



Ex-ante Producer and Consumer Preference for Finger Millet in Karnataka: Application of Conjoint analysis and Logit Model

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Authors' contributions

This work was carried out in collaboration between all authors. Author VB conducted a study during his Ph.D work. He also designed the study, performed the statistical analysis, wrote the protocol and complete manuscript. Authors KBU is the major advisor/guide for my Ph.D degree, so it is mandatory to add his name and he corrected the manuscript, guided me to select the tools for analysis, etc. Author KRH helped in framing the suitable methodology, helped in collecting the data and managed the part of the analyses of the study. Finally all authors read and approved the final manuscript.

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ABSTRACT

The common understanding by the research community is that farmers like to adopt improved varieties. While this is true in general, we often see that some improved varieties are not accepted by farmers. The reasons for such can be many. In this study, an attempt was made to verify whether there are any other traits that farmers seek in a ragi variety. We select several traits including those related to yield and production aspects as well as ultimate consumer preferences, and assess their relative importance by way of willingness to pay. This is achieved by estimating Conjoint analysis.. We further hypothesise that there are spatial relations in the willingness to pay for such traits and incorporate that into the analysis which resulted in a Logit model. Data for the study was collected by using a pre-tested questionnaire from both producers and consumers. For producer survey, the study was conducted in Tumakuru and Hassan districts of Karnataka, as they are the major ragi

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growing districts of Karnataka and for consumers survey, Bengaluru Urban and Hassan districts were selected based on consumption pattern. The results revealed that, analysis of producer preference indicated that, the farmers prefer more of long duration ragi varieties with high yield and drought tolerant. With respect to consumers preference, taste and aroma were found most important attributes. Further to know the willingness to pay (WTP) for new variety by producers was analyzed using Logit model. The results showed that, yield and colour had significant influence on farmers WTP for new ragi variety. The findings of the study further reinforce the potentials of ragi cultivation in Karnataka. Besides, the implementation of "Anna Bhagya Yojana" in Karnataka has given further impetus for increased demand for ragi. Therefore, there is a need to increase the production by means of increasing productivity. The scientists need to develop yield enhancing technologies with drought tolerance varieties.

Keywords: *Consumer preference; conjoint analysis; attributes; willingness to pay; logit model; drought tolerance.*

JEL codes: D12, C01, C25, C87

1. INTRODUCTION

Finger millet [(Ragi) *Eleusine coracana*] is one of the important and staple food crop of southern Karnataka, which is mainly grown as a rainfed crop. The incorporation of genetic resistance offers the best choice in low input crops like ragi. Evolution of varieties with higher yields combined with resistance to disease and drought is one of the long felt need in a crop like ragi which is predominantly grown by poor and marginal farmers who have little means of controlling diseases through chemicals [1]. Finger millet is a staple food in parts of Africa and India. This grain is rich in calcium, iron, methionine, and tryptophan [2]. The success of such a programme depends on the identification of stable good yielding resistant sources and its subsequent utilization in breeding.

As the common understanding about the farmers preference for seeds of a particular ragi variety is the amount of yield it generates, the development of a large number of high-yielding and improved varieties during and after the times of green revolution had been the inclination. However, the choice of varieties by farmers may not solely depend on yield but also on other characteristics related to resistance qualities of ragi, colour, nutritional quality, plant characteristics and market demands. Therefore, it is imperative that, the relative importance farmers place on these characteristics be understood in order to develop varieties, which will be adopted by farmer community. Identifying this research gap, [3] looked at farmer preferences for different rice traits. In that study, the relative importance of these traits is

assessed in terms of the Willingness to Pay (WTP) estimates obtained.

Willingness to pay is the maximum amount a person would be willing to pay or sacrifice in order to receive a product or to avoid something undesired [4]. To make resource allocation decisions based on economic values, the net economic benefit from a product should be measured. For individuals, this is measured by the amount that people are willing to pay, because measures of economic value are based on what people want; their preferences.

The long storage capacity makes ragi an important crop in risk-avoidance strategies for poorer farming communities. Ragi is especially valuable as it contains the amino acid, methionine, which is lacking in the diets of hundreds of millions of the poor who live on starchy staples such as cassava, plantain, polished rice, or maize meal [5]. Although ragi is still an important staple food for tribal. Ragi consumption was twice or thrice in a day, which has come down to once in a day, it is taken twice a day for few months immediately after the harvest (as taste sweet) or during the days of hard work, therefore from economic as well as health point of view, it becomes important for them to eat ragi. In spite of its superiority in terms of drought resistance, nutritional value and fodder quality and being a most important staple crop, best suited to rainfed condition, importance given to ragi has been reducing in India and Karnataka. Thus, this study aims at providing an overall insight into the importance of ragi crop among the farmers.

2. METHODOLOGY

2.1 Study Area

Tumakuru and Hassan districts of Karnataka were selected for producer's survey as they are the major ragi growing districts of Karnataka. For consumer survey, Hassan and Bengaluru Urban districts were selected as these are the major ragi consuming areas. Simple random sampling technique was employed for the selection of sample farmers.

2.2 Sampling Framework

The study is based on the primary data and the required data for the analysis was collected from the sample farmers and consumers using structured schedule through personal interview.

For producer's survey, eighty sample farmers were selected randomly in each district. Eighty sample farmers comprise 40 rainfed and 40 irrigated ragi growing farmers. Totally data was collected from 160 ragi growing farmers.

For consumer survey thirty sample consumers were selected from Bengaluru Urban district from urban areas and 30 sample consumers (farmers) from Hassan rural district from rural area. Thus the total sample size comprised 60 consumers.

The primary data was collected from 160 selected sample farmers. General information regarding socio-economic status, size of land holdings, livestock inventory and traits preferred by producers was collected from the sample farmers using pre-tested and well-structured schedule through personal interview method. The data collection was purely based on the memory of the respondents.

For the consumer survey, data was collected from 60 consumers. Information regarding age, education, occupation, monthly expenditure on ragi, attribute preference by consumers and their willingness to pay for new variety was collected from the sample consumers using pre-tested and well-structured schedule through personal interview method.

2.3 Analytical Tools Employed

2.3.1 Conjoint analysis

Conjoint analysis is a multivariate technique that is commonly used to determine the relative importance of a product's multidimensional

features, and it is particularly well suited for measuring human perceptions and preferences [6,7]. The analysis refers to any decompositional method that estimates the structure of buyers' preferences for a product's features, given the buyers' overall evaluations of a set of products described by levels of specific features [8].

Using conjoint analysis, a researcher can analyze a heterogeneous product market and obtain results that can be highly disaggregated into homogeneous groups of buyers. Alternatively, aggregating results for buyers who have similar preference or utility functions can be useful in modifying current products or services and in designing new ones for selected market segments [6].

The additive conjoint model was used in this study. The model has been formulated as:

$$Y = \sum_{i=1}^n \sum_{j=1}^m V_{ij} X_{ij}$$

Where,

Y = Consumers' overall evaluation of the ragi.
 V_{ij} = Part worth associated with 'j' (1, 2, 3, ...m) of attributes, 'i' (1,2,n) the attributes are given in Table 1 and Table 2 for producers and consumers, respectively.
 X_{ij} = Dummy variable representing the preference of the j^{th} level of i^{th} attribute.

For this study, profile describing alternatives was constructed by combining levels of six attributes.

The attributes and their levels were identified through discussions with the consumers during the survey and also on consultation with marketing and food science specialists.

2.3.2 Logit model

This model is useful for the kind of a situation where the prediction of the presence or absence of an outcome based on values of a set of predictor (explanatory) variables is needed. Hence, in the present study the logistic regression model was used to determine the factors that influence farmers' willingness to pay (WTP). In this analysis, dependent variable (Y_i) is having yes and no to pay higher price for the new ragi variety. The major interest is the probability of WTP for new variety. If Y_i is the random variable (dichotomous), it can then be assumed

that Y takes on the values 0 or 1, where 0 denotes not WTP higher price and 1 denotes WTP higher price for new variety. If X_1, \dots, X_n are explanatory variables to be related WTP for new variety, then the logistic model specifies that the conditional probability of event (i.e., that $Y = 1$) given the values of X_1, \dots, X_n is as follows

$$P(Y_i) = 1/[1 + \exp - (\alpha - \sum \beta_{ii} X_{ii})]$$

In order to linearize the right hand side, a logit transformation was applied by taking the logarithm of both sides, therefore we have:

$$\text{Logit } P(Y_i) = \alpha + \sum X_{ii}$$

Where,

$Y_i = 1$, if farmers WTP higher price for new variety
 $Y_i = 0$, if farmers do not WTP higher price for new variety
 α = Constant term, X_i = Independent variables (factors) and e = Error term

The explanatory variables specified in the model are education (years), income of the consumers (Rs.) farm experience (years), yield (q) drought tolerant (dummy; tolerant=1, susceptible=0), colour of ragi (dummy; red=1, white=0), taste (dummy; sweet=1, pungent=0), nutritional quality (dummy; maintain same=1, further improve=0), price (dummy; low=1, high=0), grain size (dummy; small=1, bold=0) and aroma (dummy; scented=1, non-scented=0).

The data was tabulated, coded and analyzed using GRETLL statistical computer programme. The dependent variable (WTP) was regressed on selected explanatory variables to identify explanatory variables which highly influence the producers and consumers WTP for new variety. The logistic regression coefficient (β_i) can be used to estimate adjusted odds ratios for each of the independent variables in the model.

3. RESULTS AND DISCUSSION

3.1 Socio-economic Characteristics of the Sample Respondents

The general characteristics of the sample farmers indicated that majority of the farmers in rainfed and irrigated situation belonged to old age group (Table 3). With regard to the average age, the farmers of rainfed situation had marginally higher average age (51.69

years) than the farmers of irrigated situation (51.48 years) and the difference was non-significant.

The classification of the farmer respondents according to their education level revealed that, majority of the farmers possessed primary education in rainfed situation (36%) and in irrigated situation majority of the farmers possessed secondary education (43%). In both, rainfed (21%) and irrigated (14%) situation illiterates occupied the least position. It was found that majority of the sample farmers falls in the medium sized family (4-6 no.) followed by large family (> 6 no.). With respect to land holding, the average size of land holdings was bigger in irrigated farmers (1.90 ha) compared to rainfed farmers (1.57 ha) and the difference was found to be significant.

Table 1. Attributes and attribute levels of ragi considered for conjoint analysis (Producers)

Sl. no.	Attributes	Attribute levels
1.	Crop duration	Long Short
2.	Yield	High Low
3.	Colour	Red White
4.	Drought resistant	Tolerance Susceptible
5.	Plant height	Dwarf Tall
6.	Fodder yield	High Low

Table 2. Attributes and attribute levels of ragi considered for conjoint analysis (Consumers)

Sl. no.	Attributes	Attribute levels
1.	Taste	Sweet Pungency
2.	Colour	Red White
3.	Aroma	Scented Non scented
4.	Nutritional quality	Further improve Maintain same
5.	Size of grain	Bold Small
6.	Price	High Low

Table 3. Socio-economic characteristics of ragi farmers in rainfed and irrigated situations in the study area

Particulars	Rainfed (n=80)	Irrigated (n=80)	't' Value
I. Age group (No.)			
a. Below 35 years	9 (11)	12 (15)	
b. 35-50 years	31 (39)	25 (31)	
c. Above 50 years	40 (50)	43 (54)	
Average age (Years)	51.69	51.48	-0.09176
II. Education level (No.)			
a. Primary	29 (36)	22 (28)	0.5125
b. Secondary	22 (28)	34 (43)	
c. College	12 (15)	13 (16)	
d. Illiterate	17 (21)	11 (14)	
III. Family size (No.)			
a. Small (<4)	10 (13)	11 (14)	-0.73348
b. Medium (4-6)	59 (74)	57 (71)	
c. Large (>6)	11 (14)	12 (15)	
Average family size	5	5	
IV. Land holding (No.)			
a. Small farmers (< 2 ha)	17 (21)	5 (06)	2.144**
b. Medium farmers (2 to 5 ha)	40 (50)	43 (54)	
c. Large farmers (> 5 ha)	23 (29)	32 (40)	
d. A Average land holding (ha)	1.57	1.90	

Comparison of pattern of distribution of respondents in different age-groups, education level, family size and land holding was non-significant which revealed the similarity between two situations. Even the difference in the age, family size and education of the sample respondents was statistically non-significant.

These facts clearly implied that the selected farmer-respondents in rainfed and irrigated situation were homogeneous with respect to the socio-economic characteristics.

3.2 Attributes of ragi that determine producer and consumer preferences

Ex-ante producer preference for ragi: The important attributes of ragi which determine the producer preferences in Tumakuru and Hassan districts were crop duration, yield, colour, drought tolerant, size of grain and fodder yield. For each respondent, the part-worths were estimated using Ordinary Least Square (OLS) analysis.

To find out the fit of the additive model, Persons rank and Kendall's tau correlations were computed for both Tumakuru and Hassan districts (Table 4). Pearson's rank correlation (0.737) was significant at 5% level. Similarly, Kendall's correlation value with 0.643 was also significant at 5% level, indicating strong confidence in the suitability of the additive model

for Tumakuru district. Similarly, for Hassan district, the additive model was fit since both Pearson's rank correlation value (0.789) and Kendall's correlation value (0.691) were significant at 5% level.

Table 4. Correlations between producer preferences of ragi in Tumakuru and Hassan districts

Correlations	Tumakuru	Hassan
Pearson's rank correlation	0.737**	0.789**
Kendall's tau correlation	0.643**	0.691**

Note: ** Significant at 5 % level

The relative importance of the part worth functions was compared across different attributes within segments in order to arrive at the relative importance of each attribute. Average part-worths and the relative importance of the attributes for Tumakuru and Hassan districts are presented in Table 5.

Among all the attributes studied in Tumakuru district, yield was found to be the most significant and first consideration, accounting for 18.83%. The individual utilities of high and low yield of ragi were 0.10 and -0.10, respectively, as the producer prefer high yielding varieties of ragi to

get higher returns. Drought tolerant had a strong influence on producer's preference after yield, accounting for 17.95% of relative importance, with drought tolerance having the utility of 0.24.

The scientists in the Universities need to develop improved ragi variety which will be of drought tolerant because ragi is mainly grown as rainfed crop in Karnataka. Therefore the new variety can withstand drought and increases the yield of the crop. Next important attributes were colour and crop duration with a relative importance of 17.25% and 16.98%, respectively. While, plant height and fodder yield was least important attribute with relative importance at 13.45% and 15.54%, respectively.

In case of Hassan district, colour was found to be the first contemplation and most important factor accounting for 18.33% of relative importance, with red colour having the utility of 0.34. The producers use to prefer red colour ragi rather than white one. Because demand for red colour ragi was more in the market. Yield was next important attribute after colour on producer's preference, accounting for 17.36% of relative importance, with higher yield having the utility of 0.21. The third most important factor that has influence on consumer's preference was crop duration. Next to duration of crop, fodder yield had a relative importance of 16.75%, with higher fodder yield having the utility of 0.21. The producers also look for the yield of fodder too, because to feed the animals and helps the producers to get more returns by selling their fodder. In the nutshell, the Ex- ante producer preference in Tumakuru and Hassan districts

showed that, the majority of the producers prefer more of high yielding varieties with drought tolerance. The new variety can withstand longer drought period in order to get more yield.

Ex-ante consumer preference for ragi: The important attributes of ragi that determine consumer preferences in Bengaluru Urban and Hassan districts were taste, colour, aroma, nutrition quality, size of grain and price. For each respondent, the part-worths were estimated using OLS regression analysis.

The fit of the additive model to the individual data was good. In case of Bengaluru Urban district, Pearson's rank correlation value with 0.908 was significant at 5% level, similarly, the Kendall's correlation value with 0.714 was also found to be significant at 5% level. Similar pattern of correlations (Pearson's and Kendall's) were observed for Hassan district (Table 6). This gives strong confidence in the suitability of the additive model.

Among all the attributes of ragi studied in Bengaluru Urban, taste was found to be most important and first consideration of consumers, accounting for 21.20% of relative importance with sweet taste having the utility of 0.58 (Table 7). Size of grain had a strong influence on consumer's preference after taste in urban area accounting for 18.58%. The individual utilities were small and bold size grain were 0.44 and -0.44, respectively. Aroma formed the third most important factor having a relative importance of 17.95%, with scented one having the utility of 0.39.

Table 5. Results of conjoint analysis of ragi preference by producers in Tumakuru and Hassan districts

Sl. no.	Attributes	Attribute levels	Tumakuru		Hassan	
			Partworths	Relative importance (%)	Partworths	Relative importance (%)
1.	Crop duration	Short	0.008	16.98	-0.325	17.28
		Long	-0.008		0.325	
2.	Yield	Low	-0.108	18.83	-0.217	17.36
		High	0.108		0.217	
3.	Colour	White	-0.200	17.25	-0.342	18.33
		Red	0.200		0.342	
4.	Drought tolerant	Susceptible	-0.242	17.95	-0.058	13.85
		Tolerant	0.242		0.058	
5.	Plant height	Tall	0.150	13.45	0.492	16.43
		Dwarf/Short	-0.150		-0.492	
6.	Fodder yield	Low	-0.167	15.54	-0.217	16.75
		High	0.167		0.217	
Total			100.00		100.00	

Table 6. Correlations between consumer preferences of ragi in Bengaluru urban and Hassan districts

Correlations	Bengaluru Urban	Hassan
Pearson's rank correlation	0.908**	0.958**
Kendall's tau correlation	0.714**	0.691**

Note: ** Significant at 5 % level

Nutritional quality was the important attribute but the results showed that, the consumers gave least importance (12.78%) it is due to awareness about nutrition was very less among majority of the consumers. The consumers gave least importance (12.18%) to price in Bengaluru Urban due to many of the consumers in the urban area are high income groups.

In general, consumption of ragi in urban areas was relatively lower, compared to rural areas may be due to substitution of other food additives. Meanwhile, with increase in income of individuals, the expenditure on necessities goes on decreasing and increasing trend on luxuries.

In Hassan district, aroma was found to be the most important attribute accounts 18.89% of relative importance, with scented aroma having the utility of 0.31. Nutrition quality had a more influence on consumer's preference after aroma with a relative importance of 17.01%. Price was third most important factor influences consumer's preference accounting 16.66% of relative importance, with low price having the utility of 0.09. While, taste was least important attribute with relative importance at 15.54%.

The consumers in Bengaluru Urban would prefer better taste rather than nutrition and price, because consumers in the urban area are high income groups and for the nutritional aspects the consumers are not aware about nutritional composition, they consume other foods having all characteristics such as good in protein content, rich in vitamins good nutritious foods etc. The consumers in Hassan district were residing in rural areas having low income groups, so they give importance to price as a more important attribute as well as nutritional aspects, because they consume daily and it is a more staple food.

3.3 WTP for New Variety of Ragi

Logit model: Further to know the willingness to pay for new variety by producers was analysed using logit model. Based on conjoint analysis results, the variables were chosen to know the

WTP for new ragi variety by farmers in Tumakuru and Hassan districts, respectively.

In considering the WTP decision of farmers has only two options, either to pay or to not pay the higher price. This gives the dependent variable (WTP) special features in that it takes two outcomes. Therefore, OLS is not an appropriate method to analyze the WTP, because of the nature of the dependent variable. The WTP paid by producers and consumers can only be positive or nil. The appropriate technique in this case is to apply logit estimation. Kim and Maddala [9] explicitly supported this claim [10,11].

3.4 WTP for New Variety of Ragi by Producers

There are number of factors that do influence on the farmers' WTP for new variety. So, the factors that influence WTP for new variety were determined by using logistic regression model. Here, the dependent variable (Y_i) is having yes and no to pay higher price for the new ragi variety; it takes the value 0 for no and 1 for yes. The explanatory variables were expected to influence the farmers WTP for new variety. The Log Likelihood Ratio (LLR) statistic was significant for both producers and consumer's preference implying that the explanatory variables included in the model jointly explained the probability of farmers' WTP for new variety. The result of logistic model is presented in Table 8 and Table 9.

Out of selected variables, education, yield and drought tolerance were the variables that had significant influence on farmers WTP for new ragi varieties in Tumakuru district as against yield and colour were the only variables had significant influence on farmers WTP for new ragi variety in Hassan district. Griffith and Nesheim [12] found that, 80% of households were willing to pay at least some positive amount to organic food. These findings of the present study was in line with results obtained by Piyasiri and Ariyawardana [13] and Rachel and Nesheim [12].

In case of Tumakuru district, education, yield and drought tolerance were significantly contributing for farmers WTP for new ragi variety. at various levels of significance (Table 8). 5% for education and yield and 1% for drought tolerance, respectively. Education was negatively significant, whereas yield and drought tolerance were positively significant.

A one quintal increase in yield of ragi results in increase in the probability of WTP by 0.035. Similarly, if the new variety will have a characteristic of drought tolerance, a unit increase in use of drought tolerant variety results in increase in the probability of WTP by 0.001.

The variables, such as colour and yield were the variables that had significant influence on farmers WTP for new ragi variety in case of Hassan district (Table 9). Yield was significant at 5% and having probability value 0.018 and colour was the other variable had significant contribution for farmers WTP for new ragi variety at 1% level of significance and results in increase in probability of WTP by 0.001.

It was clearly evident from the results that, the farmers would prefer more of high yielding and have a characteristic feature of tolerance of ragi crop to drought. In addition, the farmers in the study area would prefer red colour ragi as one of

Table 7. Results of conjoint analysis of ragi preference by consumers in Bengaluru urban and Hassan districts

Sl. No.	Attributes	Attribute levels	Bengaluru Urban		Hassan	
			Partworths	Relative importance (%)	Partworths	Relative importance (%)
1.	Taste	Pungency	-0.589	21.20	-0.325	15.54
		Sweet	0.589		0.325	
2.	Colour	Red	0.071	17.31	0.042	15.60
		White	-0.071		-0.042	
3.	Aroma	Non scented	-0.393	17.95	-0.317	18.89
		Scented	0.393		0.317	
4.	Nutrition quality	Maintain same	-0.018	12.78	-0.300	17.01
		Further improve	0.018		0.300	
5.	Size of grain	Small	0.446	18.58	-0.045	16.30
		Bold	-0.446		0.045	
6.	Price	Low	0.125	12.18	-0.092	16.66
		High	-0.125		0.092	
Total			100.00		100.00	

Table 8. Logit model results for the producers willingness to pay (WTP) for new ragi variety (Tumakuru district)

Parameters	Coefficient	Std. Error	Z test	p-value
Constant	-0.436	1.286	-0.33	0.734
Experience in farming	-0.083	0.086	-0.96	0.332
Education	-0.507**	0.402	-1.25	0.025
Yield	1.728**	0.823	2.09	0.035
Drought tolerant	2.849***	0.886	3.21	0.001
Log likelihood	-20.15			
Log Likelihood Ratio test (Chi-square, 4)	22.04			
Akaike criterion	50.31			
Schwarz criterion	59.35			
Cases predicted correctly	75.60			

Note: ** and *** represent 5 and 1% significant levels, respectively

Table 9. Logit model results for the producers willingness to pay (WTP) for new ragi variety (Hassan district)

Parameters	Coefficient	Std. Error	Z test	p-value
Constant	-1.952	1.196	-1.63	0.102
Experience in farming	-0.098	0.183	-0.53	0.591
Yield	1.705**	0.810	2.10	0.018
Colour	2.609***	0.803	3.24	0.001
Drought tolerant	0.462	0.784	0.58	0.555
Log likelihood	-21.14			
Log Likelihood Ratio test (Chi-square, 4)	22.07			
Akaike criterion	52.28			
Schwarz criterion	61.31			
Cases predicted correctly	75.60			

*Note: ** and *** represent 5 and 1 % significant levels, respectively*

the important attribute which will influence the purchase of ragi grains by consumers in rural and urban areas. Therefore, the researchers and University scientists have to develop a new ragi variety which is high yielding and tolerant to drought conditions along with red colour variety.

3.5 WTP for New Variety of Ragi by Consumers

There are number of factors that do influence on the consumers WTP for new variety of ragi. So, the factors that influence the consumers WTP for new variety were determined by using logistic regression model.

Out of selected variables, nutritional quality and grain size were the variables that had significant influence on consumers WTP for new ragi variety in Bengaluru urban district (Table 10) as against aroma and nutritional quality that had significant influence on consumers WTP for new ragi variety in Hassan district (Table 11). If a unit increase in consumer preference for nutritional quality of ragi to be improved further results in increase in probability of WTP by 0.006. Similarly for grain size. The new ragi variety having a small size grain would be accepted by consumers residing in Bengaluru urban. A unit increase in use of small size grains by consumer's results in increase in probability of WTP by 0.087 and it was significant at 10% level of significance.

Table 10. Logit model results for the consumers willingness to pay (WTP) for new ragi variety (Bengaluru Urban district)

Parameters	Coefficient	Std. Error	Z test	p-value
Constant	-4.716***	1.733	-2.72	0.006
Taste	1.180	1.045	1.12	0.259
Income	0.487	0.862	0.56	0.571
Price	0.380	0.287	1.35	0.176
Grain size	1.654*	0.968	1.70	0.087
Nutritional quality	3.254***	1.187	2.74	0.006
Log likelihood	-17.98			
Log likelihood Ratio Test (Chi-square, 4)	26.38			
Akaike criterion	47.97			
Schwarz criterion	58.81			
Cases predicted correctly	84.40			

*Note: *, ** and *** represents 10, 5 and 1 % significant levels, respectively*

Table 11. Logit model results for the consumers willingness to pay (WTP) for new ragi variety (Hassan district)

Parameters	Coefficient	Std. Error	Z test	p-value
Constant	-2.089**	0.980	-2.13	0.033
Price	0.035	0.199	0.18	0.856
Grain size	0.474	0.662	0.71	0.474
Aroma	2.561***	0.668	3.88	0.000
Nutritional quality	1.099*	0.663	1.65	0.097
Log likelihood	-29.46			
Log likelihood Ratio Test (Chi-square, 4)	24.18			
Akaike criterion	68.92			
Schwarz criterion	79.39			
Cases predicted correctly	78.30			

*Note: *, ** and *** represents 10, 5 and 1 % significant levels, respectively*

It was clearly evident from the results that, the consumers will prefer more of nutritionally rich ragi. Hence there is a need to develop a ragi variety which is of rich in nutrients and enhancement of bio availability of nutrients in ragi. In addition, the consumers in the study area would prefer size of grain and aroma which influence the purchase of ragi grains by consumers in rural and urban areas.

4. CONCLUSION AND POLICY RECOMMENDATIONS

For producer and consumer preference for new ragi variety, conjoint analysis was used and further to know the willingness to pay and accept new variety of ragi by producers and consumers, logit model was used. Among all the attributes studied in Tumakuru district attributed to producer preference, yield was found to be the most significant and first consideration, accounting for 18.83% and in case of Hassan district, colour was found to be the first contemplation and most important factor accounting for 18.33% of relative importance, with red colour having the utility of 0.34. With respect to consumer preference, among all the attributes studied in Bengaluru urban, taste was found most important and first consideration by consumers, accounting 21.20% of relative importance with sweet taste having the utility of 0.58 followed by size of grain.

Further the WTP for new ragi variety was estimated using logit model. Education, yield and drought tolerance were the variables had significant influence on farmers WTP for new ragi variety in case of Tumakuru district. A unit increase in use of drought tolerant variety by

farmers, results in increase in the probability of WTP by 0.001 and yield and colour were the variables had significant influence on farmers WTP for new ragi variety in case of Hassan district. With respect to WTP for new variety by consumers, nutritional quality and grain size were significantly contributing at one and five per cent level of significance, respectively in case of Bengaluru urban district. A unit increase in consumer preference for nutritional quality of ragi to be improve further results in increase in probability of WTA by 0.006. Aroma and nutritional quality had significant influence on WTP for new ragi variety by consumers residing in Hassan district.

Analysis of producer preference indicated that, the farmers prefer more of long duration ragi varieties with high yield and drought tolerant. Hence, the researchers and University scientists need to develop a new ragi varieties which are high yielding and short duration crop and it can withstand drought in order to attain higher returns and analysis of consumer preference indicated that, colour was one of the most important attribute, so research has to be taken up by State Agricultural Universities (SAU's) as well as scientists to develop new ragi varieties which have good taste and rich in nutrient contents, in order to get more nutritional benefits out of ragi.

The existing procurement price for ragi was Rs. 2100 per quintal through Ragi Market Centre (RMC) but the cost of production was Rs. 2570/q under rainfed condition and Rs. 2030/q under irrigated condition. Hence, Government should increase the procurement price at least to cover its cost of production in order to help the farmers to continue to grow ragi under both the conditions.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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