

# THE SOCIAL AND CULTURAL DIMENSIONS OF AGRICULTURAL BIOTECHNOLOGY IN SOUTHEAST ASIA:

## *Public Understanding, Perceptions, and Attitudes towards Biotechnology in Malaysia*

### I. INTRODUCTION

This country monograph on the socio-cultural dimensions of agricultural biotechnology in Malaysia is a collaborative study by communication researchers from the International Service for the Acquisition of Agri-biotech Applications (ISAAA) and the University of Illinois at Urbana-Champaign. It addresses the need for published research focusing on key stakeholders in agricultural biotechnology in developing countries. Specifically, the study seeks answers to the following questions: a) What do stakeholders generally know or understand about agricultural biotechnology? b) What are their views and opinions about the impact and role of biotechnology in their lives? c) Where do they obtain information and what kind of information do they get? and d) Who do they trust or have confidence in to tell the truth about biotechnology?

Utilizing close-ended, structured survey questionnaires largely patterned after the 1996 Eurobarometer public perception surveys, the study aims to establish a comprehensive, empirical, and in-depth documentation and analysis of public representations of biotechnology in developing countries, particularly those from Southeast Asia namely, Indonesia, Malaysia, the Philippines, Thailand, and Malaysia. Survey results are presented in country monographs that offer detailed information on how seven vital stakeholders such as consumers, businessmen, policy makers, farmer leaders, extension workers, journalists, and scientists relate to biotechnology issues and concerns.

By examining each of these stakeholders, the study hopes to identify the underlying social and cultural constructs that tend to shape public concern and perceptions of biotechnology, and to generate baseline data that can be used for tracking and comparing national and cross-national opinion trends. This study is particularly useful in comparing individual country data with overall regional data on public perceptions of biotechnology as well as similar studies such as those from the Asian Food Information Centre (AFIC), Eurobarometer, Japan, and the United States (IFIC).

The country monograph presents a profile of each stakeholder and a cross-sectoral analysis of the stakeholders. The observable differences in perceptions and attitudes toward biotechnology

among country stakeholders offer policy makers, communication strategists, outreach educators, journalists, and planners a unique vantage point from which to understand and place in context the roots of public discourse and understanding about agricultural biotechnology in Malaysia. Comparative analyses across the five countries of the key seven stakeholders are contained in a separate summative and integrative monograph.

The stakeholders, who have been identified as belonging to the so-called attentive publics of agricultural biotechnology, are defined as follows:

a) Policy makers: Individuals whose decisions and opinions have significant influence or impact on national policies, laws, and regulations relating to agricultural biotechnology as well as on the overall directions of the country's agricultural development programs, including production, research, and trade. Policy makers may include senators, parliamentarians, legislators, elected representatives at the national level; members of legislative-level agricultural committees; national or regional officials in agriculture departments or ministries such as the agriculture minister/secretary, regional directors, and heads of units.

Officers and members of non-government organizations, no matter how influential, are not considered policy makers.

b) Journalists. This group includes media writers and broadcasters on television, radio, and print whose primary beat is science and technology. This may also include prominent columnists/opinion writers/commentators in major newspapers, radio, and television programs who have covered biotechnology and other science-technological issues.

c) Scientists. This refers to individual scientists who are not part of a country's crop biotechnology research consortium, but are often consulted by the mass media, NGOs, or other private groups for their individual scientific opinions or assessments relating to crop biotechnology. They are not strictly speaking generators of research information on biotechnology.

d) Farmer leaders and community leaders. This refers to heads of farmers' associations, cooperative groups, town mayors, councilors, members of a community council whose opinions and ideas tend to influence the overall dynamics of community debates or discourse on crop biotechnology such as those relating to the field testing of biotech crops, risks, benefits, and safety issues.

e) Extension workers. This refers to the field-level staff of agriculture ministries, university action-research programs, or semi-academic research institutes who conduct outreach and information campaign programs on agriculture.

f) Consumers. They are generally defined as urban supermarket goers and buyers who tend to be middle-class and have had at least some college education.

g) Businessmen and traders. Individuals who are directly involved in the food and agricultural industry.

## II. METHOD

Survey instrument. Separate but parallel structured, close-ended questionnaires were designed and developed for each stakeholder survey. In general, the surveys covered a broad range of constructs relating to biotechnology, including demographic characteristics. Variables assigned to each construct were based on theoretical considerations as well as previous studies. The surveys focused on the following variables:

a) *Interest in and concern about agricultural biotechnology*. The wide space given to public discussions on biotechnology is assumed to have engendered varying degrees of interest and concern about biotechnology issues among different stakeholders. Interest can determine the respondents' behavioral intention to seek information about the issues or to be attentive to issues, hence interested publics are also considered "attentive publics." Level of interest, however, does not necessarily translate into awareness or knowledge about biotech issues.

On the other hand, "concern" implies some generic awareness and a sense of uncertainty about the food safety, environmental and animal welfare consequences of food production systems, and the moral/ethical issues relating to genetic modification. Level of concern, however, does not refer to the position a stakeholder takes about biotechnology.

In the surveys, respondents were asked to describe both their interest and concern in regard to the uses of biotechnology in food production on a seven-point scale ranging from 1 = "Not at all interested" through 7 = "Very interested," with 4 = "Somewhat interested." Concern was likewise measured using a seven-point scale from 1="Not at all concerned" through 7 = "Very concerned," with 4 = "Somewhat concerned."

b) *Perceived risks and benefits of biotechnology.* Perceived risks are seen as a crucial factor in understanding public support or opposition to technology. The fear of the unknown and potential hazards of biotechnology has always been part of the public discourse. In spite of the benefits associated with biotechnology, it is likely to be judged by the public not simply in terms of its scientific merits but with other fundamental questions pertaining to ethics, control, voluntariness, and other considerations. The public's perception of risks is an important element in the development of public policies of risk management, particularly in the introduction of genetically engineered food and crops.

In the surveys, respondents were asked to rate the risks or hazards associated with the uses of biotechnology in food production on a seven-point scale ranging from 1 = "Not at all hazardous" through 7 = "Very hazardous," with 4 = "Somewhat hazardous." Likewise, they were asked to rate the benefits using a similar scale, 1 = "Not at all beneficial" through 7 = "Very beneficial," with 4 = "Somewhat beneficial."

c) *Perceptions of institutional concern and institutional accountability.* Issues of institutional concern and institutional accountability are crucial to understanding risk perception and attitudes toward technology. Public acceptance of risk assessment findings generated either by scientists and experts or contrarian advocates depends on how these institutions or groups are perceived by the public as being trustworthy, i.e., they are seen as working "in the public interest." How much the public thinks these institutions or societal groups are concerned about public health and safety issues in relation to biotechnology is one measure of a group's trustworthiness and this type of perception plays a crucial part in the decision making and adoption process. The other measure is perceived responsibility for risk assessment and risk management. It is seen as a determinant of the public's view of institutions as having the competence and accountability for ensuring public health and safety.

Thus, in this study, perceived trustworthiness is conceptualized in two ways: a) the extent to which institutions or societal groups are perceived to be concerned or care about public health and safety issues with regard to agricultural biotechnology; and b) the extent to which institutions or groups are perceived to be responsible for assessing and managing the risks and benefits of agricultural biotechnology.

In order to measure perceived institutional concern, respondents were asked to rate each institution or societal group mentioned on a seven-point scale ranging from 1 = "Not at all

concerned” through 7 = “Very concerned,” with 4 = “Somewhat concerned.” They were also given the option of answering 8 = “Not sure.”

To measure perceived institutional responsibility, respondents were asked to rate each institution or societal group mentioned in the question on a seven-point scale ranging from 1 = “Not at all responsible” through 7 = “Totally responsible,” with 4 = “Somewhat responsible.” They were also given the option of answering 8 = “Not sure.”

d) *Opinions, understanding, and knowledge about science and biotechnology.* Science plays an important role in developing and justifying public policies and legislation in the political and economic domain. At many different levels of everyday life, people now need to have a basic understanding of science and technology when making choices.

In these surveys, respondents were asked about their opinion about the role of science in agricultural development, their understanding of science, and their knowledge about the uses of biotechnology in food production. In each of these questions, a seven-point scale was used.

To ascertain their factual knowledge about biotechnology in food production, respondents were asked to answer “True,” “False,” or “Don’t Know” on a 12-twelve statement “pop quiz” on biotechnology.

e) *Sources and characteristics of information on biotechnology.* The source and type of biotechnology information can have an effect on how people perceive risks.

In the surveys, respondents were asked to describe the frequency of contact they had, within the past two months, with interpersonal sources (e.g., family, friends, biotech experts, food regulators, NGOs, etc), general media sources (e.g., TV, radio, newspapers), and specialized media sources (e.g., biotech websites, books, events, newsletters) on biotechnology. They were also asked to rate the usefulness of the information they received from each of these information sources on a seven-point scale where 1 = “Not at all useful” through 7 = “Totally useful,” with 4 = “Somewhat useful.”

Respondents were also asked to describe the extent of trust they have in each of the information sources. The seven-point scale ranged from 1 = “Not trust at all” through 7 = “Total trust,” with 4 = “Some trust.”

f) *Attitudes towards biotechnology.* Attitudes are a mental predisposition to act that is expressed by evaluating a particular entity with some degree of favor or disfavor. Attitudes are also a function of an individuals beliefs and values. Hence beliefs and values on biotechnology

are often manifested by the political leanings and societal worldviews of an individual that consequently have a bearing on his/her judgments about biotechnology. For example, individuals who support a more conservative type of governance are less averse to risk than respondents who support a more liberal government.

In order to ascertain attitudes, this study first asked respondents about the kinds of issues that would influence most their judgments on biotechnology such as political, religious, moral/ethical, cultural, and scientific. Second, they were asked to state their agreement or disagreement to a series of statements on biotechnology. Lastly, they were then asked to validate their judgments on specific applications of biotechnology in society in terms of usefulness, level of risk, moral acceptability, and promise.

B. Survey sample. In these surveys, the respective populations for the stakeholders involved were large and unknown. The questions asked of the respondents basically required “Yes” or “No” type of answers that generally classified the variables as being binomially distributed. In order to determine the population of positive responses for eight unknown populations, the sampling error was set around the 5% range and the level of confidence at 95%. For such level of confidence and sampling error, in practice, the required maximum sample is 385 for all stakeholders. Increasing this maximum sample would only yield the same sampling error and level of confidence. This sample size was proportionately allocated among seven stakeholders namely consumers, businessmen, extension workers, farmer leaders, journalists, policy makers, and scientists with no effects on the desired reliability. With a sample size of at least 340, there is a 95% level of confidence that the sample estimate of  $p$  will be within 5.3% of the true population proportion  $P$ . Thus, the percentages reported in this monograph can be seen as estimates of what the distribution of responses would be if the entire population of each stakeholder had been included in the survey.

C. Data collection. The Biotechnology Information Centers (BICs) and ISAAA’s partner organizations in each of the five countries carried out the country surveys between April 15, 2002 and September 30, 2002. In Malaysia, the surveys were administered to a random sample of each stakeholder group namely, consumers, businessmen, extension workers, farmer leaders, journalists, policymakers, and scientists. The surveys were organized and conducted by the

Malaysia Biotechnology Information Centre (MABIC). The total sample for the Malaysian surveys was three hundred sixty-one (361) respondents.

Included in this monograph are selected highlights of the data analyses such as basic descriptive statistics, correlational analyses, and results of the t-tests and analysis of variance.

D. Acknowledgements. It is a great pleasure to acknowledge the singular support and assistance of See Yee Ai, Suria Aziz and Evelyn Yeong of the Malaysian Biotechnology Information Centre; Department of Chemistry, MOH, Malaysia; Farmers Organisation Authority, Department of Agriculture Malaysia; Food Quality Control Division, Ministry of Health; Federal Agricultural Marketing Authority, Ministry of Agriculture; Department of Agriculture, Selangor; Ministry of Science Technology & Environment; Forest Reserve Institute of Malaysia; Malaysian Palm Oil Board; Ministry of International Trade and Development, Malaysian Agricultural Research & Development Institute, and the Ministry of Domestic Trade and Consumer Affairs. Thanks as well to the student volunteers Yvonne Tan Yih Wan and Carina Ong Su Yin from University Putra Malaysia, and Sheila Kaur Gill from Monash University and also to representatives from the relevant industries, the media, scientists, consumers and farmer leaders.

Dr. Mariano de Ramos, Professor of Statistics, Department of Statistics at the University of the Philippines Los Baños (UPLB) conducted the data analyses. For organizing, coding, verifying, cleaning up the voluminous data, doing literature searches, and editing manuscripts, special thanks to research assistants Monina A. Villena, Carlo Custodio, Jr., and Wendell S. Arevalo at ISAAA and University of the Philippines at Los Baños; Amanda R. Fuka and Brandon M. Anderson at the University of Illinois at Urbana-Champaign; Scott G. Lesch at Cornell University; and to John P. Magbanua for developing various graphical presentations.

This project would not have been made possible without the inspired leadership of Dr. Randy A. Hautea (Global Coordinator, ISAAA) to produce high quality communication research on agricultural biotechnology. Appreciation is extended to Dr. Margarita L. Escaler and Dr. Mariechel J. Navarro of the ISAAA-Global Knowledge Center for the incredible job of initiating, mobilizing, and coordinating the surveys in all five countries as well as for their valuable technical inputs, feedback, and organizational support. At the University of Illinois at Urbana-Champaign, Dr. Steve G. Pueppke (Associate Dean of Research, University of Illinois) and Dr. Constance H.

Shapiro (Head, Department of Human and Community Development, University of Illinois) have provided astonishing commitment to this unique and pioneering research endeavor.

Funding for this study was provided in large part by ISAAA, with research contributions from the University of Illinois Agricultural Experiment Station, the Cooperative State Research, Education, and Extension Service (CSREES), U.S. Department of Agriculture, and the Illinois Council on Food and Agricultural Research (C-FAR). Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author/principal investigator and do not necessarily reflect the view of ISAAA and its partner organizations in Malaysia, University of Illinois, the U.S. Department of Agriculture, and C-FAR.

### III. STAKEHOLDER PROFILES AND CROSS-STAKEHOLDER COMPARISONS

#### A. *Interest and concern*

Interest in biotechnology. The overall mean interest score of Malaysia's stakeholders ( $\bar{x}$  =5.33) shows a moderate to high degree of interest in agricultural biotechnology implying the level of attention and information seeking efforts they give to biotechnology. Except for consumers and farmer leaders, all the other stakeholder groups have at least 60% of their respondents saying that they are highly interested in biotechnology (Table 1).

Among these stakeholders, scientists<sup>1</sup> are very positively interested in agricultural biotechnology. Scientists have posted a high mean interest score of 6.26 ( $\pm$  0.131) and nearly 100% of those surveyed have expressed high interest in biotechnology. The high interest expressed by the scientific community in Malaysia is presumably reflective of the country's thrust for modernization through science and technology. The advancement of science is a key component in Malaysia's agenda for development and there is a clear emphasis on the role of biotechnology in increasing agricultural production.

Other stakeholders are not far behind in terms of having high interest in biotechnology. As evident in their respective mean interest scores, journalists ( $\bar{x}$ =5.74  $\pm$  0.204), policy makers ( $\bar{x}$  =5.71  $\pm$  0.295), businessmen ( $\bar{x}$ =5.06  $\pm$  0.175), and extension workers ( $\bar{x}$ =5.05  $\pm$  0.212) are also highly interested in biotechnology. At least 70% of journalists, policy makers, and businessmen are very interested in biotechnology. The degree of interest or attention shown by policy makers, businessmen, and extension workers can be partly driven by the need to seek information about or have answers to biotechnology issues on behalf of either constituents or customers.

Malaysia's consumers seem to show comparatively lower interest in biotechnology. They are almost divided between having just a moderate interest and a high interest. Nearly 15% of the consumers surveyed say that they are not at all interested.

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<sup>1</sup> It must be clarified that the "scientists" referred to as part of this stakeholder group consists of so-called "scientists-teachers" from state universities and colleges. They are individual scientists who are not part of a country's crop biotechnology research consortium, but are often consulted by the mass media, NGOs, or other private groups for their individual scientific opinions or assessments relating to crop biotechnology. They do not generate research information on biotechnology. They are distinguished from scientists who are also based in universities but are directly involved in laboratory-based biotechnology studies. This latter group is referred to in this study as "University scientists."

*TABLE 1: INTEREST IN BIOTECHNOLOGY  
(MEAN SCORES AND PERCENTAGE DISTRIBUTION)<sup>2</sup>*

<i>Stakeholder (n=361)</i>	<i>Mean score (<math>\pm</math> s.e., max 7)*</i>	<i>Not at all Interested</i>	<i>Moderately interested</i>	<i>Very interested**</i>
Consumers (111)	4.59 $\pm$ 0.139 <sup>c</sup>	14.4 $\pm$ 3.33	40.5 $\pm$ 4.66	45.0 $\pm$ 4.72 <sup>c,j,p,s</sup>
Businessmen (52)	5.06 $\pm$ 0.175 <sup>bc</sup>	7.7 $\pm$ 3.70	25.0 $\pm$ 6.00	67.4 $\pm$ 6.50 <sup>c,f,j,p,s</sup>
Extension Workers (65)	5.05 $\pm$ 0.212 <sup>bc</sup>	13.8 $\pm$ 4.28	26.2 $\pm$ 5.45	60.0 $\pm$ 6.08 <sup>c,j,p,s</sup>
Farmer Leaders (47)	4.91 $\pm$ 0.285 <sup>c</sup>	19.2 $\pm$ 5.75	25.5 $\pm$ 6.36	55.3 $\pm$ 7.26 <sup>b,j,p,s</sup>
Journalists (27)	5.74 $\pm$ 0.204 <sup>ab</sup>	- 0 -	14.8 $\pm$ 6.83	85.1 $\pm$ 6.85 <sup>c,b,e,f,s</sup>
Policy Makers (28)	5.71 $\pm$ 0.295 <sup>ab</sup>	7.2 $\pm$ 4.88	14.3 $\pm$ 6.62	78.6 $\pm$ 7.75 <sup>c,b,e,f,s</sup>
Scientists (31)	6.26 $\pm$ 0.131 <sup>a</sup>	- 0 -	- 0 -	99.9 $\pm$ 0.57 <sup>c,b,e,f,j,p</sup>

\* Results of Comparison of Means by Analysis of Variance using the Duncan Test. Minimum score = 1 and Maximum score = 7. Different letter superscripts denote significant differences among stakeholders ( $p < .05$ ).

\*\* Reports significant differences between “high” percentages across stakeholders. Significant difference with a “high” percentage of a stakeholder group is indicated by a letter corresponding to the first letter of that stakeholder group. All differences reported are significant at the 0.05 level. Example: 45% of consumers having high interest is significantly different from those of extension workers, farmer leaders, journalists, policy makers, and scientists. It is not significantly different from those of businessmen and scientists. Percentages in the tables may not add up to 100% as “Don’t Know” or “Not sure” answers are not included.

Journalistic interest in biotechnology seems to mirror the prevailing coverage in the global mass media about biotechnology issues ( $\bar{x}$ =5.55  $\pm$  0.234). Majority of the journalists surveyed 74% percent ( $\pm$  8.44) of the journalists surveyed say that biotechnology is a very important news story and 22.20% ( $\pm$  7.99) think that it has moderate newsworthiness. However, their degree of interest in biotechnology is not significantly associated with their belief in biotechnology’s newsworthiness ( $r$ = 0.24;  $p > 0.05$ ).

Expressions of low interest in biotechnology across stakeholders in Malaysia are very minimal and can be noted only among nearly 20% of farmer leaders.

Personal concern about biotechnology. Mean scores on personal concern show that Malaysia’s stakeholders generally tend to be moderately concerned about biotechnology (Table 2). The overall mean concern score is above moderate ( $\bar{x}$ =4.79).

Relative to other stakeholders, scientists have a high mean concern score of 5.39 ( $\pm$  0.288), although there is no significant difference between their mean concern scores and the mean concern scores of policy makers ( $\bar{x}$ =5.18  $\pm$  0.330), farmer leaders ( $\bar{x}$ =4.91  $\pm$  0.249), and

<sup>2</sup> Percentages in the tables may not add up to 100% as “Don’t Know” or “Not sure” answers are not included.

businessmen ( $\bar{x}$ =4.85 ± 0.212). These mean concern scores resonate in terms of numbers. Considerable numbers of Malaysia’s scientists (64.50%, ± 8.59), policy makers (64.30%, ± 9.05), farmer leaders (59.60%, ± 7.16), and businessmen (55.80%, ± 6.89) say that they are very concerned about biotechnology issues.

There is no significant relationship between journalists’ interest and concern about biotechnology issues ( $p>0.05$ ). However, there is a strong and significant correlation between the journalists’ concern in biotechnology and their judgment about its value as a news story ( $r=0.46$ ;  $p\leq.05$ ).

Consumers ( $\bar{x}$ =4.63 ± 0.149), extension workers ( $\bar{x}$ =4.58 ± 0.201), and journalists ( $\bar{x}$ =4.00 ± 0.325) tend to have slightly above-moderate concerns. Only 33.30% (± 9.07) of journalists and 47.70% (± 4.74) of consumers have said that they are very concerned about biotechnology.

TABLE 2: PERSONAL CONCERN ABOUT BIOTECHNOLOGY  
(MEAN SCORES AND PERCENTAGE DISTRIBUTION)

Stakeholder (n=361)	Mean score ( $\pm$ s.e., max 7)	Not at all Concerned	Moderately concerned	Very concerned
Consumers (111)	4.63 ± 0.149 <sup>bc</sup>	19.8 ± 3.78	32.4 ± 4.44	47.7 ± 4.74 <sup>j,p,s</sup>
Businessmen (52)	4.85 ± 0.212 <sup>abc</sup>	15.3 ± 4.99	28.8 ± 6.28	55.8 ± 6.89 <sup>j</sup>
Extension Workers (65)	4.58 ± 0.201 <sup>c</sup>	15.3 ± 4.47	35.4 ± 5.93	49.3 ± 6.20 <sup>j,p,s</sup>
Farmer Leaders (47)	4.91 ± 0.249 <sup>abc</sup>	10.7 ± 4.51	29.8 ± 6.67	59.6 ± 7.16 <sup>j</sup>
Journalists (27)	4.00 ± 0.325 <sup>a</sup>	33.3 ± 9.07	29.6 ± 8.79	33.3 ± 9.07 <sup>c,b,e,f,p,s</sup>
Policy Makers (28)	5.18 ± 0.330 <sup>abc</sup>	17.9 ± 7.24	17.9 ± 7.24	64.3 ± 9.05 <sup>c,e,j</sup>
Scientists (31)	5.39 ± 0.288 <sup>ab</sup>	9.7 ± 5.32	25.8 ± 7.86	64.5 ± 8.59 <sup>c,e,j</sup>

Significant correlations can be noted in Table 4 between the interest and concern expressed by consumers ( $r=0.47$ ;  $p\leq 0.001$ ), businessmen ( $r=0.36$ ;  $p\leq 0.01$ ), extension workers ( $r=0.58$ ;  $p\leq 0.001$ ), and farmer leaders ( $r=0.73$ ;  $p\leq 0.001$ ). These correlations suggest that increased interest in biotechnology also drives up concern about biotechnology issues.

## ***B. Perceived risks and benefits of biotechnology***

Perceived risks. The overall mean score for perceived risks among Malaysia's stakeholders is quite moderate ( $\bar{x}=3.84$ ). Malaysia's journalists tend to be much more unanimous (62.90%,  $\pm 7.23$ ) about the high risks posed by biotechnology. Only about 11% ( $\pm 6.05$ ) of the journalists say that it has moderate risks and 25.90% ( $\pm 8.43$ ) believe that its risks are marginal (Table 3a). Journalists also have the highest mean score on perceived risks ( $\bar{x}=4.67 \pm .311$ ). There is a significant difference at  $p \leq 0.05$  between this mean score and the mean scores of other Malaysian stakeholders. Journalistic perceptions of risks may have been partly engendered by the need to have a mixture of risk and benefit issues in media coverage. However, as can be noted in Table 4, there is no significant relationship between the journalists' perceptions of risks and their interest and concern about biotechnology issues ( $p > 0.05$ ). There is also no significant relationship between their perceptions of risks and their assessment of biotechnology as a news story ( $p > 0.05$ ).

However, no more than one-third of the rest of the respondents surveyed share the journalists' perceptions about biotechnology risks. A much smaller percentage of scientists (32.30%,  $\pm 8.40$ ) and policy makers (28.60%,  $\pm 8.54$ ) think that the risks are high. These numbers are mirrored in much more moderate mean scores of 4.10 ( $\pm 0.264$ ) and 3.86 ( $\pm 0.234$ ). Likewise, the mean scores of consumers ( $\bar{x}=3.91 \pm 0.135$ ), businessmen ( $\bar{x}=3.85 \pm 0.210$ ), farmer leaders ( $\bar{x}=3.45 \pm 0.237$ ), and extension workers ( $\bar{x}=3.06 \pm 0.196$ ) indicate that their perceived risks are below moderate. Only 9.20% ( $\pm 3.58$ ) of extension workers and 21.2% ( $\pm 5.96$ ) of farmer leaders say the risks associated with biotechnology are very high.

Strong and significant correlations can be noted between concern and perceived risks among all stakeholders except extension workers and journalists (Table 4).

TABLE 3A: PERCEIVED RISKS OF BIOTECHNOLOGY  
(MEAN SCORES AND PERCENTAGE DISTRIBUTION)

Stakeholder (n=361)	Mean score ( $\pm$ s.e., max 7)	Low	Moderate	High
Consumers (111)	3.91 $\pm$ 0.135 <sup>a</sup>	31.5 $\pm$ 4.41	41.4 $\pm$ 4.68	27.0 $\pm$ 4.21 <sup>e,j</sup>
Businessmen (52)	3.85 $\pm$ 0.210 <sup>a</sup>	34.5 $\pm$ 6.59	38.5 $\pm$ 6.75	27.0 $\pm$ 6.16 <sup>e,j</sup>
Extension Workers (65)	3.06 $\pm$ 0.196 <sup>b</sup>	63.1 $\pm$ 5.99	27.7 $\pm$ 5.55	9.2 $\pm$ 3.58 <sup>c,b,j,p,s</sup>
Farmer Leaders (47)	3.45 $\pm$ 0.237 <sup>ab</sup>	44.6 $\pm$ 7.25	34.0 $\pm$ 6.91	21.2 $\pm$ 5.96 <sup>j</sup>
Journalists (27)	4.67 $\pm$ 0.311 <sup>c</sup>	25.9 $\pm$ 8.43	11.1 $\pm$ 6.05	62.9 $\pm$ 9.30 <sup>c,b,e,f,p,s</sup>
Policy Makers (28)	3.86 $\pm$ 0.234 <sup>a</sup>	35.8 $\pm$ 9.06	35.7 $\pm$ 9.05	28.6 $\pm$ 8.54 <sup>e,j</sup>
Scientists (31)	4.10 $\pm$ 0.264 <sup>a</sup>	32.3 $\pm$ 8.40	35.5 $\pm$ 8.59	32.3 $\pm$ 8.40 <sup>e,j</sup>

Perceived benefits. Malaysia's stakeholders generally have expressed confidence in the potential benefits of biotechnology. The overall mean across stakeholders is moderately high ( $\bar{x}$  =5.30). Less than 20% of the respondents surveyed in all the stakeholder groups think that the benefits of biotechnology are very low. None of the journalists, policy makers, or scientists surveyed believes that biotechnology has only minimal benefits.

Interestingly, Malaysia's journalists who have thought of biotechnology as posing high risks also lead stakeholders in affirming the benefits of biotechnology ( $\bar{x}$ =6.15  $\pm$  0.198). A resounding majority of journalists (88.8%,  $\pm$  6.07) together with, at least, 80% of policy makers and scientists agree that biotechnology produces high benefits. On average, 60% of farmer leaders, extension workers, businessmen and consumers likewise profess that biotechnology produces high benefits (Table 3b).

Mean scores on perceived benefits show that journalists lead the groups at 6.15 ( $\pm$  0.198), followed by scientists 6.10 ( $\pm$  0.193) and policy makers 5.68 ( $\pm$  0.206). Table 4 shows the correlations between interest, concern, perceived risks, and perceived benefits. The results indicate that levels of concern about biotechnology appear to go along with perceived risks and that this pattern of association is noticeable among consumers, businessmen, policy makers, farmer leaders, journalists, and extension workers.

Journalists' perceived benefits of biotechnology do not bear on their judgment about the value of biotechnology as a news story ( $p>0.05$ ). It is also interesting to note that strong and significant associations can be noted between the interest in biotechnology and perceived benefits among stakeholders who have some involvement in biotechnology such as businessmen ( $r=0.38$ ;  $p\leq 0.01$ ),

extension workers( $r=0.42$ ;  $p\leq 0.001$ ), farmer leaders ( $r=0.75$ ;  $p\leq 0.001$ ). Strong and significant correlation between interest and concern, ( $r=0.47$ ;  $p\leq 0.001$ ) can also be observed among consumers.

**TABLE 3B: PERCEIVED BENEFITS OF BIOTECHNOLOGY  
(MEAN SCORES AND PERCENTAGE DISTRIBUTION)**

<i>Stakeholder (n=361)</i>	<i>Mean score (<math>\pm</math> s.e., max 7)</i>	<i>Low</i>	<i>Moderate</i>	<i>High</i>
Consumers (111)	4.97 $\pm$ 0.132 <sup>bc</sup>	14.4 $\pm$ 3.33	26.1 $\pm$ 4.17	59.4 $\pm$ 4.66 <sup>j,p,s</sup>
Businessmen (52)	4.98 $\pm$ 0.206 <sup>bc</sup>	11.5 $\pm$ 4.42	28.8 $\pm$ 6.28	59.6 $\pm$ 6.80 <sup>j,p,s</sup>
Extension Workers (65)	4.68 $\pm$ 0.257 <sup>c</sup>	18.4 $\pm$ 4.81	21.5 $\pm$ 5.10	60.0 $\pm$ 6.08 <sup>j,p,s</sup>
Farmer Leaders (47)	5.11 $\pm$ 0.262 <sup>bc</sup>	10.7 $\pm$ 4.51	27.7 $\pm$ 6.53	61.8 $\pm$ 7.09 <sup>j,p,s</sup>
Journalists (27)	6.15 $\pm$ 0.198 <sup>a</sup>	- 0 -	11.1 $\pm$ 6.05	88.8 $\pm$ 6.07 <sup>c,b,e,f</sup>
Policy Makers (28)	5.68 $\pm$ 0.206 <sup>ab</sup>	- 0 -	14.3 $\pm$ 6.62	85.7 $\pm$ 6.62 <sup>c,b,e,f</sup>
Scientists (31)	6.10 $\pm$ 0.193 <sup>a</sup>	- 0 -	16.1 $\pm$ 6.60	83.9 $\pm$ 6.60 <sup>c,b,e,f</sup>

**TABLE 4: CORRELATION SUMMARY FOR INTEREST, CONCERN,  
PERCEIVED RISKS, & PERCEIVED BENEFITS**

(Spearman Correlation Coefficients / Prob > |R| under Ho: Rho=0)

<sup>a</sup> Significant at .001 level; <sup>b</sup> Significant at .01 level; <sup>c</sup> Significant at .05 level

<i>Stakeholder (n=361)</i>	<i>Interest &amp; Concern</i>	<i>Interest &amp; Perceived risks</i>	<i>Interest &amp; Perceived benefits</i>	<i>Concern &amp; Perceived risks</i>	<i>Concern &amp; Perceived benefits</i>	<i>Perceived benefits &amp; Perceived risks</i>
Consumers (111)	<b>0.47450<sup>a</sup></b>	-0.01446	<b>0.55657<sup>a</sup></b>	<b>0.22813<sup>c</sup></b>	<b>0.28896<sup>b</sup></b>	-0.08344
Businessmen (52)	<b>0.35851<sup>b</sup></b>	-0.09757	<b>0.38308<sup>b</sup></b>	<b>0.38053<sup>b</sup></b>	0.03497	-0.13852
Extension Workers (65)	<b>0.58044<sup>a</sup></b>	-0.02772	<b>0.42309<sup>a</sup></b>	<b>-0.09556</b>	<b>0.39232<sup>b</sup></b>	0.12232
Farmer Leaders (47)	<b>0.73198<sup>a</sup></b>	0.12019	<b>0.75767<sup>a</sup></b>	<b>0.29580<sup>c</sup></b>	<b>0.50209<sup>a</sup></b>	-0.11787
Journalists (27)	0.02101	0.31525	0.19854	-0.29189	0.20477	0.10488
Policy Makers (28)	0.27520	-0.06804	<b>0.50968<sup>b</sup></b>	<b>0.51732<sup>b</sup></b>	0.11529	-0.24396
Scientists (31)	0.20880	0.01014	0.27038	<b>0.51696<sup>b</sup></b>	-0.08755	-0.35354

### C. *Perceptions of institutions as being concerned about health and safety*

Stakeholders' perceptions of institutional concern about health and safety. Out of eight societal groups or institutions<sup>3</sup>, Malaysia's stakeholders have commonly mentioned *university scientists, consumer advocacy groups/NGOs, and research institutes*<sup>4</sup> as being most concerned about public health and safety issues relating to agricultural biotechnology (Table 5). The stakeholders who have rated university scientists as being highly concerned about health and safety issues relating to agricultural biotechnology include businessmen (73.10%,  $\pm$  6.15) and their fellow scientists (67.80%,  $\pm$  8.39).

Scientists (96.70%,  $\pm$  3.21), journalists (88.90%,  $\pm$  6.05), and policy makers (82.20%,  $\pm$  7.23) have also considered consumer advocacy groups/NGOs as very highly involved in health and safety issues. Nearly 80% of businessmen think that research institutes are also very concerned about health and safety issues. Consumers (75.70%,  $\pm$  4.31) and scientists (71.00%,  $\pm$  8.02) have likewise rated research institutes as being highly concerned about these issues.

On the other hand, no more than 50.00% of all stakeholders have thought of farm leaders as being concerned about health and safety issue. Religious groups have garnered at least 50.00% of scientists and policy makers' votes as being concerned about the same issues, but consumers businessmen, extension workers, farmer leaders, and journalists do not perceive religious groups to be concerned about health and safety issues.

Some stakeholder groups have also considered the *mass media* as being very concerned about health and safety issues. This perception has come mainly from policy makers (71.40%,  $\pm$  8.54), scientists (67.70%,  $\pm$  8.40), and businessmen (53.80%,  $\pm$  6.91).

On the other hand, farmer leaders and religious groups have not made it to the top list of institutions/societal groups that are perceived to care about health and safety issues on biotechnology.

TABLE 5: INSTITUTIONS PERCEIVED AS BEING CONCERNED ABOUT HEALTH AND

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<sup>3</sup> These groups are: a) University scientists, b) Private sector scientists, c) Agri-biotech companies, d) Consumer groups & NGOs, e) National farm leaders, f) Mass media/journalists, g) Religious groups, and h) Research institutes.

<sup>4</sup> The top three choices of each stakeholder (see Table 5) are in bold.

*SAFETY ISSUES RELATING TO BIOTECHNOLOGY  
(PERCENTAGE REPORT ON HIGHLY CONCERNED)*

Stakeholder (n=361)	Institutions							
	University scientists	Private sector scientists	Agri-biotech companies	Consumer groups & NGOs	National farm leaders	Mass media	Religious groups	Research institutes
Consumers	<b>66.6</b> ± 4.48	58.5 ± 4.68	56.7 ± 4.79	<b>62.1</b> ± 4.60	26.1 ± 4.17	50.4 ± 5.75	27.0 ± 4.21	<b>75.7</b> ± 4.07
Businessmen	<b>73.1</b> ± 6.15	65.4 ± 6.60	69.3 ± 6.40	<b>73.1</b> ± 6.15	44.2 ± 6.89	53.8 ± 6.91	34.6 ± 6.60	<b>78.8</b> ± 5.60
Extension Workers	<b>56.9</b> ± 6.14	<b>50.8</b> ± 6.20	43.1 ± 6.14	35.4 ± 5.93	43.1 ± 6.14	43.1 ± 6.14	30.7 ± 5.72	<b>69.2</b> ± 5.72
Farmer Leaders	<b>63.8</b> ± 7.01	<b>59.6</b> ± 7.16	55.2 ± 7.25	57.4 ± 7.21	49.0 ± 7.29	44.7 ± 7.25	38.3 ± 7.09	<b>65.9</b> ± 6.91
Journalists	<b>59.2</b> ± 9.46	33.3 ± 9.07	33.3 ± 9.07	<b>88.9</b> ± 6.05	44.4 ± 9.56	<i>Not asked</i>	25.9 ± 8.43	<b>48.1</b> ± 9.61
Policy Makers	<b>50.0</b> ± 9.45	46.4 ± 9.42	28.6 ± 9.20	<b>82.2</b> ± 7.23	14.3 ± 6.62	<b>71.4</b> ± 8.54	<b>50.0</b> ± 9.45	<b>50.0</b> ± 9.44
Scientists	<b>67.8</b> ± 8.39	35.5 ± 8.59	42.0 ± 8.86	<b>96.7</b> ± 3.21	42.0 ± 8.86	<b>67.7</b> ± 8.40	61.3 ± 8.67	<b>71.0</b> ± 8.14

***D. Perceptions of institutional responsibility for risk assessment and risk management***

Stakeholders' perceptions of institutional responsibility to conduct risk assessment and risk management. When asked about which institutions<sup>5</sup> they believe should conduct risk assessment and risk management, the respondents have turned towards science-based institutions (Table 6). Stakeholders tend to be unanimous about the role of *research institutes*, *regulatory bodies*, and *university scientists* in risk assessment and risk management. Both policy makers and scientists absolutely agree that research institutes should be totally responsible for risk assessment and risk management. Scientists have also given complete approval for regulatory bodies to be in charge of risk assessment and risk management. Consumers, businessmen, extension workers, journalists, and policy makers have also highly favored regulatory bodies when it comes to risk assessment and risk management issues relating to agricultural biotechnology.

On the other hand, Malaysia's stakeholders have thought less of religious groups and farmer groups as having a part in risk assessment and risk management relating to agricultural biotechnology. Consumer advocacy groups/NGOs, however, have made it to one of the choices of

at least 80.00% of journalists, policy makers, and scientists.

High trust in scientific institutions may partly reflect Malaysia’s social and political environment. It is perhaps safe to conclude that a high regard for research institutes, regulatory bodies, and university scientists may be a possible outcome of Malaysia’s focus on science and technology as engines of growth.

*TABLE 6: INSTITUTIONS PERCEIVED AS RESPONSIBLE FOR RISK ASSESSMENT & RISK MANAGEMENT<sup>6</sup>  
(PERCENTAGE REPORT ON TOTALLY RESPONSIBLE)*

Stakeholder (n=361)	Institutions								
	Univ scientists	Private sector sciencs	Agri- biotech companies	Consumer groups & NGOs	Nat’l farm leadrs	Mass Media	Relgiuous groups	Research institutes	Regulatory bodies
Consumers	<b>79.20</b> ±3.85	76.50 ±4.02	81.00 ±3.72	60.30 ±4.64	52.20 ±4.74	52.20 ±4.74	31.50 ±4.40	<b>83.80</b> ±3.49	<b>85.60</b> ±3.33
Businessmen	86.60 ±4.81	86.50 ±4.81	<b>90.40</b> ±4.08	71.20 ±6.27	63.50 ±6.67	53.90 ±6.91	40.40 ±6.80	<b>88.50</b> ±4.42	<b>90.40</b> ±4.08
Extension workers	<b>55.40</b> ±6.16	49.20 ±6.20	49.20 ±6.20	38.40 ±6.03	36.90 ±5.98	27.70 ±5.55	20.00 ±4.96	<b>58.50</b> ±6.11	<b>60.00</b> ±6.07
Farmer leaders	63.80 ±7.00	<b>70.20</b> ±6.67	<b>70.20</b> ±6.67	59.60 ±7.15	59.60 ±7.15	65.90 ±6.91	46.70 ±7.27	<b>80.80</b> ±5.74	68.10 ±6.79
Journalists	<b>81.40</b> ±7.48	74.00 ±8.44	70.40 ±8.78	<b>81.40</b> ±7.48	<b>81.40</b> ±7.48	<i>Not asked</i>	51.80 ±9.61	<b>92.60</b> ±5.03	<b>92.60</b> ±5.03
Policy makers	<b>100.00</b>	92.80 ±4.88	85.70 ±6.61	82.10 ±7.24	78.70 ±7.73	85.80 ±6.59	60.80 ±9.22	<b>100.00</b>	<b>96.40</b> ±3.52
Scientists	<b>96.80</b> ±3.16	90.30 ±5.31	<b>96.70</b> ±3.20	80.70 ±7.08	61.30 ±8.74	77.40 ±7.51	58.10 ±8.86	<b>100.00</b>	<b>100.00</b>

### *E. Role of science in Malaysia’s agricultural development*

Role of science in agricultural development. There is no doubt about the importance that Malaysia’s stakeholders attach to science and its function in the development of the country’s agriculture (Table 7a). Both the mean ratings and percentages confirm this support for science. Malaysia’s scientific community completely espouses the idea of science’s vital role in the country’s development.

A significant relationship exists between the level of interest in biotechnology and the belief

<sup>5</sup> These institutions or societal groups are: a) University scientists, b) Private sector scientists, c) Agri-biotech companies, d) Consumer groups & NGOs, e) Local farm leaders, f) Mass media/journalists, g) Religious groups, h) Research institutes, and i) Regulatory bodies.

<sup>6</sup> The top choices of each stakeholder are in bold.

in the role of science in agriculture and this can be noted among consumers ( $r=0.37$ ;  $p \leq 0.001$ ) and farmer leaders ( $r=0.70$ ;  $p \leq 0.001$ ). A significant relationship also exist between perceived benefits of biotechnology and belief in the role of science in agriculture, and this can be observed among consumers ( $r=0.44$ ;  $p \leq 0.001$ ), extension workers ( $r=0.33$ ;  $p \leq 0.01$ ), farmer leaders ( $r=0.60$ ;  $p \leq 0.001$ ), journalists ( $r=0.39$ ;  $p \leq 0.05$ ), and policy makers ( $r=0.59$ ;  $p \leq 0.001$ ).

*TABLE 7A: BELIEF IN THE IMPORTANCE OF SCIENCE IN MALAYSIA'S AGRICULTURAL DEVELOPMENT (MEAN RATINGS AND PERCENTAGE DISTRIBUTION)*

<i>Stakeholder (n=361)</i>	<i>Mean rating (<math>\pm</math> s.e., max 7)</i>	<i>Not at all important</i>	<i>Somewhat important</i>	<i>Very important</i>
Consumers (111)	6.17 $\pm$ 0.105	2.7 $\pm$ 1.54	8.1 $\pm$ 2.59	89.2 $\pm$ 2.95 <sup>e,f,s</sup>
Businessmen (52)	6.06 $\pm$ 0.183	1.9 $\pm$ 1.89	9.6 $\pm$ 4.09	88.5 $\pm$ 4.42 <sup>e,f,j,p,s</sup>
Extension Workers (65)	5.17 $\pm$ 0.293	16.9 $\pm$ 4.65	10.8 $\pm$ 3.85	72.2 $\pm$ 5.56 <sup>c,b,f,j,p,s</sup>
Farmer Leaders (47)	5.45 $\pm$ 0.288	10.6 $\pm$ 4.49	12.8 $\pm$ 4.87	76.6 $\pm$ 6.18 <sup>c,b,f,j,p,s</sup>
Journalists (27)	6.48 $\pm$ 0.154	- 0 -	3.7 $\pm$ 3.63	96.4 $\pm$ 3.59 <sup>b,e,f</sup>
Policy Makers (28)	6.54 $\pm$ 0.150	- 0 -	3.6 $\pm$ 3.52	96.4 $\pm$ 3.52 <sup>b,e,f</sup>
Scientists (31)	6.84 $\pm$ 0.067	- 0 -	- 0 -	100.00 <sup>c,b,e,f</sup>

*TABLE 7B: CORRELATION BETWEEN BELIEF IN SCIENCE, INTEREST & PERCEIVED BENEFITS OF BIOTECHNOLOGY (Spearman Correlation Coefficients / Prob > |R| under Ho: Rho=0)*

<i>Stakeholder (n=361)</i>	<i>Interest in biotechnology &amp; Role of science</i>	<i>Perceived benefits of biotechnology &amp; Role of science</i>
Consumers (111)	<b>0.36801<sup>a</sup></b>	<b>0.44781<sup>a</sup></b>
Businessmen (52)	0.21103	0.16709
Extension Workers (65)	0.13906	<b>0.33053<sup>b</sup></b>
Farmer Leaders (47)	<b>0.68918<sup>a</sup></b>	<b>0.60686<sup>a</sup></b>
Journalists (27)	0.31013	<b>0.39356<sup>c</sup></b>
Policy Makers (28)	0.36436	<b>0.59431<sup>a</sup></b>
Scientists (31)	0.03192	0.07931

at .001 level;

<sup>a</sup> Significant  
<sup>b</sup> Significant

at .01 level; <sup>c</sup> Significant at .05 level

### ***F. Understanding of science and biotechnology***

Self-rate understanding of science. In spite of their expressed interest in biotechnology and esteem for the pivotal role of science in agricultural development, Malaysia’s stakeholders tend to assess their understanding of science as marginally moderate (Table 8). The overall mean for their self-rate understanding of science is 4.29.

The highest mean rating of 5.18 ( $\pm 0.277$ ) can be noted among policy makers. Extension workers think that their understanding of science is quite below average ( $\bar{x}=2.97 \pm .216$ ), the lowest among the stakeholders’ mean ratings.

In terms of the number of respondents giving themselves high ratings in understanding science, most of the stakeholders cluster around moderate self-estimates. There are a comparatively bigger number of policy makers who think that they have a very adequate understanding of science (64.30%,  $\pm 9.05$ ), followed by businessmen and farmer leaders at roughly 50% each. Only 16.80% ( $\pm 4.64$ ) of extension workers and 38.70% ( $\pm 4.62$ ) of consumers believe that they have a more than adequate grasp of science. Journalists are right in the middle both in terms of mean score ( $\bar{x}=4.44 \pm 0.241$ ) and numbers. Nearly 52% ( $\pm 9.62$ ) say that their comprehension of science is just adequate. About 41% ( $\pm 9.45$ ) claim that their understanding of science is very good, while 7.40% ( $\pm 5.04$ ) rate themselves as having a very low understanding of science.

**TABLE 8: SELF-RATE UNDERSTANDING OF SCIENCE  
(MEAN RATINGS AND PERCENTAGE DISTRIBUTION)**

<i>Stakeholder (n=361)</i>	<i>Mean rating (<math>\pm s.e.</math>, max 7)</i>	<i>Low</i>	<i>Moderate</i>	<i>High</i>
Consumers (111)	4.26 $\pm$ 0.122 <sup>b</sup>	22.5 $\pm$ 3.96	38.7 $\pm$ 4.62	38.7 $\pm$ 4.62
Businessmen (52)	4.42 $\pm$ 0.195 <sup>b</sup>	21.1 $\pm$ 5.66	26.9 $\pm$ 6.15	51.9 $\pm$ 6.93
Extension Workers (65)	2.97 $\pm$ 0.216 <sup>c</sup>	49.3 $\pm$ 6.20	33.8 $\pm$ 5.87	16.8 $\pm$ 4.64
Farmer Leaders (47)	4.49 $\pm$ 0.263 <sup>b</sup>	23.5 $\pm$ 6.18	23.4 $\pm$ 6.18	53.1 $\pm$ 7.28
Journalists (27)	4.44 $\pm$ 0.241 <sup>b</sup>	7.4 $\pm$ 5.04	51.9 $\pm$ 9.62	40.7 $\pm$ 9.45
Policy Makers (28)	5.18 $\pm$ 0.277 <sup>a</sup>	17.9 $\pm$ 7.24	17.9 $\pm$ 7.24	64.3 $\pm$ 9.05
Scientists (31)	Not asked			

Self-rate knowledge/understanding of biotechnology. With the exception of scientists, Malaysia's stakeholders tend to give themselves below moderate to slightly moderate ratings in terms of their knowledge and understanding of biotechnology (Table 9). The overall mean rating of the stakeholders is 4.16.

Scientists have posted a rather high mean rating of 5.29 ( $\pm 0.174$ ). There is a significant difference between this mean rating and the mean ratings of other stakeholders. Majority of scientists (80.7%,  $\pm 7.09$ ) think their understanding is above moderate. Just over 16% ( $\pm 6.60$ ) say that they have moderate knowledge of biotechnology while only 3.20% ( $\pm 3.16$ ) assert that their knowledge about the topic is rather low.

The stakeholders who have slightly above moderate mean scores on self-rate knowledge on biotechnology include policy makers ( $\bar{x}=4.57 \pm 0.254$ ), farmer leaders ( $\bar{x}=4.34 \pm .260$ ), and (journalists ( $\bar{x}=4.33 \pm .167$ ), although there is no significant difference among these three scores. A little over half of the policy makers ( $\pm 9.43$ ) say that that they know quite a lot about biotechnology and only 17.90% ( $\pm 3.16$ ) claim that their knowledge is somewhat low.

Nearly half of farmer leaders have given themselves high ratings on their knowledge of biotechnology, although almost one-third of those surveyed also think that they do not know a lot. Likewise, almost half of the journalists believe that their knowledge of biotechnology is just moderate and only around 40% claim that they know a lot about it.

There is no significant association between journalists' assessment of their knowledge on biotechnology and their belief in the importance of biotechnology as a news story ( $p>0.05$ ).

TABLE 9: SELF-RATE KNOWLEDGE OF BIOTECHNOLOGY  
(MEAN SCORES AND PERCENTAGE DISTRIBUTION)

Stakeholder (n=361)	Mean rating ( $\pm s.e.$ , max 7)	Low	Moderate	High
Consumers (111)	3.58 $\pm$ 0.122 <sup>bc</sup>	39.6 $\pm$ 4.64	38.7 $\pm$ 4.62	21.6 $\pm$ 3.91
Businessmen (52)	4.04 $\pm$ 0.184 <sup>ab</sup>	25.0 $\pm$ 6.00	38.5 $\pm$ 6.75	36.5 $\pm$ 6.68
Extension Workers (65)	3.02 $\pm$ 0.197 <sup>c</sup>	53.8 $\pm$ 6.18	36.9 $\pm$ 5.99	9.2 $\pm$ 3.58
Farmer Leaders (47)	4.34 $\pm$ 0.260 <sup>a</sup>	29.8 $\pm$ 6.67	23.4 $\pm$ 6.18	46.8 $\pm$ 7.28
Journalists (27)	4.33 $\pm$ 0.167 <sup>a</sup>	11.1 $\pm$ 6.05	48.1 $\pm$ 9.62	40.7 $\pm$ 9.45
Policy Makers (28)	4.57 $\pm$ 0.254 <sup>a</sup>	17.9 $\pm$ 7.24	28.6 $\pm$ 8.54	53.5 $\pm$ 9.43
Scientists (31)	5.29 $\pm$ 0.174 <sup>d</sup>	3.2 $\pm$ 3.16	16.1 $\pm$ 6.60	80.7 $\pm$ 7.09

Among those who say that they do not have adequate knowledge about biotechnology are: a) extension workers ( $\bar{x}=3.02 \pm 0.197$ ), b) consumers ( $\bar{x}=3.58 \pm 0.122$ ), and c) businessmen ( $\bar{x}=4.04 \pm 0.184$ ). A little over half of the extension workers surveyed consider themselves as having low knowledge of biotechnology. Only 9.20% ( $\pm 3.58$ ) claim that they have a very high knowledge of biotechnology. Among consumers, 38.70% ( $\pm 4.62$ ) say that their knowledge of biotechnology is moderate and around 40% ( $\pm 4.63$ ) estimate that their knowledge is quite low. Only 21.60% ( $\pm 3.91$ ) of the consumers think that they have high knowledge of biotechnology.

Factual knowledge of biotechnology<sup>7</sup>. Based on a set of twelve statements that measures what stakeholders know about biotechnology, Malaysia's stakeholders have an overall mean score of 6.94 (Table 10a) which is just below moderate. Low scores range from 0-6, moderate scores are from 7-9, and high scores are from 10-12.

Policy makers have posted the highest mean knowledge score ( $\bar{x}=8.79 \pm 0.472$ ) followed by journalists ( $\bar{x}=8.74 \pm 0.442$ ), and businessmen ( $\bar{x}=7.92 \pm 0.384$ ). Almost half (48.10%,  $\pm 9.62$ ) of the journalists have obtained high scores and almost 44.44% ( $\pm 9.56$ ) have garnered moderate knowledge scores. Only 7.20% ( $\pm 4.97$ ) of the journalists have low scores. Among policy makers, 46.40% ( $\pm 9.42$ ) have high scores, nearly 36% ( $\pm 9.05$ ) have posted moderate scores, and 18% ( $\pm 7.24$ ) have gotten low scores.

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<sup>7</sup> The factual knowledge measure consisted of twelve (12) statements answerable by True, False or Don't Know. The highest score each respondent could get was 12 and lowest was 0. These 12 statements were tested for their reliability or internal consistency. Reliability analysis or test of consistency between each of these 12 statements yielded a reliability alpha coefficient of .7006 at .000 level of significance.

TABLE 10A: FACTUAL KNOWLEDGE ON BIOTECHNOLOGY  
(MEAN SCORES AND PERCENTAGE DISTRIBUTION)

Stakeholder (n=361)	Mean score ( $\pm$ s.e., max 12)	Low (0-6)	Moderate (7-9)	High(10-12)
Consumers (111)	6.89 $\pm$ 0.229 <sup>bc</sup>	39.6 $\pm$ 4.64	44.1 $\pm$ 4.71	16.2 $\pm$ 3.50 <sup>b,e,j,p</sup>
Businessmen (52)	7.92 $\pm$ 0.384 <sup>ab</sup>	25.0 $\pm$ 6.08	42.3 $\pm$ 6.85	32.7 $\pm$ 6.51 <sup>c,e,f,j,p</sup>
Extension Workers (65)	3.51 $\pm$ 0.384 <sup>d</sup>	81.6 $\pm$ 4.81	15.3 $\pm$ 4.47	3.1 $\pm$ 2.15 <sup>c,b,j,p</sup>
Farmer Leaders (47)	5.79 $\pm$ 0.439 <sup>c</sup>	51.1 $\pm$ 7.29	38.3 $\pm$ 7.09	10.6 $\pm$ 4.49 <sup>b,j,p</sup>
Journalists (27)	8.74 $\pm$ 0.442 <sup>a</sup>	7.2 $\pm$ 4.97	44.4 $\pm$ 9.56	48.1 $\pm$ 9.62 <sup>c,b,e,f</sup>
Policy Makers (28)	8.79 $\pm$ 0.472 <sup>a</sup>	17.9 $\pm$ 7.24	35.7 $\pm$ 9.05	46.4 $\pm$ 9.42 <sup>c,b,e,f</sup>
Scientists (31)	Not asked			

Extension workers have the lowest mean score ( $\bar{x}$ =3.51  $\pm$  .384) among the stakeholders, Malaysia's extension workers also have the smallest number of respondents getting high scores on factual knowledge. Only 3.10% ( $\pm$  2.15) of extension workers have obtained very high factual knowledge scores.

Farmer leaders ( $\bar{x}$ =5.79  $\pm$  .439) have the second lowest number of respondents getting high scores on factual knowledge (10.60%,  $\pm$  4.49). Over one-third (38.30%,  $\pm$  7.05) has posted moderate scores, and 51.10% ( $\pm$  7.29) have low scores. Nearly half of the consumers surveyed have moderate factual knowledge of biotechnology, and only 16.20% ( $\pm$  3.50) have managed to get high scores.

There is a strong and significant relationship between the farmer leaders' factual knowledge and interest ( $r$ =0.73;  $p$  $\leq$  0.001), concern ( $r$ =0.62;  $p$  $\leq$  0.001), perceived benefits ( $r$ =0.44;  $p$  $\leq$  0.01), and their belief in the role of science ( $r$ =0.46;  $p$  $\leq$  0.01). Likewise, there is a significant relationship between factual knowledge and interest and this can be observed among consumers ( $r$ =0.42;  $p$  $\leq$  0.001), businessmen ( $r$ =0.33;  $p$  $\leq$  0.05), extension workers ( $r$ =0.35;  $p$  $\leq$  0.01), and policy makers ( $r$ =0.44;  $p$  $\leq$  0.05).

A significant relationship exists between factual knowledge and concern. This can be seen among consumers ( $r$ =0.33;  $p$  $\leq$  0.001), extension workers ( $r$ =0.32;  $p$  $\leq$  0.01), and journalists ( $r$ =0.42;  $p$  $\leq$  0.05).

There is significant association between factual knowledge and belief in the role of science and it can be noted among consumers ( $r$ =0.39;  $p$  $\leq$  0.010), businessmen ( $r$ =0.42;  $p$  $\leq$  0.05), and farmer leaders ( $r$ =0.045;  $p$  $\leq$  0.05).

**TABLE 10B: CORRELATION TABLE BETWEEN FACTUAL KNOWLEDGE ON  
BIOTECHNOLOGY AND KEY VARIABLES**  
(Spearman Correlation Coefficients / Prob > |R| under Ho: Rho=0)

<i>Stakeholder (n=361)</i>	<i>Knowledge &amp; Interest</i>	<i>Knowledge &amp; Concern</i>	<i>Knowledge &amp; Perceived Risks</i>	<i>Knowledge &amp; Perceived Benefits</i>	<i>Knowledge &amp; Perceived role of science</i>
Consumers (111)	<b>0.42289<sup>a</sup></b>	<b>0.33032<sup>a</sup></b>	0.01596	0.39851	<b>0.39225<sup>a</sup></b>
Businessmen (52)	<b>0.33584<sup>c</sup></b>	0.16281	-0.05905	<b>0.37071<sup>b</sup></b>	<b>0.42844<sup>b</sup></b>
Extension Workers (65)	<b>0.35463<sup>b</sup></b>	<b>0.32579<sup>b</sup></b>	0.12144	0.21656	0.22022
Farmer Leaders (47)	<b>0.73400<sup>a</sup></b>	<b>0.62062<sup>a</sup></b>	0.14720	<b>0.44584<sup>b</sup></b>	<b>0.45908<sup>b</sup></b>
Journalists (27)	0.14623	<b>0.42067<sup>c</sup></b>	-0.23366	0.15277	0.04461
Policy Makers (28)	<b>0.44558<sup>c</sup></b>	0.17411	0.01497	0.25205	0.34054

<sup>a</sup> Significant at .001 level; <sup>b</sup> Significant at .01 level; <sup>c</sup> Significant at .05 level

### **G. Attitudes towards biotechnology**

Attitudes toward agricultural biotechnology<sup>8</sup>. In general, Malaysia's stakeholders hold a very just a slightly above moderate stance on biotechnology (Table 11a). The overall mean attitude score of the stakeholders is 52.52. Attitudinal scores have been classified as low (negative), moderate, and high (positive). High attitude scores are in the range of 76-100, moderate scores are between 51-75, and low scores are from 25-50.

Very few respondents have exhibited high attitudinal scores that are indicative of positive feelings or opinions about biotechnology. The individual mean scores may be more accurate in showing where the stakeholders' positions are vis-à-vis biotechnology.

<sup>8</sup> Measuring attitudes towards biotechnology consisted of twenty-five (25) questionnaire items. Respondents were asked to choose an answer from a four-point scale ranging from Strongly Agree (4) to Strongly Disagree (1) or Don't Know. Attitude scores ranged from 100 (highest, most positive) to 25 (lowest, least positive). These 25 statements were tested for their reliability or internal consistency. Reliability analysis or test of consistency between each of these 25 statements yielded a reliability alpha coefficient of .8934 at 0.001 level of significance.

Policy makers show the highest mean attitude score of 61.29 ( $\pm 1.89$ ), followed by businessmen ( $\bar{x}$ =56.98  $\pm 1.93$ ), journalists ( $\bar{x}$ =54.19  $\pm 2.25$ ), and consumers ( $\bar{x}$ =53.04  $\pm 1.38$ ). A good number of Malaysia's policy makers, 74.90% ( $\pm 8.19$ ) have expressed a moderate attitude towards biotechnology. Only 10.70% ( $\pm 5.84$ ) are highly supportive of biotechnology while 14.40% ( $\pm 6.63$ ) have shown a moderate position. Likewise a majority of businessmen (72.60%,  $\pm 6.19$ ) show a modest attitude and 19.00% ( $\pm 5.44$ ) are not totally in favor of biotechnology. A very minimal 3.80% ( $\pm 2.65$ ) of the businessmen surveyed have expressed high support.

Most of the journalists (62.90%,  $\pm 9.30$ ) also have a temperate stance, while over one third of the journalists (37.00%  $\pm 9.29$ ) surveyed tend to have a negative position. None of the respondents asserts full support for biotechnology. There is no significant relationship between the journalists' attitude towards biotechnology and their assessment of biotechnology as a news story ( $p > 0.05$ ).

Lower mean scores can be noted among farmer leaders ( $\bar{x}$ =52.32  $\pm 3.50$ ) and extension workers ( $\bar{x}$ =37.31  $\pm 3.67$ ). A majority (74.60%,  $\pm 6.35$ ) of farmer leaders show a moderate attitudinal measures on biotechnology, while 6.30% ( $\pm 3.54$ ) tend to have a negative position on biotechnology. Among extension workers, 46.00% ( $\pm 6.18$ ) have moderate attitudes towards biotechnology, and 13.70% ( $\pm 4.26$ ) have a propensity to not favor biotechnology.

TABLE 11A: ATTITUDES TOWARDS BIOTECHNOLOGY  
(MEAN SCORES AND PERCENTAGE DISTRIBUTION)

Stakeholder (n=361)	Mean score ( $\pm$ s.e, max 100)	Low (25-50)	Moderate (51-75)	High (76-100)
Consumers (111)	53.04 $\pm$ 1.38 <sup>a</sup>	30.6 $\pm$ 4.37	63.0 $\pm$ 4.58	1.8 $\pm$ 1.26 <sup>p</sup>
Businessmen (52)	56.98 $\pm$ 1.93 <sup>a</sup>	19.0 $\pm$ 5.44	72.6 $\pm$ 6.19	3.8 $\pm$ 2.65 <sup>p</sup>
Extension Workers (65)	37.31 $\pm$ 3.67 <sup>b</sup>	13.7 $\pm$ 4.26	46.0 $\pm$ 6.18	1.5 $\pm$ 1.51 <sup>p</sup>
Farmer Leaders (47)	52.32 $\pm$ 3.50 <sup>a</sup>	6.3 $\pm$ 3.54	74.6 $\pm$ 6.35	2.1 $\pm$ 2.09 <sup>p</sup>
Journalists (27)	54.19 $\pm$ 2.25 <sup>a</sup>	37.0 $\pm$ 9.29	62.9 $\pm$ 9.30	-0-
Policy Makers (28)	61.29 $\pm$ 1.89 <sup>a</sup>	14.4 $\pm$ 6.63	74.9 $\pm$ 8.19	10.7 $\pm$ 5.84 <sup>c,b,e,f,j</sup>
Scientists (31)	Not asked			

**TABLE 11B: CORRELATION BETWEEN ATTITUDES ON  
BIOTECHNOLOGY AND KEY VARIABLES**  
(Spearman Correlation Coefficients / Prob > |R| under Ho: Rho=0)

<i>Stakeholder (n=361)</i>	<i>Attitude &amp; Interest</i>	<i>Attitude &amp; Concern</i>	<i>Attitude &amp; Perceived Risks</i>	<i>Attitude &amp; Perceived Benefits</i>	<i>Attitude &amp; Factual knowledge</i>	<i>Attitude &amp; Perceived role of science</i>
Consumers (111)	0.02290	-0.00374	-0.12753	-0.04517	<b>0.49579<sup>a</sup></b>	<b>0.43158<sup>a</sup></b>
Businessmen (52)	<b>0.33659<sup>c</sup></b>	0.12335	<b>-0.31767<sup>c</sup></b>	<b>0.43237<sup>b</sup></b>	<b>0.46705<sup>a</sup></b>	<b>0.40010<sup>b</sup></b>
Extension Workers (65)	0.18930	0.12857	0.18362	<b>0.26883<sup>c</sup></b>	<b>0.69517<sup>a</sup></b>	<b>0.35368<sup>b</sup></b>
Farmer Leaders (47)	<b>0.35968<sup>c</sup></b>	0.21923	-0.08840	<b>0.43540<sup>b</sup></b>	0.11996	0.14554
Journalists (27)	0.20841	-0.41182	<b>0.76379<sup>a</sup></b>	0.15621	0.34112	0.24928
Policy Makers (28)	0.27670	0.03720	-0.11107	0.55530 <sup>c</sup>	0.26126	0.44082

<sup>a</sup> Significant at .001 level; <sup>b</sup> Significant at .01 level; <sup>c</sup> Significant at .05 level

Significant correlations can be noted between attitudes towards biotechnology and a) factual knowledge, b) perceived role of science, c) perceived benefits about biotechnology, attitude and interest in biotechnology and e) perceived risks. These relationships are evident among consumers, businessmen, and extension workers. Among businessmen, attitude is related to interest, perceived risks, perceived benefits, factual knowledge and perceived role of science. Extension workers attitude is related to factual knowledge and perceived role of science.

Concern about biotechnology issues, interest, and, for the most part, perceived risks, are not significantly associated with overall attitudes towards biotechnology.

These attitudinal scores, however, are a composite of twenty-five questionnaire items. How stakeholders have responded to specific questionnaire items may provide more useful and revealing insights about their positions in relation to agricultural biotechnology. The following data looks at stakeholders' responses to specific issues such as labeling, banning, costs, and benefits of genetically modified foods.

a) I will contribute time and money to ban GM foods. Malaysia's stakeholders tend to disagree with the notion of contributing time and money to ban GM foods (Table 12). At least

70% of policy makers and businessmen reject the notion. Likewise, about one-third of the consumers and journalists say that they will not contribute time and money to ban GM foods. Support for the banning of GM foods comes from no more than 40% of extension workers and farmer leaders.

It should be noted, however, that there is a large number of “Don’t know” answers. For instance, over 50% of the extension workers, 22.60% of consumers, and nearly 20% of farmer leaders, journalists, and policy makers have not expressed their position on the issue of contributing time and money towards banning GM foods.

*TABLE 12: I WILL CONTRIBUTE MONEY & TIME TO BAN GM FOODS.  
(MEAN SCORES AND PERCENTAGE DISTRIBUTION)<sup>9</sup>*

*\* Reversed scale: 1= Strongly agree, 2= Agree, 3=Disagree, 4=Strongly disagree*

<i>Stakeholder (n=361)</i>	<i>Mean score (± s.e, max 4)*</i>	<i>Agree</i>	<i>Disagree</i>
Consumers (111)	2.32 ± 0.131	13.5 ± 3.24 <sup>b,j,p</sup>	63.9 ± 4.56
Businessmen (52)	2.69 ± 0.166	17.3 ± 5.25 <sup>c,f</sup>	71.2 ± 6.28
Extension Workers (65)	1.46 ± 0.192	40.0 ± 6.08	9.2 ± 3.58
Farmer Leaders (47)	2.02 ± 0.168	36.2 ± 7.01 <sup>b,j,p</sup>	46.8 ± 7.28
Journalists (27)	2.44 ± 0.263	14.8 ± 6.83 <sup>c,f</sup>	66.6 ± 9.08
Policy Makers (28)	2.68 ± 0.272	7.2 ± 4.88 <sup>c,f</sup>	75.0 ± 8.18
Scientists (31)	Not asked		

b) GM foods should be labeled. All but the journalists and policy makers agree with the idea that GM foods should be labeled (Table 13). No less than 92% of journalists and 78% of policy makers disagree with labeling GM foods.

On the other hand, labeling GM foods gets a very good support from consumers (90.1%, ± 2.83), businessmen (88.5%, ± 4.42), and farmer leaders (78.7%, ± 5.04).

A considerable number of extension workers (41.5%) and farmer leaders (14%) say that they are not sure about their position on labeling.

<sup>9</sup> Note: Percentages may not add up to 100% as “Don’t Know” and “Not Sure” responses are not included.

**TABLE 13: GM FOODS SHOULD BE LABELED.**  
(MEAN SCORES AND PERCENTAGE DISTRIBUTION)

Stakeholder (n=361)	Mean score ( $\pm$ s.e, max 4)	Agree	Disagree
Consumers (111)	3.31 $\pm$ 0.092	90.1 $\pm$ 2.83 <sup>e,f,j,p</sup>	4.5 $\pm$ 1.97
Businessmen (52)	3.21 $\pm$ 0.114	88.5 $\pm$ 4.42 <sup>e,f,j,p</sup>	9.5 $\pm$ 4.07
Extension Workers (65)	1.97 $\pm$ 0.217	52.3 $\pm$ 6.20 <sup>c,b,f,j,p</sup>	6.2 $\pm$ 2.99
Farmer Leaders (47)	2.72 $\pm$ 0.184	78.7 $\pm$ 5.97 <sup>c,b,e,j,p</sup>	6.4 $\pm$ 3.57
Journalists (27)	1.37 $\pm$ 0.121	7.4 $\pm$ 5.04 <sup>c,b,e,f</sup>	92.6 $\pm$ 5.04
Policy Makers (28)	1.46 $\pm$ 0.174	14.3 $\pm$ 6.62 <sup>c,b,e,f</sup>	78.5 $\pm$ 7.76
Scientists (31)	Not asked		

c) Agricultural biotechnology will not benefit small farmers. Malaysia's stakeholders tend to disagree with the claim that agricultural biotechnology will not benefit small farmers (Table 14). Nearly half of the farmer leaders and no less than 60% of the consumers, businessmen, journalists, and policy makers think that biotechnology will be beneficial to small farmers.

Among extension workers, only 15.3% ( $\pm$  4.47) say that agricultural biotechnology will benefit small farmers while 43.1% ( $\pm$  6.14) think that it will not be beneficial for small farmers.

However, a considerable number of extension workers (41.6%) are not sure about their position.

**TABLE 14: AGRICULTURAL BIOTECHNOLOGY WILL NOT BENEFIT SMALL FARMERS.**  
(MEAN SCORES AND PERCENTAGE DISTRIBUTION)

\* Reversed scale: 1= Strongly agree, 2= Agree, 3=Disagree, 4=Strongly disagree

Stakeholder (n=361)	Mean score ( $\pm$ s.e, max 4)*	Agree	Disagree
Consumers (111)	2.31 $\pm$ 0.124	18.9 $\pm$ 3.72 <sup>e,f</sup>	62.2 $\pm$ 4.60
Businessmen (52)	2.52 $\pm$ 0.161	25.0 $\pm$ 6.00 <sup>e,f</sup>	63.5 $\pm$ 6.68
Extension Workers (65)	1.65 $\pm$ 0.184	43.1 $\pm$ 6.14 <sup>c,b,p</sup>	15.3 $\pm$ 4.47
Farmer Leaders (47)	2.09 $\pm$ 0.179	38.3 $\pm$ 7.09 <sup>c,b,p</sup>	47.7 $\pm$ 7.29
Journalists (27)	2.41 $\pm$ 0.202	33.3 $\pm$ 9.07 <sup>p</sup>	59.3 $\pm$ 9.45
Policy Makers (28)	2.75 $\pm$ 0.216	21.4 $\pm$ 7.75 <sup>c,b,e,f,j</sup>	71.4 $\pm$ 8.54
Scientists (31)	Not asked		

d) Biotechnology is good for Malaysia’s agriculture. Reflecting their position on the benefits of agricultural biotechnology to small farmers, majority of Malaysia’s stakeholders believe that biotechnology is a boon to Malaysia’s agricultural development (Table 15). In particular, 85.7% ( $\pm 6.62$ ) of policy makers and 73.1% ( $\pm 6.15$ ) believe that agricultural biotechnology is good for Malaysia’s agriculture. Close to one-third of consumers and farmer leaders share similar sentiments about the benefits of biotechnology to Malaysia’s agriculture.

On the other hand, while 53.9% ( $\pm 6.18$ ) of extension workers believe in the contributions of biotechnology, a considerable number (41.5%) are quite undecided about it.

TABLE 15: BIOTECHNOLOGY IS GOOD FOR MALAYSIA’S AGRICULTURE  
(MEAN SCORES AND PERCENTAGE DISTRIBUTION)

Stakeholder (n=361)	Mean score ( $\pm$ s.e, max 4)	Agree	Disagree
Consumers (111)	2.15 $\pm$ 0.139	64.9 $\pm$ 4.53	5.4 $\pm$ 2.15
Businessmen (52)	2.58 $\pm$ 0.174	73.1 $\pm$ 6.15 <sup>j</sup>	11.5 $\pm$ 4.42
Extension Workers (65)	1.82 $\pm$ 0.197	53.9 $\pm$ 6.18	4.6 $\pm$ 2.60
Farmer Leaders (47)	2.36 $\pm$ 0.203	63.8 $\pm$ 7.01	14.9 $\pm$ 5.19
Journalists (27)	2.19 $\pm$ 0.288	55.5 $\pm$ 9.56 <sup>bj</sup>	18.5 $\pm$ 7.47
Policy Makers (28)	3.04 $\pm$ 0.196	85.7 $\pm$ 6.62 <sup>j</sup>	7.1 $\pm$ 4.85
Scientists (31)	Not asked		

e) Current biotechnology regulations in Malaysia are sufficient. There appears to be some disagreement that the biotechnology regulations in Malaysia are sufficient. This is evident among consumers (51%,  $\pm 4.74$ ), businessmen (55.7%,  $\pm 6.89$ ), policy makers (53.6%,  $\pm 9.42$ ), and journalists (66.6%, (Malaysia’s stakeholders tend to disagree more than agree with the statement that biotechnology is adequately regulated in the country. Almost 67% ( $\pm 9.08$ ) of journalists have expressed reservations about that the country’s ability to regulate biotechnology while 11.1% ( $\pm 6.05$ ) claim that they were adequate. Close to half of the businessmen (55.70%,  $\pm 6.89$ ) and policy makers (53.6%,  $\pm 9.42$ ) share the policymakers’ reservations.

TABLE 16: CURRENT BIOTECHNOLOGY REGULATIONS IN MALAYSIA ARE SUFFICIENT.  
(MEAN SCORES AND PERCENTAGE DISTRIBUTION)

Stakeholder (n=361)	Mean score ( $\pm$ s.e, max 4)	Agree	Disagree
Consumers (111)	1.59 $\pm$ 0.108	22.5 $\pm$ 3.96 <sup>e,f,j</sup>	51.3 $\pm$ 4.74
Businessmen (52)	1.87 $\pm$ 0.150	25.0 $\pm$ 6.00 <sup>e,f,j</sup>	55.7 $\pm$ 6.89
Extension Workers (65)	1.63 $\pm$ 0.192	36.2 $\pm$ 5.96 <sup>c,b,f,j</sup>	9.2 $\pm$ 3.58
Farmer Leaders (47)	2.28 $\pm$ 0.203	59.6 $\pm$ 7.16 <sup>c,b,e,j,p</sup>	17.0 $\pm$ 5.48
Journalists (27)	1.56 $\pm$ 0.229	11.1 $\pm$ 6.05 <sup>c,b,e,f,p</sup>	66.6 $\pm$ 9.08
Policy Makers (28)	1.89 $\pm$ 0.220	28.5 $\pm$ 8.53 <sup>f,j</sup>	53.6 $\pm$ 9.42
Scientists (31)	Not asked		

f) I will pay extra cost for labeling GM food. Across stakeholders, there is a lot agreement on the notion that GM foods should be labeled (Table 13). However, it is a different issue altogether if they are willing to pay the extra cost for labeling GM food (Table 17). There is on average a 10-point drop in the percentage of respondents willing to support the notion of paying up for the extra cost for labeling GM food. With the exception of policy makers and journalists whose results are drastically different, all other stakeholders who have expressed overwhelming support for labeling GM food now find those numbers markedly lower. Nonetheless, the number of farmer leaders (61.70%,  $\pm$  7.09), policy makers (53.60%,  $\pm$  9.42), and consumers (48.60%,  $\pm$  4.74) who support labeling remain higher in comparison with those who disagree.

TABLE 17: I WILL PAY EXTRA COST FOR LABELING GM FOOD.  
(MEAN SCORES AND PERCENTAGE DISTRIBUTION)

Stakeholder (n=361)	Mean score ( $\pm$ s.e, max 4)	Agree	Disagree
Consumers (111)	2.05 $\pm$ 0.123	48.6 $\pm$ 4.74 <sup>f</sup>	28.8 $\pm$ 4.30
Businessmen (52)	2.17 $\pm$ 0.162	44.2 $\pm$ 6.89 <sup>f</sup>	42.3 $\pm$ 6.85
Extension Workers (65)	1.58 $\pm$ 0.174	36.9 $\pm$ 5.99 <sup>f,j,p</sup>	24.7 $\pm$ 5.35
Farmer Leaders (47)	2.30 $\pm$ 0.208	61.7 $\pm$ 7.09 <sup>c,b,e,j,p</sup>	14.9 $\pm$ 5.19
Journalists (27)	2.19 $\pm$ 0.239	44.4 $\pm$ 9.56 <sup>e,f</sup>	44.4 $\pm$ 9.56
Policy Makers (28)	2.39 $\pm$ 0.201	53.6 $\pm$ 9.42 <sup>e</sup>	39.3 $\pm$ 9.23
Scientists (31)	Not asked		

#### H. Information sources: Use, Exposure, and Trust

Types and frequency of media used. The surveys asked respondents about their sources of information on biotechnology and what sources of information they trust most. Generally, Malaysia's stakeholders exhibit between low to moderate information seeking behaviors on

matters relating to biotechnology (Table 18a). Looking at the top three most frequently used or consulted information sources of the eight stakeholders<sup>10</sup>, survey results show that consumers tend to receive information about biotechnology from a) general mass media (i.e., radio, television, and newspapers, b) family, friends, or colleagues, and c) books and pamphlets. Moreover, the average frequency of contact consumers have had with these media within a two-month period is extremely low.

For example, as can be noted in Table 18b, they have used, on the average, the tri-media sources 1.42 times ( $\pm 0.110$ ), family and other proximate interpersonal sources practically only once ( $0.82 \pm 0.082$ ), and books and pamphlets less than two times ( $1.87 \pm 0.242$ ).

Only 12% of the consumers surveyed have reported using experts and less than 10% have claimed accessing websites on biotechnology. Consumers have barely talked to a religious group or a local politician about biotechnology. And, very few have attended seminars.

Relative to other stakeholders, scientists, journalists, and policy makers display comparatively active information-seeking behaviors. Scientists report equally high use of experts (37.50%,  $\pm 8.56$ ) and books (37.50%,  $\pm 8.56$ ). These two sources are closely followed by tri-media (34.40,  $\pm 8.40$ ) and pamphlets (34.40%,  $\pm 8.40$ ) then by websites (25.00%,  $\pm 7.66$ ). More than 57% ( $\pm 9.35$ ) of the journalists surveyed report having used the tri-media to get or receive information on biotechnology at least three times within a two-month period. Next, 25.00% ( $\pm 8.18$ ) claim to have talked with family and friends and 21.40% ( $\pm 7.75$ ) claim to have talked to experts, professionals, and scientists about the topic. The top choices of information on biotechnology for most policy makers are tri-media (32.30%,  $\pm 8.40$ ), family and friends (25.80%,  $\pm 7.86$ ), websites (19.40%,  $\pm 7.10$ ) and books (19.40%,  $\pm 7.10$ ).

Overall, the most frequently used sources of information on biotechnology by Malaysian stakeholders are a) radio, television, and newspapers and b) books and other print media, and c) family and friends, and d) experts/professionals or scientists. Special groups like NGOs, government regulators, political leaders, agri-biotech companies, or religious groups are not as widely consulted and neither are specialized media like public forums or seminars and websites.

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<sup>10</sup> The top three choices of each stakeholder are first determined to identify the common choices (Table 18a).

TABLE 18A: INFORMATION SOURCES USED<sup>11</sup>  
(PERCENTAGE REPORT ON HIGH USAGE ONLY)

Information sources used	Stakeholders						
	Consumers	Businessmen	Extension	Farmer leaders	Journalists	Policy makers	Scientists
<b>Tri-media</b>	<b>25.20</b> ± 4.12	<b>16.00</b> ± 5.18	<b>28.00</b> ± 6.34	<b>26.00</b> ± 6.20	<b>57.10</b> ± 9.35	<b>32.30</b> ± 8.40	<b>34.40</b> ± 8.40
<b>Family/friends</b>	<b>19.20</b> ± 3.95	<b>16.00</b> ± 5.18	14.00 ± 4.90	10.00 ± 4.24	<b>25.00</b> ± 8.18	<b>25.80</b> ± 7.86	21.90 ± 7.31
Religious Groups	1.00 ± 1.00	0	0	0	0	0	3.10 ± 3.06
Experts	12.10 ± 3.27	6.00 ± 3.35	10.00 ± 4.24	10.00 ± 4.24	<b>21.40</b> ± 7.75	16.10 ± 6.60	<b>37.50</b> ± 8.56
NGOs	2.00 ± 1.40	2.00 ± 1.97	6.00 ± 3.35	4.00 ± 2.77	3.60 ± 3.52	6.50 ± 4.43	9.40 ± 5.16
Politicians	1.00 ± 1.00	4.00 ± 2.77	2.00 ± 1.97	2.00 ± 1.97	0	0	3.10 ± 3.06
Websites	6.10 ± 2.40	<b>16.00</b> ± 5.18	6.00 ± 3.35	<b>12.00</b> ± 4.59	14.30 ± 6.61	<b>19.40</b> ± 7.10	25.00 ± 7.66
<b>Books</b>	<b>19.20</b> ± 3.95	4.00 ± 2.77	<b>20.00</b> ± 5.65	<b>18.00</b> ± 5.43	14.30 ± 6.61	<b>19.40</b> ± 7.10	<b>37.50</b> ± 8.56
Pamphlets	<b>19.20</b> ± 3.95	6.00 ± 3.35	<b>20.00</b> ± 5.65	6.00 ± 3.35	10.70 ± 5.84	9.70 ± 5.32	34.40 ± 8.40
Regulators	1.00 ± 1.00	2.00 ± 1.97	2.00 ± 1.97	0	0	0	0
Seminars	2.00 ± 1.40	0	8.00 ± 3.83	2.00 ± 1.97	0	6.50 ± 4.43	9.70 ± 5.34
Ag companies	1.00 ± 1.00	0	6.00 ± 3.35	0	0	9.70 ± 5.34	3.10 ± 3.06

Table 18b shows the average number within a two-month period that each of the stakeholders has used or received information from aggregate information sources. These aggregate sources are classified as a) general mass media contacts, b) proximate interpersonal contacts, c) special media contacts, and d) special interpersonal contacts. Overall, scientists, policy makers, journalists, businessmen, and farmer leaders are the most frequent users of information, albeit in varying degrees. Scientist lead the stakeholders in using three of four categories of information sources to get information on biotechnology. They rely mostly on special media contacts such as websites, books, and newsletters, pamphlets, and brochures on biotechnology; special face-to-face contacts such as talking to experts or scientists, NGOs, food regulators, religious figures, or agri-

<sup>11</sup> The respondents were asked how often they have used an information source within the past two months. Responses have ranged from 0 through 3 or more times during the past two months. The percentages reported in this table reflect the number of stakeholders using an information source 3 or more times during the past two months. The top three information sources of each stakeholder are in bold.

biotech companies as well as seminars or forums on biotechnology, and proximate face-to-face contacts. Within a two-month period, scientists have reported having made contact with two former information sources at least 5.67 times. Policy makers have sought information from the same sources at least 4.00 times. Information from these special information sources is evidently vital to the work of these two stakeholders.

*TABLE 18B: CATEGORIZED INFORMATION SOURCES USED<sup>12</sup>  
(AVERAGE NUMBER OF TIMES SOURCES WERE USED WITHIN THE PAST TWO MONTHS)*

Stakeholders (n=361)	General media (Max.= 3)	Proximate interpersonal contacts (Max.= 3)	Special media contacts (Max. = 9)	Special interpersonal contacts (Max.= 21)
Consumers	1.42 ± 0.110	0.82 ± 0.082	1.34 ± 0.155	1.87 ± 0.242
Businessmen	1.83 ± 0.137	1.40 ± 0.156	3.44 ± 0.400	4.96 ± 0.627
Extension workers	1.06 ± 0.131	0.77 ± 0.124	1.34 ± 0.246	3.08 ± 0.516
Farmer leaders	1.40 ± 0.151	1.36 ± 0.144	3.49 ± 0.386	6.13 ± 0.811
Journalists	2.26 ± 0.174	1.30 ± 0.219	3.63 ± 0.537	4.70 ± 0.825
Policy makers	1.96 ± 0.186	0.36 ± 0.209	4.00 ± 0.582	5.64 ± 0.677
Scientists	2.10 ± 0.200	1.73 ± 0.172	5.67 ± 0.440	7.10 ± 0.765

Across the stakeholders, journalists are the most frequent users of general media at 2.26 times in frequency usage. Scientists and policy makers rank next with each one respectively posting 2.10 and 1.96 times in frequency of usage. With respect to proximate face-to-face contacts, scientists post the highest number of use reporting 1.73 times in frequency of usage. Businessmen follow in the scientist’s footsteps posting 1.40 times frequency of use. Scientists again are the most frequent users of special media contacts at 5.67 times in a two month period, followed by policy makers at 4.00 times. Scientists are also the most frequent users of special interpersonal contacts at 7.10 times, and farmer leaders are the second most frequent users at 6.13 times. Correlations between the uses of these four categories of information sources are indicated in Table 18c.

<sup>12</sup> General media sources refer to the dominant tri-media, i.e. radio, TV, & newspapers. Proximate interpersonal contacts refer to daily interactions with familial sources such as family, friends, neighbors, & colleagues. Special media contacts (SMC) refer to websites, books, brochures, newsletters, and pamphlets. Special interpersonal contacts (SIC) suggest face-to-face interactions with sources that have specialized information. Frequency of use of special media contacts and special interpersonal contacts implies active information search and usage.

Significant correlations exist between the uses of these four categories of information sources as shown in Table 18c. Policy makers are the only stakeholders who do not exhibit correlations between all sources (e.g. special interpersonal contacts and proximate contacts, and special media contacts and special interpersonal contacts). Overall, these significant associations imply that those who seek information via the mass media and through familiar sources also tend to get information from other specialized media (e.g., pamphlets, brochures, websites) as well as specialized interpersonal sources such as experts, regulators, and public forums on biotechnology. As stakeholders seek information on biotechnology, any increase in their use of mass media sources also leads to increased usage of interpersonal and social networks.

*TABLE 18C: CORRELATION BETWEEN SOURCE CATEGORIES*  
(Spearman Correlation Coefficients / Prob > |R| under Ho: Rho=0)

Stakeholders (n=361)	General media & Proximate interpersonal contacts	Special media contacts & General media	Special interpersonal contacts & Proximate contacts	Special media & Special interpersonal contacts
Consumers	0.18753 <sup>c</sup>	<b>0.41613<sup>a</sup></b>	<b>0.36948<sup>a</sup></b>	<b>0.45476<sup>a</sup></b>
Businessmen	<b>0.50545<sup>a</sup></b>	<b>0.61383<sup>a</sup></b>	<b>0.56673<sup>a</sup></b>	<b>0.71544<sup>a</sup></b>
Extension workers	<b>0.59258<sup>a</sup></b>	<b>0.61056<sup>a</sup></b>	<b>0.79727<sup>a</sup></b>	<b>0.77429<sup>a</sup></b>
Farmer leaders	<b>0.56333<sup>a</sup></b>	<b>0.56670<sup>a</sup></b>	<b>0.63022<sup>a</sup></b>	<b>0.81441<sup>a</sup></b>
Journalists	<b>0.59947<sup>a</sup></b>	<b>0.40401<sup>c</sup></b>	<b>0.56786<sup>c</sup></b>	<b>0.70025<sup>a</sup></b>
Policy makers	<b>0.71475<sup>a</sup></b>	<b>0.40520<sup>c</sup></b>	0.29034	0.29589
Scientists	<b>0.46194<sup>b</sup></b>	<b>0.55494<sup>b</sup></b>	<b>0.47862<sup>b</sup></b>	<b>0.65757<sup>a</sup></b>

<sup>a</sup> Significant at .001 level; <sup>b</sup> Significant at .01 level; <sup>c</sup> Significant at .05 level

Table 18d shows that special media contacts are strongly associated with factual knowledge for all seven stakeholders. These same contacts are also associated with the stakeholders' attitudes with the exception of journalists and policy makers. Consumers, businessmen, extension workers and farmer leaders also associate special media contacts and interest. Lastly, consumers, businessmen, farmer leaders, and scientists associate these same media contacts and the perceived benefits of biotechnology.

**TABLE 18D: CORRELATION BETWEEN SPECIAL MEDIA CONTACTS (SMC) AND KEY VARIABLES**  
(Spearman Correlation Coefficients / Prob > |R| under Ho: Rho=0)

Stakeholders	SMC & Interest	SMC & Concern	SMC & Perceived Risks	SMC & Perceived Benefits	SMC & Factual knowledge	SMC & Attitudes
Consumers	<b>0.36045<sup>a</sup></b>	0.11940	-0.04590	<b>0.31433<sup>a</sup></b>	<b>0.41291<sup>a</sup></b>	<b>0.38741<sup>a</sup></b>
Businessmen	<b>0.43596<sup>b</sup></b>	0.19283	<b>-0.32866<sup>c</sup></b>	<b>0.35971<sup>b</sup></b>	<b>0.51979<sup>a</sup></b>	<b>0.49481<sup>a</sup></b>
Extension Workers	<b>0.36887<sup>b</sup></b>	0.25714 <sup>c</sup>	0.05310	0.20709	<b>0.31193<sup>c</sup></b>	<b>0.52545<sup>a</sup></b>
Farmer Leaders	<b>0.56345<sup>a</sup></b>	<b>0.36107<sup>c</sup></b>	0.11695	<b>0.38047<sup>b</sup></b>	<b>0.37906<sup>b</sup></b>	<b>0.45774<sup>b</sup></b>
Journalists	0.22072	0.11541	-0.05081	0.19142	<b>0.45065<sup>c</sup></b>	0.16323
Policy Makers	0.08155	0.02509	-0.25959	0.17581	<b>0.49099<sup>b</sup></b>	0.21075
Scientists	0.11023	-0.18066	-0.32523	<b>0.39231<sup>b</sup></b>	Not asked	Not asked

<sup>a</sup> Significant at .001 level; <sup>b</sup> Significant at .01 level; <sup>c</sup> Significant at .05 level

Looking at Table 18e, it appears that special interpersonal sources have a strong influence on how businessmen, extension workers, farmer leaders and policy makers view biotechnology. It can only mean that active information seeking behaviors via these special channels have an impact on their assessment of biotechnology. Strong relationships exist between interpersonal contacts and factual knowledge for all stakeholders except policy makers. Similar associations can be noted between the same types of contacts and attitudes among the stakeholders, except consumers and journalists. The correlations between the same special contacts and perceived benefits and interest for a majority of the stakeholders are significant also.

**TABLE 18E: CORRELATION BETWEEN SPECIAL INTERPERSONAL CONTACTS (SIC) AND KEY VARIABLES**  
(Spearman Correlation Coefficients / Prob > |R| under Ho: Rho=0)

Stakeholders	SIC & Interest	SIC & Concern	SIC & Perceived Risks	SIC & Perceived Benefits	SIC & Factual knowledge	SIC & Attitudes
Consumers	0.31622 <sup>a</sup>	0.17246	-0.07497	0.13627	0.30683 <sup>b</sup>	0.11583
Businessmen	0.32848 <sup>c</sup>	0.24651	-0.28078 <sup>c</sup>	<b>0.37938<sup>b</sup></b>	<b>0.37777<sup>b</sup></b>	<b>0.66060<sup>a</sup></b>
Extension Workers	<b>0.37949<sup>b</sup></b>	0.33720 <sup>b</sup>	0.05858	0.29259	<b>0.41568<sup>a</sup></b>	<b>0.52356<sup>a</sup></b>
Farmer Leaders	<b>0.36993<sup>c</sup></b>	0.23350	0.01815	0.36190 <sup>b</sup>	<b>0.35752<sup>b</sup></b>	<b>0.33838<sup>b</sup></b>
Journalists	0.07844	0.12016	0.11887	0.23661	<b>0.40025<sup>c</sup></b>	0.03928
Policy Makers	<b>0.39244<sup>c</sup></b>	-0.04631	<b>-0.44838<sup>c</sup></b>	<b>0.51759<sup>b</sup></b>	0.24480	<b>0.63395<sup>a</sup></b>
Scientists	0.18328	-0.08242	<b>-0.56159<sup>b</sup></b>	<b>0.49703<sup>b</sup></b>	Not asked	Not asked

<sup>a</sup> Significant at .001 level; <sup>b</sup> Significant at .01 level; <sup>c</sup> Significant at .05 level

Perceived trust in information sources. University scientists and science magazines rank high among the top three possible sources of information considered as trustworthy by stakeholders (Table 19). Websites are cited next by most stakeholders.

TABLE 19: TRUST IN SOURCES OF INFORMATION<sup>13</sup> (PERCENTAGE REPORT ON HIGH TRUST)

Information Sources	Stakeholder					
	Consumers	Businessmen	Extension	Farmer leaders	Journalists	Policy makers
Agri-biotech companies	26.10 ± 4.17	36.50 ± 6.68	27.70 ± 5.55	38.30 ± 7.09	11.10 ± 6.05	32.20 ± 8.83
<b>University scientists</b>	<b>66.60</b> ± 4.48	<b>75.00</b> ± 6.00	<b>44.70</b> ± 6.17	<b>61.80</b> ± 7.09	<b>55.50</b> ± 9.56	<b>82.10</b> ± 7.24
Private sector scientists	47.70 ± 4.74	<b>67.20</b> ± 6.51	29.30 ± 5.65	<b>49.00</b> ± 7.29	22.20 ± 8.00	57.10 ± 9.35
Television	28.80 ± 4.30	42.30 ± 6.85	<b>32.30</b> ± 5.00	42.60 ± 7.21	11.10 ± 6.05	46.50 ± 9.43
Radio	25.20 ± 4.12	32.70 ± 6.51	27.70 ± 5.55	42.60 ± 7.21	7.40 ± 5.04	42.90 ± 9.35
Newspapers	18.90 ± 3.72	50.00 ± 6.93	29.20 ± 5.64	44.70 ± 7.25	18.50 ± 7.47	46.40 ± 9.42
<b>Websites</b>	<b>46.80</b> ± 4.74	50.10 ± 6.93	16.90 ± 4.65	<b>53.10</b> ± 7.28	40.70 ± 9.45	<b>85.70</b> ± 6.62
Religious groups	9.90 ± 2.83	23.10 ± 5.84	26.10 ± 5.45	36.20 ± 7.01	11.10 ± 6.05	39.30 ± 9.23
<b>Science magazines</b>	<b>58.50</b> ± 4.68	<b>76.90</b> ± 5.84	<b>35.30</b> ± 5.93	48.90 ± 7.29	<b>66.60</b> ± 9.08	<b>92.80</b> ± 4.88
NGOs	37.80 ± 4.60	42.30 ± 6.85	18.50 ± 4.82	40.40 ± 7.16	<b>48.10</b> ± 9.62	53.60 ± 9.42
Family	18.90 ± 3.72	23.00 ± 5.84	9.30 ± 3.60	19.20 ± 5.75	14.80 ± 6.83	14.30 ± 6.62

### I. Quality of information

High information users such as farmer leaders, journalists, policy makers and scientists have rated quite highly the usefulness of the information they have received so far on biotechnology. In particular, scientists have rated highly ( $\bar{x}=5.47 \pm 0.218$ ) the usefulness of the information they get from various sources on biotechnology. Exactly 80.00% ( $\pm 7.18$ ) find that the information is very useful and only 3.30% ( $\pm 3.21$ ) think that it is not at all useful. Policy makers are also very

<sup>13</sup> The top three trusted information sources of each stakeholder are in bold.

confident about the information they have on biotechnology ( $\bar{x}$ =5.00  $\pm$  0.304). About 65% ( $\pm$  9.05) and 25.00% ( $\pm$ 8.18) rate the information they have as very useful and moderately useful respectively. At least 49% ( $\pm$ 7.29) of farmer leaders consider the information they have received thus far on biotechnology as very useful.

Even among low information seekers, judgments about the usefulness of information they have received on biotechnology are not all that bad. Businessmen think the information they have about biotechnology is somewhat useful. Over 46% ( $\pm$ 6.91) say it is very useful and a close 32.70% ( $\pm$  6.51) say the information is moderately useful and only 19.20% ( $\pm$  5.46) think it is not useful at all. Although they show the lowest mean score of usefulness of biotechnology information, there is still a fairly decent number of extension workers ( $\bar{x}$ =3.29  $\pm$  0.296) and consumers ( $\bar{x}$ =3.81  $\pm$  0.152) who think information they receive on biotechnology is very useful. Over 60% of consumers find the information very useful or somewhat useful. A little less than one-third of the extension workers (30.80%,  $\pm$  5.73) think the information is moderately useful and 29.30% ( $\pm$  5.65) rate the information very useful.

TABLE 20: PERCEIVED USEFULNESS OF INFORMATION  
(MEAN SCORES AND PERCENTAGE DISTRIBUTION)

Stakeholder (n=361)	Mean score ( $\pm$ s.e., max 7)	Not useful (1-3)	Somewhat useful (4)	Very useful (5-7)
Consumers (111)	3.81 $\pm$ 0.152	34.20 $\pm$ 4.50	33.30 $\pm$ 4.47	30.60 $\pm$ 4.37
Businessmen (52)	4.42 $\pm$ 0.222	19.20 $\pm$ 5.46	32.70 $\pm$ 6.51	46.20 $\pm$ 6.91
Extension Workers (65)	3.29 $\pm$ 0.296	10.80 $\pm$ 3.85	30.80 $\pm$ 5.73	29.30 $\pm$ 5.65
Farmer Leaders (47)	4.28 $\pm$ 0.313	14.90 $\pm$ 5.19	23.40 $\pm$ 6.18	49.00 $\pm$ 7.29
Journalists (27)	4.67 $\pm$ 0.226	14.80 $\pm$ 6.83	37.00 $\pm$ 9.29	48.10 $\pm$ 9.62
Policy Makers (28)	5.00 $\pm$ 0.304	7.20 $\pm$ 4.88	25.00 $\pm$ 8.18	64.30 $\pm$ 9.05
Scientists (31)	5.47 $\pm$ 0.218	3.30 $\pm$ 3.21	16.70 $\pm$ 6.70	80.00 $\pm$ 7.18

Stakeholders have been asked the extent to which the information they have received on biotechnology is scientific. All the stakeholders believe the information they hear or know about biotechnology tends to be moderately to very scientific. With the exception of consumers (29.70%,  $\pm$  4.34) and extension workers (27.80%,  $\pm$  5.56), at least 40% of businessmen, farmer leaders, journalists, policy makers and scientists consider the information as highly scientific. Majority of the scientists consider the information highly scientific (66.60%,  $\pm$  8.47) with a little less than 7% expressing the information is not at all scientific.

*TABLE 21: IS IT SCIENTIFIC?  
(MEAN SCORES AND PERCENTAGE DISTRIBUTION)*

<i>Stakeholder (n=361)</i>	<i>Mean score (<math>\pm</math>s.e., max 7)</i>	<i>Not at all Scientific</i>	<i>Somewhat scientific</i>	<i>Very scientific</i>
Consumers (111)	4.02 $\pm$ 0.115	24.30 $\pm$ 4.07	45.00 $\pm$ 4.72	29.70 $\pm$ 4.34
Businessmen (52)	4.25 $\pm$ 0.184	15.30 $\pm$ 4.99	38.50 $\pm$ 6.75	44.20 $\pm$ 6.89
Extension Workers (65)	2.85 $\pm$ 0.280	16.90 $\pm$ 4.65	23.10 $\pm$ 5.23	27.80 $\pm$ 5.56
Farmer Leaders (47)	4.00 $\pm$ 0.315	19.10 $\pm$ 5.73	25.50 $\pm$ 6.36	40.40 $\pm$ 7.16
Journalists (27)	4.07 $\pm$ 0.311	22.20 $\pm$ 8.00	25.90 $\pm$ 8.43	44.40 $\pm$ 9.56
Policy Makers (28)	4.64 $\pm$ 0.248	17.80 $\pm$ 7.23	21.40 $\pm$ 7.75	60.70 $\pm$ 9.23
Scientists (31)	4.90 $\pm$ 0.175	6.70 $\pm$ 4.49	26.70 $\pm$ 7.95	66.60 $\pm$ 8.47

Table 22 shows the correlations between special media contacts, special interpersonal contacts and quality of information. Among consumers, businessmen, extension workers, farmer leaders and journalists significant correlations at  $p \leq 0.001$  or  $p \leq 0.01$  exist between special media contacts and special interpersonal contacts and usefulness of information. Policy makers also show a significant correlation at the same level between special interpersonal contact and usefulness of information. Consumers, extension workers, and farmer leaders also associate special media and interpersonal contacts with whether or not information they have received on biotechnology is scientific at  $p \leq 0.001$  or  $p \leq 0.01$ . Interpersonal contacts and scientific information is associated for businessmen at  $p \leq 0.01$ .

*TABLE 22: CORRELATION BETWEEN SPECIAL MEDIA CONTACTS (SMC) AND SPECIAL INTERPERSONAL CONTACTS (SIC) AND QUALITY OF INFORMATION  
(Spearman Correlation Coefficients / Prob > |R| under Ho: Rho=0)*

<b>Stakeholder (361)</b>	<b>SMC &amp; Info as useful</b>	<b>SMC &amp; Info as scientific</b>	<b>SIC &amp; Info as useful</b>	<b>SIC &amp; Info as scientific</b>
Consumers	0.32743 <sup>a</sup>	<b>0.36904<sup>a</sup></b>	<b>0.40557<sup>a</sup></b>	0.29425 <sup>b</sup>
Businessmen	<b>0.35920<sup>b</sup></b>	0.25616	<b>0.37485<sup>b</sup></b>	<b>0.39048<sup>b</sup></b>
Extension Workers	<b>0.39569<sup>b</sup></b>	<b>0.54711<sup>a</sup></b>	<b>0.54148<sup>a</sup></b>	<b>0.59273<sup>a</sup></b>
Farmer Leaders	<b>0.52348<sup>a</sup></b>	<b>0.51769<sup>a</sup></b>	<b>0.53090<sup>a</sup></b>	<b>0.44058<sup>b</sup></b>
Journalists	<b>0.51385<sup>b</sup></b>	0.22067	<b>0.43481<sup>c</sup></b>	0.04841
Policy Makers	0.23310	0.27191	<b>0.60694<sup>a</sup></b>	0.10859
Scientists	0.17459	-0.00885	0.33113	0.06840

<sup>a</sup> Significant at .001 level; <sup>b</sup> Significant at .01 level; <sup>c</sup> Significant at .05 level

TABLE 23: CORRELATION BETWEEN INFORMATION AS SCIENTIFIC AND KEY VARIABLES  
(Spearman Correlation Coefficients / Prob > |R| under Ho: Rho=0)

Stakeholder (n=361)	Scientific & Interest	Scientific & Concern	Scientific & Perceived risks	Scientific & Perceived benefits	Scientific info & Factual knowledge	Scientific info & Attitudes
Consumers	0.22918 <sup>c</sup>	0.23395 <sup>c</sup>	0.04818	0.22063 <sup>c</sup>	0.29712 <sup>b</sup>	0.20719 <sup>c</sup>
Businessmen	<b>0.42618<sup>b</sup></b>	<b>0.34569<sup>c</sup></b>	0.13425	0.17593	0.28374 <sup>c</sup>	0.24477
Extension Worker	0.33616 <sup>b</sup>	0.19919	0.21076	0.28898	<b>0.62978<sup>a</sup></b>	<b>0.72049<sup>a</sup></b>
Farmer Leaders	<b>0.64467<sup>a</sup></b>	<b>0.44054<sup>b</sup></b>	0.27740	<b>0.55622<sup>a</sup></b>	<b>0.46400<sup>a</sup></b>	0.34999 <sup>c</sup>
Journalists	-0.00535	0.16539	0.02556	0.23925	<b>0.40674<sup>c</sup></b>	0.16611
Policy Makers	0.05437	0.05312	-0.09334	-0.11187	-0.06827	-0.12535
Scientists	0.21067	0.35438	0.08703	0.22697	Not asked	Not asked

<sup>a</sup> Significant at .001 level; <sup>b</sup> Significant at .01 level; <sup>c</sup> Significant at .05 level

Table 23 shows a significant correlation between quality of information and factual knowledge and attitude towards biotechnology at  $p \leq 0.001$  among extension workers and farmer leaders, at  $p \leq 0.01$  among consumers, and at  $p \leq 0.05$  among businessmen and journalists. Businessmen and extension workers show a similar relationship at  $p \leq 0.01$  between the quality of information and their interest in biotechnology. At  $p \leq 0.001$  farmer leaders exhibit the same correlation, and consumers follow at  $p \leq 0.05$ . Businessmen and consumers show a relationship at  $p \leq 0.05$  between the quality of information and their concern for biotechnology. Farmer leaders show a similar relationship between the same two variables at  $p \leq 0.01$ .

TABLE 24: OTHER TYPES OF ISSUES/CONCERNS THEY HAVE HEARD OR KNOWN ABOUT BIOTECHNOLOGY<sup>14</sup>

Stakeholder (n=361)	Political	Religious	Moral/Ethics	Cultural
Consumers (111)	18.90	31.50	59.40	20.70
Businessmen (52)	28.70	28.60	61.40	30.60
Extension Workers (65)	18.50	26.00	29.10	16.80
Farmer Leaders (47)	12.70	25.50	40.40	14.80
Journalists (27)	66.60	55.50	77.70	40.70
Policy Makers (28)	18.00	64.40	60.90	21.40
Scientists (31)	26.60	43.30	59.90	23.20

<sup>14</sup> Question requires multiple responses, thus percentages do not add up to 100. Percentages represent number of respondents citing an issue or concern, other than scientific ones, that they have heard or known about biotechnology.

An average 55% of all the stakeholders report they have heard or known about moral or ethical issues or concerns raised about biotechnology. Almost 40% of stakeholders, on average have heard moral/ethical concerns raised about biotechnology.

TABLE 25: ISSUES THAT WOULD INFLUENCE JUDGMENT<sup>15</sup>

<i>Stakeholder (n=361)</i>	<i>Political</i>	<i>Religious</i>	<i>Moral/Ethics</i>	<i>Cultural</i>
Consumers (111)	9.90	18.90	75.60	30.60
Businessmen (52)	19.30	34.50	57.70	25.00
Extension Workers (65)	10.70	30.80	32.30	20.00
Farmer Leaders (47)	14.90	42.50	38.30	23.50
Journalists (27)	25.90	40.70	74.00	3.70
Policy Makers (28)	7.20	50.00	57.10	7.10
Scientists (31)	3.30	29.90	66.60	10.00

Morality/ethical and religious concerns are the top two reported biggest influences on judgments the stakeholders make about biotechnology. An average 57% of all the stakeholders mention moral/ethics, while an average 35% of all stakeholders mention religious issues would influence their judgment. All the stakeholders report political issues as the least influence on their judgments about biotechnology.

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<sup>15</sup> Question requires multiple responses, thus percentages do not add up to 100. Percentages represent number of respondents citing an issue or factor as being influential to judgments about biotechnology.

## J. Applications of Biotechnology: Making judgments

TABLE 26: BIOTECHNOLOGY APPLICATIONS AND ISSUES POLICY MAKERS SAY THEY WOULD FOCUS ON WHEN MAKING DECISIONS ON BIOTECHNOLOGY

FRAMES FOR POLICY DECISION MAKING	Never	Seldom	Almost always	All the time	Don't Know
1. Make food more nutritious, taste better, and keep longer	3.60 (± 3.52)	10.70 (± 5.84)	64.30 (± 9.05)	21.40 (± 7.75)	0
2. Make crops resistant to pests & diseases	0	21.40 (± 7.75)	60.70 (± 9.23)	17.90 (± 7.24)	0
3. Produce medicines & vaccines	14.30 (± 6.62)	25.00 (± 8.18)	46.40 (± 9.42)	14.30 (± 6.62)	0
4. Study human diseases like cancer	14.30 (± 6.62)	25.00 (± 8.18)	46.40 (± 9.42)	14.30 (± 6.62)	0
5. Introduce fish genes into strawberries for resistance to freezing	42.90 (± 9.35)	32.10 (± 8.82)	17.90 (± 7.24)	3.60 (± 3.52)	3.60 (± 3.52)
6. Detect & treat diseases inherited from parents	7.10 (± 4.85)	32.10 (± 8.82)	35.70 (± 9.05)	21.40 (± 7.75)	3.60 (± 3.52)
7. GM foods are safe & tested	7.10 (± 4.85)	14.30 (± 6.62)	46.40 (± 9.42)	25.00 (± 8.18)	7.10 (± 4.85)
8. GM crops will be so resistant to pests and diseases but will push native plants into extinction	7.10 (± 4.85)	35.70 (± 9.05)	25.00 (± 8.18)	3.60 (± 3.52)	28.60 (± 8.54)
9. No evidence GM crops can harm environment	0	39.30 (± 9.23)	42.90 (± 9.35)	10.70 (± 5.84)	7.10 (± 4.85)
10. GM crops will contaminate native plant species and further reduce biodiversity	3.60 (± 3.52)	28.60 (± 8.54)	53.60 (± 9.42)	7.10 (± 4.85)	7.10 (± 4.85)
11. Farmers want GM crops because they make crop production cheaper, increase yield, and increase income.	3.60 (± 3.52)	10.70 (± 5.84)	71.40 (± 8.54)	14.30 (± 6.62)	0
12. Opponents of modern biotechnology have no factual evidence for their claims of negative health consequences or environmental impact.	3.60 (± 3.52)	21.40 (± 7.75)	64.30 (± 9.05)	10.70 (± 5.84)	0
13. For plant breeders and farmers, modern biotechnology is simply another tool to increase productivity.	3.60 (± 3.52)	17.90 (± 7.24)	46.40 (± 9.42)	25.00 (± 8.18)	7.10 (± 4.85)
14. Pest-resistant GM crops would also harm non-target organisms like butterflies.	7.10 (± 4.85)	35.70 (± 9.05)	35.70 (± 9.05)	14.30 (± 6.62)	7.10 (± 4.85)

Remarkably, at least some of the Malaysia's policy makers surveyed have expressed willingness to focus on these biotechnology issues and applications all the time (Table 26). It is also worth noting the fact that there are very few "Don't Know" responses to several specific statements, and the considerable number of policy makers who have said that they will never or seldom focus on some of the issues when making decisions about biotechnology.

The only two issues about biotechnology that stands out in terms of policy makers' intent to use in decision making processes is making sure that GM foods are safe and protected, and, at least for plant breeders and farmers, modern biotechnology is simply another tool to increase productivity. Exactly 25.00% ( $\pm 8.18$ ) of the policy makers say that they will almost focus on these potential benefits.

When confronted with crop related uses of biotechnology, Malaysia's policy makers indicate that they would focus on these types of issues when considering biotechnology related issues. Over 85% would almost always or always focus on the idea that biotechnology can be used to make food more nutritious, taste better, and keep longer. Similarly, almost 80% would almost always or always focus on a biotechnology application to make crops more resistant to pests and diseases.

Medical issues are also a strong focus for policy makers, with slightly less percentages than the crop related applications. Roughly 60% of policymakers would consider the application of using biotechnology to produce medicines and vaccines, and using it to study human diseases like cancer.

Policy makers are slightly less enthusiastic about the effects that applications of biotechnology could have on the environment. Slightly more than 53% would almost always or always consider something like the fact that there is no evidence that GM crops can harm the environment. Also 50.00% indicated that they would focus on the idea pest-resistant GM crops would also harm non-target organisms such as butterflies.

Overall, Malaysia's policy makers are very willing to focus on an array of different applications of biotechnology. These uses include medical, agricultural and environmental applications.

TABLE 27: BIOTECHNOLOGY APPLICATIONS AND ISSUES **JOURNALISTS** SAY THEY WOULD TEND TO FOCUS ON WHEN COVERING OR REPORTING ON BIOTECHNOLOGY

<b>FRAMES FOR MASS MEDIA COVERAGE</b>	<b>Never</b>	<b>Seldom</b>	<b>Almost always</b>	<b>All the time</b>	<b>Don't Know</b>
1. Make food more nutritious, taste better, and keep longer	22.20 (± 8.00)	18.50 (± 7.47)	51.90 (± 9.62)	0	7.40 (± 5.04)
2. Make crops resistant to pests & diseases	14.80 (± 6.83)	33.30 (± 9.07)	44.40 (± 9.56)	3.70 (± 3.63)	3.70 (± 3.63)
3. Produce medicines & vaccines	33.30 (± 9.07)	22.20 (± 8.00)	37.00 (± 9.29)	3.70 (± 3.63)	3.70 (± 3.63)
4. Study human diseases like cancer	37.00 (± 9.29)	33.30 (± 9.07)	18.50 (± 7.47)	3.70 (± 3.63)	7.40 (± 5.04)
5. Introduce fish genes into strawberries for resistance to freezing	48.10 (± 9.62)	22.20 (± 8.00)	22.20 (± 8.00)	0	7.40 (± 5.04)
6. Detect & treat diseases inherited from parents	33.30 (± 9.07)	25.90 (± 8.43)	29.60 (± 8.79)	3.70 (± 3.63)	7.40 (± 5.04)
7. GM foods are safe & tested	37.00 (± 9.29)	22.20 (± 8.00)	33.30 (± 9.07)	0	7.40 (± 5.04)
8. GM crops will be so resistant to pests and diseases but will push native plants into extinction	0	22.20 (± 8.00)	33.30 (± 9.07)	29.60 (± 8.79)	14.80 (± 6.83)
9. No evidence GM crops can harm environment	37.00 (± 9.29)	25.90 (± 8.43)	29.60 (± 8.79)	0	7.40 (± 5.04)
10. GM crops will contaminate native plant species and further reduce biodiversity	0	25.90 (± 8.43)	29.60 (± 8.79)	29.60 (± 8.79)	14.80 (± 6.83)
11. Farmers want GM crops because they make crop production cheaper, increase yield, and increase income.	11.10 (± 6.05)	48.10 (± 9.62)	18.50 (± 7.47)	3.70 (± 3.63)	18.50 (± 7.47)
12. Opponents of modern biotechnology have no factual evidence for their claims of negative health consequences or environmental impact.	25.90 (± 8.43)	44.40 (± 9.56)	11.10 (± 6.05)	0	18.50 (± 7.47)
13. For plant breeders and farmers, modern biotechnology is simply another tool to increase productivity.	29.60 (± 8.79)	29.60 (± 8.79)	25.90 (± 8.43)	3.70 (± 3.63)	11.10 (± 6.05)
14. Pest-resistant GM crops would also harm non-target organisms like butterflies.	0	18.50 (± 7.47)	48.10 (± 9.62)	22.20 (± 8.00)	11.10 (± 6.05)

All of the Malaysia's journalists makers surveyed have expressed an unwillingness to focus on these biotechnology issues and applications all the time (Table 27). It is also worth noting the fact that there are very few "Don't Know" responses to several specific statements, and the considerable number of journalists who have said that they will never or seldom report on some of the issues when making decisions about biotechnology.

The only two issues about biotechnology that stands out in terms of journalists' intent to use in reporting is Gm crops will be so resistant to pests and diseases but will push native plants into extinction, and GM crops will contaminate native plant biodiversity. Exactly 29.60% ( $\pm 8.79$ ) of the journalists say that they will always report on these potential complications.

When confronted with crop related uses of biotechnology, Malaysia's journalists indicate that they would report seldom or almost always on these types of issues when considering biotechnology related issues. Over 70% would seldom or almost always focus on the idea that biotechnology can be used to make food more nutritious, taste better, and keep longer. Similarly, almost 80% would seldom or almost always focus on a biotechnology application to make crops more resistant to pests and diseases.

Medical issues are also not as highly focused on for journalists, with slightly less percentages than the crop related applications. Roughly 60% of journalists would seldom or almost always report on the application of using biotechnology to produce medicines and vaccines, and just over 50% would report on using it to study human diseases like cancer.

Journalists are more concerned about reporting about the effects that applications of biotechnology could have on the environment. Around 60% would report on GM crops being so resistant to pests and diseases but will push native plants into extinction. Also, nearly 70% indicated that they would report on the idea pest-resistant GM crops would also harm non-target organisms such as butterflies. On the other hand, slightly more than 60% would never or seldom consider something like the fact that there is no evidence that GM crops can harm the environment.

Malaysia's journalists are not as willing to focus on an array of different applications of biotechnology as the other stakeholders (policy makers or scientists).

TABLE 28: BIOTECHNOLOGY APPLICATIONS AND ISSUES **SCIENTISTS** SAY THEY WOULD TEND TO FOCUS ON WHEN TALKING ABOUT BIOTECHNOLOGY

FRAMES FOR SCIENTISTS' DISCUSSIONS	Never	Seldom	Almost always	All the time	Don't Know
1. Make food more nutritious, taste better, and keep longer	6.50 (± 4.43)	9.70 (± 5.32)	67.70 (± 8.40)	16.10 (± 6.60)	0
2. Make crops resistant to pests & diseases	0	12.90 (± 6.02)	64.50 (± 8.59)	22.60 (± 7.51)	0
3. Produce medicines & vaccines	9.70 (± 5.32)	25.80 (± 7.86)	41.90 (± 8.86)	22.60 (± 7.51)	3.20 (± 3.16)
4. Study human diseases like cancer	3.20 (± 3.16)	32.30 (± 8.40)	51.60 (± 8.98)	12.90 (± 6.02)	0
5. Introduce fish genes into strawberries for resistance to freezing	38.70 (± 8.75)	32.30 (± 8.40)	22.60 (± 7.51)	6.50 (± 4.43)	0
6. Detect & treat diseases inherited from parents	9.70 (± 5.32)	29.00 (± 8.15)	35.50 (± 8.59)	22.60 (± 7.51)	3.20 (± 3.16)
7. GM foods are safe & tested	9.70 (± 5.32)	29.00 (± 8.15)	41.90 (± 8.86)	19.40 (± 7.10)	0
8. GM crops will be so resistant to pests and diseases but will push native plants into extinction	9.70 (± 5.32)	19.40 (± 7.10)	41.90 (± 8.86)	25.80 (± 7.86)	3.20 (± 3.16)
9. No evidence GM crops can harm environment	19.40 (± 7.10)	22.60 (± 7.51)	48.40 (± 8.98)	9.70 (± 5.32)	0
10. GM crops will contaminate native plant species and further reduce biodiversity	0	32.30 (± 8.40)	45.20 (± 8.94)	19.40 (± 7.10)	3.20 (± 3.16)
11. Farmers want GM crops because they make crop production cheaper, increase yield, and increase income.	12.90 (± 6.02)	16.10 (± 6.60)	51.60 (± 8.98)	19.40 (± 7.10)	0
12. Opponents of modern biotechnology have no factual evidence for their claims of negative health consequences or environmental impact.	9.70 (± 5.32)	25.80 (± 7.86)	38.70 (± 8.75)	25.80 (± 7.86)	0
13. For plant breeders and farmers, modern biotechnology is simply another tool to increase productivity.	6.50 (± 4.43)	19.40 (± 7.10)	51.60 (± 8.75)	22.60 (± 7.51)	0
14. Pest-resistant GM crops would also harm non-target organisms like butterflies.	3.20 (± 3.16)	35.50 (± 8.59)	41.90 (± 8.86)	19.40 (± 7.10)	0

As with the journalists, all of the Malaysia's scientists surveyed have expressed an unwillingness to focus on these biotechnology issues and applications all the time (Table 28). It is also worth noting the fact that there are very few "Don't Know" responses to several specific statements, and the considerable number of scientists who have said that they will never or seldom focus on some of the issues when making decisions about biotechnology.

The only two issues about biotechnology that stands out in terms of scientists' intent focus on in scientific conversation pertaining to biotechnology is GM crops will be so resistant to pests and diseases but will push native plants into distinction, and opponents of modern biotechnology have no factual evidence for their claims of the negative health consequences or environmental impact. Exactly 25.80% ( $\pm 7.86$ ) of the scientists say that they will always focus on these potential benefits.

When confronted with crop related uses of biotechnology, Malaysia's scientists indicate that they would focus on these types of issues when considering biotechnology related issues. Over 80% would almost always or always focus on the idea that biotechnology can be used to make food more nutritious, taste better, and keep longer. Similarly, over 85% would almost always or always focus on a biotechnology application to make crops more resistant to pests and diseases.

Medical issues are also a strong focus for scientists, with slightly less percentages than the crop related applications. Roughly 60% of scientists would consider the application of using biotechnology to produce medicines and vaccines, and using it to study human diseases like cancer.

Scientists are equally enthusiastic about the effects that the applications of biotechnology could have on the environment. Slightly more than 58% would almost always or always consider something like the fact that there is no evidence that GM crops can harm the environment. Also 60.00% indicated that they would focus on the idea pest-resistant GM crops would also harm non-target organisms such as butterflies.

Overall, Malaysia's scientists are very willing to focus on an array of different applications of biotechnology in a very similar manner to the policy makers. These uses include medical, agricultural and environmental applications.

TABLE 29: BIOTECHNOLOGY APPLICATIONS **OTHER STAKEHOLDERS** SAY THEY WOULD CONSIDER WHEN MAKING JUDGMENTS ON BIOTECHNOLOGY<sup>16</sup>

a. *Use of modern biotechnology in the production of foods to make them more nutritious, taste better and keep longer.*

	<i>Useful</i>	<i>Risky</i>	<i>Morally acceptable</i>	<i>To be encouraged</i>	<i>Not sure</i>
<b>Consumers</b>	59.40	24.30	39.60	33.30	2.70
<b>Businessmen</b>	48.00	19.10	38.40	24.90	3.80
<b>Extension Workers</b>	20.00	7.70	16.90	20.00	35.40
<b>Farmer Leaders</b>	23.30	12.70	38.20	21.20	17.00

In general, the use of biotechnology to enhance food gets a lot of approval from nearly 60% of Malaysia’s consumers and half of the businessmen surveyed. There is not much of a support for this particular biotechnology application from farmer leaders and extension workers where no more than one-third of those surveyed think that this application is useful. Interestingly, most of the stakeholders also hold the opinion that there is less risk involved in the use of biotechnology in the production of foods to make them more nutritious, taste better, and keep longer. A little over one-third of the consumers, businessmen, and farmer leaders think that the application is morally acceptable. In general, there is also not much support among these four stakeholders on the idea that this application should be encouraged.

b. *Taking genes from plant species and transferring them into crop plants, to make them more resistant to pests and diseases.*

	<i>Useful</i>	<i>Risky</i>	<i>Morally acceptable</i>	<i>To be encouraged</i>	<i>Not sure</i>
<b>Consumers</b>	63.90	23.40	34.20	32.40	2.70
<b>Businessmen</b>	42.20	21.10	48.00	21.10	3.80
<b>Extension Workers</b>	20.00	7.70	12.30	26.20	33.80
<b>Farmer Leaders</b>	23.30	21.20	25.40	29.70	17.00

The benefit of biotechnology in making crops pest and disease resistant gains a lot of practical acceptability among 63.90% of Malaysia’s consumers surveyed. However, this particular biotechnology application fails to muster enough support from the three other stakeholders. Only 42% of the Malaysia’s businessmen think that this application is useful, and no more than 25% of the extension workers and farmer leaders believe that it is useful.

<sup>16</sup> The tables report multiple responses, hence the percentages should not add up to 100 across stakeholders or across responses.

Although perceptions of risks are in the minds of only about a quarter of consumers, businessmen, and farmer leaders and minimally among extension workers (8%), no more than one-third of all four stakeholders say that this is an application that needs to be encouraged. Among the businessmen surveyed, 48% think that this application is morally acceptable. Thirty-four percent of consumers share the same sentiments. However, there is rather low support about the moral acceptability of this type of application among extension workers (12.30%) and farmer leaders (25.40%).

c. *Introducing human genes into bacteria to produce medicines or vaccines, for example, to produce insulin for diabetes.*

	<i>Useful</i>	<i>Risky</i>	<i>Morally acceptable</i>	<i>To be encouraged</i>	<i>Not sure</i>
<b>Consumers</b>	59.40	28.80	33.30	29.70	2.70
<b>Businessmen</b>	48.00	26.80	26.90	25.00	1.90
<b>Extension Workers</b>	21.50	9.20	20.00	10.80	38.50
<b>Farmer Leaders</b>	27.60	17.00	34.00	19.10	17.00

The application of biotechnology in medicine, particularly on the producing medicines or vaccines, garners a lot of favorable votes and assessments from Malaysia’s consumers (59.40%) and nearly half of the businessmen who think that this application is useful. There is not much of a very positive opinion about the usefulness of this application from extension workers and farmer leaders, although they also seem to associate lesser risks to this application. Around one-third of consumers and farmer leaders think that this application is morally acceptable. In general, the idea that this application must be encouraged has not generated as much support from all four stakeholders. In the matter of encouraging this application, only 30% of consumers have expressed approval, followed by 25% of businessmen. Very few (10.80%) of extension workers say that this application should be encouraged.

d. *Modifying genes of laboratory animals such as a mouse to study human diseases like cancer.*

	<i>Useful</i>	<i>Risky</i>	<i>Morally acceptable</i>	<i>To be encouraged</i>	<i>Not sure</i>
<b>Consumers</b>	54.90	29.70	26.10	18.90	2.70
<b>Businessmen</b>	42.20	28.80	28.80	13.40	3.80
<b>Extension Workers</b>	18.50	10.80	26.20	7.70	36.90
<b>Farmer Leaders</b>	33.90	23.30	29.70	10.60	17.00

A little over half of the Malaysia’s consumers surveyed say that the application of biotechnology for possible cancer treatment is useful. Among Malaysia’s businessmen, 42.20% share this opinion with consumers and one-third of the Malaysia’s farmer leaders also say that this application is rather useful. Not much support for this idea has come forth from Malaysia’s extension workers. Only 18.50% of the extension workers surveyed thinks that this particular application is useful. Less than one-third of the respondents surveyed in these four stakeholder groups associate this application with risks. However, there are not enough positive votes with regard to the moral acceptability of this application. No more than one-third of the respondents in each of the four stakeholder groups think that this application is morally acceptable. Moreover, there is little support in general for the idea that this application should be encouraged.

e. *Using genetic testing to detect and treat diseases we might have inherited from our parents.*

	<i>Useful</i>	<i>Risky</i>	<i>Morally acceptable</i>	<i>To be encouraged</i>	<i>Not sure</i>
<b>Consumers</b>	63.90	15.30	30.60	30.90	5.40
<b>Businessmen</b>	44.10	19.20	28.80	32.70	3.80
<b>Extension Workers</b>	20.00	10.80	18.50	12.30	38.50
<b>Farmer Leaders</b>	16.90	8.50	14.80	8.50	63.80

The use of biotechnology to detect and treat diseases inherited from parents gets some support from Malaysia’s consumers (63.90%) and businessmen (44.10%). However, no more than 20% of extension workers and farmer leaders believe that this application is useful. In terms of perceived risks relating to this particular application, no more than 20% of the respondents in these four stakeholder groups say that that it is risk. However, in general, the numbers are still quite low when it comes to questions of moral acceptability and encouraging this type of application. Only around 30% of Malaysia’s consumers and businessmen think that this biotechnology application is acceptable, and no more than 20% of extension workers and farmer leaders share this opinion. The same pattern holds true about encouraging this application. Only 32.70% of the businessmen

and 30.90% of the consumers say that this application should be encouraged. No more than 15% of the extension workers and farmer leaders think that this application should at all be encouraged.

#### IV. SURVEY HIGHLIGHTS

##### A. Malaysia's Consumers<sup>17</sup>

- Moderately to very interested in biotechnology
- Moderately to very concerned about biotechnology issues
- Perceive the risks of biotechnology to be moderate
- Perceive the benefits of biotechnology to be between moderate to high
- Have a high regard for research institutes (76%), university scientists (67%) and consumer groups/NGOs (62%) as being highly concerned about public health and safety issues relating to biotechnology
- Believe that regulatory bodies (86%), research institutes (84%) and university scientists (79%) have total responsibility for conducting risk assessment and risk management on biotechnology.
- Have a very high regard for the role of science in the development of agriculture in Malaysia (89%)
- Rate themselves as having a moderate understanding of science
- Rate themselves as having a slightly low to moderate understanding of biotechnology
- Have moderate score on factual knowledge about biotechnology
- Generally exhibit moderate attitudes toward biotechnology
- *On banning GM foods.* 64% would be in favor being actively involved through either time or money in banning GM foods. Only 14% are not in favor of this action.
- *On labeling GM foods.* 90% believe that GM foods should be labeled.
- *On benefits of biotechnology to small farmers.* 62% agree with the proposition that agricultural biotechnology will not benefit small farmers.
- *On the benefits of biotechnology to Malaysian agriculture.* 65% believes that biotechnology is good for Malaysian agriculture.
- *On the adequacy of biotechnology regulations in Malaysia.* 51% disagree with the statement that current biotechnology regulations in Malaysia are sufficient. Only 23% agree about current regulations sufficiency.
- *On paying extra for the labeling of GM foods.* 49% indicated that they are willing to pay extra for the labeling of GM foods, where as 29% are not willing to pay extra.
- Average frequency of contact had with the media within a two-month period is extremely low, the tri-media sources 1.42 times, family and other proximate

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<sup>17</sup> For complete demographical comparisons across stakeholders, see Appendix 1.

interpersonal sources practically less than once and books and pamphlets less than once also.

- 12% reported using experts and less than ten percent have claimed accessing websites on biotechnology. They have listened to NGOs. They have barely talked to a religious group, regulators or a local politician about biotechnology nor have they attended seminars.
- Are highly trusting of information that comes from University scientists, science magazines and private sector scientists at 67%, 59% and 48% respectively.
- 31% feel that information they have received concerning biotechnology is useful. 33% feel that it is only somewhat useful and 34%, the highest percentage, feel that it is not useful.
- When asked if they perceive the information they receive about biotechnology, 30% percent feel that the information is highly scientific, 45% feel that the received information is moderately scientific, and 24% thought the information was not at all scientific.
- Types of issues/concerns they have heard or known about biotechnology are as follows: 60% have heard of moral/ethical issues, 32% have heard of religious issues/concerns, 20% about cultural and 19% about political issues/concerns.
- Think that moral/ethical issues influence 76% will influence most their judgment about biotechnology.

## **B. Malaysia's Businessmen**

- Moderately to very interested in biotechnology
- Moderately to very concerned about biotechnology issues
- Perceive the risks of biotechnology to be moderate
- Perceive the benefits of biotechnology to be between moderate to high
- Have a high regard for research institutes (76%), university scientists (67%) and consumer groups/NGOs (62%) as being highly concerned about public health and safety issues relating to biotechnology
- Believe that agri-biotech companies (90%), regulatory bodies (90%), and research institutes (89%) have total responsibility for conducting risk assessment and risk management on biotechnology.
- Have a very high regard for the role of science in the development of agriculture in Malaysia (89%)
- Rate themselves as having a moderate understanding of science
- Rate themselves as having a moderate understanding of biotechnology
- Generally have moderate mean score on factual knowledge about biotechnology
- Generally exhibit moderate attitudes toward biotechnology
- *On banning GM foods.* A considerable number, 71% are not in favor of being actively involved through either time or money in banning GM foods. Only 17% would be in favor of this action.
- *On labeling GM foods.* 89% believe that GM foods should be labeled.

- *On benefits of biotechnology to small farmers.* 64% say that agricultural biotechnology will not benefit small farmers.
- *On the benefits of biotechnology to Malaysian agriculture.* 73% of the stakeholders surveyed believe that biotechnology is good for Malaysian agriculture.
- *On the adequacy of biotechnology regulations in Malaysia.* 56% say that current biotechnology regulations in Malaysia are not sufficient. 25% believe that the current regulations are sufficient.
- *On paying extra for the labeling of GM foods.* Similarly, 49% indicated that they would pay extra for the labeling of GM foods, whereas 29% would not be willing to pay extra.
- Tend to use general mass media, family/friends, and websites to gather information on biotechnology.
- Have sought information from special media sources on biotechnology at least 3.44 times in the past two months.
- Are highly trusting of information that comes from science magazines (77%), university scientists (75%), and private sector scientists (67%).
- 46% feel that information they have received concerning biotechnology is useful. 33% feel that it is only somewhat useful and 19% feel that it is not useful.
- 30% think that the information they have received concerning biotechnology is highly scientific and 45% think it is somewhat scientific.
- Types of issues/concerns they have heard or known about biotechnology are as follows: 61% have heard of moral/ethical issues, 29% have heard of religious issues/concerns, 29% about cultural and 31% about political issues/concerns.
- 58% believe that moral issues will influence their judgment about biotechnology

### **C. Malaysia's Extension Workers**

- Moderately to very interested in biotechnology
- Moderately to very concerned about biotechnology issues
- Perceive the risks of biotechnology to be low
- Perceive the benefits of biotechnology to be between moderate to high
- Have a high regard for research institutes (69%), university scientists (57%), and private sector scientists (51%) as being highly concerned about public health and safety issues relating to biotechnology
- Believe that regulatory bodies (60%), research institutes (59%), and university scientists (55%) have total responsibility for conducting risk assessment and risk management on biotechnology.
- Have a very high regard for the role of science in the development of agriculture in Malaysia (72%)
- Rate themselves as having a low to moderate understanding of science
- Rate themselves as having a low to moderate understanding of biotechnology
- Generally have low factual knowledge about biotechnology
- Generally exhibit moderate attitudes toward biotechnology

- *On banning GM foods:* 40% are in favor of being actively involved through either time or money in banning GM foods. Only 9.2% are not in favor of this action.
- *On labeling GM foods:* 52% believe that GM foods should be labeled.
- *On benefits of biotechnology to small farmers:* 43% percent say that biotechnology will not benefit small farmers.
- *On the benefits of biotechnology to Malaysia's agriculture:* 54% believes that biotechnology is good for Malaysian agriculture.
- *On the adequacy of biotechnology regulations in Malaysia:* 36% think that the current biotechnology regulations in Malaysia are sufficient. 9% say that the current regulations are not sufficient.
- *On paying extra for the labeling of GM foods:* 37% say that they will pay extra for the labeling of GM foods; 25% are not willing to pay extra.
- Tend to receive information about biotechnology from a) general mass media (i.e., radio, television, and newspapers), b) pamphlets, and c) books.
- Are highly trusting of information that comes from university scientists, television and science magazines.
- 28% think that the information is highly scientific.
- Types of issues/concerns they have heard or known about biotechnology are as follows: 29% have heard of moral/ethical issues, 26% have heard of religious issues/concerns, 17% about cultural and 19% about political issues/concerns.
- Think that moral/ethical issues on biotechnology would influence most their judgment about biotechnology.

#### **D. Malaysia's Farmer Leaders**

- Moderately to very interested in biotechnology
- More than moderately concerned about biotechnology issues
- Perceive the risks of biotechnology to be low to moderate
- Perceive the benefits of biotechnology to be moderate to high
- Have a high regard for research institutes (66%), university scientists (64%) and private scientists (60%) as being highly concerned about public health and safety issues relating to biotechnology
- Believe that research institutes (81%), private sector scientists (70%) and agri-biotech companies (70%) have total responsibility for conducting risk assessment and risk management on biotechnology.
- Have a very high regard for the role of science in the development of agriculture in Malaysia (88%)
- Rate themselves as having a more than moderate understanding of science
- Rate themselves as having a more than moderate understanding of biotechnology
- Generally have a low to moderate mean score on factual knowledge of biotechnology
- Generally exhibit moderate attitudes toward biotechnology
- *On banning GM foods:* 26% are in favor of being actively involved through either time or money in banning GM foods. 47% are not in favor of this action.

- *On labeling GM foods:* 79% think that GM foods should be labeled.
- *On benefits of biotechnology to small farmers:* 38% believe that agricultural biotechnology will benefit small farmers.
- *On the benefits of biotechnology to Malaysia's agriculture:* 64% believe that biotechnology is good for Malaysian agriculture.
- *On the adequacy of biotechnology regulations in Malaysia:* 60% think that current biotechnology regulations in Malaysia are sufficient.
- *On paying extra for the labeling of GM foods:* 62% say that they will pay extra for the labeling of GM foods. 15% are not willing to pay extra.
- Tend to receive information about biotechnology from a) general mass media, b) books, and c) websites.
- Have sought information from special media contacts at least 3.49 times in a two-month period.
- Are highly trusting of information that comes from university scientists, private scientists and websites.
- Tend to think that the information they receive about biotechnology is highly scientific.
- Types of issues/concerns they have heard or known about biotechnology are as follows: 40% have heard of moral/ethical issues, 26% have heard of religious issues/concerns, 15% about cultural and 13% about political issues/concerns.
- Believe that religious issues will influence their judgments about biotechnology.

#### **E. Malaysia's Journalists**

- Moderately to highly interested in biotechnology
- Moderately concerned about biotechnology issues
- Perceive the risks of biotechnology to be moderate to high
- Perceive the benefits of biotechnology to be between moderate to high
- Have a high regard for consumer groups and NGOs, university scientists and research institutes as being highly concerned about public health and safety issues relating to biotechnology
- Believe that a) research institutes (93%), b) regulatory bodies (93%), c) university scientists (81%), d) consumer groups and NGOs (81%), and farmer leaders (81%) have total responsibility for conducting risk assessment and risk management on biotechnology.
- Have a very high regard for the role of science in the development of agriculture in Malaysia (96%)
- Rate themselves as having a moderate understanding of science
- Rate themselves as having a moderate understanding of biotechnology
- Generally have moderate to high mean score on factual knowledge of biotechnology
- Generally exhibit moderate attitudes toward biotechnology
- *On banning GM foods:* 67% are in favor of banning GM foods.
- *On labeling GM foods:* 93% think that GM foods should be labeled.

- *On benefits of biotechnology to small farmers:* 59% say that biotechnology will not benefit small farmers.
- *On the benefits of biotechnology to Malaysia's agriculture:* 56% believe that biotechnology is good for Malaysian agriculture.
- *On the adequacy of biotechnology regulations in Malaysia:* 67% do not think that the current biotechnology regulations in Malaysia are sufficient.
- *On paying extra for the labeling of GM foods:* 44% of the journalists surveyed say that they will pay extra for the labeling of GM foods. 44% are not willing to pay extra.
- Tend to receive information about biotechnology from a) general mass media, b) family and friends, and c) experts, professionals, and scientists
- Have sought information from special face-to-face contacts at least 4.70 times in a two-month period.
- Are highly trusting of information that comes from science magazines, university scientists and NGOs at 67%, 56%, and 48% respectively.
- 26% think that the information they get about biotechnology is moderately scientific. 44% feel that the received information is highly scientific, and 22% thought the information is not at all scientific.
- Types of issues/concerns they have heard or known about biotechnology are as follows: 78% have heard of moral/ethical issues, 56% have heard of religious issues/concerns, 41% about cultural and 67% about political issues/concerns.
- Believe that moral issues concerning biotechnology will influence their judgment.

## **F. Malaysia's Policy Makers**

- Highly interested in biotechnology
- Moderately concerned about biotechnology issues
- Perceive the risks of biotechnology to be moderate
- Perceive the benefits of biotechnology to be high
- Have a high regard for consumer groups/NGOs (82%), mass media (71%) and religious groups, research institutes and university scientists (50%) as being highly concerned about public health and safety issues relating to biotechnology
- Believe that university scientists (100%) research institutes (100%), and regulatory bodies (93%) have total responsibility for conducting risk assessment and risk management on biotechnology.
- Have a very high regard for the role of science in the development of agriculture in Malaysia (96%)
- Rate themselves as having a moderate to high understanding of science
- Rate themselves as having a more than moderate understanding of biotechnology
- Generally have moderate mean score on factual knowledge about biotechnology
- Generally exhibit moderate attitudes toward biotechnology
- *On banning GM foods:* 75% are in favor of being actively involved through either time or money in banning GM foods. Only 7% are in favor of this action.

- *On labeling GM foods:* Majority (79%) believes that GM foods should not be labeled.
- *On benefits of biotechnology to small farmers:* 71% believe that agricultural biotechnology will not benefit small farmers.
- *On the benefits of biotechnology to Malaysia's agriculture:* 86% believe that biotechnology is good for Malaysia's agriculture.
- *On the adequacy of biotechnology regulations in Malaysia:* 54% do not think that current biotechnology regulations in Malaysia are sufficient.
- *On paying extra for the labeling of GM foods:* 54% say that they will pay extra for the labeling of GM foods, whereas 39% are not willing to pay extra.
- Tend to receive information about biotechnology from a) general mass media, b) family/friends, c) websites, and d) books.
- Have talked to specialized face-to-face contacts at least 5.64 times in a two-month period.
- Are highly trusting of information that comes from science magazines, websites, and university scientists.
- 61% think that the information they get about biotechnology is highly scientific. 21% feel that the received information is moderately scientific, and 18% say that it is not at all scientific.
- Types of issues/concerns they have heard or known about biotechnology are as follows: 61% have heard of moral/ethical issues, 64% have heard of religious issues/concerns, 21% about cultural and 18% about political issues/concerns.
- Believe that moral/ethical issues influences will influence their judgments most about biotechnology.

## **G. Malaysia's Scientists**

- Highly interested in biotechnology
- More than moderately concerned about biotechnology issues
- Perceive the risks of biotechnology to be moderate
- Perceive the benefits of biotechnology to be high
- Have a high regard for consumer groups/NGOs (97%), research institutes (71%) and tri-media and religious groups (68%) as being highly concerned about public health and safety issues relating to biotechnology
- Believe that research institutes and regulatory bodies (100%) and university scientists and agri-biotech companies (97%) have total responsibility for conducting risk assessment and risk management on biotechnology.
- Have a very high regard for the role of science in the development of agriculture in Malaysia (100%)
- More than moderately knowledgeable on biotechnology
- Report high use of tri-media and pamphlets (34%) and family and friends and books at 38%.
- Have sought information from special media contacts at least 5.67 times in a two-month period.

- 67% feel that the information is highly scientific. 27% feel that the received information is moderately scientific, and 7% thought the information was not at all scientific.
- Types of issues/concerns they have heard or known about biotechnology are as follows: 60% have heard of moral/ethical issues, 43% have heard of religious issues/concerns, 23% about cultural and 27% about political issues/concerns.
- Believe that moral/ethical issues will influence most their judgments about biotechnology.

## V. SUMMARY AND CONCLUSIONS

This study is part of a larger effort to understand the responses to agricultural biotechnology by different stakeholders in Malaysia. Evidently, this survey cannot fully capture the phenomena of public understanding, the diffusion of an innovation such as biotechnology through a social system, and the full nature of public perceptions and concerns about biotechnology.

Characterizing public responses to and understanding of agricultural biotechnology, however, is an important step towards devising more appropriate information-education-communication interventions to facilitate an informed dialogue about biotechnology. By noting the differences and similarities among stakeholders in Malaysia, the study establishes the character of the social environment in which discourses about agricultural biotechnology in Malaysia takes shape.

Interest and Concern. Interest in agricultural biotechnology among Malaysia's stakeholders is moderately high. Malaysia's scientists lead stakeholders in expressing very high interest in agricultural biotechnology, followed by journalists and policy makers. Considerable number of extension workers and farmer leaders has also reported being highly interested in agricultural biotechnology. Malaysia's journalists also think that biotechnology is a very important news story.

Across stakeholders, moderate concerns about agricultural biotechnology can be noted even among Malaysia's scientists. Most stakeholders tend to be either moderately or highly concerned about biotechnology. Except for policy makers, less than 20% of the stakeholders say that they are not at all concerned about agricultural biotechnology.

These results imply that while there is an initial level of engagement among Malaysia's stakeholders, communication-information activities will need to focus on addressing some of the questions stakeholders may have about agricultural biotechnology. Increased level of concern, however, should not be viewed purely as a "negative" but a customary response of stakeholders to new technologies as these diffuse through the social system. Thus, it is not surprising to note journalists, businessmen, and extension workers as having more questions about biotechnology since these are the stakeholders who need to have immediate answers to specific constituents.

Level of concern should also be seen positively as an input to the risk communication planning. In a way, it alerts communicators to pay much more attention to the types of questions stakeholders may have about biotechnology rather than focusing on its benefits.

Perceived risks and benefits. In general, Malaysia's stakeholders tend to have moderate perceptions of the risks relating to agricultural biotechnology. Except among scientists, the level of concern expressed by most stakeholders about biotechnology is significant related to their perceptions of risks. Journalists tend to perceive risks rather highly compared to other stakeholders.

On the other hand, the stakeholders' perspectives on the benefits of biotechnology are resoundingly high. Less than 10% of consumers, businessmen, extension workers, farmer leaders, and policy makers think that the benefits are very low. None of the journalists and scientists has said that the benefits are very low, and no less than 70% of all stakeholders have said that biotechnology brings in very high benefits.

In striking a balance in communication activities, there is clearly no need to drumbeat the possible benefits of biotechnology. Stakeholders are already predisposed to looking at these facets of biotechnology. However, it may be, indeed, more practical to identify the specific concerns or questions stakeholders may still have and to design communication programs or forums that can address these specific concerns.

Understanding and knowledge of science and agricultural biotechnology. Notwithstanding their interest in biotechnology, the high benefits they associate it with, and their belief in the pivotal role that science plays in Malaysia's agriculture, the stakeholders in Malaysia rate their understanding of science to be marginally moderate. Malaysia's policy makers rate themselves rather highly in terms of understanding science. On the other hand, businessmen think that their understanding of science is quite below average.

With the exception of scientists, Malaysia's stakeholders have also rated their understanding and knowledge of biotechnology as between below and slightly moderate. These self-assessments about their understanding and knowledge of biotechnology may perhaps explain the high level of concern they may have.

These self-ratings are reflected in the pop-quiz that seeks to ascertain their factual knowledge of biotechnology. Malaysia's stakeholders have obtained scores that are between low and moderate reflecting somewhat poor knowledge of biotechnology. Consumers and extension workers, in particular, have garnered the lowest scores. Only 8.08% of consumers and 4% of extension workers have obtained high scores.

Attitudes toward biotechnology. Generally, Malaysia's stakeholders hold a very moderate stance on biotechnology. Only 2% of farmer leaders and 3.6% of journalists have exhibited very positive attitudes towards biotechnology. On the other hand, it cannot be said that the position of Malaysia's stakeholders are very negative since most of them tend to cluster around a moderate position.

These results should be taken in the context of the concerns that the stakeholders have shown. Malaysia's stakeholders appear to be expressing some guarded optimism about biotechnology. Thus, the levels of concern and attitude are not necessarily negative but are indicative of the questions the stakeholders may have about biotechnology. Indeed, it may be safe to assume that the stakeholders are rather sophisticated in recognizing both the positive and negative sides of biotechnology.

Trustworthiness and credibility of institutions. Stakeholders' perceptions of the trustworthiness and credibility of institutions play a vital part in the acceptance and diffusion of new technologies. In general, Malaysia's stakeholders tend to see university scientists, religious groups, and the mass media as the institutions that are much more concerned about public health and safety issues relating to agricultural biotechnology. They view these institutions as caring for the public's interests. Evidently, expertise does not play a significant role in stakeholders' perceptions.

When it comes to the question of the institutions that ought to be in charge of risk assessment and risk management, Malaysia's stakeholders turn to science-based institutions such as university scientists, research institutes, and agri-biotech companies. These results can only affirm the emerging character that is being established about the stakeholders in Malaysia, that is, they are best served by a well-rounded presentation of biotechnology information. This implies a type of communication program that engages them into considering the various dimensions of biotechnology rather than just focusing on either a positive or a negative aspect.

Sources of information. Information-seeking behaviors among Malaysia's stakeholders are still quite low. Relative to other stakeholders, scientists, journalists and policy makers tend to be active information-seekers.

Overall, the most frequently used sources of information on biotechnology are a) the general media (radio, television, and newspapers), b) books and other special print media, c) family and friends, and d) experts and professionals. Special groups such as NGOs government regulators,

political leaders, agri-biotech companies, or religious groups are not as widely consulted and neither are specialized media such as forums or seminars and websites on biotechnology.

Factors that influence judgments about biotechnology. Generally Malaysia's stakeholders report having heard or known mostly about cultural concerns and moral/ethical concerns about biotechnology.

Malaysia's stakeholders say that moral/ethical and cultural concerns will tend to influence most their judgments about biotechnology. Sixty-five percent of all the stakeholders have mentioned moral/ethical issues, while 60% have said that cultural issues will have a bearing on the judgments about biotechnology. All stakeholders say that religious issues will be least influential on their judgment about biotechnology.

Making judgments about biotechnology. When it comes to making judgments about specific applications of biotechnology, the numbers do not seem to be there. Interest in biotechnology as a concept and optimism about its benefits may run high among Malaysia's stakeholders, but when faced with the specifics, the support seems to waver a bit. This can be partly explained by the fact that stakeholders, in general, do not feel that they have enough information to make good judgments.

Overall, it can be noted that stakeholders who have a much more direct involvement in biotechnology such as farmer leaders and extension workers are much more upbeat about the applications of biotechnology in crop production and medicine. Other stakeholders are much more cautious.

a) Policy frames: Overall, the scenario that we get from Malaysia in terms of policy making discourses on biotechnology appears to be one of caution or a "wait-and-see" attitude. This may be brought about by lack of relevant information about biotechnology that can engender more defined thinking and attitudes toward biotechnology. Thus, while there is some interest and concern about the concept, the tenor of policy making discussions change when policy makers are faced with specific issues on biotechnology.

b) Journalistic frames: Malaysia journalists seem to take a very cautious approach to covering biotechnology, especially in terms of highlighting its potential benefits. Overall, they are intent on ensuring a balance between the risks and benefits of biotechnology, and the results are rather consistent with their moderate attitudinal stance towards biotechnology.

c) Scientific frames: Likewise, Malaysia's scientists take a very cautious stance on what they will likely focus on when talking about biotechnology. It is worth noting that quite a significant number have expressed intent to give attention to the possible environmental consequences of biotechnology. These intended talking points among Malaysia's scientists do not necessarily run counter to their high interest and low concern, low perceptions of risk and high perceptions of benefits relating to biotechnology. In a way, this can be viewed as a discourse strategy of Malaysia's scientists to immediately address public anxieties about the possible environmental effects of biotechnology. For the scientists, the benefits are clear-cut, but there is an urgent need to clarify many of the nagging doubts other stakeholders may have about biotechnology. It also makes for a good risk communication strategy not to antagonize biotechnology opponents and to focus instead on addressing the questions that tend to have most impact on the public's acceptance and understanding of biotechnology.

The main purpose of this monograph is to provide an empirical profile of key stakeholders in Malaysia. This baseline data offers a good starting point for communication strategists, policy makers, planners, decision makers, and other researchers interested in understanding some of the important contexts that drive public perceptions, knowledge, attitudes, and information-gathering behaviors of stakeholders in Malaysia in relation to agricultural biotechnology. The data are not by any means exhaustive, and the contextual interpretations that have been discussed in the monograph are partly meant to motivate readers to offer their own reflective insights, analyses, and explanations for the patterns they may now be able to see based on the survey data. Social science research on public understanding of biotechnology deals with a plethora of amorphous variables. Evidently, the sheer complexity of these social phenomena cannot be totally captured by survey research. Indeed, the survey data that we thought can provide answers are clearly leading us to more complex questions. In the final summative and integrative monograph that compares the data across five countries in Southeast Asia, we will discuss the next possible directions for research on public representations of agricultural biotechnology.

**APPENDIX 1: SUMMARY OF SOCIO-DEMOGRAPHIC CHARACTERISTICS OF MALAYSIA SURVEY  
RESPONDENTS**

*SEX*

	<b>Male</b>	<b>Female</b>	<b>No Answer</b>
Consumers (111)	45.0	52.3	2.7
Businessmen (52)	63.5	34.6	1.9
Extension Workers (65)	52.3	18.5	29.2
Farmer Leaders (47)	25.5	8.5	66.0
Journalists (27)	33.3	59.3	7.4
Policy Makers (28)	50.0	50.0	0
Scientists (31)	61.3	38.7	0

*MARITAL STATUS*

	<b>Single</b>	<b>Married</b>	<b>Separated</b>	<b>Divorced</b>	<b>Widowed</b>	<b>No Answer</b>
Consumers (111)	51.4	43.2	0	0.9	1.8	2.7
Businessmen (52)	44.2	53.8	0	0	0	1.9
Extension Workers (65)	9.2	60.0	0	0	1.5	29.2
Farmer Leaders (47)	2.1	31.9	0	0	0	66.0
Journalists (27)	51.9	40.7	0	0	0	7.4
Policy Makers (28)	14.3	82.1	3.6	0	0	0
Scientists (31)	16.1	77.4	3.2	0	3.2	0

*EDUCATIONAL ATTAINMENT*

	<b>High School</b>	<b>Associate Degree</b>	<b>BS Degree</b>	<b>Grad/Post Grad Degree</b>	<b>No Answer</b>
Consumers (111)	25.2	18.0	41.4	12.6	2.7
Businessmen (52)	7.7	17.3	36.5	34.6	1.9
Extension Workers (65)	37.4	10.7	9.2	4.6	38.5
Farmer Leaders (47)	6.4	12.8	12.8	2.1	66.0
Journalists (27)	0	14.8	33.3	33.3	18.5
Policy Makers (28)	0	0	25.0	71.4	3.6
Scientists (31)	0	0	6.5	90.3	3.2

*AREA OF RESIDENCE*

	<b>Rural</b>	<b>Suburban</b>	<b>Urban</b>	<b>No Answer</b>
Consumers (111)	0.9	31.5	63.1	3.6
Businessmen (52)	7.7	32.7	57.7	1.9
Extension Workers (65)	21.5	41.5	4.6	32.3
Farmer Leaders (47)	12.8	21.3	0	66.0
Journalists (27)	3.7	44.4	48.1	3.7
Policy Makers (28)	7.1	28.6	60.7	3.6
Scientists (31)	3.2	48.4	48.4	0

