditional paddy varieties, farmers have been conserving these valuable genetic resources on-farm. However, stronger concerted institutional interventions are required for full-fledged, systematic and sustained in situ conservation of agricultural biodiversity.

Keywords: Agrobiodiversity, *in-situ* conservation, traditional paddy varieties, varietal traits.

TRADITIONAL paddy varieties (TPVs) have been the source of economic, cultural, food and nutritional needs of local communities since ages[1]. Owing to their agroclimatic suitability and genetic diversity, TPVs tolerate local stresses, adapt quickly and are capable of surviving vagaries of nature[2,3]. Hence, they are the contributors of valuable genes for stress tolerance[4]. They also generate a multitude of ecosystem services essential for ecological stability[5]. Additionally, TPVs are low-input intensive, making them environmental friendly and affordable for cultivation by smallholders[6]. Thus, they form crucial components of agrobiodiversity (diversity of crops and varieties in agricultural systems) essential for the resilience and sustainability of food production systems especially under changing climate[7,8].

India's abundance of rice varieties has always found a special mention in the records of the ancient times where rice was documented as a medicinal plant capable of curing various disorders and vital for sustenance of life[9]. Experiments have substantiated that most TPVs are significantly superior in nutritional values when compared to modern varieties[10,11]. Thus, TPVs can aid in alleviating malnutrition and achieving nutritional security. TPVs also form integral components of regional cultures. For instance, each rice variety in Kerala caters to specific cultural needs of the state's diverse communities[12]. Aromatic rice varieties are highly preferred for consumption and widely used during festivals and rituals in India[13].

Green revolution, with its focus on higher yielding and input responsive varieties led to the replacement of many valuable TPVs globally[14]. In several paddy biodiversity hotspots, TPVs which were an integral part of local life, tribal culture and food security were being replaced by other varieties and crops[15]. The growing preference of farmers for modern varieties thus led to a gradual loss of many TPVs. The replacement of diverse local varieties with a small array of improved ones is a prominent cause of agrobiodiversity loss[16]. Several indigenous aromatic rice varieties which, over the course of many years, had evolved to adapt to specific local agroecological conditions had already gone extinct or were on the verge of it[17]. Conversion of paddy fields and erosion of genetic diversity on adoption of modern cultivars is thus a major threat to the floral, faunal and agricultural biodiversity, especially in the context of climate change[18,19].

Loss of TPVs is an irrevocable effect since these valuable genes get lost forever. Therefore, TPVs which form integral components of crop germplasm and household nutrition need to be preserved. Cultivation of TPVs in farmers' fields is a form of *in situ* conservation strategy which allows for natural evolution of the crop[20,21]. It also helps in keeping the cultural heritage associated with these farming systems alive[22]. Since farmers through their field experimentation and learning have profound knowledge of the biodiversity within agroecosystems[23], loss of TPVs would also lead to the loss of traditional knowledge used by farmers in selection, maintenance and cultivation of these varieties[6,24].

Despite rapid replacement of TPVs with new varieties, farmers in Wayanad, Kerala continue to cultivate and conserve TPVs. This paper therefore attempts to seek answers to

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as to who were conserving them and why they preferred to do so. Also, the present study documents major TPVs grown by farmers in Wayanad along with reasons for the same. Since the traits of a variety, to a great extent, influence farmers' decision to cultivate it at present and also in future, the study makes a novel assessment of farmers' perception of the varietal traits of TPVs that make them preferable for cultivation. Thus, this study sheds light on the contribution of farmers in conserving valuable genetic resources on-farm.

Materials and methods

The present study was undertaken in Wayanad district of Kerala which has been witnessing alarming rates of paddy land conversions[25] and replacement of TPVs[26] over the years. Primary data was collected during February–March 2020, using stratified multistage random sampling design, wherein 225 paddy farmers were surveyed across 14 panchayats and 20 villages randomly selected from the district. To elicit farmers' perception of traits of TPVs, Friedman rank test (non-parametric test) was employed with a total of 22 traits categorized into production aspects, biotic stress tolerance, abiotic stress tolerance, marketing aspects and consumption aspects (Table 1). Farmers cultivating TPVs were asked to rank the traits of the major TPV being grown by them on a scale of 1 to 5 implying a continuum of very low to very high level of trait expression. Based on the mean rank obtained for each of the 22 varietal traits, the best trait as perceived by farmers was identified. Mean rank was calculated as:

$$\text{Mean rank} = 12/n_r k(k+1)\Sigma R_i^2 - 3n_r(k+1),$$

where k is the number of columns (treatments), n_r the number of rows (blocks) and R_i is the sum of ranks.

Results and discussion

Among the 225 paddy farmers surveyed at Wayanad, 152 were found to be cultivating only TPVs, 50 were cultivating both TPVs and new varieties, and 23 were cultivating only new varieties (Table 2). Most paddy farmers were aged above 51 years pointing to the relative disinterest of the younger generation in this enterprise. In the other paddy growing districts of Kerala too, the younger lot in agrarian families report being not keen on taking up paddy cultivation owing to its lower profitability, and wished to either leave land fallow or sell it out for real estate[27]. This highlights dual risks of paddy land conversions and uncertain future of TPVs in the absence of conservation interventions. In Wayanad, farmers growing both types of paddy varieties had relatively higher levels of education which could be the reason for higher Padashekhara Samithi (local paddy farmers' groups) membership, better knowledge of banking and bank-linked schemes, more Kisan credit card holders and higher contacts with extension agencies among this group. The majority of farmers have landholdings below 2 ha who grew paddy mainly for their own consumption. Also, low input requirement of TPVs makes them preferable for cultivation by resource-poor farmers of the district. In Odisha state also it has been observed that poor farmers preferred to grow TPVs owing to the low input requirement of these varieties[6]. Among the social groups, the highest percentage of paddy farmers belonged to scheduled tribes groups such as the *Kuruma* and *Kurichiya* who had been cultivating paddy and conserving TPVs as familial occupation and tradition across generations. Therefore, TPVs form vital sources of food and nutritional security, income and livelihood as well as traditional symbols of cultural heritage of communities of Wayanad, cultivating and conserving them since ancient times.

The 16 major TPVs being cultivated by 202 farmers growing TPVs alone or in combination with other varieties was documented along with the traits/reasons influencing their cultivation as reported by farmers (Table 3). *Gandhakashala*, *Thondi*, *Adukkan* and *Veliyan* were found to be grown widely. When asked why they preferred to cultivate TPVs, 49.5% of farmers stated that they did so for self-consumption since they consumed what they grew in their fields (Figure 1). Other studies had also reported that TPVs were an integral part of the food security of farmers who cultivated them for their own consumption[1]. Around 24.6% and 3.8% of farmers reported that they cultivated TPVs as part of their tradition

Table 1. List of traits for perception test

Trait aspect	Trait
Production aspects	Grain size
	Straw yield
	Water requirement
	Fertilizer requirement
	Labour requirement
Biotic stress tolerance	Insect/non-insect pest resistance
	Disease resistance
Abiotic stress tolerance	Acidity tolerance
	Drought tolerance
	Flood tolerance
	Lodging resistance
Marketing aspects	Market price
	Consumer demand
	Ease of processing
	Export demand
	Ease of selling in local market
Consumption aspects	Preference for self-consumption
	Cooking quality
	Suitability for variety of dishes
	Preference for taste
	Nutritional value
	Preference for fodder

Table 2. Socio-economic characteristics of respondents at Wayanad

Particulars	Farmers cultivating TPVs (n = 152)	Farmers cultivating new paddy varieties (n = 23)	Farmers cultivating both (n = 50)
Gender (%)			
Female	73	13	14
Male	66	10	24
Age (%)			
≤30 yrs	4.6	0	0
31–50 yrs	34.9	30.4	34
51–70 yrs	50	69.6	54
≥71 yrs	10.5	0	12
Education (yrs of schooling)	6.9	6.9	7.8
Family size	5	4	4
Landholding (%)			
Marginal (<1 ha)	61.8	78.3	60
Small (1–2 ha)	20.4	17.4	24
Semi-medium (2–4 ha)	11.2	4.3	10
Medium (4–10 ha)	5.3	0	6
Large (>10 ha)	1.3	0	0
Social group			
General	22.4	30.4	30
Scheduled tribes	65.1	69.6	58
Scheduled castes	5.9	0	2
Other backward castes	6.6	0	10
Padashekhara Samithi membership	78.9	65.2	82
Crop loan availed (%)	24.3	4.3	34
Adoption of crop insurance	62.5	0	54
Possession of Kisan credit card (%)	13.2	4.3	16
Contact with extension agencies	82.9	56.5	84

Table 3. Major traditional paddy varieties of Wayanad

Name of the variety	Growers (%) (n = 202)	Major traits/reasons influencing cultivation
Gandhakashala	32.7	Preference for self-consumption, higher price, cultural value, higher nutritional value
Thondi	24.8	Preference for self-consumption, high biotic/abiotic stress tolerance, less input requirement, higher grain yield, Higher straw yield
Adukkan	15.8	Preference for self-consumption, high biotic/abiotic stress tolerance, less input requirement, higher grain yield
Veliyan	8.4	High biotic/abiotic stress tolerance, less input requirement, preference for self-consumption, cultural value
Kunjootti	5.9	Preference for self-consumption, high biotic/abiotic stress tolerance, less input requirement
Ayiramkana	2.5	Preference for self-consumption, high biotic/abiotic stress tolerance, less input requirement
Kunjanthondi	2.4	High biotic/abiotic stress tolerance, higher grain yield, Non-lodging
Chennellu	1.5	Preference for self-consumption, high biotic/abiotic stress tolerance, less input requirement, Higher nutritional value
Jeerakashala	1.5	Preference for self-consumption, higher price, cultural value, higher nutritional value
Kuruvatty	1.0	Cultural value, High biotic/abiotic stress tolerance, preference for self-consumption
Mullankaima	1.0	High biotic/abiotic stress tolerance, preference for self-consumption, cultural value, higher nutritional value
Kanali	0.5	Preference for self-consumption
Koduveliyan	0.5	Preference for self-consumption, high biotic/abiotic stress tolerance
Kunjoottan	0.5	Higher grain yield
Marathondi	0.5	High biotic/abiotic stress tolerance
Paalthondi	0.5	Preference for self-consumption, higher nutritional value

and culture respectively. Farmers in the Wayanad district have big religious sentiments attached with paddy cultivation. The tribal farmers in particular believe that the cultivation of TPVs brings in the blessings of their Goddess and ancestors. Also, specific varieties such as the aromatic *Gandhakashala* are exclusively used in preparation of special dishes during festivals and rituals. The social and cultural values attached with TPVs in India

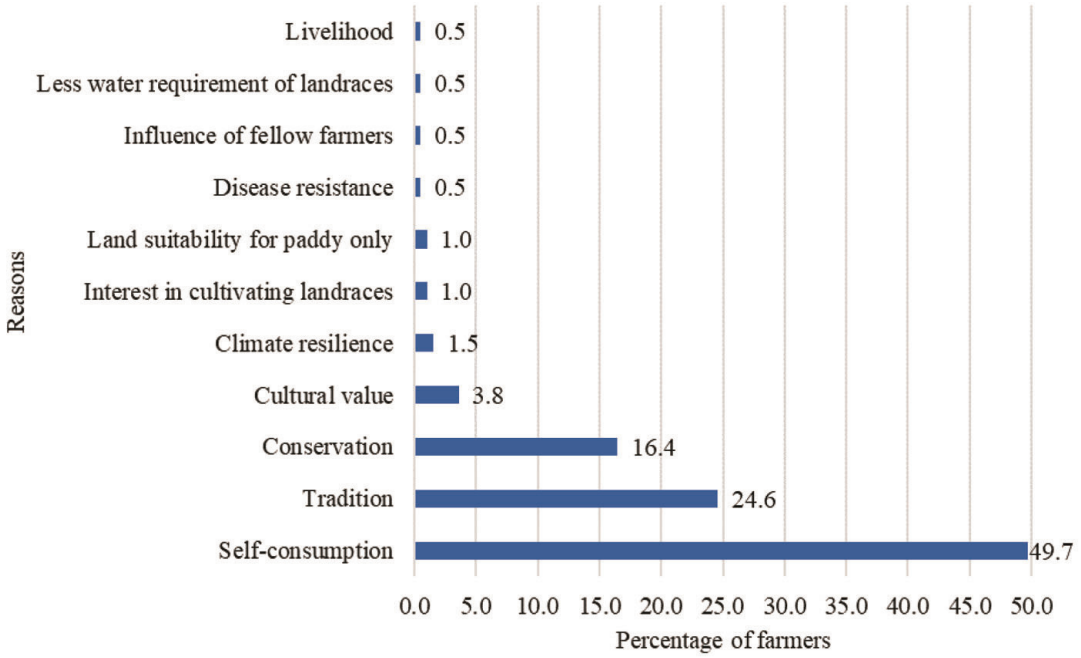

Figure 1. Reasons for cultivating traditional paddy varieties in Wayanad (n = 202).

Table 4. Test statistics of Friedman rank test

n	202
Chi-square	0
Degrees of freedom	21
Asymptotic significance	0

was reported by other studies as well[12]. The tribal communities of Wayanad had been cultivating and preserving indigenous paddy since time immemorial[28]. This was observed in our study too, wherein 16.4% of farmers stated that they cultivated TPVs for conserving these valuable genetic resources for posterity. One prime example of this was a tribal farmer who grew more than 40 TPVs in his plot of 1.5 acres and gave seeds free of cost to interested growers on the promise that they return twice the amount of seeds next year[29]. Similarly, with the sole aim to conserve paddy diversity, a farmer in Karnataka state's Mittabagilu village cultivates 154 paddy varieties on his 5 acre farm[30]. There are also several private organizations that are undertaking large scale conservation and promotion of TPVs in the country[31,32]. Climate resilience of TPVs was stated by 1.5% of farmers who reported that these varieties adapted to changing climate, withstood weather abnormalities better and gave higher or stable yields in comparison to their improved counterparts. In West Bengal also TPVs were found to be cultivated for their higher adaptability[6]. Experiments have in fact shown that the Wayanad TPV *Jeerakashala* gave grain yield comparable to that of the improved variety *Pusa Basmati-1* (ref. 33). Farmers in Wayanad opine that TPVs such as *Veliyan* could survive under flood water and regain growth when water receded, while *Thondi* could survive dry spells. As a result, they preferred cultivating TPVs for assured food and income even during calamities. Also, since TPVs required less to no inputs, their cultivation could be afforded by small and marginal farmers. Additionally, few TPVs such as *Gandhakashala* fetch a higher market price due to the steep demand for its aroma and taste[5]. In fact, owing to the 'geographical indications' tag which this variety received in 2010, its producers were able to witness positive changes in their incomes[34].

Friedman rank test for evaluating farmers' perception of traits of TPVs revealed significant differences among the 22 varietal traits studied (Table 4). Among all the traits, suitability for multiple dishes was ranked highest with a mean rank of 17.04 indicating that a TPV which could be used to prepare variety of delicacies was perceived to be the best by farmers (Table 5). Next major trait was found to be the preference for taste with mean rank of 16.85. For instance, *Gandhakashala* was largely preferred for its aroma, flavour and suitability for preparing diverse foods such as dosa, neyyappam and biryani. Nutritional value was ranked third since farmers believed that TPVs were good for health and packed with nutrition. For this reason, infants were fed with *chennellu* for its nutrients and *paalthondi* was consumed as gruel for improving health. In fact due to the high nutritional and medicinal values, TPVs are used to treat various disorders and illnesses by natives in many regions of India[35]. TPVs have also been scientifically proven to have higher nutrient content[36]. Lowest mean rank was obtained by fertilizer requirement which could be due to low input

intensity of TPVs. Therefore, the test results revealed that traits related to consumption aspects were perceived to be most important by farmers for selecting and cultivating a particular TPV.

Conclusion

The present study found that 16 major TPVs were cultivated in Wayanad mainly by marginal, tribal farmers for self-consumption, tradition and conservation. The driving factors for the selection and cultivation of a TPV were found to be its traits related to consumption aspects. In particular, traits such as suitability towards variety for multiple dishes and taste were perceived as best by farmers for cultivating a TPV. Therefore, despite rising popularity and mass-scale cultivation of new varieties, most farmers in Wayanad chose to cultivate and conserve TPVs. The socio-economic importance and cultural significance of TPVs as well as their genetic diversity makes them invaluable for future crop improvement strategies, especially in the context of climate change which necessitates their conservation. Though farmers have been contributing significantly towards conserving these valuable genetic resources on-farm, more concerted efforts need to be in place for the same. Full-fledged and systematic *in situ* conservation of genetic resources would require extending support to farmers so that their costs of conservation lessen[37]. This could be in the form of incentivizing cultivators economically to maintain diversity in their fields[38]. Thus, future agrobiodiversity conservation initiatives could be encouraged and incentivized through instruments such as ecological compensation and payments for ecosystem services[5,39]. In addition to agrobiodiversity conservation, eco-compensation payments would also benefit farmers in the form of enhanced incomes[40,41]. Both *ex situ* and *in situ* conservation methods are imperative and need to go hand in hand for preserving agrobiodiversity[42,43]. Hence, there is a need for stronger institutional interventions for conservation of TPVs worldwide.

Table 5. Ranks of traits of traditional paddy varieties of Wayanad

Varietal trait	Mean rank
Suitability for variety of dishes	17.04
Preference for taste	16.85
Nutritional value	16.13
Preference for self-consumption	15.88
Preference for fodder	15.81
Cooking quality	15.37
Straw yield	13.72
Consumer demand	11.09
Disease resistance	10.8
Insect/non-insect pest resistance	10.54
Ease of selling in local market	10.51
Grain size	10.31
Ease of processing	10.14
Export demand	9.79
Drought tolerance	9.59
Market price	9.33
Flood tolerance	9.25
Labour requirement	9.11
Acidity tolerance	8.84
Water requirement	8.19
Lodging resistance	8.09
Fertilizer requirement	6.62

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