Emerging Markets for GM Foods: A Study of Consumer's Willingness to Pay in India

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Keywords: GM Foods, Golden Rice, Bt cottonseed oil, GM fed chicken, Willingness to Pay, Random utility approach, Logit, India.

JEL Classifications*:* Q13, D12.

Selected Paper prepared for presentation at the American Agricultural Economics Association Annual Meeting, Orlando, Florida, July 27-29, 2008.

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An Indian Perspective on Consumer Understanding and Willingness to Pay

Abstract

A random utility approach is used to estimate logit equations which indicate what factors affect the likelihood of consumption of non-GM and GM foods, and, whether or not consumers are willing to pay a premium for non-GM/GM foods. C*eteris paribus* as the price difference between non-GM and GM food rose, people were more likely to consume GM foods. Likelihood of GM food consumption was higher in the middle income brackets. Consumers were willing to pay an expected premium of 19.5% and 16.12% for golden rice and GM edible oil respectively. In case of chicken, consumers seemed to pay a very negligible premium for non-GM fed chicken. Overall, it appears that GM foods may be acceptable in the Indian market. However, basic awareness about the GM foods may have to be created among the consumers through government ministries, consumer interest groups, and biotech food-crop companies.

Introduction

India has been a late entrant in introducing GM crops for commercial use. While China and US had introduced GM crops by the middle of the last decade, India allowed commercial production of its first GM crop, Bt Cotton, only in 2002. However, since then, India made a rapid progress in the production of GM cotton. With an area of about 10 million acres under Bt cotton in 2006, India has surpassed the early entrant, China to become the 5th largest country in terms of area under GM crops (ISAAA, 2007). However, no permission has been given so far for the commercial production of food crops. Interestingly, in many states of India, particularly in the cotton producing states such as Gujarat, cottonseed oil is commonly used as a cooking medium. Therefore, inadvertently GM edible oil might have already made its way into the market. Meanwhile, further researches are being carried out in India and abroad, which are at the laboratory and field trial stages of their development (USDA, 2005). These researches may seem to hold promise for food crops in terms of reduced pesticide use, higher productivity, and, higher nutritional content.

While food technologists have worked on the GM technology *per se*, economists have also contributed to the related supply-side issues. For example, in the Indian context, pros and cons of GM technology and the grower violations of patent rights have been studied by Gupta and Chandak (2005). A study by Neilsen and Anderson (2000) indicated that if insect resistant (1st generation) GM rice varieties were to be introduced internationally, then India would stand to benefit to the tune of $1.18 billion per year and benefit to the world economy would be of $6.2 billion per year in 1995 dollars. The studies and researches mentioned above have focused on the technology and supply side issues. The demand side of the Indian market has been ignored altogether. In our understanding, no study has been conducted in India that tries to understand the GM food crop issue from consumers' perspective. For example, Neilsen and Anderson study made a strong assumption that the consumers were indifferent between GM and non-GM crops. At the same time, however, they did exclude EU and Japan from their model because of restrictions on GM crops in those countries.

With rapid development of GM food crops in India and around the world, liberalized trade environment, stagnant productivity of green-revolution-era crops, prevalence of malnutrition, and the burgeoning of population; policy makers would very soon be asking themselves – When (and not If) they should allow production and import of GM food crops. In fact, India has now eliminated custom duties on imports of corn due to the pressure from the poultry sector and the starch manufacturing industry (Grainnet, 2007). And, most likely India would receive such imports from countries that produce GM corn. Unfortunately, at this time, neither the exporters have explicit GM/non-GM labelling requirement put in place nor India has an effectively operational GM testing mechanism in place. While one may argue that consumers may be less concerned whether or not their cotton clothes are made up of GM cotton or non-GM cotton (non-food crop), the same, however, may not be assumed regarding food (crops).

What is the level of awareness among Indian consumers regarding GM foods? What are their perceptions and attitudes towards consumption of GM foods? What is their willingness to pay for GM foods? India is being perceived as a giant emerging market for GM foods with more than 1.1 billion consumers. Therefore, it is important that these questions are addressed first before GM foods are introduced in India in the near future. In developed countries the debate about GM foods among various stakeholders has been going on for quite sometime now. Studies have been conducted to understand consumers' awareness, acceptance, and willingness to pay for GM foods in many countries including Australia (James and Burton, 2002), Italy (Boccaletti and Moro 2000), and US (Kaneko and Chern, 2005). Similar studies have also been conducted in some developing countries such as Argentina (Mucci and Hough, 2003) and China (Zhong, *et al*., 2002). In this study we have attempted to investigate consumers' understanding, perception and willingness to pay for GM foods in one of the largest potential markets – India.

In this context we conducted a consumer survey - through household visits in the city of Ahmedabad, India and through an internet portal eliciting e-mail responses regarding consumers' understanding, perception, acceptance and willingness to pay for

GM foods. We realize that households from rural towns across India on one hand, and households from the modern mega-cities like Mumbai and Delhi on the other are quite different from each other. Hence, their responses to our questionnaire may vary quite a lot. Ours being the first study of this kind in India, we selected the city of Ahmedabad, Gujarat which represented a mix of rural town and urban city dwelling households. Details of the questionnaire, survey and choice of food products are discussed in Section 2 below. We have conceptualised the random utility approach for our data analysis which is presented in Section 3. Descriptive statistics and logit regression results are reported in Section 4, and concluding observations are made in Section 5.

Questionnaire, Survey, and Choice of Food Products

The Questionnaire and Survey

For the survey we developed a questionnaire adapted from the work of Kaneko and Chern (2005). Initially, the questionnaire provided a brief introduction to what GM foods are, as also the benefits and concerns regarding the technology in a language a layperson can understand. For ease of understanding of the questionnaire by the households, the text was also translated into Gujarati, the state language of Gujarat. The questionnaire consisted of seven sections. The first three sections sought to gather information on respondents' food purchasing habits, knowledge, attitude, and perception with regard to GM (food) technology, and their views on GM food regulation. The next three sections covered a series of questions on three food items which form part of household consumption in Gujarat, and which have a potential for commercial introduction of GM varieties. The last section was devoted to gathering socioeconomic and demographic information of the households.

The surveys were conducted during the months of February, March and April 2006 in Ahmedabad city. The pilot questionnaire was tested by administering it to 10 households. Field investigators from a reputed agency were hired for the household interviews. They were given training on the specifics of the questionnaire and the pilot interviews were personally monitored. Ahmedabad Municipal Corporation (AMC) has divided the city into 43 wards. From each of these wards, 12 to 15 households were randomly selected for administering the questionnaire. A total of 602 filled and usable

questionnaires were considered for the analysis. Different groups of wards among the 43 wards represented a continuum on the socio-economic ladder of the society. An internet based survey was also developed for the same questionnaire, where various stakeholders including students, academicians, and businesspersons were asked to fill-out the questionnaire online. The character of the internet based survey was national in nature in the sense that most of the respondents were from different parts of India, either studying or working in the premier academic institutes in Ahmedabad. Sample size of the returned usable internet based questionnaires was 110.

The Choice of Food Products

We selected vegetable oil (cottonseed oil), rice and a non-vegetarian product (chicken) for our analysis. We chose these products because GM varieties of such food products have either already appeared in foreign markets, they have a potential for introduction in India, and/or they might have appeared in the food chain in India in some form or the other. GM soybeans are quite common in US, and, hence, so are GM based edible vegetable oils. In India, cultivation of Bt cotton has been a success story in the state of Gujarat. At the same time, edible cottonseed oil has been a popular cooking medium in Gujarat. Therefore, we chose edible (GM) oil with particular reference to cottonseed oil as one of our products under consideration. Although no GM related foods are allowed in India at this time, cottonseed oil pressed out of Bt cottonseeds probably has made an inadvertent entry onto the consumer plate.

In the case of rice, we chose to make a comparison between the conventional rice and the GM rice which is popularly known as golden rice. Golden rice is a genetically modified rice crop capable of producing provitamin-A (beta-carotene) which is not present in traditional rice varieties. This rice has a vast potential as a source of alleviation of vitamin A (retinol) deficiency in the diets of poor and disadvantaged people in developing countries. According to the World Health Organization (WHO), vitamin A deficiency (VAD) is the leading cause of preventable blindness in children. It is estimated that 250,000 to 500,000 children with VAD become blind every year and half of those children die within a year of losing their sight. Nearly 600,000 women die from

childbirth-related causes each year, many of them from complications which could be reduced through better provision of vitamin A (Sommer and West, 1996). India figures prominently in such reported deficiencies. In this context, Golden Rice Humanitarian Board, along with its partner institutions in India has been entrusted with evaluating the need for golden rice, analyzing and comparing pros and cons of it, and setting a framework for implementation of golden rice that best suits the needs in India.

Finally, we have considered one of the meat products, chicken in our analysis. This choice was an obvious one, for among the non-vegetarians in India, consumption of chicken is quite significant. Among other meat products, beef and ham are religious taboo, and mutton is very expensive. It is quite possible that eventually chickens will be given feed that is made of GM corn or other GM oilseed meal. In fact, unknowingly this might be happening at this time. One does not know if informed consumers would like to eat chicken that is fed with GM feed.

Analytical Framework

Following Kaneko and Chern (2005), we use the random utility approach of making a dichotomous choice between GM and non-GM foods. Let consumer j's indirect utility function from choosing alternative i be given by:

(1) $U_{ij} = u(D_j, Z_j, g_{ij})$,

where D_j is the income variable, Z_j is a vector of variables representing respondent characteristics that influence utility, and g_{ij} is the random component that represents factors unknown to the researcher. Consumer j chooses alternative i if $U_{ij} > U_{kj}$ for all $k \neq i$. We assume that:

(2) $U_{ij} = V_{ij} + g_{ij}$,

where V_{ij} is the deterministic component of the utility. Further, the deterministic component is considered to be a linear function. If there are two alternatives, namely

consuming GM food (i=0) or non-GM food (i=1), then the deterministic component is given by:

(3) $V_{0j} = a_0 + b_0 Z_j + c_0 (D_j - Pgm_j)$, and

(4) $V_{1j} = a_1 + b_1 Z_j + c_1 (D_j - Pngm_j)$,

where Pgm_j and $Pngm_j$ are the prices faced by consumer j for GM and non-GM food item. Finally, we define a latent variable I^* as:

(5) $I^* = (U_{1j} - U_{0j}) = a_1 + b_1 Z_j + c_1(D_j - Pngm_j) + g_{1j} - a_0 - b_0 Z_j - c_0 (D_j - Pgm_j) - g_{0j}$

Assuming that marginal utility of money is constant ($c_1=c_0$) = c, and letting ($a_1 - a_0$) = a, ($b_1 - b_0$) = b, ($g_{1j} - g_{0j}$) = g_j, equation (5) can be re-written as:

(6) $I^* = a + bZ_j - c(Pngm_j - Pgm_j) + g_j$, or

(7) $I^* = a + bZ_j - c\Delta P + g_j$,

where $\Delta P = (Pngm_j - Pgm_j)$. Respondent j chooses non-GM food (i=1) if $I^* > 0$ and GM (i=0) if $I^* \leq 0$. Latent variable I^* ranges from $-\infty$ to $+\infty$. We convert the equation into a probabilistic functional form by considering the following representation which converts the dependent variable range between 0 and 1:

(8) Prob (Non-Gm) = $E(i=1 \mid Z_j, \Delta P) = [\ 1 + e^{-Xj}\ ]^{-1}$,

where, $X_j = a + bZ_j - c\Delta P$. Converting equation (8) into a log odds ratio, we econometrically estimate it using logit.

The contingent valuation (CV) questions from the survey questionnaire make respondents choose between a current alternative and a proposed alternative at different prices. The difference in payment, therefore, gives respondent's wiliness to pay (WTP)

in order to achieve the proposed scenario. WTP is arrived at by finding the proposed price of non-GM product that would make the respondent indifferent between consuming GM food and non-GM food. Therefore, WTP for non-GM product can be defined as:

(9) $a_1 + b_1 Z_j + c\,(D_j - WTPngm_j) + g_{1j} = a_0 + b_0 Z_j + c\,(D_j - WTPgm_j) + g_{0j}$

Solving (9) we get:

(10) $WTPngm_j - WTPgm_j = [\, a + bZj + g_j \,]/\, c$, and

(11) $E[WTPngm_j - WTPgm_j] = a/c + b/c\ \bar{Z}_j$

The expected WTP can be calculated by solving equation (11).

In the description of the model above, we referred to Contingent valuation (CV) technique being used in the questionnaire. CV is a survey-based economic technique for the valuation of non-market resources. While these resources may give people utility, they do not have a price as they are not sold in the market. The approach asks people to directly report their willingness to pay (WTP) to obtain a specified good, or willingness to accept (WTA) to give up a good. We used this technique in eliciting consumer willingness to pay for GM foods, precisely for the reason that while we consider actual market prices of non-GM food products, we use hypothetical (but realistic enough) prices of GM foods which we allow to vary around the actual market prices of non-GM foods.

The CV part of the questionnaire consisted of sequential closed-ended binary choice questions. To calculate WTP we use a stated choice method (SCM), which is based upon buyers' hypothetical choice for GM food purchases. The choice experiment consisted of five steps and except for the first step other steps consisted of one binary choice for each product. In the first step, the respondents were asked if they would choose non-GM food, GM food, or would they be indifferent given identical prices for non-GM vegetable oil and GM vegetable oil, non-GM rice and golden rice, and, non-GM fed chicken and GM fed chicken. Based on the respondents' choice, they were asked up

to four follow-up questions by offering price reductions of ten percent at every step to a maximum of forty percent for the commodity they did not choose. If the respondent switched alternatives, the questioning stops. Else another question follows until the final one. The base prices chosen reflected prices for the non-GM products in stores in Ahmedabad during March 2006. The indifferent respondents in step one were randomly offered reduced price for one of the alternatives and their choice was elicited. The choices made in each step are taken as separate observations in the econometric analysis.

Descriptive Statistics and Regression Results

Socio-economic Characteristics

We collected data through a city survey and an internet based survey. We got data on 602 respondents from the city survey and 110 respondents from internet based survey. The economic status of the survey samples is presented in Table 1(a). The modal value of city respondents (44.48%) and internet based respondents (34%) is in the income brackets of Rs. 50,000 to 100,000 and Rs. 250,000 to 500,000, respectively. The socio-demographic data of the sample is provided in Table 1(b). In the city based survey, about 65% of the respondents are females. The average age of the respondents is 37 years with a standard deviation of 10 years, and 73% of all respondents have children under the age of 18 years. 63% have done their schooling and 34 percent have completed their (bachelors) graduation. Nearly 76 percent live in a joint family. In comparison, for the internet survey, majority of the respondents (99%) are either graduates or post-graduates. About 74% of the respondents are students, 79% are males, 86% with a nuclear family, and about 64% do not have any children.

Consumer Awareness and Opinion

In March 2002, India's Genetic Engineering Approval Committee (GEAC) had granted permission for the commercial cultivation of a GM cotton crop (Bt Cotton) resistant to bollwarm. Although success of the crop in different states of India was mixed, the crop was very successful in the state of Gujarat. It is also true that cottonseed oil is one of the popular cooking mediums in Gujarat. The city of Ahmedabad being in the same state, we thought of assessing awareness among the consumers regarding GM crops. We asked two questions to the respondents - one on the knowledge about GM foods and

organisms and other on the awareness about the GM cotton. As reported in Table 2, an overwhelming proportion of respondents in Ahmedabad were unaware of GM foods and organisms and GM cotton. In the case of internet based survey, however, relatively small proportion of respondents had no idea about GM foods, organisms and GM cotton.

We tried to understand consumer opinions through the attitudes and perceptions regarding various aspects related to GM foods. This included their views on health risk, religious and ethical concerns, and their views on government regulations and labelling. Before eliciting their responses, we briefly informed them about what the GM technology is about, and what are the main benefits and concerns. The results given below reveal that about 70% of the city respondents are inclined to believe that GM foods are safe (Table 3). On the other hand, about 60% of the internet based respondents seem to be either indifferent or consider GM foods somewhat risky. With respect to ethical and religious concerns, more that half of the city respondents consider them to be important. For internet based respondents, however, these percentages are 27% and 20% respectively.

Further, we sought respondent opinion on labelling issue. We asked, "How important it is to label food products for GM/Non-GM attributes?" More than 85% of respondents from city survey and more than 77% of respondents from internet survey opined that labelling is extremely important (Table.4). Importantly, more than 93% of respondents in both surveys prefer mandatory labelling over voluntary labelling. However, when it comes to paying extra amount for labelling, about 28% of respondents from city survey are against it. As against this, only about 5% of internet based respondents are not willing to pay anything extra. While more than 35% of the city consumers support labelling if the prices are raised by not more than by 5%, this figure is about 42% for internet based respondents. Moreover, in the internet survey, only about 5% of respondents are not willing to pay anything extra as labelling cost. In fact, about 34% are ready to pay more than 15% of price as labelling cost (Table 5).

Acceptance and Willingness to Pay

Although, currently GM foods are not available in Indian markets, there is a distinct possibility of these foods entering the Indian market. Hence attempt was made to study consumers' acceptance of GM foods in general and their willingness to buy GM food which have attributes such as crop resistance to pests and enriched vitamin contents. Results in Table 6 show that a majority of the city survey respondents (72%) and about 28% of the web based survey respondents claimed that they were somewhat or extremely willing to consume foods produced with GM ingredients. Reduction in pesticide use was considered quite favourably by respondents in both the city survey and internet survey. About 85% and 77% of respondents respectively were somewhat or extremely willing to consume GM foods if pesticide use gets reduced. The response was very similar if GM foods were to have more nutrition than conventional foods. In contrast, if GM foods posed a risk of allergic reactions, the acceptance for GM foods was low. The acceptance levels were very low for internet based respondents. While only 44% of city respondents were somewhat or extremely unwilling to consume GM foods, this percentage was very high at 87% for the internet based respondents.

Given the level of awareness, perceptions and willingness to consume, one would like to know how much more or less consumers are willing to pay for GM foods. Would consumers be ready to pay a premium for non-GM foods or is it vice-versa? As described earlier, since no actual GM foods are in the market yet, we selected three (GM) foods that have a potential for adoption, namely GM rice, GM edible oil and GM fed chicken. CV technique was applied in the questionnaire to elicit consumer response based on actual market prices of the three goods and hypothetical prices of their GM variants. For example, the initial choice of the respondents between GM and non-GM foods for identical prices for both the variants is shown in Tables 7 and 8. In case of city survey a substantial proportion of respondents chose GM foods. As against this, the proportion of internet respondents who chose GM foods is very low. The proportion of indifferent respondents was extremely low in city survey, while that in internet survey was as high as 31% and 45% for edible oil and chicken, respectively.

Subsequent to the initial choice, the questionnaire offered the respondents reduced prices from 10% to 40% on price of the alternate choice and once again they were asked to choose between GM and non-GM variety. For those who were indifferent, we reduced price of one of the variants randomly and asked respondents to make a choice between the two variants. Through this process we could elicit the price differences at which respondents switched between the variants. Having done this, we estimated binary logit models to understand what explanatory factors are critical in explaining the likelihood of consumers choosing non-GM or GM foods. The observations of the dependent variable of the logit model were the initial and subsequent (follow-up) choices made by the respondents. The dependent variable took a value of 1 if non-GM food was chosen and a value of 0 if GM food was chosen. Moreover, we used the estimated equations for calculating the mean willingness to pay for non-GM/GM foods. Both Survey data were merged and identified with a dummy variable.

The list of variables and the maximum likelihood logit estimates of the model are presented in Table 9 and 10. The combined observations in the logit equation for chicken were only 600 as against 2937 and 2834 observations in logit equations for rice and oil respectively. This is due to the fact that a significant proportion of Indians are vegetarians. Many are vegetarians because of cultural, ethical, and/or religious reasons, and many remain vegetarians because they cannot afford meat products. As a result, out of 602 households in the city survey, only 121 have responded to questions pertaining to chicken. In the internet survey, the proportion of non-vegetarians was much higher. Out of 110 respondents, 58 have answered questions pertaining to chicken.

For all three equations, price variable is quite significant. As the price variable represents difference between the price of non-GM and GM alternatives, the negative significant coefficient of this variable makes an intuitive sense. The higher the price difference the lower is the likelihood of acceptance of non-GM food, i.e., the more relatively expensive non-GM food is, the less likely are consumers to purchase non-GM food. The positive and significant coefficients of the HR and ETHIC variables indicate that perceptions of health risks and ethical considerations increase the acceptance of non-

GM foods. However, Ethical consideration seems unimportant in the case of chicken. For all three food products, if one considers government regulatory performance as good or excellent then this does not increase the possibility of choosing non-GM foods. One may argue that if regulatory mechanism for GM foods is (perceived to be) satisfactory by consumers, it may not go against consumers' decision to choose GM foods.

The coefficients on income levels are negative. The coefficients are statistically very significant as one moves away from the very poor income bracket to middle income brackets. However, as one moves to high income bracket this is not so. This implies that the middle class sections of the society are more likely to consume GM foods. Similarly, being female and joint family member increase the likelihood of choosing non-GM rice and edible oil. Education does not seem to affect the choice between the two food variants. Based on the estimated logit equation, we also calculated mean willingness to pay for GM/non-GM foods. The expected willingness to pay was computed for each observation for each product and then the sample mean (expected premiums) was calculated. The premiums are presented both in Indian rupees and in percentages with regard to the relevant base prices of the three food products (Table 11). The results revealed that the mean WTP for non-GM rice, non-GM edible oil, and non-GM-fed chicken were Rs. -3.90, Rs. -8.06, and Rs. 0.58 respectively. The negative signs for rice and edible oil indicate that on an average the consumers are willing to pay a premium for GM food, i.e., in percentage terms it implies that consumers do not mind paying 19.5% and 16.12% extra for GM rice and GM edible oil. This could be ascribed to a net benefit perceived due to high nutritive content and low pesticide usage for GM foods. In the case of chicken, however, on balance consumers seem to pay a very negligible premium for non-GM fed chicken. We have to bear in mind, however, that the result for chicken was based on a far smaller number of observations as compared to the number of observations for the other two products. The sample size of for chicken was about one-fifth of the sample size of the other two products.

The expected premiums at the sub-sample level are consistent. Those whose initial preference was for GM foods, are willing to pay a premium of Rs. 9.71 and Rs.

25.00 for GM rice and GM oil respectively. On the other hand, those whose initial preference was for non-GM foods are willing to pay a premium of Rs. 8.12 and Rs. 21.32 for non-GM rice and non-GM oil respectively. Thus, premium for GM foods is higher than the premium for non-GM foods at the sub-sample level. Moreover, in the sub samples, the expected premiums for non-GM fed chicken (Rs.5) is higher than the premium for GM fed chicken (Rs.4). Those who were indifferent between consuming GM rice and non-GM rice seemed to pay a premium of about Re.1 for GM rice. On the other hand, those who were indifferent between GM oil and non-GM oil were ready to pay a premium of about Rs. 7.30 for non-GM oil. Of course, the premiums for the indifferent households are very small, and, only about 2% of the sampled households were indifferent between the two types of rice and oil.

Concluding Observations

With rapid development of GM food crops in India and around the world, liberalized trade environment, stagnant productivity of green-revolution-era crops, pervasive malnutrition, and the burgeoning of population; policy makers in India will very soon be asking themselves – How soon (and not If) they should allow production and import of GM food crops. In this context, while supply side issues have already been addressed to some extend, demand side issues were ignored altogether. Before GM foods get introduced in the Indian markets, it was imperative, therefore, that we know Indian consumers' level of understanding, perceptions, acceptability and willingness to pay for GM foods. We attempted just that. A random utility approach was used to estimate logit equations which indicate what factors affect the likelihood of consumption of non-GM and GM foods and whether or not consumers are willing to pay a premium for non-GM/GM foods. Data was generated through a questionnaire survey which was administered to 602 respondents in the city of Ahmedabad and 110 respondents on internet. Important descriptive statistics was also generated in the process.

It turned out that awareness about GM technology was extremely low among the Ahmedabad city respondents who in our understanding were a representative sample of India. On the other hand, the internet survey consumers were more aware of GM

technology. However, after informing the city respondents about the pros and cons of GM foods, more than 70% were willing to consume GM foods even if GM and non-GM foods were available for the same price. This indicates that information to consumers regarding the GM foods may have to be enhanced through consumer education societies, extension agencies of government ministries, and biotech food companies. In the absence of such information, one would be apprehensive about strong consumer reaction to sudden appearance of GM foods in Indian market.

It was also clear from the study that overwhelming proportion of Indian consumers would like to see mandatory labelling of GM foods, although about 30% of them did not want to pay for labelling. Regulatory authorities will have to consider this factor seriously, at least until such time that awareness and acceptability of GM foods is not pervasive. Results also suggest that if one considers government regulatory performance as good or excellent then this does not increase the likelihood of choosing non-GM foods. Internet based respondents were not much bothered about ethical and religious issues associated with GM foods, however, they were more averse to GM foods due to the perceived health risks associated with GM foods. On the other hand, although respondents from the city survey were concerned about ethical and religious issues, more than 70% of them were ready to consume GM foods. In fact, the middle class sections of the society are more likely to consume GM foods as compared to very poor and the high income consumers.

Regression results also suggest that controlling for other factors, likelihood of consumers opting GM food goes up if prices of GM foods go down or prices of non-GM foods go up. Thus, GM foods may become acceptable to Indian consumers for the right price. In fact, the mean WTP estimates suggest that consumers are, on an average, ready to pay 19.5% and 16.12% premiums for golden rice and GM edible oil, respectively. This could be ascribed to a net benefit perceived due to high nutritive content and low pesticide usage for GM foods. In the case of chicken, the overall premium for non-GM fed chicken was very negligible indicating that consumers are almost indifferent between GM fed chicken and non-GM fed chicken. This study was conducted in Ahmedabad,

which in our opinion, is a representative cohort of Indian population in terms of mix of dwellers from rural town and a metropolitan city. Therefore, the study indicates that on the whole, GM foods may be acceptable in the Indian market provided information about GM technology and GM foods is passed-on to consumers in a planned manner.

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Table 1(a): Income Distribution of the Respondents

Particulars	City Survey	Internet Survey

	Number	*Percentage*	*Number*	*Percentage*
Yearly total household income (Rs)				
<50000	147	24.58	4	3.64
50000 to <1 lakh	266	44.48	9	8.18
1 lakh to < 2.5 lakhs	149	24.92	31	28.18
2.5 lakhs to < 5 lakhs	33	5.52	37	33.64
5 lakhs to < 10 lakhs	3	0.50	20	18.18
≥ 10 lakhs			9	8.18
Total	598*	100	110	100

- 4 respondents did not reveal their income

Table 1(b): Socio-Demographic Characteristics of the Respondents

Particulars	**City survey**		**Internet Survey**	
	Number	*Percentage*	*Number*	*Percentage*
1. Gender				
Female	390	64.78	23	20.91
Male	212	35.22	87	79.09
2. Marital status				
Married	548	91.03	31	28.18
Unmarried	52	8.64	77	70.00
Others	2	0.33	2	1.82
3. Working status				
Employed	156	25.91	29	26.36
Students	10	1.66	81	73.64
Homemakers	329	54.65		
Retired	19	3.16		
Unemployed	5	0.83		
Others	83	13.79		
4. Education				
Illiterate	21	3.49		
High School	377	62.63	1	0.91
College	204	33.89	99	99.09
5. Family Type				
Nuclear	146	24.25	98	86.09
Joint	456	75.75	12	10.91
6. Children				
No Children	160	26.58	70	63.64
Have children	442	73.42	40	26.36
7. Age				
Mean Years	37	10 (std dev)	29	10 (std dev)

Table 2: Consumer Awareness about GM Technology

Particulars	City Survey		Internet Survey	
	Number	*Percentage*	*Number*	*Percentage*
1. Before this survey, how well did you know about GM foods or GM organisms				
Very well	9	1.49	25	22.73
Somewhat	61	10.13	70	63.64
Not at all	532	88.37	15	13.64
2.The GM technology has been used to create cotton that is resistant to pest				
Agree	38	6.31	78	70.90
Disagree	10	1.66	6	5.45
Don't know	554	92.03	26	23.63

Table 3: Consumer Perceptions of GM Food

Particulars	City Survey		Internet Survey	
	Number	*Percentage*	*Number*	*Percentage*
1. Between GM and Non-GM foods, how would you rate GM foods in terms of their effects on human health				
Extremely risky	7	1.16	1	0.91
Somewhat risky	48	7.97	37	33.64
Indifferent	87	14.45	29	26.36
Somewhat safe	184	30.56	11	10.00
Extremely safe	241	40.03	2	1.82
Don't know	35	5.81	30	27.27
2. Importance of ethical concerns in consuming GM foods				
Extremely important	110	18.27	11	10.00
Somewhat important	201	33.39	19	17.27
Indifferent	69	11.46	29	26.36
Somewhat unimportant	21	3.49	15	13.64
Extremely unimportant	197	32.72	36	32.73
Don't know	4	0.66	0	0
3. Importance of religious concerns in consuming GM foods				
Extremely important	175	29.07	5	4.55
Somewhat important	146	24.25	17	15.45
Indifferent	53	8.80	24	21.82
Somewhat unimportant	30	4.98	10	9.09
Extremely unimportant	195	32.39	54	49.09
Don't know	3	0.50	0	0

Table 4: Consumer Opinion on Labelling of GM foods

Particulars	City Survey		Internet Survey	
	Number	*Percentage*	*Number*	*Percentage*
1. How important it is to label food products for GM/non-GM attributes				
Extremely important	514	85.38	85	77.27
Somewhat important	71	11.79	19	17.27
Indifferent	8	1.33	4	3.64
Somewhat unimportant	3	0.50	2	1.82
Extremely unimportant	4	0.66		
Don't know	2	0.33		
2. Preferred type of labelling				
Mandatory Labelling	562	93.36	105	95.45
Voluntary Labelling	24	3.99	5	4.55
No Labelling is Necessary	12	1.99		
Don't know	4	0.66		

Table 5: Willingness-to-Pay Extra for Labelling

Particulars	City Survey		Internet Survey	
	Number	*Percentage*	*Number*	*Percentage*
Don’t support labelling if the food price increases	167	27.74	5	4.55
Support labelling only if the prices are higher by no more than five percent	216	35.88	46	41.82
Support labelling even if the prices are higher than 5% but no more than 10% percent	105	17.44	19	17.27
Support labelling even if the prices are higher than 10% but no more than 15% percent	31	5.15	2	1.82
Support labelling even if the prices are higher than 15%	67	11.13	37	33.64

Table 6: Consumer Acceptance of GM Foods

Particulars	City survey		Internet based survey	
	Number	*Percentage*	*Number*	*Percentage*
1. How willing are you to consume foods produced with GM ingredients				
Extremely willing	215	35.71	7	6.36
Somewhat willing	220	36.54	24	21.82
Neutral	95	15.78	39	35.45
Somewhat unwilling	27	4.49	24	21.82
Extremely unwilling	30	4.98	9	8.18
Don't know	15	2.49	7	6.36
2. How willing are you to consume GM food if it reduced the amount of pesticide applied to crops				
Extremely willing	390	64.78	46	41.82
Somewhat willing	125	20.76	39	35.45
Neutral	48	7.97	13	11.82
Somewhat unwilling	21	3.49	6	5.45
Extremely unwilling	12	1.99	3	2.73
Don't know	6	1.00	3	2.73
3. How willing are you to consume GM food if it posed a risk of causing allergic reactions for some people				
Extremely willing	52	8.64	0	0
Somewhat willing	107	17.77	6	5.45
Neutral	152	25.25	4	3.64
Somewhat unwilling	94	15.61	33	30.00
Extremely unwilling	171	28.41	63	57.27
Don't know	26	4.32	4	3.64
4. How willing are you to consume GM food if it was more nutritious than similar food that isn't genetically modified				
Extremely willing	369	61.30	31	28.18
Somewhat willing	147	24.42	53	48.18
Neutral	47	7.81	11	10.00
Somewhat unwilling	23	3.82	6	5.45
Extremely unwilling	12	1.99	5	4.55
Don't know	4	0.66	4	3.64

Table 7: Initial Choice at Equal Prices in City Survey

Particulars	Rice (N=602)		Edible oil(N=602)		Chicken(N=121)	
	Number	Percentage	Number	Percentage	Number	Percentage
Non GM	162	26.91	169	28.07	42	34.71
GM	428	71.09	423	70.26	75	61.98
Indifferent	12	1.99	13	1.99	4	3.30

Table 8: Initial Choice at Equal Prices in Internet Survey

Particulars	Rice (N=110)		Edible oil (N=110)		Chicken (N=58)	
	Number	Percentage	Number	Percentage	Number	Percentage
Non GM	44	40.00	55	50.00	25	43.10
GM	41	37.27	21	19.09	7	12.06
Indifferent	25	22.72	34	30.90	26	44.82

Table 9: Description of Variables

Variable Name	Description
PRICE	Price difference between Non GM and GM alternatives
KNOW	1 if very well/somewhat informed about GMOs or GM foods; 0 otherwise.
GOVT	1 if the government's regulatory performance is excellent or good; 0 otherwise.
HR	1 if one thinks GM food is extremely or somewhat risky to human health; 0 otherwise.
ETHIC	1 if one considers ethical issue is extremely or somewhat important in choosing food product; 0 otherwise
SAFETY	1 if one consider safety as an important attribute in selecting a food product; 0 otherwise
FEMALE	1 if female; 0 if male.
MARRIED	1 if married; 0 otherwise
EDU	1 if one achieves a bachelor's degree or more; 0 otherwise.
JOINT	1 if the respondent live in a joint family; 0 otherwise
CHILD	1 if one is living with children of age 17 or younger; 0 otherwise
INC1	1 if the annual income is between Rs 50,000 to < 100,000; 0 otherwise
INC2	1 if the annual income is between Rs. 100,000 to <250,000; 0 otherwise
INC3	1 if the annual income is above 250,000; 0 otherwise
AGE	1 if one's age is above 30; 0 otherwise 0
SURVEY	1 if Ahmedabad city survey; 0 if internet survey
NG	1 if non-GM is chosen initially; 0 otherwise.
GM	1 if GM is chosen initially; 0 otherwise.

Table 10: Logit Regression Estimates for Rice, Edible Oil and Chicken

Products / Variable	Initial and Follow-up Responses		
	Rice	**Oil**	**Chicken**
PRICE	-.340**	-0.126**	-0.053**
	(.025)	(.010)	(0.10)
KNOW	-0.275	.021	-0.412
	(.204)	(.200)	(0.518)
HR	0.733**	.600**	1.145**
	(.197)	(.205)	(0.418)
ETHIC	0.514**	.502**	0.259
	(.133)	(.130)	(0.278)
SAFETY	-0.154	-.023	0.049
	(.126)	(.124)	(0.260)
GOVT	0.136	-.163	-0.529
	(.157)	(.155)	(0.390)
FEMALE	0.428**	.460**	0.171
	(.134)	(.135)	(0.282)
MARRIED	-0.088	-.225	0.062
	(.236)	(.230)	(0.467)
EDU	-0.185	-.055	0.307
	(.153)	(.154)	(0.467)
JOINT	0.301*	.567**	0.599
	(.133)	(.134)	(0.299)
CHILD	-0.081	.186	-0.206
	(.143)	(.144)	(0.303)
INC1	-0.454**	-.640**	-1.128**
	(.157)	(.159)	(0.335)
INC2	-0.663**	-1.180**	-1.672**
	(.193)	(.199)	(0.467)
INC3	-0.215	-.651*	-0.714
	(.262)	(.274)	(0.520)
AGE	-0.853**	-.793**	0.027
	(.288)	(.300)	(0.930)
SURVEY	0.282*	.241	-0.158
	(.147)	(.143)	(0.787)
NG	3.849**	2.230**	3.141**
	(.395)	(.395)	(0.537)
GM	-2.911**	-4.301**	-2.547**
	(.384)	(.399	(0.584)
CONSTANT	0.024	1.648**	0.784
	(.453)	(.437)	(0.723)
-2 log- likelihood	1929.70	1926.99	472.90
Cox & Snell R^2	0.476	0.485	0.449
N	2937	2834	600

* significant at 5%, ** significant at 1 %. Figures in parenthesis are standard errors.

Table 11: Mean Willingness to Pay for non-GM Foods

Particulars	Mean of Initial and Follow-up Response		
Base Price/kg	Rice (Rs. 20)	Oil (Rs. 50)	Chicken (Rs. 100)
	All Respondents		
Mean(Rs)	-3.90	-8.06	0.58
Percentage	-19.5	-16.12	0.58
	Non-GM Respondents		
Mean(Rs)	8.12	21.32	5.00
Percentage	41	43	5.00
	GM Respondents		
Mean(Rs)	-9.71	-25	-4.00
Percentage	-48	-50	-4.00
	Indifferent Respondents		
Mean(Rs)	-0.994	7.36	-0.809
Percentage	-4.97	14.72	0.008