

Farm Women's willingness to pay for bio fortified rice variety-a micro level study

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ABSTRACT

Milled rice, though a good source of energy, is poor source of micronutrients. Where rice is a staple food, fortification with essential vitamins and minerals would make it more nutritious, which can fetch premium price. This study used the contingent valuation method (CVM) to estimate the farm women's willingness to pay (WTP) for DRR Dhan 45, the bio-fortified (with zinc) rice variety developed by ICAR-Indian Institute of Rice Research, Hyderabad. Correlation analysis was carried out to ascertain the significant relationships of WTP with socioeconomic variables. The farm women were willing to pay an average premium of about 26% over the prevailing price of non-bio-fortified rice. The results also showed that young and educated farm women are willing to pay higher price, who in turn could be the potential target group for creating awareness and promotion of bio-fortified rice varieties to address the micronutrient deficiencies among malnourished masses.

Key words: Micronutrient deficiencies, Bio-fortified rice, willingness to pay, contingent valuation method, farm women

INTRODUCTION

Micronutrient deficiencies is an important global health issue. Micronutrients are needed in trace amounts and play vital roles in various physiological functions. More specifically, deficiencies of iron and zinc are reported to be widespread, and their adverse health consequences are severe, affecting more than two billion people worldwide, mostly in the low and middle-income countries. According to the Global Nutrition Report (GNR, 2018), India is home to over 30.9% of world's stunted children under the age of five, which is highest in the world. Over 70% of India's population still consumes less than 50% of Recommended Dietary Allowance (RDA) for micronutrients (FSSAI, 2017). Fortification of staple foods can be an efficient, simple and inexpensive strategy for supplying additional vitamins and minerals to the diets of large segments of the population (WHO, 2018). Staple crops are targeted for bio-fortification efforts, because they often have low micronutrient density and are consumed in large quantities by large proportion of resource-poor

populations (Bouis et al., 2011). Multiple stakeholders led by the Food Safety Standards Authority of India (FSSAI) in the year 2016 issued a declaration stating food fortification as a realistic and sustainable complementary strategy to food supplementation and dietary diversification for elimination of micronutrient deficiencies (FSSAI, 2017).

There are four main methods commonly used to address the micro nutrient deficiencies: dietary diversification, supplementation, fortification and bio-fortification (Campos-Bowers and Wittenmyer, 2007). Bio-fortification is the development of food crops rich in bio-available micronutrients, either through conventional breeding or genetic modification (Johns and Eyzaguirre, 2007). This method does not rely on food processing or the milling process to incorporate micronutrients into the diet and repeat purchases are not necessary. Therefore, bio-fortification particularly targets rural areas where home production and consumption of staple food crops are significant and consumption of the marketed surplus is likely to remain in the community. Bio-fortification complements

existing interventions, such as supplementation and industrial food fortification as no single intervention will alleviate micronutrient deficiencies (Bouis and Saltzman, 2017). Bio-fortified crops offer a rural-based intervention that, by design, initially reaches these more remote populations, which constitutes a major share of the undernourished in many countries, The success of bio fortification as a strategy largely depends on the willingness of consumers and producers to accept the newly bred crop varieties (Talsma et al., 2017). Research on farmers' adoption and consumers' acceptance has revealed that farmers and consumers like the various production and consumption characteristics of bio-fortified varieties, as much as (if not more than) that of the popular conventional varieties, even in the absence of nutritional information (Saltzman et al., 2017).

Rice forms an important cereal for fortification to address micronutrient deficiencies in populations whose diet depends mainly on rice consumption. Inspite of being a good source of energy, milled rice is a poor source of micronutrients (Table 1). Rice fortification is the enrichment of rice with essential vitamins and minerals at post-harvest stage, to increase its nutritional value as a large proportion of global population depends on rice as a staple food. Rice fortification offers a unique opportunity to substantially improve nutrition with essential vitamins and minerals and is being considered as a proven and cost-effective intervention. People differ in their preferences and choice about the type of rice they consume and therefore it is essential to understand the different preferences and the willingness

of consumers to accept fortified rice. Fortified rice increases micronutrient intake without requiring consumers to change their buying, preparation or cooking practices (Milani et al., 2017).

The Indian Institute of Rice Research (IIRR) has put in considerable efforts to breed zinc fortified rice and the recently released bio-fortified rice variety DRR Dhan 45 is the first high zinc rice variety and one of the three bio-fortified rice varieties notified at national level to ensure nutritional security (IIRR, 2016). However, success of this newly developed bio-fortified rice variety heavily depends on its consumer acceptability. Consumer acceptance can have important ramifications for development of new technologies, as has been shown by consumers' resistance to genetically modified products in Europe and Japan (Chern et al., 2002). Consumer acceptability studies involve assessment of the sensory qualities of bio-fortified rice and also consumers' willingness to pay (WTP) for bio-fortified rice. Accurately gauging consumers' willingness to pay (WTP) for a product or service is critical for formulating competitive strategies and developing new products (Anderson et al., 1993). There are various approaches to measure WTP and primarily they differ in terms of whether WTP is measured directly or indirectly and also whether hypothetical WTP or actual WTP is measured. The direct approach of eliciting WTP entails, asking consumers directly to state their WTP for a specific product through an open-ended question format (Abrams, 1964; Mitchell and Carson, 1989). WTP estimates are often determined through different valuation methods and procedures and in this study, Contingent valuation method (CVM) was used to elucidate their willingness to pay contingent on the provision of some hypothetical good or service.

The main objective of this study was to elicit the farm women's willingness to pay (WTP) for bio fortified rice in selected villages of Telangana State, India.

MATERIALS AND METHODS

Study area

In Telangana State of India, paddy is grown in an area of 1.05 million hectares, with a production of 3.05 million tonnes per annum and productivity of 2913 kg/ hectare (DES, 2017). Nalgonda is the major paddy growing

Table 1. Zinc contents in different foodgrain

Food Grain	Zinc content (ppm)
Rice	16*
Wheat	16.2
Finger millet	17.3
Sorghum	22.4
Maize	14.8*
Chick pea Whole	20.3
Chick pea decorticate	26.8
Green gram whole	24.0
Green gram decorticated	21.9
Red gram	23.5
Black gram	23.0
Cow pea	25.7
French bean	21.8

Source: Hemalatha et al., 2007; *lowest in maize and rice

district of Telangana state with an area of 0.21 million hectares under paddy and production of 0.62 million tonnes per annum (DES, 2016). Nalgonda district was selected for the study as it is the major paddy growing district with highest average production of rice (Samarpatha et al., 2016). Deverkonda Mandal was selected for collection of primary information as nutrition information campaigns to highlight the importance of micronutrients especially zinc in diet were organized in selected villages of this Mandal. On-farm demonstrations for popularization of bio-fortified rice variety DRR Dhan 45 were also organized in this Mandal by ICAR-IIRR, Hyderabad.

Sampling and data

The respondents for the present study were farm women (beneficiaries of a project being implemented by ICAR-IIRR, Hyderabad) selected through convenience sampling for ease of access and the preparedness of farm women to respond without any bias. Convenience sampling is used for researching subjects of the population that are easily accessible to the researcher (Lisa, 2008). Eleven villages from the block Deverkonda were selected randomly and from each village 10 farm women were chosen. Thus, a total of 110 respondent households constituted the sample for the study. Data on demographic parameters (*viz.*, education, age, farm size, household size) and rice purchasing behaviour (source and frequency of purchase) of respondents were collected by personal interview.

Estimation of WTP

Farm women's acceptance of a bio fortified rice was determined through preference elicitation methods *i.e.* WTP. Based on the concept provided by Varian (1992), WTP in this study has been operationalized as the maximum price at or below which a consumer will definitely buy one unit of the product (in this case a bio-fortified rice variety) given their preference, income level and other characteristics. The study used the contingent valuation method (CVM) to estimate the farm women's willingness to pay (WTP) for DRR Dhan 45, the bio fortified rice variety. In determining WTP estimates, first, consumers were presented with a hypothetical scenario concerning the benefits of bio-fortified rice variety. The respondents' WTP for a bio

fortified rice variety was obtained at four denominations of premium in terms of Indian National Rupee (INR), *i.e.*, INR 5, INR 10, INR 15 and INR 20 per kilogram of rice over the prevailing market price for rice in the study area.

A correlation matrix was created for all variables to identify significant relationships of the independent variables to the dependent variable, WTP.

RESULTS AND DISCUSSION

Demographic profile

The demographic profile of farm women has been presented in Table 2. About half of the respondents (54%) belonged to middle age group, followed by young (24%) and old (22%) age groups. High percentage (77%) of the farm women were illiterates and majority (67%) of the respondents had small land holding. About 72% of the sample households are of medium size. Forty three percent of the respondents were members of credit societies.

Rice purchase behaviour

Table 3 indicates that majority (62%) of the respondents purchased rice from local market for consumption, while 32% of the respondents consumed their own produced

Table 2. Demographic Profile of farm women of Deverkonda, Nalgonda (N=110)

Characteristics	Percentage (%)
Age (years)	
Young age (<30)	24.55
Middle age (31-50)	54.55
Old age (>50)	20.91
Education level	
Illiterates	77.27
Primary education	12.73
Secondary education	6.36
Intermediate education	3.64
Acreage	
1-5 acres	67.27
6-10 acres	26.36
more than 10 acres	6.36
Family size	
Small family (1-3 members)	20.91
Medium size family (4-6)	71.82
Large size (7-9)	7.27
Membership in societies	
No	57.27
Yes	42.73

Table 3. Distribution of respondents based on source and frequency of rice purchase.

Particulars	Reporting frequency (%)
Source of purchase	
Local market	62.73
Own production	31.82
Gift from parents/relatives	5.45
Frequency of purchase	
Weekly	5.45
Weekly twice	7.27
Monthly	46.36
Once in three months	40.91

rice and a small section (5%) of the respondents consumed the rice gifted to them by their parents/relatives. The frequency of rice purchase indicated that most of them were purchasing it monthly (46%) or once in three months (41%).

Distribution based on WTP for a bio-fortified rice variety

In administering the CVM scenario, the first step was to ask the farm women, whether they were willing to pay for the bio-fortified rice variety. Eighty one percent of the farm women stated that they are willing to pay a premium price to obtain the bio-fortified rice variety (Table 4). The farm women who answered 'yes' to the first question were further asked to indicate their WTP estimates from the provided list of premium denominations, i.e., INR 5, INR 10, INR 15 and INR 20. The prevailing price of commonly consumed rice was estimated to be INR 48. Consumers randomly chose different levels of premiums based on their preferences (Table 5). Nearly half (49%) of the farm women are willing to pay premium of INR 5 per kg for bio fortified rice followed by that of INR 10 (35%). Relatively smaller proportions of the respondent were willing to pay premiums of INR 15 (10%) and INR 20 (5%). Taking the prevailing price for a kilogram of commonly consumed rice as INR 48, the farm women were willing to pay an average premium of 26.04%. In

Table 4. Distribution of farm women based on WTP premium price for bio-fortified rice variety.

Willingness to pay	Reporting frequency (%)
No	18.18
Yes	81.82
Total	100.00

a recent review, De Steur et al. (2016) had reported the average premium for bio-fortified food to be 21.3%. In separate studies, Bouis et al. (2011) and Birol et al. (2015) had reported consumers' WTP for bio-fortified crops, viz., sweet potato, maize and cassava in Africa and pearl millet in India. Ongudi et al. (2017) reported that the consumers were willing to pay an average premium as high as 42% above the prevailing market price of finger millet varieties in Kenya. Jena et al. (2012) reported that village communities were willing to pay 10 to 20% more for a new rice variety that will make pregnant women stronger subject to its easy availability with preference for its taste not being different from that of commonly consumed rice.

Table 5 also elicits that while the WTP premium price ranged between 10 to 41%, majority of the farm women were willing to pay a premium of only 10%, and only a small proportion of farm women were willing to pay a high premium over 10%. This calls for greater educational efforts for convincing the farm women about potential benefits and effectiveness of bio-fortified rice variety in overcoming micronutrient malnutrition.

Determinants of WTP for bio-fortified rice variety

Results of Spearman's correlation analysis revealed that education and membership in savings group had significant and positive relationship with WTP for bio fortified rice (Table 6). However, age showed a significant and negative relationship, which indicates that younger farm women had a higher willingness to pay for bio fortified rice compared to older farm women. The findings indicate that young and better educated farm women can influence the willingness to pay additional price for bio fortified rice. Influence of educational status on acceptance of iron rich rice has been reported earlier by Edith et al. (2011). Young and educated farm women could be the potential target

Table 5. Distribution of farm women based on WTP premium price for bio-fortified rice variety.

Additional amount willing to pay (INR)	Reporting frequency (%)	WTP premium price (%)
5	49.09	10.42
10	35.45	20.83
15	10.00	31.25
20	5.45	41.66
	100	

Table 6. Determinants for WTP for bio-fortified rice variety.

	Correlations	
		Willingness to pay more
Age	Pearson Correlation	-0.190*
	Sig. (2-tailed)	0.047
	N	110
Education	Pearson Correlation	0.213*
	Sig. (2-tailed)	0.026
	N	110
Family members	Pearson Correlation	0.137
	Sig. (2-tailed)	0.152
	N	110
Membership in society	Pearson Correlation	0.198*
	Sig. (2-tailed)	0.039
	N	110
Landholding	Pearson Correlation	0.115
	Sig. (2-tailed)	0.230
	N	110
Experience in paddy cultivation	Pearson Correlation	0.102
	Sig. (2-tailed)	0.291
	N	110

*Correlation is significant at the 0.05 level (2-tailed).

group for creating awareness and promotion of bio fortified rice varieties to address the micronutrient deficiencies among children.

CONCLUSION

The results of this study indicated that nearly half of the farm women are willing to pay an additional 5 rupees. On an average, the farm women were willing to pay an average premium of 26.04% over the prevailing price of non-bio-fortified rice. The findings revealed that young and better educated farm women are willing to pay a higher premium price for bio-fortified rice. As such, young and educated farm women could be the potential target group for creating awareness and promotion of bio-fortified rice varieties to address the micronutrient deficiencies among children. Concentrated educational and promotional efforts are needed by multiple stakeholders to popularize the acceptance of bio-fortified products to combat micronutrient malnutrition among rural masses.

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