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A CHOICE-BASED CONJOINT ANALYSIS ON EVALUATING CONSUMERS' WILLINGNESS TO PAY FOR COTTON GROWN WITH INTEGRATED PEST MANAGEMENT

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ABSTRACT

This research identifies the consumer preferences for the seed cotton grown with Integrate Pest Management (IPM) in the study area. The model of sustainable agriculture mostly emphasizes on enhancing the efficacy of agrochemical usage by the implementation of integrated pest management (IPM) technology. Farmers produce cotton irrespective of the need and preferences of the ginners. So, this study would help the farmers in cultivating and selling their cotton with regard to the need of the consumers. Based on both primary and secondary data, the research was confined to Rajasthan state of India. Irrigated north western plain zone (zone 1b) was purposively selected based on considerable area and production of cotton. A total of 30 cotton ginners as the consumers of seed cotton from the study area were selected based on convenient sampling. Three preferences and two levels were identified and accordingly eight combinations from these were formulated and the consumers were asked to rank them, accordingly. Conjoint model was found suitable to analyse the eight alternative combinations formulated from the preferences and levels.From the research, it was found that, he total utility (7.61) of the combination, i.e. 'willingness to pay premium over market price'→ 'organized source' → 'Bt variety', is highest among all alternative combinations.This outcome was suggested to be considered as an opportunity, through which the farmers could take benefit from premium pricing by supplying the IPM produce, with the preferred attributes.

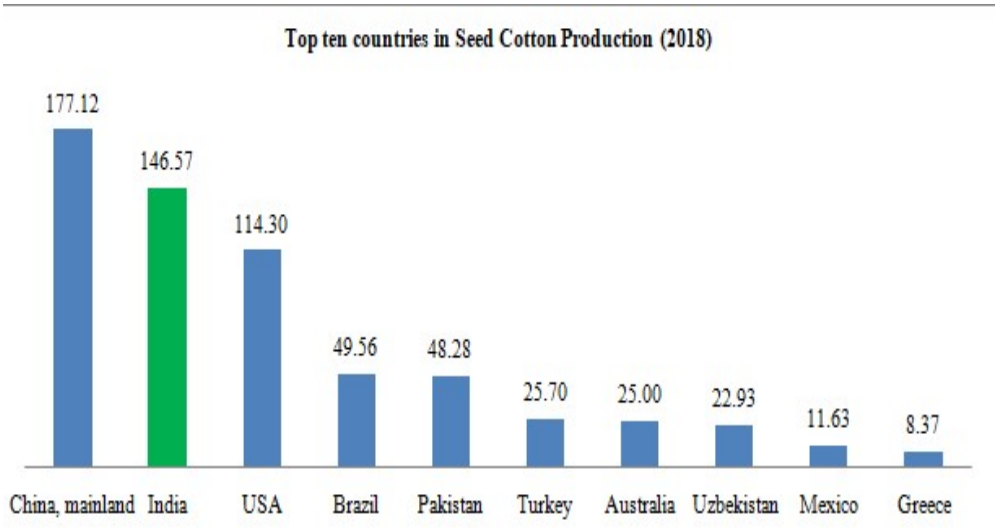
KEYWORDS: *Conjoint Analysis, IPM, Cotton, Willingness to Pay*

INTRODUCTION

It was during the Second World War that the scientists realized about the potential hazards of indiscriminate use of synthetic pesticides. In order to address the two major problems i.e. the development of insecticide resistance in pests and the destruction of beneficial insects by pesticide application, the theory of integrated pest management was introduced, during the 1950s. The Australian ecologists, P. W. Geier and L. R. Clark introduced the concept of "pest management", in the year 1961. Rachel Carson in the year 1962, wrote a book named "Silent Spring", in which she had highlighted about the adverse effects of chemical pesticides that caught the attention of the scientists and the public, worldwide. It was in 1967, that the term "Integrated Pest Management", was used for the first time by Van dan Bosch and Smith. The model of sustainable agriculture mostly emphasizes on enhancing the efficacy of

agrochemical usage by the implementation of integrated pest management (IPM) technology. It substitutes various inputs and practices with effective alternative technologies involving low energy utilization and plant/animal integration (Alam *et al.,* 2016; Lechenet *et al.*, 2014; Seufert *et al.,* 2012).With an estimated increase in the world population from 7.7 billion to 9.7 billion people by 2050, the demand for food and fibre will also rise, leading to the increase in the need for control of pests that will compete for fibre and food. Significant progress has also been witnessed in many of the developing countries, where the applications of inexpensive pesticide in huge quantities still continue to be an important practice (Robson, 2019). Integrated pest management is a technology that is based on an eco-friendly approach of pest management involving an integration of various conventional and modern practices. The demand for integrated pest management technology in the world was valued at USD 91.8 billion in 2016, which was expected to grow at a compound annual growth rate (CAGR) of 5.8 per cent, valued at USD 151 billion by 2025. With an anticipated CAGR of 6.4 per cent from 2017 to 2025, the Asia pacific region was expected to witness the fastest growth in IPM technology(Research and Markets, 2017).

Cotton is a global crop grown by around 80 countries in the world. It is well known that production of cotton in India has been heavily associated with the use of hazardous pesticides. Cotton cultivation in India is 44.5 per cent of the total pesticides consumed in the country(WWF, 2012). With the inception of Bt cotton, the use of pesticides has been decreased though in some places Bt has been affected by pink bollworm. It can be seen from the figure 1 that, India produced around 147 lakh tonnes in 2018 after China (177 lakh tonnes) ranked second in cotton production.



Source: http://www.fao.org/faostat/en/#data/QC/visualize, retrieved as on 14.08.2020

Figure 1: Major Countries in Cotton Production.

In agricultural and industrial sectors, cotton is the major fibre crop grown in India and plays a leading role. 70 per cent of total fibre consumption in textile sector and 38 per cent of the country's export, fetching over ₹42,000 crore, has been contributed by cotton. The area and production of cotton during the year 2018-19 was 12 million hectare and 362 lakh bales (170 kg of each bale), respectively(Mageshwaran *et al.,* 2019).

Table 1: Area, Production and Yield of Cotton of Major States in India (2017-18)

Major States	2017-18*		
	Area (Million Hectares)	Production (Million Tonnes)	Yield (kg/ha)
Gujarat	2.62	12.64	819
Maharashtra	4.21	6.55	265
Telangana	1.90	4.75	426
Andhra Pradesh	0.64	2.04	538
Rajasthan	**0.58**	**1.89**	**551**
Madhya Pradesh	0.60	1.87	527
Haryana	0.67	1.63	413
Punjab	0.29	1.28	750
Karnataka	0.53	1.22	392
All India	**12.43**	**34.89**	**477**

Source: Agricultural Statistics At A Glance 2018, Directorate of Economics & Statistics, ND
**4th Advance Estimates*

As seen from the table 1, Gujarat followed by Maharashtra, Telangana, Andhra Pradesh, Rajasthan and others are major cotton growing states of India. For the implementation of IPM technology, NCIPM and CIPMCs have been actively contributing their efforts in every major parts of India. Promotion through field demonstrations, farmer field schools, etc. is the major focus of NCIPM. For example, in the year, 2018-19, validation of cotton through IPM technology with major emphasis on pink bollworm was done in Jalna, Maharashtra, in 24 hectares covering 30 farming families. IPM implementation resulted in more than 70 per cent decrease in pesticide use and 16-22 per cent increase in net return in IPM over farmer's practice. Secondly, field trial on IPM in cotton-based cropping system in whitefly infected region of Fazilka, Punjab was continued during 2018-19, in Nihalkhera village with participation of 10 farmers in 60 hectares of land. Roving surveys are also conducted every year. In 2018-19, Bt cotton, roving surveys were conducted in Fazilka, Muktsar districts of Punjab, Sirsa district of Haryana and Sri Ganganagar and Hanumangarh districts of Rajasthan(NCIPM, 2019).

The willingness to pay for any produces is basically dependent on consumer preferences. The concept of consumers' demand is necessary for an organization to understand for selling any product or service. In agriculture, the consumer is not given that importance, especially in case of raw products, like, seed cotton, whole chickpea, paddy, wheat, etc. So, understanding the need and preference of consumers is very important in agriculture as well. Consumer preference is defined as the subjective tastes of individual consumers, measured by their satisfaction after the purchase. This satisfaction is often referred to as utility. Consumer value can be determined by how consumer utility compares between different items. The individual consumer has a set of preferences which needs to be identified for the farmers to sell the produce, accordingly. This research identifies the consumer preferences for the seed cotton in the study area. For the seed cotton the cotton ginners were regarded as the consumers. Farmers produce cotton irrespective of the need and preferences of the ginners. So, this study would help the farmers in cultivating and selling their cotton with regard to the need of the consumers. Various similar studies were evident for the application of conjoint analysis. The preferences of consumers and their willingness to pay for locally grown organic apples, with various product attributes like price, certification, product origin and production method, was determined with the application of conjoint analysis, in the study conducted in Vermont, United States. Based on conjoint analysis the study indicated strong willingness of the consumers who had already purchased

organic food to pay significantly more for apples grown, organically, locally and certified by the Northeast Organic Farming Association (Wang *et al*., 2010). To determine the willingness to pay for fair trade coffee among Italian consumers and to identify various factors influencing their preference for coffee, conjoint analysis was applied. The results of the study depicted the major preference for the factors like, brand, followed by aroma, habit and price, as the major factors affecting the Italian consumers. The study also revealed, willingness of Italian consumers to pay a premium price of about 2.2 euros, for a 250 gm of certified fair trade coffee packet., with slight variations, owing to age, gender, job and purchasing habits of the consumers (Rotaris and Danielis,2011). A study regarding various attributes that acted as driving forces behind consumers' willingness to pay for organic apples, by applying the method of conjoint analysis in the study, was conducted in the city of Talca, Chile. The evaluation of part worth utilities of each attribute, estimated from the survey data of 400 respondents, indicated that, consumers showed higher preference for organically produced apples and a positive willingness to pay an additional 130 pesos, per kilogram of organic apples (Cerda *et al.,* 2012). To examine the various attributes responsible for determining the preference for broiler meat, among various categories of customers, a research was attempted. In doing so, conjoint analysis was taken into account, and it revealed the attribute of price followed by the form of meat as the major attributes, influencing the ordering of consumers' preference in buying broiler meat, though taste, availability and proximity were also considered to be some of the important attributes affecting consumers' willingness to pay (Kwadzo *et al.*, 2013). A research, based on identifying the preferences of consumers for integrated pest management (IPM) among 189 French tomato consumers, was conducted and analysed. From the findings, the information on production system was found to be a matter of higher interest for the consumers, rather than the attributes of the final product, in terms of residual levels of pesticides and more in IPM than organic. From the review of various studies related to the aspect of willingness to pay, it was determined that, consumers have inclination towards products which have less chemical content and show willingness to pay for such products, higher than the prevailing rate, if adequate information regarding the product attributes is properly shared with them. For analysing the willingness to pay, statistics like percentage, conjoint analysis etc. were determined to be some of the suitable tools, in tabulation and interpretation of the gathered information (Biguzzi *et al.,* 2014).

RESEARCH METHODOLOGY

The study was focused to irrigated north western plain zone (zone 1b) of Rajasthan, India. The research was based on both primary and secondary data collected from the study area. The research was confined to Rajasthan state only. Sri Ganganagar and Hanumangarh district were selected based on considerable area and production of cotton. From each districts, *tehsils* were selected based on advises of experts viz. Central Integrated Pest Management Centre (CIPMC), Sri Ganganagar,Agricultural Research Station, Sri Ganganagar, and Agricultural Technology Management Agency (ATMA), Hanumangarh. Cotton ginners as consumers of seed cotton were selected based on convenient sampling. A total of 30 consumers from both the districts were interviewedfor their preferences for the final produce. Three preferences and two levels for each preference were identified and accordingly eight combinations from these were formulated. Willingness to pay, Crop variety and source were identified as the key preferences. Premium & no premium over market price, Bt & non-Bt variety and organized & unorganized source were selected as two levels under the preferences viz. willingness to pay, crop variety and source, respectively. Conjoint model was found suitable to analyse the eight alternative combinations formulated from the preferences and levels, stated.

The additive model of conjoint analysis is as follows.

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

Where,

Y= The consumer's overall evaluation of the preference alternative

V_{ij}= Part worth associated with 'j' (1,2,3,…,m) of preferences 'i' (1,2,3,…,n)

X_{ij}= Dummy variable representing the preference of the j^{th} level of i^{th} preference

RESULTS AND DISCUSSIONS

Willingness to pay is estimating how much a customer would be willing to pay for a particular product or service. There are a number of techniques that can be used to calculate a customer's willingness to pay for a product and even to value a particular attribute or feature of that product. As reviewed from several studies, in order to determine the consumers' preferences and willingness to pay for the preferred attributes in a product, conjoint analysis is applied to assess consumer valuation of their preferred combination of attributes. Conjoint analysis is a statistical technique used in market research to determine how people value different attributes (feature, function, benefits) that make up an individual product or service. It is a discrete choice analysis where combinations or levels of different product attributes/preferences are formed and consumers are asked to choose across alternatives of combination of attributes/preferences presented to them. It's done because customers cannot directly articulate the value they attribute to any particular characteristic, so they prefer the package/combination of preferences.Here, the analysis has been used to estimate the part-worth (utility) that the consumers attach to the various levels of preferences for cotton and chickpea grown through IPM technology, and their willingness to pay for the most preferred level has been determined.Preferences of cotton and chickpea grown with IPM were identified and the relative importance of preferences/attributes, among consumers was analysed. Consumers' willingness to buy the IPM produces involving price incentives was examined. Major preferences having higher relative importance were considered to be highly important by farmers, involved in adoption of IPM. Conjoint analysis was used to identify the combination of choices, out of important preferences which is the most influential for decision making. A controlled set of preferences, with specific levels identified through the literature reviewed, were determined and were presented before the consumers and they were asked to rank according to their preferences. The three major preferences for IPM produce identified were viz. 'Source', 'Variety' and 'Willingness to Pay'. Two levels of each of the three preferences were identified and included in the choice for better result. This was done for each of the crops. In case of 'Source', the two levels were 'Organized source' and 'Unorganized Source', for cotton as well as for chickpea. Organized source was meant for the statutory organizations viz. Farmer Producer Organizations or Cooperatives, etc., whereas the unorganized source was limited to farmers. In the same manner, two levels were determined for 'variety' under cotton, viz. Bt. cotton and non Bt cotton. It was limited to non-Bt cotton, because most farmers in the study area were cultivating Bt cotton and rarely any other variety of cotton. In case of chickpea, the two levels, considered under 'variety', were '*des*i' and '*kabuli*'. Under 'willingness to pay', 'no premium over market price' and 'premium over market price' were the two levels, taken into consideration, for both cotton and chickpea. Next, taking into consideration the three preferences and two levels under each preference, SPSS was used to create orthogonal design for finding out the combination of preferences. As a result, a total

of 8 alternative combinations of preferences (two levels of willingness to pay X two varieties X two sources) were formed. In order to quantify part-worth utilities, the respondents were asked to sort a set of 8 alternative preference levels, and conjoint analysis was applied to estimates the part worth utility, representing a respondent's degree of preference for each level. This was done both for chickpea as well as cotton.The consumers of raw cotton or seed cotton were found to be majority of ginners in the study area. In order to determine their extent of willingness to pay for raw cotton, conjoint approach was followed to determine the most preferred level, out of the 8 combination levels, formed. A total of 30 ginners were asked about their willingness to pay for cotton grown under IPM technology, by asking them to rate each of 8 level and the findings of the analysis has been depicted in the table below.

Table 2: Estimated Utilities of the Preferences for IPM Produce (Cotton)

Preferences	Levels	Utilities	Standard Error	Averaged Importance Score
Willingness to pay	No premium over market price	-2.000	0.165	64.468
	Premium over market price	2.000	0.165	
Source	Organized	0.775	0.165	24.571
	Unorganized	-0.775	0.165	
Variety	Bt	0.333	0.165	10.961
	Non Bt	-0.333	0.165	
(Constant)		4.500	0.165	-

Source: Researcher's computation from field data through SPSS

Table 2 shows the part worth utility values for each level of preference as well the relative importance of each, calculated through 'averaged importance score', that indicates how influential each attribute level is, in the formation of respondents' preferences to pay for cotton, grown under IPM.It can be seen from the above table 2, out of three preferences, the utility estimate of 'organized' source, '*desi*' variety and willingness to pay 'premium over market price' was higher than the others. In case of source, the utility of 'organized source' (0.775) was found to be higher than the 'unorganized' source (-0.775). For 'variety', utility of 'Bt variety' (0.333) was more than the non-Bt variety (-0.333). Likewise in case of willingness to pay, the utility of giving 'premium over market price' (2.000) for cotton grown with IPM technology was greater than the preference of 'no premium over market price' (-2.000). The value of constant is 4.500.It can also be well observed from the averaged importance score in the above table that, the relative importance of 'willingness to pay' is highest (64.46) followed by 'source' (24.57) and 'variety' (10.961) of raw cotton grown with IPM technology.

Table 3: Total Utilities for All the Eight Alternative Possible Choices for IPM Produce (Cotton)

Choice No.	Constant	Willingness to Pay	Utility	Source	Utility	Variety	Utility	Total Utility
2	4.50	Premium over market price	2.00	Organized	0.78	Bt	0.33	7.61
4	4.50	Premium over market price	2.00	Organized	0.78	Non-Bt	-0.33	6.94
6	4.50	Premium over market price	2.00	Unorganized	-0.78	Bt	0.33	6.06
7	4.50	Premium over market price	2.00	Unorganized	-0.78	Non-Bt	-0.33	5.39
1	4.50	No Premium over market price	-2.00	Organized	0.78	Bt	0.33	3.61
3	4.50	No Premium over market price	-2.00	Organized	0.78	Non-Bt	-0.33	2.94
8	4.50	No Premium over market price	-2.00	Unorganized	-0.78	Bt	0.33	2.06
5	4.50	No Premium over market price	-2.00	Unorganized	-0.78	Non-Bt	-0.33	1.39

Source: Researcher's computation from field data through SPSS

The table 3 depicts the total utility of each of the eight alternative possible choices for cotton. The total utility as seen from the table is estimated taking into account the part worth utility of each of the preference level i.e. source, (involving both organized and unorganized), variety (Bt and *non-Bt)* and willingness to pay (premium over market price & no premium over market price).The table 3 depicts that the total utility (7.61) of the combination, i.e. 'willingness to pay premium over market price'→ 'organized source' → 'Bt variety', is highest among all alternative combinations. This shows that this combination is highly preferred by the consumers of cotton. The second best alternative was found to be the combination of 'willingness to pay premium over market price' → 'organized source' → 'non-Bt variety' (total utility: 6.94), followed by the preference for 'willingness to pay premium over market price '→ 'unorganized source' → 'Bt variety' (total utility: 6.06), 'willingness to pay premium over market price' → 'unorganized source' → 'non-Bt variety' (total utility: 5.39), 'willingness to pay no premium over market price' → 'organized source'→ 'Bt variety' (total utility: 3.61), 'willingness to pay no premium over market price' → 'organized source' → 'non-Bt variety' (total utility: 2.94), 'willingness to pay no premium over market price' → 'unorganized source' → 'Bt variety' (total utility: 2.06), and 'willingness to pay no premium over market price' → 'unorganized source' → 'non-Bt variety' (total utility: 1.39), being the least preferred combination. Thus from the above findings, it can be said that, among the consumers of raw cotton the willingness to pay a premium over market price, for Bt cotton variety, procured from an organised source was higher, than rest of the other possible alternative combinations.

In general, from the findings, it can be inferred that the consumers for seed cotton grown with IPM exhibited a positive willingness to pay. Estimation of the part worth utilities of each preference confirms that in case of cotton, 'organised source', 'Bt' variety and 'willingness to pay a premium over market price' are the preferred levels of each preference. The relative importance of price (willingness to pay) was greater than source and variety. It gave an idea on the main attributes that consumers look for when making a purchasing decision. So, it can be said that the willingness to pay (price) is very important and is highly considered in making purchase decision, than the other preferences. This is followed by the importance of 'source' of the produce which meant that the next preference is the type of source, followed by the preference for 'variety'. Thus it can be assumed that the probability of the willingness to pay premium over market price is higher, if the source is organised and the variety is 'Bt cotton' grown under IPM. So initiatives should be taken towards formation of such organisations that could procure cotton, grown under IPM and facilitate the sale of such crops from farmers to the consumers through a formally organised way. This analysis has given an insight into the attitude and preferences of consumers towards IPM grown produce that could be instrumental in devising strategies and policies relating to marketing of IPM produce.

CONCLUSIONS

From the study regarding willingness to pay, it was observed that, consumers were willing to pay premium over market price, if the source would be organized and the crop variety would be 'Bt' variety for cotton.It was observed that the ginners of seed cotton are more interested for Bt cotton, as it was found to be less damaged than non-Bt cotton because the infestation of bollworm is absent in Bt cotton. So, farmers were suggested to produce Bt cotton and sell it for better price opportunities in cotton. Also, it was suggested from the findings of the research that farmers should join together to form an FPO or a cooperative society and procure the cotton grown under IPM technology and sell the volume to the ginners or cotton traders so as to maintain the credibility towards the quality of the produce.

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