Full Length Research Paper

Consumer awareness and attitudes toward GM foods in Kenya

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A survey of 604 consumers was conducted in Nairobi, Kenya, in November and December 2003, at three points of sale (supermarkets, kiosks, and posho mills) to determine consumer awareness and attitudes towards genetically modified (GM) foods. Above a third (38%) of the respondents were aware of GM crops, mostly from newspapers, television and radio. Others had learned about GM crops at school. Newspapers and television were more important to higher-income and more educated consumers. Consumers acknowledged the technology's potential positive impacts, with more than 80% agreeing that it increases productivity. Sixty-eight percent said they would buy GM maize meal at the same price as their favorite brands, although many had concerns; half of the respondents feared that GM technology could lead to a loss of biodiversity and affect non-target insects; while more than one- third (37%) had concerns about the effects of GM food on human health. We conclude that GM technology has a role to play in food security in Kenya. However, consumers need more information about the technology, which can be provided through established sources of information. Finally, consumer attitudes should be studied regularly, and the survey population broadened to include rural consumers.

 Key words: consumer, awareness, attitudes, GM crops, Kenya.

INTRODUCTION

Although GM crops have been accepted in many developed countries, they have generally not been well received in Europe and Japan. Farmers in the United States (USA) have embraced GM crops but at the same time are frustrated with the uncertainty of marketing them (Chern et al., 2002). Uncertainties about consumer acceptance have increased in many parts of the world, partly due to differing attitudes. Consumer organizations, environmentalists and some non-governmental organizations have expressed concerns about food safety,

ethical, religious and environmental grounds, isues as well as lack of consumer choice due to inadequate labeling. Studies have verified that many consumers in the European Union have difficulties accepting GM products. Verdurme and Viaene (2002) observed that consumers (especially in the EU and Japan) oppose the use of GM technology in food production. Consumers in the USA, on the other hand, are generally willing to accept GM food if sufficient price discounts are made on them (Kaneko and Chern, 2003). Li et al. (2002) observed that although the majority of Chinese consumers reported that they had little or no knowledge of biotechnology, their attitudes toward GM foods was generally positive, translating to a willingness to pay a premium for GM rice and soybean, and hence their acceptance of these foods. Compared to developed

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countries (UK and USA), Curtis et al. (2004) observe that generally, consumers in developing countries (China and Columbia) have more positive perceptions towards GM foods, most likely stemming from more urgent food needs, more positive media influence, higher trust in government, and a more positive perception of science. Other key factor that influence consumer acceptance of GM foods are awareness and information. Consumers who are better informed about GMOs are more likely to perceive the risks of genetic modification, but they are also more likely to perceive the benefits (Loader and Henson, 1998).

The success of any biotechnology program will depend on whether consumers accept its products. Springer et al. (2002) observed that consumers would be the final judges of emerging technologies in agricultural production. Africa, where per capita food production struggles to keep pace with population growth and serious food shortages are a regular occurrence, may not have the option of rejecting food with GM content (De Groote et al., 2004). African policymakers face a dilemma of whether to embrace the technology to feed their people or whether to protect them from potential, as yet unproven, dangers. Because many developing nations have not formulated official positions on genetic modification, they may end up adopting those of developed countries as their own. To give African farmers and consumers a voice in the debate, their concerns need to be known. Pinstrup-Andersen and Schioler (2002) argue that the agenda should be set by those people who have to live with the consequences of the action, in this case African farmers and consumers. De Groote et al. (2003) observe that in order to help make decisions in this heated debate, it is important that scientists contribute their objective analysis to the debate.

Farmers in developing countries face a variety of problems and constraints. In Kenya, insect pests are one of the major constraints to maize production. Of special significance are maize stem borers. These are estimated to cause crop losses of 13.5% per year nationwide, amounting to 0.4 million tons with an estimated value of US$ 80 million (De Groote, 2002). The significance of crop pests has prompted researchers to develop insect-resistant crop varieties. One such effort is the Insect Resistant Maize for Africa (IRMA) project, a joint venture between the International Maize and Wheat Improvement Center (CIMMYT) and the Kenya Agricultural Research Institute (KARI). The project is developing stem borer resistant maize using both conventional breeding methods and GM technology (Bt maize).

It is estimated that the Bt maize varieties could produce annual benefits of $49 million in Kenya, two-thirds of which would go to consumers (De Groote et al., 2003). The estimate is based on the following

assumptions: (i) the IRMA project is successful in developing Bt maize adapted to Kenyan conditions; (ii) the Bt maize is effective against all the major stem borers in the country; and (iii) at least two-thirds of the farmers who use modern varieties will adopt the Bt varieties. Discounted benefits over 25 years reach $208 million, compared to discounted costs of $6.8 million. This produces a benefit/cost ratio of 31:1, and an internal rate of return of 83%. However, these benefits will only be realized if consumers accept the Bt maize. Currently, there is little information about the acceptability of GM crops to consumers in sub-Saharan Africa, thus we cannot know whether these potential benefits will be realized. Therefore, a consumer survey was conducted in Nairobi to elicit consumers' awareness, attitudes, and willingness to pay for GM crops.

MATERIALS AND METHODS

This study uses data collected from 604 personal interviews in Nairobi, Kenya, in November and December 2003.The survey was conducted at three different types of points of sale: supermarkets, kiosks (small roadside shops), and posho mills (mechanical mills for maize), in order to ensure proper representation of different categories of consumers. Seventeen (17) supermarkets were selected using systematic sampling from a list of supermarkets obtained from Kenya's Central Bureau of Statistics (CBS), which included 12 large ones (with more than 3 branches within the city), and 5 small ones. One hundred and eight-three (183) respondents were interviewed in the supermarkets. A list of city estates (administrative subdivisions) was also obtained from CBS, and 7 estates were selected randomly. Within each of these, 3 kiosks were selected, leading to a total of 21 kiosks. From each of the selected kiosks, 10 consumers were systematically selected and interviewed, bringing the number of respondents interviewed in kiosks to 210. Finally, the city was toured in order to establish the number of posho mills in each estate, identifying 16 estates with different number of posho mills. Posho mills were then selected depending on their number within the estates, and 211 respondents were interviewed in 21 poshomills.

The questionnaire used sought to obtain information from maize consumers about their awareness and knowledge of biotechnology and GM crops, their attitudes towards GM food, and their willingness to pay for it. It further included questions on the respondents' source(s) of information about GM food, and maize consumption habits. The survey instrument was pre-tested at the three points of sale and the enumerators thoroughly trained on its administration. The enumerators approached every third consumer that came along for a possible interview. The first question in the questionnaire sought to establish whether the respondents were aware of GM crops. If the respondent answered in the affirmative, the entire questionnaire was administered, including questions on knowledge of GM foods. Respondents were asked whether, according to their opinion, different statements about risk and benefits of GM crops were true or false, and to indicate how sure they were about their answer on a five-point scale (ranging from 1 = "not sure at all," to 5 = "absolutely sure").

Consumers who were not aware of GM crops were first given a short presentation on GM crops. The text gave a definition of GM crops, the reasons why they are grown, Kenya's position on this research, current and potential benefits of GM crops, potential risks

Table 1. Consumer's socioeconomic characteristics, expressed as the percentage of respondents in different categories (sample size in brackets).

Variable	Category	By point of sale			Total
		Supermarket (N₁=183)	Kiosk (N₂=210)	Posho mill (N₃=211)	(N=604)
Gender	Female	40	35	59	45
	Male	60	65	41	55
Employment status	Formally employed	54	37	35	41
	Self employed	23	35	28	29
	Unemployed	14	17	25	19
	Student	9	11	12	11
Highest level of education	None	1	1	1	1
	Some primary	14	16	30	20
	Some secondary	34	46	40	40
	Some tertiary college	27	29	25	27
	Some university	25	9	4	12
Income level per month (KShs)	0(student)	8	11	12	10
	0(non-student)	10	16	26	18
	0 to 15000	51	46	47	48
	15001 to 50000	27	26	15	22
	Over 50000	5	1	1	2

and perceived concerns, biosafety measures, examples of countries growing GM crops, and the leading GM crops being grown. Studies have shown that attitudes can be changed by the type of information given to respondents. Lusk et al. (2004) found that consumers' willingness to pay for GM food was positively influenced by information on health and environmental and global benefits accruing from GM technology. Unaware respondents were therefore given both the pros and cons on GM crops, to avoid biasing them either way. In order to control for possible order effect, some of the respondents received information on benefits first and others on risks first. This group was not asked to respond to questions on knowledge about GM crops.

Consumer attitudes on five types of perceptions on genetic modification were obtained: benefits, health risks, environmental risks, ethics, and equity concerns. For each type, several statements were read, and consumers were asked their opinion, rated on a 5-point scale from 1 = 'totally disagree' to 5 = 'totally agree', with 3 as a neutral mid-point.

Descriptive statistics were used to summarize the variables of interest and determine relationships between them. This entailed computation of measures of central tendency, frequencies, and cross-tabulation using the SPSS software. MS Excel was used in formatting tables and figures.

RESULTS

Consumer characteristics by points of sale

The basis for targeting three points of sale was the need to incorporate views of all categories of consumers, based on the assumption that there are distinct differences in socioeconomic characteristics that may

influence awareness and attitudes toward GM crops. The survey results clearly confirm these differences (Table 1). Fifty-nine percent (59%) of the maize buyers in posho mills were women, while more than half of the maize buyers in the supermarkets were male. Supermarkets had the highest percentage of formally employed clients, the highest percentage of those with university education, and also the highest percentage of those with income levels above KShs 15,000 per month (1US$=KShs75). This indicates that people in the higher socioeconomic categories buy their maize more frequently at supermarkets than at posho mills. Kiosks clients represented a more amorphous group, because kiosks are found everywhere, in both well-to-do and low-income estates. Posho mills were characterized by the highest percentage of the unemployed, and those with the lowest education and income levels. Posho mills also had the highest percentage of non-students with no income (26%) and lowest percentage of people earning above KShs 15,000 per month (16%). This can be explained by the location of the posho mills; they are typically found in high-density neighborhoods with many low-income families.

Consumer awareness of genetically modified crops

Overall, 38% of all the respondents had heard or read something about GM crops. Awareness about

Table 2. Consumers' awareness of biotechnology and GM crops by socioeconomic characteristics.

Variable	Category	% Of respondents aware of:	
		Biotechnology	**GM crops**
Gender	Male	53	45
	Female	38	29
Employment	Student	62	42
	Formally employed	52	43
	Self employed	39	35
	Unemployed	35	28
Highest education level	None	17	17
	Some primary	19	10
	Some secondary	32	26
	Some tertiary college	68	53
	Some university	93	90
Income/month (KShs)	0 (student)	60	42
	0 (non-student)	35	28
	0 to 15000	37	28
	15001 to 50000	64	59
	Over 50000	100	92
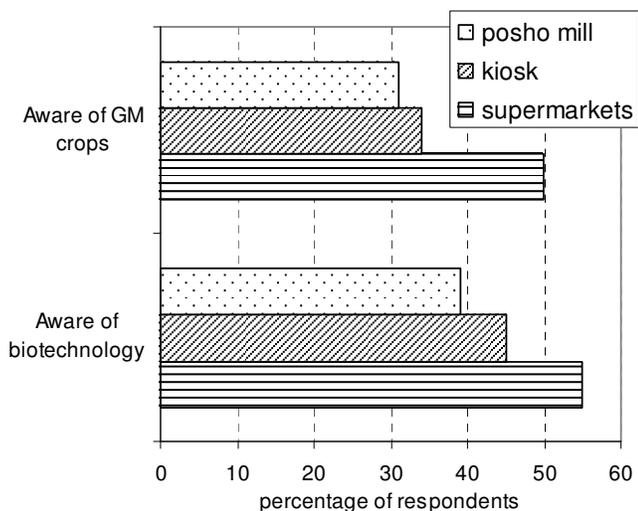
Figure 1. Consumers' awareness of biotechnology and GM crops by point of sale (as percentage of respondent in that category).

biotechnology was also high, at 46%. Of the respondents aware of GM crops, 95% were also aware of the term "gene"; 65% knew about the virus-resistant sweet potato, 54% about Bt maize, and 21% about Bt cotton.

Awareness about GM crops and biotechnology differed clearly by point of sale. It was highest among supermarket clients and lowest at the posho mills (Figure 1). Half of the supermarket respondents were aware of

GM crops, compared to 34% and 31% of those interviewed in kiosks and posho mills, respectively. This implies that people in the higher socioeconomic groups are more aware of GM crops and biotechnology. Awareness about particular GM crops, which was only asked of those aware of GM crops in general, did not differ by points of sale or by socioeconomic characteristics.

Analysis of the awareness of GM crops shows clear differences by socioeconomic characteristics (Table 2). Men are more aware than women (45% vs. 29%), and awareness varies by employment category, from the unemployed (28%), over the self-employed (35%) to the formally employed (43%). Similarly, awareness of GM crops clearly rises with education and with income. Excluding students with zero income, awareness of GM crops increased with income from 28% for those with zero income (non-students) to 92% for those with monthly incomes of above KShs 50,000.

Sources of information

Consumers who had heard or read something about GM crops were also asked about the source of that information (Table 3). The most important source of information on GM crops was the media, especially newspapers, television, and radio. The second most important source was schools, followed by resource people such as farmers and friends. Information sources

Table 3. Sources of information about GM crops, in general and by crop, expressed as a percentage of those respondents aware of GM crops.

Source of information	Consumers aware GM crops in general (229 respondents)	Consumers aware of particular GM crops		
		Virus resistant sweet potato (148 respondents)	Bt maize (124 respondents)	Bt cotton (47 respondents)
Newspapers	34	24	29	17
School/college	21	16	13	30
Media	15	11	16	4
Television	11	8	3	7
Friends/other people	10	8	9	9
Radio	7	4	6	7
Press	5	4	6	4
Seminars/ Conferences	4	4	1	2
Books	3	3	1	4
Journals/articles	3	4	3	
Place of work	2	1	3	2
Agricultural institutes	1	4	2	2
Farmers	1	6	6	9
Internet	1	1	2	2
Agricultural show	0	1	2	0
Agrochemical shops	0	1	1	0
Scheme/project	0	2	1	0

clearly differed by the type of GM crop (sweet potatoes and maize are already being tested, while cotton is not) and socioeconomic categories (especially schooling and income).

Newspapers were by far the most important source of information on GM crops in general (34% of respondents aware of GM crops) (Table 3). They were also the most important source of information on GM sweet potato and Bt maize, but not on Bt cotton, whose research is not ongoing in the country. The importance of newspapers, however, differed between socioeconomic groups (Table 4). In particular, it increased strongly from people without income (17%), to those in the highest income bracket (82%). Similarly, the importance of newspapers rose from 0% for those without education to almost half in the university educated (45%). Finally, newspapers were mentioned by more men (36%) than women (29%).

Schools were generally the second most important source of information (21%, Table 3), although they were the first source for Bt cotton (30%). Since research in this crop has not started in Kenya, newspapers have likely given it less attention than the other crops. The importance of schools as a source of information decreased with increasing income levels; while it was very important for the group without income (38%), it becomes relatively unimportant for the highest income

group (9%) (Table 4). This indicates that low-income groups have less access to other sources of information after completing formal schooling. Also interesting was that women mentioned schools more often (29%) than men (17%).

The media in general was mentioned by 15% of the respondents, and television in particular by 11% (Table 3). Television is clearly more important for the high-income group (27%) than for those without an income (7%), and more for the educated (16% for university educated vs. 0% for primary educated). A bit surprising is that only 3% of respondents aware of Bt maize got their information from the television. Radio was also less important as a source of information on GM crops (only 7% of respondents). However, it was particularly important for people with only some primary education (25%), the self-employed (15%), and people in the lowest income category (11%). It is clear that lower income and less educated groups have less access to television, but more to radio.

Informal contacts through resource people, in particular friends, are also an important source of information (10% of respondents). This source is particularly important for people with only primary education (25%) and the self-employed (15%). Agricultural research institutes, extension, agricultural shows, and projects were rarely

Table 4. Major sources of information about GM crops by socioeconomic characteristics, expressed as a percentage of that category.

Source	Income level per month (KShs)					Highest level of education					Employment status				Gender	
	0 (Student)	0 (Others)	0 -15000	15001 - 50000	Over 50000	None	Some Primary	Some Secondary	Some Tertiary	Some University	Formal	Self	Unemployed	Student	Male	Female
Newspapers	28	17	26	42	82	0	25	22	36	45	38	33	22	32	36	29
School/college	40	38	21	12	9	0	17	25	24	14	17	13	38	36	17	29
Media	16	10	20	14	9	0	0	10	20	19	16	17	13	14	16	14
Television	20	7	5	16	27	0	0	8	13	16	14	8	3	18	12	10
Friends/other people	8	6	11	10	9	0	25	14	8	6	9	15	9	7	10	9
Radio	4	7	11	6	0	100	25	13	3	3	6	15	3	4	9	4
Press	0	3	8	5	0	0	0	2	8	5	6	7	3	0	5	5
Books	4	7	1	1	0	0	0	0	1	9	2	0	6	11	3	4
Journals/articles	0	0	2	4	9	0	0	0	3	3	5	2	0	0	3	1
Place of work	0	0	0	5	0	0	0	0	3	2	4	0	0	0	2	1
Number	25	29	80	77	11	1	12	63	87	64	107	60	32	28	149	78

Table 5. Consumers' attitudes on GM technology (expressed as percentage of respondents).

Type of perception	Statement	Agree	Disagree	Neutral (don't know)
Benefit	GM technology increases productivity and offers solution to world food problem	81	12	7
	GM can reduce pesticides on food	79	11	10
	GM can create foods with enhanced nutritional value	78	13	9
	GM has potential of reducing pesticide residues in the environment	73	14	13
Environment risk	Insect resistant GM crops may cause death of untargeted insects	51	36	14
	GM can lead to a loss of original plant varieties	50	41	8
	GM threatens the environment	34	53	13
Health risk	People could suffer allergic reaction after consuming GM foods	40	39	20
	Consuming GM foods can damage ones health	37	48	15
	Consuming GM foods might lead to an increase in antibiotic-resistant diseases	35	43	22
Ethical concerns	GM food is artificial	50	41	10
	GM is tampering with nature	48	46	7
	GM technology makers are playing god	23	72	5
Equity concerns	GM products are being forced on developing countries by developed countries	36	54	10
	GM products only benefit multinationals making them	30	65	5
	GM products don't benefit small-scale farmers	22	71	7

mentioned, but this is not surprising, since only urban consumers were interviewed. However, urban consumers did get some information directly from farmers, in particular on GM sweet potato (6% of those who were aware of this crop), Bt maize (6%), and Bt cotton (9%).

Consumer attitudes on GM technology

Consumer attitudes on GM technology were determined using 5 variables representing perception of benefits, environmental risk, health risk, ethics, and equity concerns. However, to facilitate the analysis, "strongly agree" and "agree" were collapsed into a single category, as were "strongly disagree" and "disagree." Table 5 shows the percentage of consumers that completed the statements with "agree", "disagree", and "neutral."

Most people believed in the technology's potential positive impacts, with more than 80% agreeing that it can offer a solution to the world's food problems, 79% that it can reduce pesticides in food, and 73% that it has potential to reduce pesticide residues in the environment. However, a large number of consumers expressed concerns about potential negative effects. About half of the respondents thought that insect resistant GM crops

may kill non-target insects and that the technology could lead to a loss of local varieties. More than one-third of the consumers expressed fears about the health effects of GM foods. Forty percent of them thought that people could suffer allergic reactions after consuming GM foods while another 35 % feared that their consumption could lead to an increase in resistance to antibiotics. Half of the people surveyed thought that GM food is artificial and that GM technology is akin to tampering with nature. Only 23% thought that producers of GM foods are "playing God." On equity issues, the consumers clearly disagreed that GM crops are biased to large-scale farmers and multinationals. A majority (71%) disagreed with the statement that GM products do not benefit small-scale farmers. Less than one-third (30%) thought that GM products only benefit multinationals while 65% disagreed. Only one-third (36%) thought that GM products are being forced on developing countries, with a majority (54%) disagreeing.

Table 6 shows differences in benefit perception by awareness about GM crops. Those people initially unaware of GM crops had a slightly higher benefit perception (80-89%) than those initially aware (62-74%). This implies that the information text given to the non-aware respondents may have skewed their benefit perception upwards. Other perceptions did not differ

Table 6. Consumers' benefit perception of GM technology by awareness about GM crops (as percentage of respondents in their category).

	Aware		Non-aware	
	Agree	Disagree	Agree	Disagree
GM technology increases productivity and offers solution to world food problem	73	14	89	10
GM can create foods with enhanced nutritional value	65	16	87	12
GM can reduce pesticides on food	74	11	83	11
GM has potential of reducing pesticide residues in the environment	62	15	80	14

Table 7. Consumers' attitudes by point of sale (as percentage of respondents in that category).

Statement	Supermarket		Kiosk		Posh mill	
	Agree	Disagree	Agree	Disagree	Agree	Disagree
GM can reduce pesticides on food	74	12	81	11	81	10
GM technology increases productivity and offers solution to world food problem	73	21	86	8	84	8
GM can create foods with enhanced nutritional value	70	21	80	10	83	10
GM has potential of reducing pesticide residues in the environment	60	19	81	12	76	13
GM can lead to a loss of original plant varieties	62	26	46	45	45	51
Insect resistant GM crops may cause death of untargeted insects	54	28	49	37	49	40
GM threatens the environment	39	48	35	54	30	56
People could suffer allergic reaction after consuming GM foods	41	40	39	38	41	41
Consuming GM foods can damage ones health	40	47	38	46	35	51
Consuming GM foods might lead to an increase in antibiotic-resistant diseases	34	47	40	38	31	44
GM food is artificial	57	30	49	43	43	48
GM is tampering with nature	51	46	51	41	41	50
GM technology makers are playing god	35	60	19	78	17	76
GM products are being forced on developing countries by developed countries	45	42	34	58	30	61
GM products only benefit multinationals making them	44	53	23	71	26	70
GM products don't benefit small-scale farmers	32	60	20	72	15	79

between the 'initially aware' and the 'unaware' categories.

Attitudes differed by points of sale (Table 7). In general, people in the supermarkets had the lowest benefit perception and highest environmental risk perception compared to those at other points of sale, who did not show much difference. Supermarket consumers had the highest equity and ethical concerns, followed by those in kiosks, and then posho mills. There were small differences according to income, with students and those having incomes of over KShs 50,000 per month having higher environment risk perception than the other groups.

To assess consumers' willingness to pay for GM maize meal, people were first asked whether they would buy it at the same price as their favorite brand, and then asked if they would purchase it if offered at a premium or a discount, depending on their response to the initial question. More than two-thirds (68%) were willing to buy GM maize meal at the same price as their favorite maize meal brand. This indicates acceptance of the technology despite there being concerns.

DISCUSSION

The success of a genetically modified crop program will depend on the acceptability of its products by consumers, so it is important to determine the opinions of the public on such technologies. The results of this consumer survey show that more than one-third of the urban consumers surveyed were aware of GM crops, so it is generally possible to engage them in the debate. However, awareness, sources of information, and attitudes varied by point of sale and socioeconomic grouping. To have a representative picture while tracking consumer opinions, it should be ensured that all categories of consumers are included because different categories may present different views.

The core of the controversy over GM crops is the extent to which consumers perceive benefits from the technology relative to its risks, as this will determine acceptability. Generally, people are appreciative of the positive benefits of the technology, although many are worried about potential negative effects. The government, the IRMA project, and a range of stakeholders face an important challenge in communicating the advantages and disadvantages of the technology to the general public. In particular, they should aim to inform the public that GM foods, based on extensive scientific testing, are now generally accepted as safe for human and animal consumption by national and international research institutions and others (FAO, 2004). With regard to equity issues, which are becoming increasingly important in the debate, consumers should be informed that multinational corporations do not hold patents over the Bt maize being developed by IRMA. This study has identified the important sources of information for the urban Kenyan consumer, which can serve as a starting point for effectively targeted communication on GM goods in the future. The mass media was the foremost source of information, followed by schools/colleges. In such communication efforts, newspapers and television should be specifically used to target people of high socioeconomic status, while the radio can specifically target the lower socioeconomic groups.

The consumers surveyed generally had a positive attitude towards GM foods suggesting that the technology could play a major role in food security in Kenya. However, emphasis must also be given to educating people about the technology by providing them factual information.

Finally, studies tracking public opinion should be conducted regularly, in order to determine awareness levels, capture the impact of awareness activities, and reveal trends. Studies should be extended to smaller towns and rural areas, in order to include these segments of the population in the national discourse.

The present study provided some important insights to improve the methodology. First, the different points of sale represent different types of consumers. However, the number and respective percentage of people that shop in each category is not known. Household surveys could solve this problem, and they are therefore highly recommended. Further, this survey determined the major sources of information, so future surveys can move from open-ended to closed-ended questions.

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