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# **Farmers' Willingness to Cultivate Traditional Rice in Sri Lanka: A Case Study in Anuradhapura District**

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Ginigaddara Appuhamilage Sanjeewanie Ginigaddara and  
Sampath Priya Disanayake

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## **Abstract**

Increasing health threats is a common problem among both rice growers and consumers in many parts of Sri Lanka and in the Asian region in general. Increasing trends in growing and consuming traditional rice could be observed in searching solutions for these problems. This study explored objectively the factors affecting willingness to grow traditional rice and its varietal selection in Anuradhapura district of Sri Lanka. 100 traditional and 100 non-traditional rice growers were selected using stratified sampling method for the field survey and data were analyzed descriptively, using logistic regression and factor analysis. Results revealed that 67% of the male farmers were willing to cultivate traditional rice over improved varieties and 65.6% traditional rice cultivation was observed among families with non-communicable diseases. Awareness of medicinal and nutritional values of traditional rice, land extent, farm gate price, age and education level of farmers, farming experience and farming system significantly affects ( $P \leq 0.05$ ) the willingness to cultivate traditional rice while factors related to varietal attributes, personal, market and production, respectively affects selection of traditional rice variety. Results conclude that farmers are willing to cultivate traditional rice in Anuradhapura district of Sri Lanka and selection of traditional rice varieties is most affected by varietal attributes which are adoptable to existing environmental conditions and personal factors like presence of non-communicable diseases, age of the farmers, education level and experience for farming.

**Keywords:** willingness to cultivate, traditional rice, varieties, rice farmers, Sri Lanka

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## **1. Introduction**

Rice production in Sri Lanka has grown into a self-sufficiency level during the last two to three decades. Rice being the staple food of Sri Lankans and having 114 kg per capita

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consumption plays a major role in providing energy, protein and fat to the whole population [1]. Approximately 1,210,140 hectares of lands was devoted for paddy cultivation in 2015 and 2,992,333 metric tons of total rice availability for human consumption from domestic sources exceeded 2,310,321 metric tons of total rice requirement in 2015 while demonstrating the 129.32% of self-sufficiency rate [2]. Many programmes have been implemented in Sri Lanka to fulfill the national demand for rice through the effectively bred high-yielding varieties which are resistant to different stresses [3]. Nonetheless, people are more health conscious and interested in purchasing nutritional good quality products as the level of human health awareness increases among Sri Lankans. Traditional rice is being considered as more healthy and nutritious among Sri Lankans; a considerable demand is generating for traditional rice varieties in both local and international markets.

Sri Lanka is one of Asian countries which had a rich treasure of over 2400 traditional rice varieties [4] with identical nutritional and medicinal values [5]. Besides, these varieties are with varied maturity periods and highly resistant to extreme climatic conditions, pest and disease attacks [1] and adoptable to various soil and geographical conditions in the country. Out of these 2400 varieties, over 400 varieties are popular among Sri Lankan farmers at present. With the introduction of high-yielding newly improved varieties around the 1960s, traditional rice varieties became vanished from the Sri Lankan farming environments [6]. Thanks to the small-scale farmers, seeds of some of these old traditional varieties are still preserved in the gene banks. Moreover, traditional rice cultivation occupies a significant place among the rural communities in dry zone from past to present and even beyond the dry zone mainly due to threatening of people by common health problems like non-communicable diseases. In that scenario, farmers have increased the extent of traditional rice cultivation by adopting indigenous cultivation methods and organic inputs. Some non-governmental organizations have taken initiatives to promote traditional rice cultivation in the country advocating farmers to produce own seed paddy, cultivating rice for own consumption and fulfilling the market demand by selling surplus. Specially, districts like Anuradhapura, Polonnaruwa, Puttalam, Vavuniya, Kurunegala, Kegalle, Matale, Kandy, Rathnapura, Gampaha, Colombo, Galle, Matara, Monaragala, Badulla, Ampara, Batticaloa and Akkaraipattu are predominantly adopted to cultivate traditional rice varieties in the last few decades [7]. Importantly, the tolerance of traditional rice cultivars for submergence and salinity conditions has popularized them among farmers from those problematic areas. Compared to the improved rice varieties, some of traditional rice varieties are capable of being raised in nurseries for 2–3 months and tolerating water scarcities and heavy rainfalls or floods. And also, the strong vigorous stem helps to withstand against the heavy rains, winds and drought conditions. Their vigorous seeds are tolerant to other adverse conditions like waterlogging and drought. Therefore, most of the traditional rice varieties have the potential to cope with the drastic climatic changes which are generally detrimental to paddy cultivation [8]. Further, medicinal values of traditional rice have been experienced by Sri Lankans over few decades [9]. The lower starch hydrolysis rate lowers in vitro digestion rate which is suitable for diabetic patients. Most of the cultivars own officinal properties of preventing diabetic conditions, fatty liver, blood pressure and muscle recovering from free radicals and controlling weight, gallstones and protection against breast cancer. Namely, *Suwandel*, *Madathawalu*, *Kaluheenati*, *Suduheenati*, *Kuruluthuda*, *Pachchaperumal*, *Ma wee*, *Hatadaa wee*, *Rathdel*, *Kahamala* and *Kahawanu* are some of the most popular traditional rice varieties among the rice farmers and among traditional rice consumers in present Sri Lanka.

Anuradhapura, one of the largest districts in Sri Lanka, is situated in the North Central Province. The total land area is 6664 km<sup>2</sup>, and the total human population is 856,232. Moreover, cultivated land extent under paddy is reported as 254,296 hectares including cultivations under major and minor irrigation and rainfed systems which produced 4612 kg of average paddy yield per hectare which was more or less similar to the country's average paddy production per hectare of 4527 kg. Rice farming is practiced by 65% of the population and nearly 17% of labor force is engaged with related occupations in rice cultivation in Anuradhapura district [10].

At present, there are increasing health threats from non-communicable diseases, namely, diabetes, high blood pressure, renal failures, variety of cancers and high blood cholesterol among both farmers and consumers in dry zone of Sri Lanka where the Anuradhapura district is located specifically and all over the island in general. As both growers and consumers highly believe that these health threats are basically due to unhealthy food habits and poor quality of the food items that they are consuming every day. Therefore, an increasing interest in growing and consuming traditional rice over improved varieties in this district could be observed. Thus, there is an increasing trend of the rice farmers in Anuradhapura district to cultivate traditional rice at least in few perches in their lands to be used for their family consumption, while some farmers are cultivating them in large scale expecting higher price in the market. Different farmers prefer to grow different varieties of traditional rice in their paddy fields, and there is a lack of research and findings on which factors trigger rice farmers to cultivate traditional rice over newly improved or hybrid rice in their paddy lands in different scales and which varieties of traditional rice do they prefer to cultivate over the others. Hence, this study was conducted to identify the factors affecting the willingness to cultivate traditional rice and to select their varieties for cultivation by rice farmers in Anuradhapura district of Sri Lanka.

## 2. Methodology

This experimental study focused on rice farmers who are growing traditional rice varieties compared to nontraditional rice varieties in Anuradhapura district and was conducted in five divisional secretariat (DS) divisions in Anuradhapura district, namely, *Padaviya*, *Medawachchiya*, *Rambewa*, *Thalawa* and *Rajanganaya*, where most of the farmers are engaged in traditional rice cultivation (**Figure 1**).

Two hundred paddy farmers were interviewed with a pretested questionnaire for identifying willingness to cultivate traditional rice and factors affecting the selection of traditional rice varieties. Three-stage stratified random sampling method was utilized to select 100 traditional rice growers and 100 nontraditional rice growers. At the first stage, five DS divisions were selected purposely where the highest farmers' registration under paddy cultivation has been reported. Accordingly, the *Grama Niladhari* (GN) divisions which reported the highest farmers' registration pertaining to the above five divisions were selected at the second stage, and at the final stage, both traditional rice farmers and nontraditional rice farmers were randomly selected for the questionnaire survey proportionately to the total farmers registered in the above five DS divisions. Additionally, focus group discussion and key personal interviews were conducted during the study. Secondary data were collected from different publications of

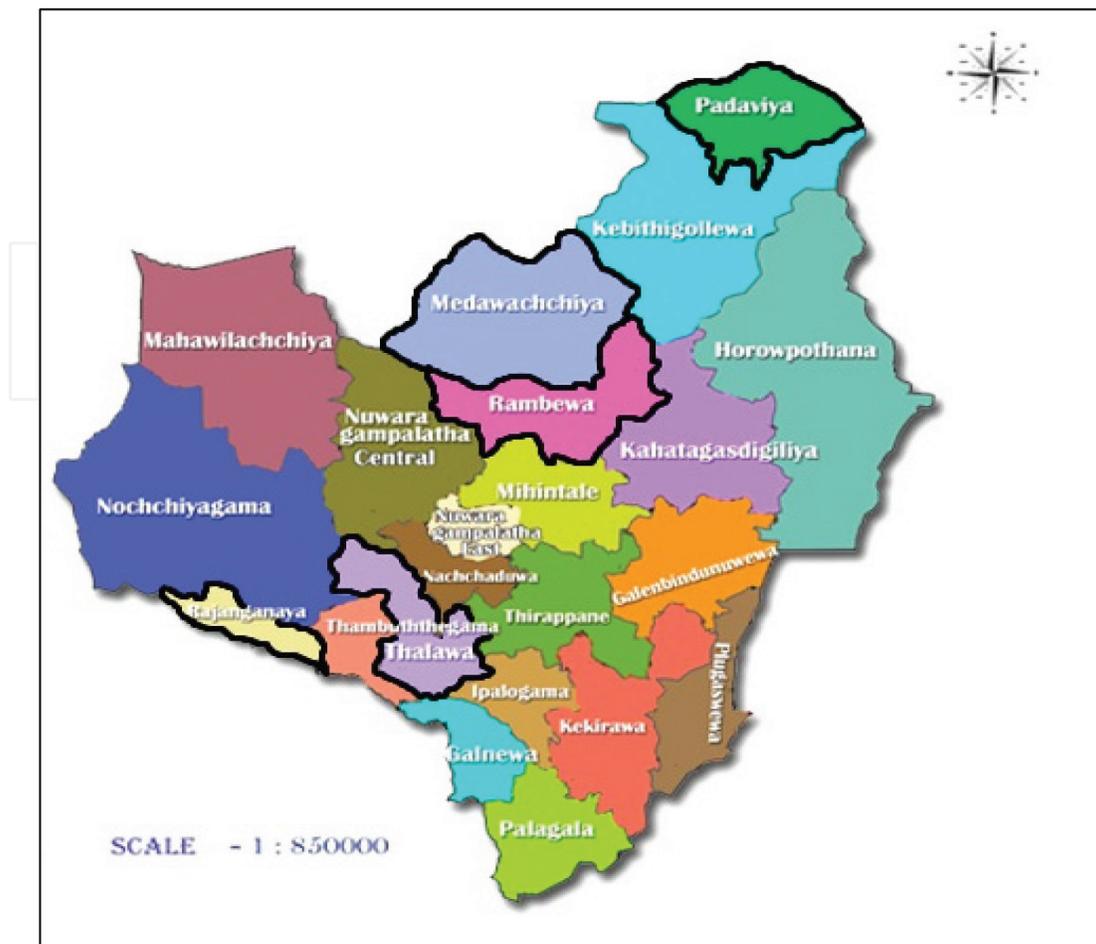


Figure 1. Map of selected Divisional Secretariat (DS) divisions.

Department of Census and Statistics, Central Bank of Sri Lanka and relevant research reports, project reports, journal articles and newspaper articles.

The collected data and information were subjected to logistic regression analysis to analyze the factors affecting willingness to grow traditional rice varieties and factor analysis to identify the factors affecting varietal selection.

### 3. Results and discussion

#### 3.1. Demographic characteristics

Demographic characteristics of the study sample are summarized in **Table 1**. Mean age of the traditional rice-growing farmers was 48 years, while nontraditional rice-growing farmers have 51 years of mean age. Results revealed insignificant differences in household size (four members) and the number of years attained to a particular formal education (10 years) between these two categories of farmers. Moreover, for both farmer categories, at least two family members are available as family labor mainly consisting of the household head and his/her spouse. The land extent under traditional rice cultivation is smaller (1.34

Parameter	Traditional rice farmers		Nontraditional rice farmers	
	Mean	±SD	Mean	±SD
Age of the respondent (years)	47.87 (48 <sup>*</sup> )	11.54	51.31 (51)	11.15
Household size (number)	4.10 (4)	1.26	3.74 (4)	1.43
Educational level (years)	10.19 (10)	2.31	9.33 (9)	2.87
Available family labor (number)	2.22 (2)	1.07	2.16 (2)	1.095
Land extent (Ac)	1.34	1.90	1.91	1.713
Yield (kg/Ac)	1199.60	521.77	1695.88	701.38
Farm gate price (Rs./kg)	50.24	14.90	31.32	5.28
Farming experience (years)	22.95	12.96	5.96	7.77
	<b>Percentage (%)</b>		<b>Percentage (%)</b>	
Gender of the respondent				
Male	67		92.6	
Female	33		7.4	
Presence of non-communicable diseases				
Yes	65.6		78.7	
No	31.4		21.3	
Awareness of traditional rice				
Yes	100		55.6	
No	0		44.4	
Farming system				
Organic	86.5		1.9	
Inorganic	8.1		87.0	
Mixed	5.4		11.1	

\*Numbers in parenthesis are rounded numbers.

**Table 1.** Demographic characteristics.

acres) compared to improved rice cultivation (1.91 acres). The reason is that many of the traditional rice growers tend to cultivate traditional rice in their small paddy plots only for their family consumption as they are more health conscious, affected by non-communicable diseases (65.6%) and more aware (100%) on the nutritional and medicinal value of traditional rice varieties.

Compared to nontraditional rice varieties (Rs. 31.00), traditional rice varieties have higher farm gate price (Rs. 50.00) which shows comparatively better potential market for traditional rice. With respect to the existing farming systems, 86.5% of traditional rice farmers are practicing organic farming methods in their rice farms which ensure environmental, social and economic

benefits to the society, while majority of the nontraditional rice farmers (87%) apply inorganic fertilizers and agrochemicals in their rice fields expecting a higher yield for better income.

### 3.2. Factors affecting willingness to grow traditional over nontraditional rice varieties

Logistic regression analysis was used to determine the factors affecting willingness to cultivate traditional rice by rice farmers. The binomial logistic analysis of measured variations in the outcome explained by predictors was significant ( $Pr < 0.001$ ). Awareness of traditional rice, presence of non-communicable diseases in the household, land extent, yield, farm gate price, gender of respondent, age of the respondent, educational level, family labor availability, household size, farming experience and farming system were included in the logistic regression.

**Table 2** explains the strength and the direction of the effect of each factor on the willingness to cultivate traditional rice. As revealed by the results, awareness of medicinal and nutritional values of traditional rice ( $Pr = 0.0062$ ) show strong positive associations with the willingness to cultivate traditional rice compared to nontraditional rice. Land extent of rice cultivation shows a negative significant effect ( $Pr = 0.0404$ ) on cultivation of traditional rice. It reveals that when farmers are having increased land extents, they are reluctant to cultivate traditional rice varieties. This is mainly due to the lower potential yield of traditional rice varieties over nontraditional (improved or hybrid) rice varieties. Most importantly, farm gate price shows a positive relationship with the willingness to cultivate traditional rice ( $Pr = 0.0076$ ). Since the selling price is higher, farmers are more willing to go for traditional rice in their paddy fields over nontraditional rice varieties. Age of the respondent ( $Pr = 0.0141$ ) and farming experience ( $Pr = 0.0169$ ) positively affected the decisions-making regarding cultivation of traditional rice

Parameter	Estimate	Pr> chisq
Intercept	10.451	0.0946
Awareness of traditional rice	7.2517	<b>0.0062</b>
Presence of non-communicable diseases in the household	-12.372	0.5697
Land extent	-1.4726	<b>0.0404</b>
Yield	0.0015	0.2742
Farm gate price	0.3572	<b>0.0076</b>
Gender of the respondent	4.1364	0.0058
Age of the respondent	0.1586	<b>0.0141</b>
Educational level	0.2797	<b>0.0403</b>
Family labour availability	-1.8423	0.0887
Household size	0.7163	0.2626
Farming experience	0.2752	<b>0.0169</b>
Farming system	-6.1856	<b>0.0116</b>

**Table 2.** Maximum likelihood estimates for factors affecting willingness to cultivate traditional rice varieties.

varieties where farmers are able to ascertain more knowledge on the importance of healthy consumption and food habits, awareness of non-communicable diseases and adverse impact of synthetic fertilizer and other chemicals to human and environment through their maturity with age and cumulative farming experiences. Further, the education level of the farmers shows a positive impact toward getting into traditional rice cultivation which emphasized that when people are more educated, they tend to consider their health and nutrition compared to illiterate people. Both traditional and nontraditional rice farmers practice organic and inorganic farming systems and mixture of these two. As revealed by the results, farming system has significantly negative effect on willingness to cultivate traditional rice.

The presence of non-communicable diseases, yield, gender of the respondent, available family labor and household size were not significantly ( $P < 0.05$ ) associated with willingness to cultivate traditional rice.

When farmers enhance their awareness on medicinal and nutritional values of traditional rice (OR = 4.025), nontraditional paddy farmers are also more likely to cultivate traditional paddy varieties (Table 3). The results further prove that when farmers increase their land extent by 1 acre (OR = -4.361), many of the traditional rice farmers tend to be relied on nontraditional rice cultivation. Moreover, the odds of being traditional rice cultivator is higher for higher farm gate price (OR = 1.704), old age of the farmers (OR = 1.17), higher educational level of the farmers (OR = 1.756) and more farming experience of the farmers (OR = 1.317).

### 3.3. Factor analysis for selection of traditional rice varieties for cultivation

Factor analysis was executed to determine the factors affecting varietal selection by traditional rice farmers. Principal component analysis (PCA) emphasized that multiple observed variables

Parameter	Point estimates	95% confidence limits
<b>Awareness of traditional rice</b>	<b>4.205</b>	<b>1.105–9.790</b>
Presence of non-communicable diseases in household	2.356	0.882–6.290
<b>Land extent</b>	<b>-4.361</b>	<b>1.066–17.832</b>
Yield	1.002	0.999–1.004
<b>Farm gate price</b>	<b>1.704</b>	<b>0.544–1.911</b>
Gender of the respondent	1.238	0.746–1.882
<b>Age of the respondent</b>	<b>1.17</b>	<b>0.948–1.448</b>
<b>Educational level</b>	<b>1.756</b>	<b>0.394–1.851</b>
Family labor availability	0.158	0.019–1.322
Household size	2.047	0.585–7.146
<b>Farming experience</b>	<b>1.317</b>	<b>1.051–1.656</b>
<b>Farming system</b>	<b>0.001</b>	<b>0.001–0.055</b>

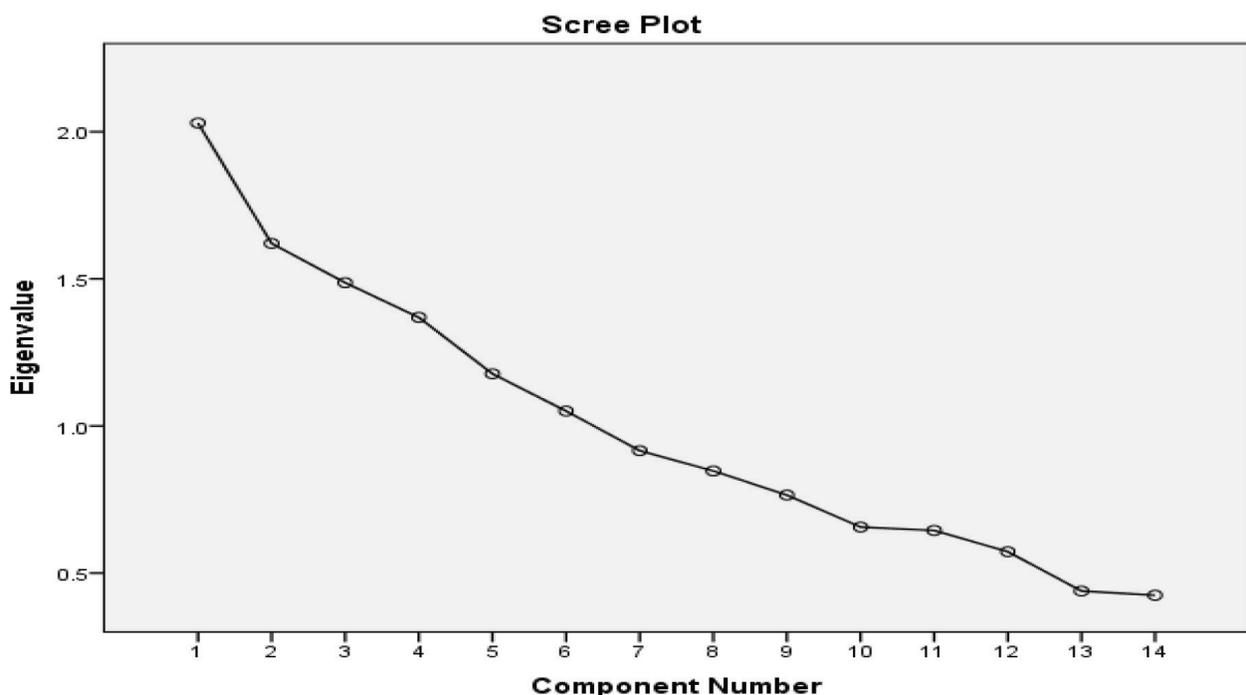
Table 3. Odd ratio of logistic regression analysis.

have similar patterns of responses because of their association with an underlying latent variable [11]. Accordingly, it examines underlying variable in a number of observed variables of factors which affect selection of varieties.

The variance of the independent variables, explained by each principal component, is given by Eigen values. Any factor with an Eigen value  $\geq 1$  explains more variance than a single observed variable. **Figure 2** presents the scree plot used to identify six numbers of factors affecting varietal selection of traditional rice farmers where the first five factors (Eigen value  $\geq 1$ ) are highly affected factors loading from scree plot (**Table 4**).

The factor analysis revealed that four factors are affecting selection of varieties of traditional rice by rice farmers (**Table 5**). The first factor, namely, the varietal attributes, includes tolerance to pest and diseases, tolerance to drought conditions and tolerance to salinity. Factors, namely, presence of non-communicable diseases, gender, age, educational level and farming experience, are consolidated into the second factor which is named as personal factors. The third factor comprises of market-related attributes such as farm gate price and availability of buyers, while the fourth factor includes production-related resources, namely, cultivated land extent, yield, availability of family labor and farming system.

With the increase of world population and hence the galloping food demand, high-yielding rice varieties were highly popular among the cultivators. This practice hitherto has led to serious “genetic erosion” – the loss of traditional varieties from agroecosystems [12, 13] in the rice production sector. Due to their incredible health benefits, it has made them a pleasing choice for consumers who are suffering from diabetes, overweight or regulating their sugar intake. Cultivation and consumption of traditional rice varieties are not restricted to certain places in Sri Lanka, because consumption of these varieties in both national and international has been very consistent.



**Figure 2.** Scree plot for components.

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
	1	2.030	14.498	14.498	2.030	14.498	14.498	1.586	11.328
2	1.620	11.574	26.072	1.620	11.574	26.072	1.514	10.811	22.139
3	1.487	10.621	36.693	1.487	10.621	36.693	1.494	10.674	32.813
4	1.369	9.779	46.472	1.369	9.779	46.472	1.493	10.664	43.477
5	1.177	8.410	54.881	1.177	8.410	54.881	1.419	10.137	53.614
6	1.051	7.506	62.387	1.051	7.506	62.387	1.228	8.774	62.387
7	.916	6.543	68.930						
8	.847	6.051	74.981						
9	.765	5.464	80.445						
10	.656	4.689	85.134						
11	.645	4.607	89.741						
12	.573	4.090	93.831						
13	.439	3.136	96.967						
14	.425	3.033	100.000						

**Table 4.** Total variance explained by factor loadings.

People also credit traditional varieties with other health benefits, such as giving sensations of cooling in the body; improving vocal clarity, eyesight and fertility; maintaining body sugar levels; and mitigating rashes. Among the local communities, many of traditional rice varieties are popular due to their inheriting characteristics. For example, *Surwandel* variety which has a milky taste upon cooking is highly recommended to be eaten by hard-working people. According to Ayurvedic medicine, this variety is known to promote fair and glowing skin, improves the functioning of the excretory system, enhances vocal clarity, increases the male sexual potency and helps to control diabetes and constipation. Likewise, variety *Pachchaperumal* is a highly nutritious red rice cultivar which helps to cool the body, is preferred by patients who are suffering from diseases like diabetes and cardiovascular complications and is also good for patients with high blood pressure. Another example is that of variety *Madathawalu*, which is able to remove toxic components especially some cancer causative agents from the human body. This variety can clean the blood circulation system and promote the activity of sweating glands. It strengthens the immune system and adds to the nutritive value of the cooked rice for lactating mothers and infants.

Besides, it is known to all that the paddy production system is extremely vulnerable to climate change impacts. Traditional agricultural practices coupled with indigenous rice varieties have proven to be more successful in facing climate change and its related threats such as droughts, floods, attack of pests and disease outbreaks. These traditional rice varieties have strong characteristics that help them survive climate change impacts compared to newer varieties used in conventional paddy cultivation. Hence, the traditional rice cultivation is not only a solution for health concerns but also a way of achieving sustainability via conservation of agricultural

Parameter	Component				
	1	2	3	4	5
Presence of non-communicable diseases in the household	-0.330	<b>0.718</b>	-0.574		
Land extent		-0.291	-0.260	<b>0.489</b>	0.622
Yield		0.284		<b>0.586</b>	
Farm gate price		0.368	<b>0.482</b>	-0.360	
Gender of the respondent	-0.299	<b>0.433</b>	0.254		
Age of the respondent	-0.265	<b>0.710</b>			0.392
Educational level	0.447	<b>-0.553</b>			
Family labor availability	0.263			<b>0.499</b>	
Farming experience	-0.329	<b>0.282</b>	0.561		
Farming system	0.434			<b>0.603</b>	
Availability of buyers			<b>0.318</b>		-0.651
Tolerance to pest and diseases	<b>0.578</b>	0.302			
Tolerance to drought	<b>0.576</b>			-0.351	
Tolerance to salinity	<b>0.636</b>			-0.300	

Extraction method: principal component analysis.

\*Five components extracted.

**Table 5.** Component matrix of factor analysis.

practices which promise more congenial environment for future generation. According to [14], Indian farmers in a district in Uttar Pradesh rediscovered the advantages of traditional rice cultivation which were resistant to drought condition and have not been susceptible to diseases and fetched better market prices. Therefore, traditional rice cultivation does not restrict to a particular region or area. Therefore, findings of this study could be generalized to other areas in Sri Lanka and Asian region as a whole.

#### 4. Conclusion

It seems logical to conclude from this study that awareness of medicinal and nutritional value of traditional rice varieties, land extent, farm gate price, age of the respondent, education level, farming experience and farming system have significant influence on the willingness of farmers to opt traditional rice cultivation in Anuradhapura district of Sri Lanka. The trend in willingness to grow traditional rice in Anuradhapura district showed that 59% of farmers attached to families with non-communicable disease are willing to grow traditional rice compared to farmers from healthier families. The study further revealed that two of the most vital factors responsible for selection of traditional rice variety are personal choices and varietal attributes. Hence, the study brings few recommendations to enhance the structured organization of traditional rice-growing

farmers to make crop agronomic and management information and potential marketing information available through government policy interventions in order to empower the traditional rice-cultivating farmers in Anuradhapura district and throughout the country as a whole.

## Author details

Ginigaddara Appuhamilage Sanjeevanie Ginigaddara\* and Sampath Priya Disanayake

\*Address all correspondence to: [sanjeewanieg@gmail.com](mailto:sanjeewanieg@gmail.com)

Faculty of Agriculture, Rajarata University of Sri Lanka, Anuradhapura, Sri Lanka

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