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Rural households' preferences for nutri-cereals supplied through public distribution system: a discrete choice experiment

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Abstract The Public Distribution System (PDS) is one of the largest safety net programmes in India, set up to provide subsidised grains to the poor population. This paper examines the rural households' preferences of specific attributes of millets supplied through the PDS. To assess their stated preferences, a Discrete Choice Experiment was conducted in the Sonipat district of Haryana and Baghpat district of Uttar Pradesh in 2018. The sample included 100 respondents who hold BPL (below poverty line) ration card. In all, six attributes of millets, that is product type, form, price, quantity, frequency of supply, and substitution with existing products were identified and a D-efficient fractional factorial design was used to construct pairs of preferences over the existing foodgrains supply through PDS. Respondents' preference for nutri-millets' attributes was analysed using a mixed logit model. The results reveal sorghum as the most preferred choice, followed by pearl millet. The respondents expressed their strong preference for supply of nutri-millet flour at least once a month in addition to the existing provision of rice or wheat. Respondents are willing to pay Rs 6.57 more for sorghum and Rs 10.77 more for pearl- millet compared to other minor millets. The acceptance is higher if it is supplied as flour and the willingness to pay was Rs 5.83 more over the grain.

Keywords Consumer preferences, Nutri-cereals, Public distribution, Discrete choice experiment, Willingness to pay

JEL Classification I12, Q1, R12

1 Introduction

The Public Distribution System (PDS) is one of the largest safety net programmes in India, set up to distribute foodgrains, especially wheat and rice at highly subsidised price of Rs. 1-3 per kg to the poor households. Although, it began as a universal programme owing to food shortages during the 1960s, from 1997 it has been targeted towards the poor primarily to eliminate hunger and ensure food and nutrition security. While the PDS ensured availability of foodgrains, the problem of undernutrition and malnutrition continue to persist across the country. A large body of literature suggest providing nutri-cereals

and millets to people through PDS along with rice and wheat, which is likely to make a difference in the nutritional status of the beneficiaries. Recently in 2017, the Government of India has chosen to promote production and consumption of millets. Production of millets covering *Jowar, Bajra, Ragi* and little millets like *Kutki, Kodo, Sawa, Kangni and Cheena* are promoted through a sub-mission under the National Food Security Mission (NFSM) called NFSM–Nutri-cereals. The year 2018 has also been declared as the “National Year of Millets”. Further, in order to improve their consumption, especially among the poor households, the government has decided to supply nutri-cereals, particularly sorghum, pearl millet and ragi through PDS (PIB 2018). Including millets in the PDS

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basket may augment production and consumption and help in improving the nutritional standards of poor people. The state of Karnataka has already set an example for others to follow (Behera 2017; Rajshekar & Raju 2017). In this context, an important question arises that if millets are available through the PDS, what specific attributes of millets are preferred by the households. This study makes an attempt to identify the preferences for specific attributes of millets such as price, frequency of supply, type and form of millets, quantity and preferred method of supply.

In brief, millets are nutritionally rich and climate-smart and are considered as grains for the future and “harbingers of evergreen revolution (Ravindran 1991; Hegde & Chandra 2005; Kalinova & Moudry 2006; Gupta et al. 2012). Yet, their production and consumption have remained ignored. In the past six decades, area under millets declined by 60%, from 36.9 million hectares in 1965-66 to 14.72 million hectares in 2016-17 mainly due to their decline in demand. Nutri-cereals have never been considered as primary food. The provision of rice and wheat at subsidized rates through PDS is one of the major reasons for lower consumer preference for millets (Sandeep 2012; Rao & Basavaraj 2013; Desai & Vanneman 2015). A low preference for millets can also be due to lack of awareness amongst the consumers about their nutritional components, deep rooted social perceptions about millets as low status food, lack of policies oriented towards millets, and lack of markets (Weber & Fuller 2008). The green revolution technologies and policies that primarily focussed on wheat and rice also acted as disincentive for cultivation of millets. However, rice and wheat alone are not adequate to meet the nutritional requirements (Longvah et al. 2017). Of late, the government is contemplating their supply through PDS at an affordable price and as an additional supply to increase the use of millets as food.

2 Data and methodology

As elicited above, this study aims to find out the key characteristics of millets that are most preferred by rural households, if supplied through the PDS. Accordingly, a primary survey of 100 rural households falling below the poverty line (BPL) and have ration card holders was carried out in April and May, 2018. Millets namely sorghum, pearl millet, ragi and other minor millets were chosen for the analysis purposively, since the

government has decided to supply these through the PDS. The survey was carried out in Uttar Pradesh and Haryana as consumption of these millets was very low in these northern states. A Discrete Choice Experiment (DCE) was conducted to identify the attributes preferred by the consumers. DCE is one of the quantitative methods that values various factors influencing the choices of individuals. It provides estimates on the relative importance of these factors and also the trade-offs among these while making choices (WHO 2012). DCE is used to quantify individuals’ preferences for selected attributes by asking them to state their choice over different hypothetical alternatives. It is a better method than qualitative assessments, ranking and rating exercises and is helpful for policy makers to identify appropriate strategies for implementation of any programme. DCE is an attribute-based measure of benefit. It assumes that individual decisions with regard to a good or service are determined by the attributes or characteristics of that good or service. These have been used in trade-offs between attribute importance and willingness to pay (WTP) for attributes (de Bekker-Grob et al. 2012). This technique has also been used in addressing the issues of recruitment, and retention of health workers in several countries (Wordsworth et al. 2004; Scott et al. 2007; Hanson & Jack 2010; Vujicic et al. 2010; Kruk et al. 2010; Jaskiewicz et al. 2012; Rao et al. 2012; Rockers et al. 2012).

The first step in DCE analysis is identification of attributes and their levels as presented in table 1. In total, six attributes with 18 levels have been chosen for the analysis. The ‘type of millets’ i.e. the most preferred millet, is one of the issues taken up in this study, and therefore, different millets with four levels (ragi, sorghum, pearl millet and other millets) were chosen as one of the attributes. Price is an important variable influencing the consumption behaviour and in commensurate with the existing PDS cereals’ price, three price levels have been chosen. Presuming the nutri-millets are supplied through the PDS, it is important to know the preferred quantity effectively to strategize their supply through the PDS. Hence, based on the existing cereal consumption, three levels were chosen. The distribution frequency is also a major factor, as frequent supply may take buyers’ time and energy. On the other hand, too much gap in the supply or lump sum supply at a time may create storage

Table 1. Attributes of millets and their levels

Attributes	Levels
Price (Rs/kg)	1.5, 3.0 and 4.5
Quantity (kg/member/month)	1.0, 1.5 and 2.0
Nutri-millets	Ragi, pearl millet, sorghum and other minor millets,
Frequency of distribution/supply	Once in a month, once in 3 months and once in 6 months
Substitutability	Extra/additional supply, substitute with wheat and substitute with rice
Form	Grain and flour

problem for the households. Therefore, identifying optimum distribution supply is also one of the major factors. It is also important to know that whether to change or not to change the existing cereals' supply. Therefore, substitutability factor was also considered. As far as the form of the millet is concerned, the choice between the grain or flour may vary from household to household. Some people may want grain for preparing different dishes (porridge, sprouts), while others may want to have readymade flour for preparing rotti, *halwa* etc. We included this as one of the attributes with two levels i.e. grain and flour.

From the selected attributes and their levels, a total of 648 ($3^4 \times 4^1 \times 1^1$) unique choices have been formed in full factorial design. However, it is difficult to get respondents' preferences for all the choices. Thus, through fractional factorial design method, a total 32 choices were prepared. The chosen choices are also large and respondents may get bored or tired. Therefore, we divided the selected 32 choices into two blocks (Block-I and Block II) with 16 choices in each block and eight choice sets were prepared in each choice set card comprising three choices A or B or C. The sample choice set card is given in table 2. Finally, each respondent was asked to choose eight choices from the eight cards and each card contains three choices and thus in total 24 choices were faced by each

respondent. Total 50 respondents were asked to choose amongst the choices in Block I and another 50 to choose from Block II.

The sample was drawn from a cluster of three villages (Jagadishpur, Jhari and Shajadpur) in Sonapat district (Haryana) and also from a cluster of equal number of villages (Lachoda, Bassi and Mukari) in Baghpat district of Uttar Pradesh. These clusters were selected purposively, as many initiatives regarding nutritional security have been implemented by the ICAR-Indian Agricultural Research Institute, New Delhi. From each cluster, 50 respondents (both men and women member of the rural BPL households) were identified by using snowball sampling techniques as it was difficult to find respondents for the survey, hence participants in the initial rounds were asked to identify other BPL card holders. The total sample size was 100 and the survey was conducted until the required sample size was met. It is one of the non-probability sampling methods and has coverage bias and sampling error, hence, the inferences could not be generalised. However, the evidence can provide an overview of rural households' preferences for nutri-cereals supplied through the PDS.

The DCE analysis is based on the random utility model. It is assumed that respondents will choose among several alternative choices which is having the highest

Table 2. Sample choice set card

Attributes	Choice A	Choice B	Choice C
Price (Rs/kg)	1.5	3	Existing scenario
Quantity (kg/member/month)	1.0	1.5	or no change required
Nutri cereals	Ragi	Pearl millet	
Frequency of supply	Once in a month	Once in 3 months	
Substitutability	Extra supply	Substitute with wheat	
Form	Grain	Flour	

utility. Random utility model assumes that utility has two components, deterministic and random. The deterministic components contain the attributes considered for the analysis and the unobserved attributes influencing purchasing behaviour of the consumers and individuals' taste preferences constitute random component. The utility function for nutri-milletts are specified as:

$$U = \alpha + \beta_1 x_{1n} + \beta_2 x_{2n} + \dots + \beta_{mn} x_{mn} + \varepsilon_n$$

Where, U is the utility, n represents respondent, m is attribute and ε is random error. β coefficients provide strength of the preference for each attribute level (WHO 2012). The mixed logit model was employed to analyse the preference. Inclusion of the price in the model allows us to estimate monetary value of each attribute of nutri-milletts. That is, how much the respondents are willing to pay to have a preferred attribute in their choice. It was estimated as the ratio of value of the coefficient to the negative of the price attribute. The formula for willingness to pay (WTP) is:

$$WTP(i^{th} \text{ attribute}) = \frac{\frac{\partial U}{\partial (i^{th} \text{ attribute})}}{\frac{\partial U}{\partial (price)}} = - \left(\frac{\beta_i}{\beta_{price}} \right)$$

3 Results and discussion

3.1 Preference for nutri-cereals

The socio-economic profile of the respondents is presented in table 3. It shows that most of the respondents (37%) belong to middle age category and have education up to high school (26%). The monthly average per capita income is in the range of Rs. 1,200 to 3,000 per month. There are 81% nuclear families. Majority of them (71%) has farming as the main occupation, 18% are engaged in services, and 11% are agriculture labours. The average family size is 7.8, comprising 4.7 males and 3.1 females. The average size of landholding is less than an acre.

Table 4 presents results of the DCE for preferred attributes of nutri-cereals. The signs of the coefficients indicate the degree of preference—positive and negative sign indicates the most and the least preference for a particular variable, respectively. All the variables included in the model are significant, except quantity. It indicates that the quantity attribute does not influence

Table 3. Socio-economic profile

Characteristics	% respondents
Age	
Young	19
Middle	37
Old	44
Education	
Illiterate	20
Primary	18
High school	26
Higher secondary	18
College	18
Family type	
Nuclear	81
Joint family	19
Occupation	
Farming	71
Farming+ service	18
Labour	11

nutri-cereals purchasing behaviour. As expected, price is one of the main factors influencing the purchasing behaviour of respondents. Its coefficient is negative indicating that an increase in price of millets will decrease its utility. In choosing nutri-cereals, the respondents had expressed strong preference for the type of millets and sorghum appears as the most preferred choice, followed by pearl millet and ragi. The frequency of PDS supply is one of the significant factors and respondents prefer once in a month supply as the most preferred choice, as compared to options put forth - once in three months or six months. It may be because the utility decreases with increase in the supply gap. Respondents preferred millets in flour form as compared to grain. They also had strong preference for extra supply of nutri-milletts without affecting the current provision of rice or wheat. Respondents were willing to pay Rs. 6.57 more for sorghum and Rs 5.97 more for pearl millet as compared to other millets. They were also willing to pay Rs 10.77 more for monthly supply as against a six-monthly supply. If the respondents were supplied with extra supply compared to substitution with wheat, then, WTP is more by Rs 8.09. The respondents WTP is more at Rs 5.83 for flour form when compared to grain form.

The DCE analysis highlighted several options for increasing the availability and accessibility of nutri-

Table 4. Results of mixed logit model

Variables	Coefficients	P> z	WTP
Price (Rs/kg)	-0.090	0.041	-
Quantity (kg/member)	0.161	0.282	1.78
Nutri-millet			
Minor millets base category			
Ragi= 1; ow = 0	0.272	0.297	3.02
Pearl millet=1; ow = 0	0.538	0.010	5.97
Sorghum =1; ow = 0	0.592	0.014	6.57
Frequency of distribution/supply			
once in 6 months is base category			
once in 3 months = 1; ow = 0	0.178	0.456	1.97
once in a month = 1; ow = 0	0.970	0.000	10.77
Substitutability			
Extra is base category			
Substitute with wheat = 1; ow = 0	-0.729	0.001	-8.09
Substitute with rice = 1; ow = 0	-0.303	0.298	-3.37
Product form			
Grain = 1; flour = 0	-0.525	0.006	-5.83

cereals. Expectedly, price, choice, supply frequency, substitutability and form are most important. This has several implications. Millets such as ragi and minor millets are little known among the respondents. Even though, sorghum and pearl millet are known, the most preferred millet was sorghum. Most of the respondents consume pearl millet in the form of *rotti* or porridge during the winter seasons, and not during the summers due to the belief that its consumption during summers results in stomach ailments. Another important observation is that the respondents prefer millet flour over grain because of non-availability of flour mills or lack of innovative millet processing technologies in their vicinity. Women have to process it manually. Similar constraints were reported by Ushakumari et al. (2004) and Samuel (2016). If these millets are supplied in limited quantity through PDS, people prefer it as flour only. Further, they do not want to substitute millets with rice or wheat. Indeed, they want it as an extra item. Study highlights that replacing a certain portion of wheat flours with millet flours is the best method for preparation of nutritional, healthy and safe food products at household level and commercial scales to promote utilization of millet grains. From the analysis, it is observed that households are happy with inclusion of nutri-cereals in PDS. They also shared their earlier life style, where, millets were part of their daily

diet and it was cultivated by all. The younger generation is not known to prepare bajra *rotti*, jowar *rotti*, bajra porridge, etc. because of lack of skills for kneading the flour. The youngsters are not much aware about millets- based food. In this context, a study from Karnataka has reported that even though there is a strong demand for millets, the taste and ease of cooking rice is equally strong (Rajshekar & Raju 2017). It is also clearly understood from the study that the rice-wheat cropping system in Haryana and UP has led to disappearance of millets. Despite the fact that Haryana and U.P. are the largest producers of wheat, the problem of malnutrition is high among people (Paul et al. 2018; Vashist et al. 2009). Hence, replacement or substitution of millets with wheat may help them to achieve better nutritional status.

4 Conclusion

Given that millet is a naturally nutrient-dense agricultural commodity providing nutrition and livelihood security, this study brings out that its availability through the PDS will enable poor to have better access to nutri-cereals and hence help in addressing the problem of malnutrition among them. It is suggested that millets should be introduced into the PDS in a comprehensive way, starting from

consumer awareness campaign, to production enhancement (including appropriate system for easy access to seed, price incentive and local procurement and storage) and to supply systems. A piece-meal introduction may not serve the purpose. Effective implementation and delivery of millets under the PDS can have far reaching implications for addressing the problem of malnutrition for which an active policy support is needed.

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