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Assessing farmers' preferences for e-NWR benefits in Andhra Pradesh: A conjoint analysis approach

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Abstract

This study employed conjoint analysis to evaluate farmers' preferences for e-NWR services in Andhra Pradesh, focusing on Guntur and Krishna districts. A multistage sampling technique was employed to select 80 farmers who obtained bank loans using e-NWRs as collateral. Data for the agricultural year 2022-23 was gathered through structured surveys and institutional reports and conjoint analysis used to assess farmer preferences. The conjoint analysis revealed that the positive price movements (>20%) were the most influential factor (49.03%) in decision-making, followed by access to credit (>70% value of produce, 18.86%), the ability to issue >30 e-NWRs per farmer (16.42%), low storage costs (<₹50 per bag, 9.32%), and direct sales (6.37%). The findings emphasized that e-NWRs' has impact on financial access, improved market opportunities there by increased farm income.

Keywords: e-NWR, conjoint analysis, price movements, access to credit and market access

Introduction

The flow of formal agricultural credit has shifted from cooperatives in the 1950s-60s to scheduled commercial banks, with RRBs becoming key institutional lenders (Thejeswini *et al*., 2014) [18]. However, access to credit remains limited, as banks are reluctant to lend to small and marginal farmers (Ramesh, 2007) [14]. Non-institutional sources continue to dominate rural credit, comprising 57% in Telangana, 50% in Andhra Pradesh, and 56% in Jharkhand (NABARD, 2020-21) [13]. Providing credit to farmers remains a challenge, further aggravated by the lack of suitable assets for collateral (Shalendra *et al*., 2016) [17]. Farmers' financial commitments during production and low harvest prices often force distress sales. To address this, the government integrated credit with marketing by establishing warehouses, enabling farmers to repay loans and sell their produce at better prices (Dasireddy *et al*., 2021) [5].

Warehousing in India gained importance with the Royal Commission on Agriculture (1928), leading to licensed warehouses. The Gadgil Committee (1945) emphasized improved crop storage and marketing for better rural credit. Subsequent committees led to the Agricultural Produce (Development and Warehousing) Corporations Act (1956), establishing a three-tier warehousing system. The Warehousing Development and Regulatory Authority (WDRA) was established on 26th October 2010 under the Warehousing (Development and Regulation) Act, 2007. The Act, effective from 25th October 2010 through Warehousing Development and Regulatory Authority (WDRA) introduced the Negotiable Warehouse Receipt (NWR) system to enhance agricultural credit access, to register and regulate warehouses for issuing NWRs.

Despite the potential of the NWR system to enhance rural liquidity, improve storage, reduce financing costs, and strengthen price risk management, its adoption has been slow due to excessive paperwork, security risks like theft, and lack of accuracy, limiting farmers' access to pledge finance and leading to distress sales (Dwivedi & Diwakar, 2006) [6]. To address these challenges, the WRDA has introduced electronic Negotiable Warehouse Receipts (e-NWR) on September 26, 2017 and it is mandatory for all registered warehouses to issue NWRs exclusively in electronic form from August 1, 2019.

Even though, Electronic Negotiable Warehouse Receipts (e-NWRs) has introduced to enhance financial access and price realization for farmers, challenges such as limited awareness, adoption barriers, and financial institutions' willingness to lend against e-NWRs affect the extent to which farmers benefit. Additionally, the ability of paddy farmers to leverage e-NWRs for better market price realization depends on factors like storage infrastructure, trading mechanisms, and price volatility. Understanding these challenges is crucial to assessing the effectiveness of e-NWRs in improving financial security and income for

paddy farmers**.** In view of this, it is proposed to conduct the study on "Assessing Farmers' Preferences for e-NWR Benefits in Andhra Pradesh: A Conjoint Analysis Approach" to provide data-driven insights into farmers' decision-making process regarding e-NWR adoption, helping policymakers, financial institutions, and warehouse service providers tailor their offerings to better meet farmers' needs.

Materials and Methods

Multistage sampling technique was used for the selection of state, districts, warehouses and respondents. Andhra Pradesh state was purposively selected as it stands 6th position in India with a total of 151 WDRA registered warehouses including private warehouses (WDRA, 2023) [19]. In Andhra Pradesh, Guntur and Krishna districts which issued highest number of e-NWRs for paddy *i.e* 628 and 531, respectively were selected. Paddy is one of the major crops in Guntur and Krishna districts with an area of 2.54 lakh ha and 2.68 lakh ha, respectively. In both the districts, warehouses which issued highest number of e-NWR including APSWC, CWC and private warehouses were selected.

In Andhra Pradesh, From each district, 40 farmers who availed loan from bank by pledging e-NWR as security were selected constituting the 80 farmers.

Data collection

The data pertaining to the study were obtained through survey method and enquiries were made with the help of pre-tested structured questionnaire, Commercial & cooperative banks and Warehouse reports. The present study pertains to the agricultural year 2022-23.

Data analysis

Conjoint analysis was employed to identify the determinants of paddy farmers preference towards electronic Negotiable Warehouse Receipt (e-NWR) in the study area. It is a multivariate technique used to determine how respondents develop preferences for products or services while making a decision (Hair *et al.* 1995) [9]. The analysis evaluates the value or utility of a product or service by combining the separate amounts of utility provided by each attribute. The technique was first developed by mathematical psychologists Luce and Tukey (1964) [11]. The analysis is commonly found in behavioural studies (Green and Srinivasan, 1978) [8] and in marketing studies (Green and Rao, 1971) [7] where the predictor variables are called attributes, and the dependent variable is often an overall evaluation of a product. The basic principle underlying conjoint analysis is that a product is composed of attributes and that each attribute may have two or more levels.

For measuring consumer preferences about the attributes of a product or service which determines both relative importance of each attribute and the levels of each attribute which are most preferred. Conjoint analysis closely resembles analysis of variance (ANOVA), which has a foundation in the analysis of experiments. The flexibility and uniqueness of conjoint analysis arise primarily from the following:

1. An ability to accommodate either a metric or a non-metric dependent variable.
2. The use of only categorical predictor variables.

Utility is a conceptual basis for measuring value in a conjoint analysis, which is an assessment of subjective preferences that are unique for each respondent. The conjoint analysis's main output is a series of utility values for each level of the attributes. Each attribute that enjoys higher utility value will have a higher preference and a higher chance of being selected and *vice versa*. The predicted preference for each level of selected attributes of farmers preferences in availing different benefits from e-NWR would be obtained from the merging of these utilities across the respondents. This is given by:

$$Y= X_1 + X_2 + X_3 +\text{……...}+ X_n + \text{Constant}$$

Where, the independent variables on the RHS are the attributes of farmer preferences for availing e-NWR. These independent variables are non-metric (ranked) data for different profiles of farmers preferences for e-NWR, considering different levels across the selected attributes. While the dependent variable, *Y* is the overall or total utility preference of the respondent to different levels across different attributes. This dependent variable also includes farmer ratings of the importance of levels across the attributes of availing e-NWR.

Thus, in this study,

Total utility = Utility X_1 (attribute level 1 to i) + Utility X_2 (attribute level 2 to i) + Utility X_3 (attribute level 3 to i) + Utility X_4 (attribute level 4 to i) + Utility X_5 (attribute level 5 to i) + Constant

where, Y = total utility, X_1 to X_5 = Predicted utility values of (five) selected attributes and Constant = the constant value in the analysis. The mean utility values across all the selected profiles serve as the analysis summary.

The relative importance of an attribute is essentially its share of importance. Attribute importance is the difference between the highest and lowest utility levels of the attribute. If the distance between the utility levels of an attribute is large (*i.e.,* the difference between highest and lowest utility levels of the attribute), then that attribute will have a larger bearing on the farmers' choice of preference than another attribute. The distance, therefore, reflects the importance of the attribute in determining farmer preferences.

Part-worth estimates were used to calculate relative importance of the product attributes (Halbrendt *et al*., 1991) [10]. The relative importance of the attribute (RI) is defined as,

$$RI = (\text{Utility Range}/ \Sigma \text{ utility ranges of all attributes}) *100$$

Conjoint analysis is used to determine the best possible combination of the attributes for e-NWR by identifying the utility values for different levels by the farmers. Five attributes were selected for the study with three levels each. The selected attributes were 1. Positive price movements 2. Access to credit 3. Access to market 4. Storage cost per 75 kg bag for 6 months (₹) 5. Number of e-NWR per farmer.

Table 1: Attributes for e-NWR with different levels

S. No	Attributes	Levels
1	Positive price movements	<10%
		10-20%
		>20%
2	Access to credit	>70% of value of produce
		50-70% of value of produce
		<50% of value of produce
3	Access to market	Direct sales
		Indirect sales
		Online sales
4	Storage cost per 75 kg bag for 6 months (₹)	>70
		50-70
		<50
5	No. of e-NWR per farmer	>30
		10-30
		<10

Results and Discussion

Conjoint analysis was employed to identify the determinants of paddy farmers preference for electronic Negotiable Warehouse Receipt (e-NWR) in the study area. The utility estimates with the greatest positive value from the e-NWR farmers' preferences indicated that most preferred attribute level by the e-NWR farmers, whereas the smallest negative value indicated that least favourable attribute level by the e-NWR farmers. The results were presented in the Table 2 below.

Table 2: Mean utility values of each attribute level

S. No.	Attributes	Levels	Utility Estimates	S. D
1	Positive price movements	<10%	2.018*	0.595
		10-20%	4.037	1.190
		>20%	6.055**	1.785
2	Access to credit	>70% of value of produce	2.028**	1.812
		50-70% of value of produce	1.352	1.208
		<50% of value of produce	0.676*	0.604
3	Access to market	Direct sales	0.371**	0.679
		Indirect sales	0.306	0.646
		Online sales	-0.677*	0.636
4	Storage cost per 75 kg bag for 6 months (₹)	>70	0.384*	0.550
		50-70	0.766	1.100
		<50	1.150**	1.650
5	No. of e-NWR per farmer	>30	-0.776**	0.523
		10-30	-1.553	1.046
		<10	-2.329*	1.569
Constant			2.104	1.932

** The highest utility values represent more value from the e-NWR farmers' perspective.
* The lowest utility values represent less value from the e-NWR farmers' perspective.

From the above table, it was observed that, e-NWR farmers highest preference was '>20%' level from 'Positive Price movements' attribute with the utility value of 6.055. This suggests that they expect a price increase of more than 20% and choose to store their produce in warehouses to take advantage of better price realization. So, they can sell at a later date when the market offers higher returns.

For the 'Access to credit' attribute, the most preferred level was '>70% value of the produce' with highest utility value of 2.028. Farmers can access credit facilities and have the ability to access credit up to 75% of the current paddy market price. This preference indicates that farmers consider financial liquidity important, as it allows them to meet their immediate needs while keeping their produce stored safely.

For the 'Access to market' attribute, farmers preferred 'Direct sales' level with highest utility value of 0.371 as it eliminates middlemen, allowing them to sell their produce directly to buyers. This direct selling approach helps them secure better prices by reducing commissions and other costs associated with intermediaries.

For the 'Storage cost per 75 kg bag for 6 months (₹)' attribute, the '<50' level was preferred by farmers with highest utility value of 1.150. Storage cost varies with the type of warehouse. This preference is influenced by the proximity of warehouses to villages, which minimizes transportation hassles and additional costs. Low storage costs ensure that the benefits of warehousing do not get eroded by excessive expenses.

For the 'Number of e-NWR per farmer' attribute the '>30' level was mostly preferred with highest utility value of -0.776. Although this level has a negative utility value, the preference for having more than 30 e-NWRs per farmer suggests that farmers value the flexibility of selling their produce in multiple lots. This allows them to take advantage of favorable market conditions by selling gradually rather than all at once.

Based on the findings of this study which was on the utility and relative importance values of each aspect of the service obtained using conjoint analysis, it was concluded that the e-NWR farmers mostly preferred more than 20% of 'Positive price movements, more than 70% value of the produce for credit from institution, direct sales for marketing, less than ₹.50 for storage cost per 75 kg bag for 6 months (₹) and more than 30 e-NWRs issued per farmer in the study area.

Correlation test used to determine the conjoint analysis result aggregate's validity in predicting respondents' preferences using the correlation value (Table 3). Pearson's rank correlation value of 0.892 were found to be statistically significant at 1% level of significance. It showed relatively strong correlation between the anticipated preference and actual preference or it comprises precise prediction in the conjoint process.

Table 3: Correlation Values

S. No	Correlations	Value	Significance
1	Pearson's R	0.892	0.000

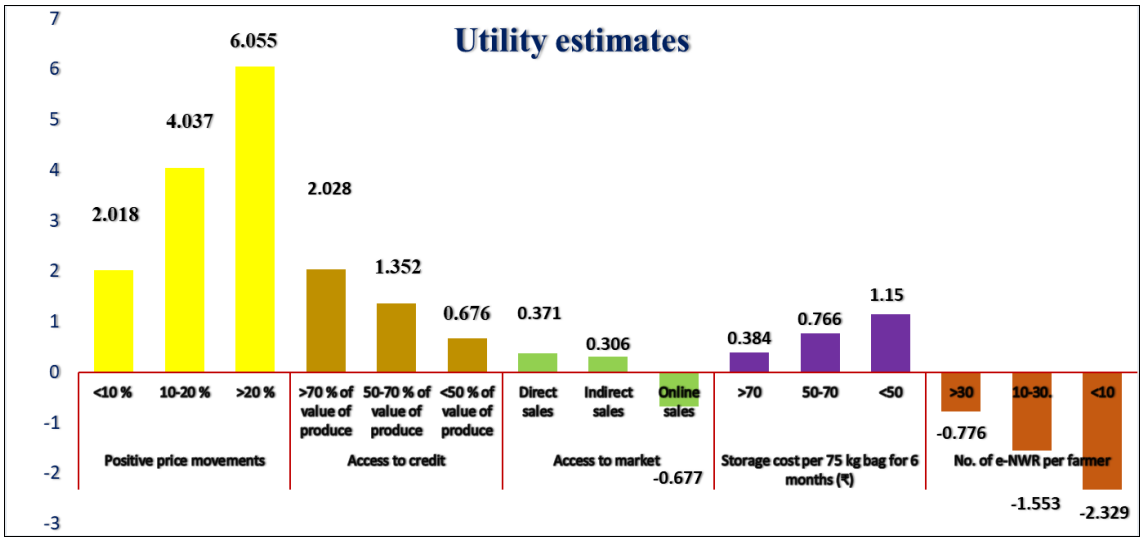

Fig 1: Mean utility values of each attribute level

Relative Importance among the selected attributes

The choice of attribute levels has a critical bearing on perceived attribute importance, and this highlights why both the highest and the lowest prevalent levels should preferably be included in the research design to get unbiased estimates of the importance of attributes. If the range of levels within an attribute is stretched beyond the beneficiaries' prevailing levels, its importance will be inflated. Since it may not always be desirable or feasible to cover a realistic range of levels within attributes, the correct interpretation should be in terms of the relative importance of the selected attributes. The findings of relative importance of each attribute were shown in Table 4. and Fig.2.

It was observed that, for the average farmer, given the attribute properties tested in terms of relative importance, 'Positive price movements' has the strongest influence with 49.03 per cent on the decision-making, followed by 'Access to credit' (18.86), 'Number of e-NWR per farmer' (16.42), 'Storage cost per 75 kg bag for 6 months (₹)' (9.32) and 'Access to market' (6.37). This shows that farmers were aware of the benefits of e-NWR that lead to increased sales price, more price realization, farm income, and better access to marketing finance. Farmers are expected to store as long as the expected future price is greater than the current price plus the unit storage costs (Saha and Stroud, 1994) [15].

Table 4: Utility range of each attribute and its relative importance among selected attributes

S. No.	Attributes	Utility range of each attribute	Relative importance (Per cent)
1	Positive price movements	8.073	49.03
2	Access to credit	2.704	18.86
3	Access to market	1.048	6.37
4	Storage cost per 75 kg bag for 6 months (₹)	1.534	9.32
5	Number of e-NWR per farmer	3.105	16.42
Total		16.464	100

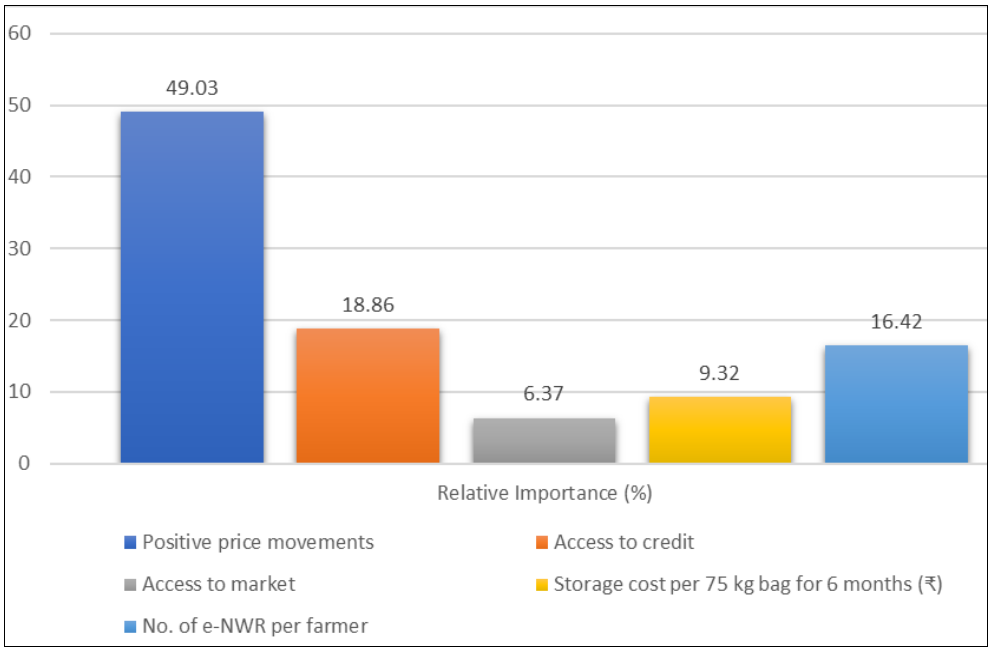

Fig.2: Relative Importance among selected attributes

Summary and Conclusion

The study highlights the preferences of farmers for e-NWR services, emphasizing key factors such as price movements, credit access, market availability, storage costs, and the number of e-NWRs per farmer. Farmers prioritize higher price gains for better returns, greater credit accessibility for financial flexibility, and direct sales to eliminate intermediaries. They also prefer lower storage costs for affordability and a greater number of e-NWRs for strategic selling. The findings show a strong alignment between expected and actual preferences, confirming the reliability of the results. To conclude, price movements emerged as the most influential factor in decision-making, followed by credit access, number of e-NWRs, cost efficiency, and market access. The adoption of e-NWRs enhances financial stability, storage efficiency, and direct market participation, ultimately benefiting farmers. The study suggested that policymakers can take several steps to enhance market efficiency and expand warehouse capacity in rural areas to ensure farmers have sufficient storage options. Also suggested to strengthen Agricultural Market Information Systems (AMIS) to provide accurate price trends and market demand updates via mobile apps and extension services. In addition to that, strengthening market linkages to enabling digital platforms to facilitate direct farmer-to-buyer transactions and agricultural financing to improve farmers' liquidity.

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