

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

Public Understanding, Perceptions, and Attitudes towards Biotechnology in Thailand

I. INTRODUCTION

This country monograph on the socio-cultural dimensions of agricultural biotechnology in Thailand 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 Vietnam. 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 Thailand. Comparative analyses across the five countries of the key seven stakeholders are contained in a separate summative and integrative monograph.

The stakeholders, who have 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 sense of uncertainty about the food safety, environmental and animal welfare consequences of food production systems, and the moral/ethical issues that customarily attend the introduction of innovations such as genetic modification. Level of concern, however, does not necessarily reflect 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 the 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 are 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 to 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 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 got 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 ranges 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 individual beliefs and values. Hence, these 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 was 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 was 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 Thailand, 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 under the leadership of Dr. Boonyanath Nathwong of the National Center for Genetic Engineering and Biotechnology. The total sample for Thailand surveys was three hundred sixty-five (365) 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.

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III. STAKEHOLDER PROFILES AND CROSS-STAKEHOLDER COMPARISONS

A. INTEREST AND CONCERN

Interest in biotechnology. The mean interest scores of Thailand's stakeholders range from moderate to high, with an overall mean interest score of 5.12 (Table 1). Thailand's policy makers ($\bar{x}=5.76 \pm .175$) and scientists ($\bar{x}=5.60 \pm .212$) show comparatively high interest about agricultural biotechnology issues, followed closely by extension workers ($\bar{x}=5.46 \pm 1.83$), businessmen ($\bar{x}=5.44 \pm .200$), and farmer leaders ($\bar{x}=5.32 \pm .21$). These mean interest scores are almost within the same range, however. There is no significant difference between the mean interest scores of these five stakeholders ($p>.05$).

The number of stakeholders expressing high interest in biotechnology validates the trends shown by the mean scores. Thailand's scientists¹ rank first in showing high interest in agricultural biotechnology (83.30%, ± 6.80), followed by policymakers (79.10%, ± 6.20), businessmen (74.00%, ± 4.85), extension workers (69.90%, ± 5.92), and farmer leaders (60.00%, ± 6.93). The percentage of scientists expressing high interest in biotechnology is significantly different from those of businessmen, policy makers, and extension workers ($p\leq 0.05$). Scientists are expected to lead the discourse on biotechnology. Showing a very high interest in biotechnology is certainly the first step.

Relative to other stakeholders, Thailand's consumers and journalists show least interest in biotechnology. Their respective mean interest scores are just slightly above moderate at $\bar{x}=4.07$ ($\pm .159$) and $\bar{x}=4.22$ ($\pm .26$). Among Thailand's consumers, 38.00% (± 4.85) claim they are highly interested in biotechnology while nearly one-third (34.00%, ± 4.74) says that are not at all interested.

Nearly half of the journalists (46.90%, ± 8.82) claim to only have a moderate interest, and 31.30% (± 8.20) say that they are highly interested.

¹ It must be clarified that the "scientists" referred to as a stakeholder group consists of "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."

Thailand's journalists assess the newsworthiness of biotechnology as somewhat important ($\bar{x}=4.47 \pm 0.23$). Almost 47% (± 8.82) of the journalists surveyed give moderate scores to the newsworthiness of biotechnology. On the other hand, 38.50% (± 8.55) think that biotechnology is a very important story, and 15.70% (± 6.43) say that it is not at all newsworthy. There is a strong and significant relationship between the journalists' level of interest in biotechnology and their view of biotechnology as a news story ($r=0.53$; $p \leq 0.001$).

*TABLE 1: INTEREST IN BIOTECHNOLOGY
(MEAN SCORES AND PERCENTAGE DISTRIBUTION)²*

<i>Stakeholder (n=365)</i>	<i>Mean score (\pms.e., max 7)*</i>	<i>Not at all interested</i>	<i>Moderately interested</i>	<i>Very interested**</i>
Consumers (100)	4.07 \pm .159 ^b	34.00 \pm 4.74	28.00 \pm 4.49	38.00 \pm 4.85 ^j
Businessmen (50)	5.44 \pm .200 ^a	10.00 \pm 4.24	16.00 \pm 5.18	74.00 \pm 4.85 ^{e,p,s}
Extension Workers (60)	5.46 \pm 1.83 ^a	3.40 \pm 2.34	26.70 \pm 5.71	69.90 \pm 5.92 ^{b,f,p}
Farmer Leaders (50)	5.32 \pm .21 ^a	4.00 \pm 2.77	36.00 \pm 6.79	60.00 \pm 6.93 ^e
Journalists (32)	4.22 \pm .26 ^b	22.00 \pm 7.32	46.90 \pm 8.82	31.30 \pm 8.20 ^{c,j}
Policy Makers (43)	5.76 \pm .175 ^a	- 0 -	20.90 \pm 6.20	79.10 \pm 6.20 ^{b,e,s}
Scientists (30)	5.60 \pm .212 ^a	3.30 \pm 3.26	13.30 \pm 6.20	83.30 \pm 6.80 ^{b,e,p}

* 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: 79.10% of policy makers having high interest is significantly different from those of businessmen, extension workers, and scientists. It is not significantly different from those of consumers, journalists, and farmer leaders.

Personal concern about biotechnology. Mean scores on personal concern show rather mixed sentiments among Thailand's stakeholders. The overall mean concern score is 4.14 (Table 2). Thailand's policymakers ($\bar{x}= 4.86 \pm .236$), scientists ($\bar{x}=4.80, \pm .312$), and businessmen ($\bar{x}=4.80 \pm .23$) have relatively higher mean concern scores, indicating an above moderate level of concern about biotechnology.

Nearly 57.00% (± 9.05) of scientists surveyed say that they are highly concerned about biotechnology issues, followed by businessmen (56.00%, ± 7.02), and policy makers (53.50%, \pm

² Percentages in the tables may not add up to 100% as "Don't Know" or "Not sure" answers are not included.

7.61). The percentage of scientists expressing high concern about biotechnology is significantly different from those of businessmen and policy makers ($p \leq 0.05$).

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

Stakeholder (n=365)	Mean score (\pm s.e., max 7)	Not at all Concerned	Moderately concerned	Very concerned
Consumers (100)	3.83 \pm .147 ^{bc}	43.00 \pm 4.95	25.00 \pm 4.43	32.00 \pm 4.66 ^e
Businessmen (50)	4.80 \pm .23 ^a	24.00 \pm 6.04	20.00 \pm 5.66	56.00 \pm 7.02 ^{p,s}
Extension Workers (60)	4.30 \pm .233 ^{ab}	31.70 \pm 6.00	25.00 \pm 5.59	43.30 \pm 6.40 ^{c,p}
Farmer Leaders (50)	2.92 \pm .28 ^d	54.00 \pm 7.05	28.00 \pm 6.35	18.00 \pm 5.43 ^j
Journalists (32)	3.38 \pm .25 ^{cd}	43.70 \pm 8.77	43.80 \pm 8.77	12.50 \pm 5.85 ^f
Policy Makers (43)	4.86 \pm .236 ^a	14.00 \pm 5.29	32.60 \pm 7.15	53.50 \pm 7.61 ^{b,e,s}
Scientists (30)	4.80 \pm .312 ^{bc}	16.70 \pm 6.81	26.70 \pm 8.08	56.70 \pm 9.05 ^{b,p}

On the other hand, Thailand's farmer leaders have the lowest mean concern score at 2.92 (\pm .28). A little over half (54.00%, \pm 7.05) of the farmer leaders surveyed say that they are not at all concerned about biotechnology, and only 18.00% (\pm 5.43) claim to be very concerned. Consistent with their level of interest, Thailand's journalists and consumers likewise appear less concerned about biotechnology than other stakeholders do. Their respective mean concern scores are 3.38 (\pm .25) and 3.83 (\pm .147). About 43% of both journalists and consumers say that they are not at all personally concerned about biotechnology. There is no correlation between the journalists' concerns on biotechnology and their view of biotechnology as a news story.

As can be noted in Table 4, there is a strong and significant correlation between the levels of interest and concern expressed by consumers ($r=0.37$; $p \leq 0.001$), businessmen ($r=0.62$; $p \leq 0.001$), policy makers ($r=0.45$; $p \leq 0.01$), and scientists ($r=0.71$; $p \leq 0.001$). These relationships suggest that the interest shown by these stakeholders goes along with the degree of concern they have about biotechnology.

B. Perceived risks and benefits of biotechnology

Perceived risks. Thailand’s stakeholders rate the possible risks of biotechnology to be within the range of low to moderate (Table 3a). The overall mean score for perceived risks among Thailand's stakeholders is 3.61. Looking at the mean scores of each stakeholder, farmer leaders rate the risks of biotechnology to be quite low (\bar{x} =2.88 ± .27). Policy makers and journalists also tend to associate biotechnology with low risks. Both stakeholders have a mean risk estimate of 3.44.

Roughly, 40 to 50% of the respondents in each stakeholder group relate biotechnology with low risks. Half of the businessmen (50.00%, ± 7.07) and farmer leaders (50.00%, ± 7.07) believe that risks associated with biotechnology are rather low. About 24.00% (± 6.04) of the businessmen and 20.00 (± 5.66) of farmer leaders think that the risks are high.

Relatively fewer respondents among journalists (12.50%, ± 6.80), policy makers (13.90%, ± 5.28), and scientists (16.60%, ± 6.79) perceive risks to be high, and these differences between percentages are significant ($p \leq 0.05$). There is a strong and significant relationship between the journalists’ perception of risk and a) their interest in biotechnology ($r=0.45$; $p \leq 0.01$) and b) their perception of benefits ($r=0.52$; $p \leq 0.01$). Their perception of risk is not correlated with their assessment about the newsworthiness of biotechnology ($p > 0.05$).

There are significant correlations between stakeholders’ level of concern about biotechnology and their perceptions of risks (Table 4). These can be observed among extension workers ($r=0.47$; $p \leq 0.001$), consumers ($r=0.52$; $p \leq 0.001$), and farmer leaders ($r=0.73$; $p \leq 0.001$).

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

Stakeholder (n=365)	Mean score (± s.e., max 7)	Low risks	Moderate risks	High risks
Consumers (100)	3.84 ± .121 ^a	46.00 ± 4.98	25.00 ± 4.33	29.00 ± 4.53 ^{b,e,f}
Businessmen (50)	3.58 ± .22 ^a	50.00 ± 7.07	26.00 ± 6.20	24.00 ± 6.04 ^{c,f,p,s}
Extension Workers (60)	3.83 ± .204 ^a	41.70 ± 6.37	21.70 ± 5.32	36.70 ± 6.22 ^c
Farmer Leaders (50)	2.88 ± .27 ^b	50.00 ± 7.07	28.00 ± 6.35	20.00 ± 5.66 ^{c,b,j,p,s}
Journalists (32)	3.44 ± .20 ^{ab}	46.90 ± 8.82	37.50 ± 8.56	12.50 ± 5.85 ^{f,p,s}
Policy Makers (43)	3.44 ± .216 ^{ab}	44.30 ± 7.58	39.50 ± 7.45	13.90 ± 5.28 ^{b,f,j,s}
Scientists (30)	3.83 ± 0.18 ^a	43.30 ± 9.05	40.00 ± 8.94	16.60 ± 6.79 ^{b,f,j,p}

Perceived benefits. Thailand's stakeholders generally hold a favorable view about the benefits of biotechnology. The overall mean benefits score among Thailand's stakeholders is 5.09. A resounding majority of businessmen (84.00%, ± 5.18) and policy makers (83.80%, ± 5.62) believe that biotechnology brings in high benefits (See Table 3b). Only 4.00% (± 2.77) of farmer leaders, 6.00% (± 5.18) of the businessmen and 7.00% (± 3.89) of policy makers associate biotechnology with minimal benefits. Indeed, with the exception of Thailand's journalists, nearly 50.00% and upwards of respondents from each of the stakeholder groups give high marks to biotechnology.

On the other hand, Thailand's journalists assess the benefits associated with biotechnology to be just below moderate. They have a mean benefits score of 3.88 ($\pm .25$). A little over half claims that it has either moderate or high benefits. A sizable number of journalists (43.70%, ± 8.77) claim that its benefits are low. There is a strong and significant relationship between the journalists' level of interest in biotechnology as a news story and their perceptions of benefits ($r=0.52$; $p\leq 0.001$).

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

<i>Stakeholder (n=365)</i>	<i>Mean score (\pms.e. max7)</i>	<i>Low benefits</i>	<i>Moderate benefits</i>	<i>High benefits</i>
Consumers (100)	4.55 \pm .122 ^c	17.00 \pm 2.22	34.00 \pm 4.74	49.00 \pm 2.88 ^s
Businessmen (50)	5.72 \pm .20 ^a	6.00 \pm 5.18	10.00 \pm 4.24	84.00 \pm 5.18 ^p
Extension Workers (60)	5.05 \pm .176 ^{bc}	10.00 \pm 3.87	26.70 \pm 5.71	63.30 \pm 6.22 ^{f,s}
Farmer Leaders (50)	5.28 \pm .19 ^{ab}	4.00 \pm 2.77	30.00 \pm 6.48	66.00 \pm 6.70 ^{e,s}
Journalists (32)	3.88 \pm .25 ^d	43.70 \pm 8.77	25.00 \pm 7.65	28.10 \pm 7.94
Policy Makers (43)	5.55 \pm .186 ^{ab}	7.00 \pm 3.89	9.30 \pm 4.43	83.80 \pm 5.62 ^b
Scientists (30)	5.66 \pm .181 ^a	-0-	13.30 \pm 6.20	56.60 \pm 9.05 ^{c,e,f}

TABLE 4: CORRELATION SUMMARY FOR INTEREST, CONCERN,
PERCEIVED RISKS, & PERCEIVED BENEFITS
(Spearman Correlation Coefficients / Prob > /R/ under Ho: Rho=0)

Stakeholder (n=365)	Interest & Concern	Interest & Perceived risks	Interest & Perceived benefits	Concern & Perceived risks	Concern & Perceived benefits	Perceived benefits & Perceived risks
Consumers (100)	0.37187^a	0.12807	0.03917	0.58252^a	-0.13036	-0.14514
Businessmen (50)	0.62896^a	0.25604	0.44430^a	0.22469	0.30302^c	0.07399
Extension Workers (60)	0.03763	-0.07652	0.41918^a	0.47347^a	-0.01474	-0.01119
Farmer Leaders (50)	-0.00227	0.05271	0.44065^a	0.73889^a	-0.17512	-0.15505
Journalists (32)	0.30363	0.32355^b	0.52982	0.15599	0.15869	0.52773^b
Policy Makers (43)	0.45112^b	-0.08597	0.27393	0.21627	0.18364	-0.05296
Scientists (30)	0.71546^a	-0.12881	0.43808^c	0.08453	0.27987	-0.28236

^a Significant at .001 level; ^b Significant at .01 level; ^c Significant at .05 level

Significant correlations can be noted in Table 4 between the level of interest in biotechnology and perceptions of benefits among businessmen (r=0.44; p≤0.001), extension workers (r=0.41; p≤0.001), farmer leaders (r=0.44; p≤0.001), and scientists (r=0.43; p≤0.05). Among journalists, there exists a significant correlation between their perceptions of risks and benefits as well as their interest in biotechnology and their perceptions of risks.

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 institutions³, Thailand's stakeholders have commonly cited *research institutes* and *consumer advocacy groups/NGOs*⁴ as being most concerned about public health and safety issues relating to agricultural biotechnology (Table 5).

A clear majority of Thailand's businessmen (90.00%, ±4.24) views research institutes as being highly concerned about health and safety issues on agricultural biotechnology, while a little over half (56.00%, ±7.02) says that consumer advocacy groups/NGOs are very concerned about these issues. Policy makers (83.70%, ± 5.63) and scientists (80.00%, ±7.30) have also looked at

³ 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.

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

research institutes as being very concerned about issues of health and safety.

Among the stakeholders who believe that consumer advocacy groups/NGOs are very concerned about health and safety issues include consumers (71.00%, ± 4.54), and extension workers (76.70%, ± 5.46). This finding is quite noteworthy because consumer advocacy groups and NGOs tend to be sources of arguments relating to the social, cultural, and economic impacts of biotechnology. Thus, initiatives to hold public communication dialogue about biotechnology will have to consider the affective attraction to audiences of societal groups who are perceived of as standing up for citizens' needs and consumer rights.

TABLE 5: INSTITUTIONS PERCEIVED AS BEING CONCERNED ABOUT HEALTH AND SAFETY ISSUES RELATING TO BIOTECHNOLOGY (PERCENTAGE REPORT ON HIGHLY CONCERNED)

Stakeholder (n=365)	Institutions							
	University scientists	Private sector scientists	Agri-biotech companies	Consumer groups & NGOs	National farm leaders	Mass media	Religious groups	Research institutes
Consumers	35.00 ± 4.77	35.00 ± 4.77	30.00 ± 4.58	71.00 ± 4.54	36.00 ± 4.80	49.00 ± 4.99	19.00 ± 3.92	49.00 ± 5.00
Businessmen	42.00 ± 6.98	42.00 ± 6.98	64.00 ± 6.79	56.00 ± 7.02	36.00 ± 6.79	52.00 ± 7.06	22.00 ± 5.86	90.00 ± 4.24
Extension workers	26.70 ± 5.71	26.70 ± 5.71	18.30 ± 4.99	76.70 ± 5.46	31.60 ± 6.00	40.00 ± 6.32	33.30 ± 6.08	53.40 ± 6.44
Farmer Leaders	30.00 ± 6.48	30.00 ± 6.48	26.00 ± 6.20	32.00 ± 6.60	54.00 ± 7.05	24.00 ± 6.04	24.00 ± 6.04	42.00 ± 6.98
Journalists	37.50 ± 8.56	18.80 ± 6.91	12.50 ± 5.85	46.90 ± 8.82	25.00 ± 7.65	<i>Not asked</i>	18.70 ± 6.89	43.80 ± 8.77
Policy Makers	53.50 ± 7.61	53.50 ± 7.61	62.90 ± 7.37	74.40 ± 6.66	32.50 ± 7.14	46.60 ± 7.60	28.00 ± 6.84	83.70 ± 5.63
Scientists	53.40 ± 9.11	53.40 ± 9.11	40.00 ± 8.94	66.70 ± 8.60	26.60 \pm	50.00 ± 9.12	20.00 ± 7.30	80.00 ± 7.30

Table 5 above shows how the other groups have fared vis-à-vis stakeholders' perceptions of their concern for biotechnology issues. Comparatively, the private sector scientists, religious groups, and national farm leaders have not garnered as many favorable votes as the others. Nearly two-thirds of the businessmen (64.00%, ± 6.79) and policy makers (62.90%, ± 7.37) have cited agri-biotech companies as being very concerned about health and safety issues. Likewise, journalists and scientists consider university scientists as being one of the top three institutions concerned about health and safety issues of agricultural biotechnology.

Generally, Thailand's stakeholders do not regard religious groups as being very concerned about health and safety issues.

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 institutions⁵ they believe should be responsible for conducting risk assessment and risk management, stakeholders in Thailand have turned towards science-based institutions (Table 6). *Regulatory bodies, research institutes, agri-biotech companies, and university scientists* rank high on the list of most stakeholders. University scientists, in particular, who are directly involved in biotechnology are highly esteemed by other non-biotechnology scientists with 96.70% (± 3.26) showing high approval. Policy makers (86.10%, ± 5.28) have likewise expressed trust in university scientists followed by extension workers at 83.40% (± 4.80). Consumers and businessmen give university scientists a trust rating of 79.00% (± 4.07) and 74.00% (± 6.20) respectively.

Similarly, regulatory bodies get high approval ratings from extension workers (90.00%, ± 3.87), journalists (84.40%, ± 6.41), consumers (83.00%, ± 3.76), policy makers (81.40%, ± 6.41), and farmer leaders (80.00%, ± 5.66).

No less than 90% of Thailand's policy makers (95.40%, ± 3.19) and businessmen (90.00%, ± 4.24) believe that research institutes should be on top of assessing and managing the risks related to agricultural biotechnology. A good majority of scientists (80.00%, ± 7.30) also think that research institutes are totally responsible for risk assessment and risk management.

Agri-biotech companies are also on top of the list. A high percentage of extension workers (86.70%, ± 4.38), consumers (85.00%, ± 3.57), and policy makers (83.70%, ± 5.63) recognize agri-biotech companies as having the responsibility to conduct risk assessment and risk management. Relative to other stakeholders, less farmer leaders (58.00%, ± 6.48) give agri-biotech companies a high trust rating. Nearly 70% (68.80%, ± 8.19) of journalists rate agri-

⁵ These institutions or societal 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, h) Research institutes, and i) Regulatory bodies.

biotech companies as having a perceived responsibility in conducting risk assessment and risk management.

TABLE 6: INSTITUTIONS PERCEIVED AS RESPONSIBLE FOR RISK ASSESSMENT & RISK MANAGEMENT⁶ (PERCENTAGE REPORT ON TOTALLY RESPONSIBLE)

Stakeholder (n=365)	Institutions								
	University scientists	Private sector scientists	Agri-biotech companies	Consumer groups & NGOs	Nat'l farm leadrs	Mass media	Religious groups	Research institutes	Regulatory bodies
Consumers	79.00 ± 4.07 ^{b,e,p}	77.00 ± 4.21 ^{e,p,s}	85.00 ± 3.57 ^{e,p,s}	75.00 ± 4.33 ^{e,s}	58.00 ± 4.94 ^{b,e,f,p,s}	58.00 ± 4.94 ^{b,e,p,s}	25.00 ± 4.43	72.00 ± 4.49	83.00 ± 3.76
Businessmen	74.00 ± 6.20 ^{c,e}	60.00 ± 6.93 ^j	74.00 ± 6.20 ^{j,p,s}	50.00 ± 7.07 ^{j,p}	46.00 ± 7.04 ^{c,e,f,p,s}	50.00 ± 7.07 ^{c,e,j,p,s}	28.00 ± 6.35	90.00 ± 4.24	78.00 ± 5.86
Extension workers	83.40 ± 4.80 ^{c,b,p}	83.20 ± 4.83 ^{c,p,s}	86.70 ± 4.38 ^{c,p,s}	73.30 ± 5.71 ^{c,s}	53.30 ± 6.44 ^{c,b,f,p,s}	60.00 ± 6.32 ^{c,b,s}	38.30 ± 6.28	81.60 ± 5.00	90.00 ± 3.87
Farmer leaders	56.00 ± 7.02 ^j	42.00 ± 6.98	58.00 ± 6.48	28.00 ± 6.35	56.00 ± 7.02 ^{c,e,s}	30.00 ± 6.48 ^j	20.00 ± 5.66	62.00 ± 6.86	80.00 ± 5.66
Journalists	50.00 ± 8.84 ^f	59.40 ± 8.68 ^b	68.80 ± 8.19 ^{b,s}	53.20 ± 8.82 ^{b,p,s}	40.10 ± 8.66	<i>Not asked</i>	21.90 ± 7.31	68.80 ± 8.19	84.40 ± 6.41
Policy makers	86.10 ± 5.28 ^{c,e}	86.00 ± 5.29 ^{c,e}	83.70 ± 5.63 ^{c,b,e,s}	55.80 ± 7.57 ^{b,j,s}	41.90 ± 7.52 ^{b,e,s}	46.60 ± 7.61 ^{c,b,j,s}	25.70 ± 6.66	95.40 ± 3.19	81.40 ± 5.93
Scientists	96.70 ± 3.26	86.70 ± 6.20 ^{c,e}	76.70 ± 7.72 ^{c,b,e,j,p}	63.30 ± 8.80 ^{c,e,j,p}	53.30 ± 9.11 ^{c,b,e,f,p}	56.60 ± 9.05 ^{c,b,e,p}	23.30 ± 7.72	80.00 ± 7.30	59.90 ± 8.95

E. Role of science in Thailand's agricultural development

Role of science in agricultural development. The overall mean rating of 6.19 across stakeholders in Thailand suggests a very high and unanimous regard for the pivotal role of science in the development of Thailand's agriculture (Table 7a). Over 90% of extension workers (\bar{x} =6.68 ± .101), policy makers (\bar{x} =6.51 ± .13), scientists (\bar{x} =6.50 ± .16), consumers (\bar{x} =6.21 ± .09), and businessmen (\bar{x} =6.18 ± .14) have all expressed high appreciation for the role of science in Thailand's agriculture. None of the consumers, businessmen, and extension workers has said that science's role in Thailand's agricultural development is not at all important.

⁶ The top choices of each stakeholder are in bold.

Comparatively less number among journalists (81.30%, \pm 6.89) and farmer leaders (64%, \pm 6.79) believes that science is important in agricultural development. It should also be noted that less than 4.00% each of farmer leaders, journalists, policy makers, and scientists thinks that science is not at all critical to agricultural development in Thailand.

There is no relationship between journalistic assessment of the role of science and their judgment about the newsworthiness of biotechnology ($p > 0.05$). In Table 7b, significant correlation between the regard for science and the level of interest in biotechnology can be noted among businessmen ($r = 0.41$; $p \leq 0.01$) and farmer leaders ($r = 0.48$; $p \leq 0.001$). There is also a significant association between businessmen's regard for science and their perceived benefits of biotechnology ($r = 0.35$; $p \leq 0.05$).

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

Stakeholder (n=365)	Mean rating (\pm s.e., max7)	Not at all Important	Somewhat important	Very important
Consumers (100)	6.21 \pm 0.09 ^{bc}	- 0 -	8.00 \pm 2.71	92.00 \pm 4.54 ^{fj}
Businessmen (50)	6.18 \pm 0.14 ^{bc}	- 0 -	8.00 \pm 3.84	92.00 \pm 3.84 ^{fj}
Extension Workers (60)	6.68 \pm 0.10 ^a	- 0 -	3.30 \pm 2.31	96.70 \pm 2.31 ^{fj}
Farmer Leaders (50)	5.28 \pm 0.23 ^d	2.00 \pm 1.98	32.00 \pm 6.60	64.00 \pm 6.79 ^{c,b,e,j,p,s}
Journalists (32)	5.91 \pm 0.27 ^c	3.10 \pm 3.06	12.50 \pm 5.85	81.30 \pm 6.89 ^{c,b,e,f,p,s}
Policy Makers (43)	6.51 \pm 0.13 ^{ab}	2.30 \pm 2.29	- 0 -	97.70 \pm 2.23 ^{fj}
Scientists (30)	6.50 \pm 0.16 ^{ab}	3.30 \pm 3.26	- 0 -	96.70 \pm 3.26 ^{fj}

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

Stakeholder (n=365)	Interest in biotechnology & Role of science	Perceived benefits of biotechnology & Role of science
Consumers (100)	0.03366	0.19363
Businessmen (50)	0.41426^b	0.35466^c
Extension Workers (60)	-0.00634	-0.15307
Farmer Leaders (50)	0.48606^a	0.17274
Journalists (32)	0.03198	0.00729
Policy Makers (43)	0.04866	-0.06088
Scientists (30)	0.09831	0.04252

^a Significant at .001 level; ^b Significant at .01 level; ^c Significant at .05 level

F. Understanding of science and biotechnology

Self-rate understanding of science. Thailand's stakeholders assess their understanding of science as moderate (\bar{x} =4.10). Policy makers consider their understanding of science as quite high (\bar{x} =5.23 \pm 0.178), with 74.40% (\pm 6.66) saying that they do have a very good understanding of science (Table 8). Only 7% (\pm 3.89) of policy makers believe that they have a poor grasp of science. Thailand's businessmen (\bar{x} =4.88 \pm 0.20; 58.00%, \pm 6.98) follow the policy makers in reporting a good grasp of science.

On the other hand, farmer leaders think that they have a poor understanding of science (\bar{x} =2.74 \pm 0.24). Only 12% (\pm 4.60) are confident about their understanding of science, and over 52.00% (\pm 7.07) say they have a poor grasp of science.

Thailand's extension workers believe that they have a moderate understanding of science (\bar{x} =4.00 \pm 0.187). In assessing their understanding of science, nearly one-third of the extension workers (33.30%, \pm 6.04) give themselves a low rating, while 38.30%, \pm 6.28) think that they have a good understanding of science.

Thailand's journalists show a below moderate mean rating (\bar{x} =3.63 \pm 0.22), with 37.60% (\pm 8.56) saying that they have a rather poor understanding of science. There is no significant relationship between the journalists' self-estimate of their understanding of science and their rating of the newsworthiness of biotechnology.

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

Stakeholders (n=365)	Mean rating (\pm s.e., max7)	Low	Moderate	High
Consumers (100)	4.10 \pm 0.121 ^b	26.00 \pm 4.38	36.00 \pm 4.80	38.00 \pm 4.85 ^{b,f,j,p}
Businessmen (50)	4.88 \pm 0.20 ^a	18.00 \pm 5.43	24.00 \pm 6.04	58.00 \pm 6.98 ^{c,e,f,j,p}
Extension Workers (60)	4.00 \pm 0.187 ^b	33.30 \pm 6.04	28.30 \pm 5.81	38.30 \pm 6.28 ^{b,f,j,p}
Farmer Leaders (50)	2.74 \pm 0.24 ^c	52.00 \pm 7.07	36.00 \pm 6.79	12.00 \pm 4.60 ^{c,b,e,p}
Journalists (32)	3.63 \pm 0.22 ^b	37.60 \pm 8.56	43.80 \pm 8.77	18.80 \pm 6.91 ^{c,b,e,p}
Policy Makers (43)	5.23 \pm 0.178 ^a	7.00 \pm 3.89	18.60 \pm 5.93	74.40 \pm 6.66 ^{c,b,e,f,j}
Scientists (30)	Not asked	-0-	-0-	-0-

Self-rate knowledge of biotechnology. When it comes to qualifying their knowledge of biotechnology, nearly two-thirds of stakeholders tend to consider themselves as having near moderate understanding, with overall mean ratings of 3.94 (Table 9). Policy makers (\bar{x} =4.74 ± .159) and scientists (\bar{x} =4.63 ± 0.21) show comparatively higher mean ratings.

Only 4.00% (± 2.77) of farmer leaders claim they know a lot about biotechnology, while 40.00% (± 6.93) say they know very little. Over two-thirds (± 5.92) of extension workers think that they have a moderate understanding of biotechnology. Only 7.00% (± 3.21) believe they have a high understanding of biotechnology, and 23.30% (±5.46) say that they have a very poor understanding of biotechnology.

Even among scientists, only 13.40% (± 6.22) say that they know a lot about biotechnology. This number is significantly lower than policy makers (21.00%, ± 6.21) and just slightly above those of journalists (9.40%, ± 5.16). Likewise, there are more scientists (10.00%, ± 5.48) reporting that they do not know much about biotechnology compared to policy makers (9.30%, ± 4.43).

A little over half of the journalists (53.10%, ± 8.82) claim to have a moderate knowledge of biotechnology. More than one-third, however, says that they do not know much about biotechnology. There is a significant relationship between the journalists' self-rating of their knowledge of biotechnology and their assessment of biotechnology as news ($r=0.38$; $p\leq 0.05$).

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

Stakeholders (n=365)	Mean rating (± s.e., max 7)	Low	Moderate	High
Consumers (100)	3.69 ± 0.144 ^{cd}	37.00 ± 4.83	56.00 ± 4.96	7.00 ± 2.55 ^{b,p}
Businessmen (50)	4.54 ± 0.18 ^{ab}	18.00 ± 5.43	56.00 ± 7.02	26.00 ± 6.20 ^{c,e,f,j,s}
Extension Workers (60)	4.10 ± 0.147 ^{bc}	23.30 ± 5.46	70.00 ± 5.92	6.60 ± 3.21 ^{b,p,s}
Farmer Leaders (50)	3.18 ± 0.21 ^d	40.00 ± 6.93	56.00 ± 7.02	4.00 ± 2.77 ^{b,p,s}
Journalists (32)	3.56 ± 0.27 ^{cd}	37.50 ± 8.56	53.10 ± 8.82	9.40 ± 5.16 ^{p,b}
Policy Makers (43)	4.74 ± 0.159 ^a	9.30 ± 4.43	69.70 ± 7.01	21.00 ± 6.21 ^{j,f,e,c}
Scientists (30)	4.63 ± 0.21	10.00 ± 5.48	76.70 ± 7.72	13.40 ± 6.22 ^{b,f}

Factual knowledge on biotechnology⁷. In general, Thailand's stakeholders have low to moderate scores on a set of twelve statements that quizzed them on what they know about biotechnology (Table 10a). Low scores range from 0-6, moderate scores are from 7-9, and high scores are from 10-12. The overall factual knowledge mean score is 6.75.

Among the stakeholders, majority of farmer leaders ($\bar{x}=4.48 \pm 0.35$) report the lowest scores (82.00%, ± 5.43) on factual knowledge of biotechnology, with only 6.00% receiving high scores. Policy makers have the highest mean scores ($\bar{x}= 9.09 \pm .291$). Close to 47% (± 7.61) has garnered high scores. They are followed by extension workers whose mean score is 7.65 ($\pm .206$) and businessmen ($\bar{x}=7.48 \pm .31$). Just slightly over half of the consumers and journalists have low scores.

Significant correlation between factual knowledge and interest in biotechnology can be observed among farmer leaders ($r=0.40$; $p\leq 0.01$) and journalists ($r= 0.51$; $p\leq 0.01$). There is a significant relationship between factual knowledge and belief in the role of science in agriculture, and this can be seen among farmer leaders ($r=0.37$; $p\leq 0.01$) and policy makers ($r=0.47$; $p\leq 0.01$).

Among journalists, there is a significant relationship between their level of factual knowledge and their concern about biotechnology ($r=0.45$; $p\leq 0.01$).

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

<i>Stakeholders (n=365)</i>	<i>Mean score (\pm s.e., max 12)</i>	<i>Low</i>	<i>Moderate</i>	<i>High</i>
Consumers (100)	6.13 \pm 0.241	52.00 \pm 5.00	41.00 \pm 4.92	7.00 \pm 2.55 ^P
Businessmen (50)	7.48 \pm 0.31	26.00 \pm 6.20	62.00 \pm 6.86	12.00 \pm 4.59 ^P
Extension Workers (60)	7.65 \pm 0.206	23.30 \pm 5.46	63.30 \pm 6.22	13.40 \pm 4.40 ^P
Farmer Leaders (50)	4.48 \pm 0.35	82.00 \pm 5.43	12.00 \pm 4.60	6.00 \pm 3.36 ^P
Journalists (32)	6.25 \pm 0.43	50.10 \pm 8.84	43.80 \pm 8.77	6.30 \pm 4.30 ^P
Policy Makers (43)	9.09 \pm 0.291	4.60 \pm 3.19	48.90 \pm 7.62	46.50 \pm 7.61 ^{c,b,e,f,j}
Scientists (30)	Not asked			

⁷ 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 10B: CORRELATION TABLE BETWEEN FACTUAL KNOWLEDGE ON BIOTECHNOLOGY AND KEY VARIABLES

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

<i>Stakeholder (n=365)</i>	<i>Knowledge & Interest</i>	<i>Knowledge & Concern</i>	<i>Knowledge & Perceived Risks</i>	<i>Knowledge & Perceived Benefits</i>	<i>Knowledge & Perceived role of science</i>
Consumers (169)	0.09808	0.01564	0.04817	0.17469	0.17404
Businessmen (54)	0.23789	0.15558	0.02253	0.22602	0.24515
Extension Workers (92)	0.15090	-0.06619	0.01044	-0.18632	0.03630
Farmer Leaders (57)	0.40588^b	0.01106	0.06051	-0.07499	0.37158^b
Journalists (44)	0.51592^b	0.45429^b	0.25467	0.10712	0.09658
Policy Makers (97)	-0.04144	-0.01601	-0.19216	-0.08667	0.47349^b

^a Significant at .001 level; ^b Significant at .01 level; ^c Significant at .05 level

G. Attitudes toward biotechnology

Attitudes toward agricultural biotechnology⁸. Generally, Thailand’s stakeholders hold a moderate stance on biotechnology (Table 11a). Their overall mean attitude score is 55.29. Attitudinal scores are classified as low (negative), moderate, and high (positive). High scores are in the range of 76-100, moderate scores are between 51-75, and low scores are from 25-50.

Very few respondents exhibit high attitudinal scores that are indicative of positive feelings or opinions about biotechnology. There are, in fact, no journalists, farmer leaders, and scientists who have expressed highly favorable attitudes towards biotechnology. The individual mean attitude scores may be more accurate in showing where the stakeholders’ positions are vis-à-vis biotechnology.

⁸ 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 .000 level of significance.

Policy makers show the highest mean score of 64.26 (± 1.13), followed by businessmen ($\bar{x}=57.30 \pm 2.06$), extension workers ($\bar{x}=56.03 \pm 1.34$), consumers ($\bar{x}=54.33 \pm 1.28$, and farmer leaders ($\bar{x}=51.98 \pm 1.45$).

Comparatively low mean scores can be noted among journalists ($\bar{x}=46.88 \pm 2.71$). There is no significant relationship between the journalists' attitudes towards biotechnology and their assessment of the newsworthiness of biotechnology.

There are a number of significant associations between attitudes towards biotechnology and some key variables. Among businessmen, there is a significant relationship between attitudes towards biotechnology and a) their interest in biotechnology ($r=0.36$; $p\leq 0.05$), b) factual knowledge of biotechnology ($r=0.35$; $p\leq 0.05$), and c) their belief in the role of science in agriculture ($r=0.48$; $p\leq 0.001$).

Significant relationships can be noted in extension workers' attitude towards biotechnology and a) their concern about biotechnology issues ($r=0.35$; $p\leq 0.001$) and b) factual knowledge on biotechnology ($r=0.37$; $p\leq 0.01$).

There is a significant relationship between farmer leaders' attitudes towards biotechnology and their interest in biotechnology ($r=0.36$; $p\leq 0.05$). Among journalists, attitudes are related to their interest ($r=0.41$; $p\leq 0.01$), perceived benefits ($r=0.036$; $p\leq 0.05$) and factual knowledge of biotechnology ($r=0.43$; $p\leq 0.01$).

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

<i>Stakeholder (n=365)</i>	<i>Mean score ($\pm s.e.$, max 100)</i>	<i>Low (25-50)</i>	<i>Moderate (51-75)</i>	<i>High (76-100)</i>
Consumers (100)	54.33 \pm 1.28	27.00 \pm 4.44	70.00 \pm 4.58	1.00 \pm .99 ^{b,e,j}
Businessmen (50)	57.30 \pm 2.06	24.00 \pm 6.04	68.00 \pm 6.60	6.00 \pm 3.36 ^c
Extension Workers (60)	56.03 \pm 1.34	20.00 \pm 5.16	78.30 \pm 5.32	7.00 \pm 3.29 ^c
Farmer Leaders (50)	51.98 \pm 1.45	44.00 \pm 7.02	56.00 \pm 7.02	- 0-
Journalists (32)	46.88 \pm 2.71	34.50 \pm 8.40	53.10 \pm 8.82	- 0-
Policy Makers (43)	64.26 \pm 1.13	4.70 \pm 3.23	88.40 \pm 4.88	6.90 \pm 3.87 ^c
Scientists (30)	Not asked			

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

<i>Stakeholder (n=365)</i>	<i>Attitude & Interest</i>	<i>Attitude & Concern</i>	<i>Attitude & Perceived Risks</i>	<i>Attitude & Perceived Benefits</i>	<i>Attitude & Factual knowledge</i>	<i>Attitude & Perceived role of science</i>
Consumers (100)	0.17028	0.09960	0.13248	0.09147	0.22988^c	-0.00722
Businessmen (50)	0.35766^c	0.23180	-0.13070	0.28477 ^c	0.35131^c	0.48167^a
Extension Workers (60)	0.08487	-0.35138^a	-0.12548	-0.01050	0.36966^b	-0.09030
Farmer Leaders (50)	0.35913^c	-0.00865	-0.00463	0.22851	0.26348	0.44011^a
Journalists (32)	0.41083^b	0.25372	0.18970	0.35744^c	0.43603^b	0.31464
Policy Makers (43)	0.32777 ^c	0.13068	-0.26515	0.01503	0.06352	-0.04121

^a Significant at .001 level; ^b Significant at .01 level; ^c Significant at .05 level

These attitudinal scores, however, are a composite of twenty-five questionnaire items. How stakeholders respond to specific questionnaire items may provide more useful and revealing insights about their positions in relation to agricultural biotechnology. The following data look 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. Over half of the businessmen (64.00%, ± 6.79) and policy makers (62.80%, ± 7.37) disagree with the notion of contributing their own resources to ban GM foods. Exactly fifty percent each of the farmer leaders (± 7.07) and the journalists (± 8.84) take the opposing stance (Table 12).

Other stakeholders appear to be undecided about their position on banning GM foods. While 50% of the farmer leaders and journalists have expressed agreement to contributing time and money towards banning GM foods, it should also be noted that there is a preponderance of "Don't know" responses. For instance, 37.50% of the journalists, 31.60% of extension workers, and 28% of farmer leaders surveyed claim that they "Don't know" or are unsure of their position. Although consumers are seemingly divided on their answers, with 40% saying they agree with contributing time and money towards banning GM foods and 35% expressing disagreement, a sizable 25% has not taken a position on the issue.

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

Stakeholder (n=365)	Mean score (\pm s.e, max 4)*	Agree	Disagree
Consumers (100)	1.84 \pm 0.128	40.00 \pm 4.90 ^{b,p}	35.00 \pm 4.77
Businessmen (50)	2.72 \pm 0.17	26.00 \pm 6.20 ^{c,e,f,j}	64.00 \pm 6.79
Extension Workers (60)	1.81 \pm 0.175	41.70 \pm 6.37 ^{b,p}	26.70 \pm 5.71
Farmer Leaders (50)	1.96 \pm 0.20	50.00 \pm 7.07 ^{b,p}	22.00 \pm 5.86
Journalists (32)	1.81 \pm 0.27	50.00 \pm 8.84 ^{b,p}	12.50 \pm 5.85
Policy Makers (43)	2.51 \pm 0.112	34.90 \pm 7.27 ^{c,e,f,j}	62.80 \pm 7.37
Scientists (30)	Not asked		

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

b) GM foods should be labeled. An overwhelming majority of Thailand's stakeholders agrees with the idea of labeling GM foods (Table 13). Extension workers totally agree with labeling, followed by consumers (95.00%, \pm 2.18), and farmer leaders (84.00%, \pm 5.18). Nearly 75% of businessmen and journalists also concur with the notion of labeling GM foods. On the other hand, close to 70% of Thailand's policy makers believe that GM foods should not be labeled.

The position taken by most stakeholders that labeling is good does not come as a surprise given the current need of citizens to have the right to know about the food they eat.

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

Stakeholder (n=365)	Mean score (\pm s.e, max 4)	Agree	Disagree
Consumers (100)	3.44 \pm 0.07	95.00 \pm 2.18 ^{b,f,p}	3.00 \pm 1.70
Businessmen (50)	2.94 \pm 0.17	74.00 \pm 6.20 ^{s,j,f,p}	18.00 \pm 5.43
Extension Workers (60)	3.71 \pm 0.05	100.00	-0-
Farmer Leaders (50)	3.16 \pm 0.17	84.00 \pm 5.18 ^{c,b,j,p}	8.00 \pm 3.84
Journalists (32)	2.13 \pm 0.09	75.00 \pm 7.65	18.00 \pm 6.79
Policy Makers (43)	1.93 \pm 0.13	25.60 \pm 6.65 ^{c,b,f,j}	69.80 \pm 7.00
Scientists (30)	Not asked		

c) Agricultural biotechnology will not benefit small farmers. Majority of the farmer leaders (64.00%, ± 6.79), and consumers (60.00%, ± 4.90) stakeholders believe that agricultural biotechnology will benefit farmers. Quite a sizable number of journalists (68.80%) also think that it will bring benefit to the small farmers. Just over half of the businessmen (58.00%, ± 6.98) and extension workers (55.00%, ± 6.42) believe that biotechnology will bring benefits to the small farmers.

However, a good number of respondents have also said that they “Don’t know” or are not sure about their position on this issue. This includes 21.80% of journalists, 15% of the consumers, 16% of farmer leaders, and 14% of businessmen.

Thailand’s policymakers are clearly divided on this issue: while 48.80% (± 7.62) believe that biotechnology will benefit small farmers, another 48.80% disagree with the idea (Table 14).

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

Stakeholder (n=365)	Mean score (\pm s.e, max 4)*	Agree	Disagree
Consumers (100)	1.74 \pm 0.074	25.00 \pm 4.33 ^{b,e,j,p}	60.00 \pm 4.90
Businessmen (50)	2.26 \pm 0.17	28.00 \pm 6.35 ^{c,f,j}	58.00 \pm 6.98
Extension Workers (60)	2.30 \pm 0.137	38.30 \pm 6.28 ^{c,f,j}	55.00 \pm 6.42
Farmer Leaders (50)	1.70 \pm 0.15	20.00 \pm 5.66 ^{b,e,p}	64.00 \pm 6.79
Journalists (32)	1.47 \pm 0.17	9.40 \pm 5.16 ^{b,e,p}	68.80 \pm 8.19
Policy Makers (43)	2.25 \pm 0.129	48.80 \pm 7.62 ^{e,f,j}	48.80 \pm 7.62
Scientists (30)	Not asked		

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

d) Biotechnology is good for Thailand agriculture. On the surface, it looks like at least 50% of the respondents across stakeholders agree with this statement (Table 15). The extension workers (81.70% \pm 4.99), policy makers (81.40%, \pm 5.93), and farmer leaders (80.00%, \pm 5.66) have very positive thoughts about the value of agricultural biotechnology in the country. Based on the mean scores, the least support for this statement comes from journalists (\bar{x} =1.75 \pm 0.25), although at least half still said they agree that biotechnology is good for Thailand agriculture.

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

Considerable support for biotechnology’s role in Thailand agriculture is still noticeable among businessmen (68.00%, \pm 6.59) and consumers (53.00%, \pm 4.99).

However, these numbers should be interpreted with caution and must consider the sizeable “Don’t know” responses from consumers (23%), businessmen (20%), extension workers (10%), farmer leaders (16%), and policy makers (7%). A little over one-third of the journalists surveyed have indicated that they are not sure about their position on this issue.

*TABLE 15: BIOTECHNOLOGY IS GOOD FOR THAILAND AGRICULTURE.
(MEAN SCORES AND PERCENTAGE DISTRIBUTION)*

<i>Stakeholder (n=365)</i>	<i>Mean score (\pm s.e, max 4)</i>	<i>Agree</i>	<i>Disagree</i>
Consumers (100)	2.13 \pm 0.130	53.00 \pm 4.99 ^{b,e,f,p}	24.00 \pm 4.27
Businessmen (50)	2.54 \pm 0.20	68.00 \pm 6.59 ^{c,e,f,j,p}	12.00 \pm 4.59
Extension Workers (60)	3.05 \pm 0.158	81.70 \pm 4.99 ^{c,b,j}	8.40 \pm 4.73
Farmer Leaders (50)	2.72 \pm 0.18	80.00 \pm 5.66 ^{c,b}	4.00 \pm 2.77
Journalists (32)	1.75 \pm 0.25	50.00 \pm 8.84 ^{b,e,f,p}	15.70 \pm 6.43
Policy Makers (43)	2.88 \pm 0.16	81.40 \pm 5.93 ^{c,b,e,j}	11.60 \pm 4.88
Scientists (30)	Not asked		

e) Current biotechnology regulations in Thailand are sufficient. Majority of the stakeholders believe that there are insufficient biotechnology regulations in Thailand (Table 16). Most of the journalists (65.00%, \pm 8.40) do not think that the regulations are adequate. Consumers (60.00%, \pm 4.90), businessmen (58.00%, \pm 6.98), a little over half of the extension workers and farmer leaders share this opinion with journalists.

Thailand’s policymakers are clearly divided on this issue with almost equal numbers of respondents agreeing (46.50%, \pm 7.61) and disagreeing (48.90%, \pm 7.62).

The number of “Don’t know” answers should be accounted for in interpreting these trends. Nearly 30% of the journalists and about 20% of the businessmen and extension workers have not taken a position on the issue.

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

Stakeholder (n=365)	Mean score (\pm s.e, max 4)	Agree	Disagree
Consumers (100)	1.82 \pm 0.10	25.00 \pm 4.33 ^{f,j,p}	60.00 \pm 4.90
Businessmen (50)	1.48 \pm 0.15	16.00 \pm 5.18 ^{f,p}	58.00 \pm 6.98
Extension Workers (60)	1.65 \pm 0.146	23.30 \pm 5.46 ^{f,j,p}	55.00 \pm 6.42
Farmer Leaders (50)	2.02 \pm 0.16	36.00 \pm 6.79 ^{c,b,j}	50.00 \pm 7.07
Journalists (32)	1.13 \pm 0.16	6.30 \pm 4.30 ^{c,e,p}	65.60 \pm 8.40
Policy Makers (43)	2.44 \pm 0.14	46.50 \pm 7.61 ^{c,b,e,j}	48.90 \pm 7.62
Scientists (30)	Not asked	0	0

f) I will pay extra cost for labeling GM food. As can be noted in Table 13, there is strong agreement among Thailand's stakeholders on the notion that GM foods should be labeled (Table 13). However, the hesitancy shows among stakeholders when asked about their willingness to pay the extra cost for labeling GM foods (Table 17). There is on average a 30-point drop in the percentage of respondents willing to support the notion of paying up for the extra cost for labeling GM foods. Extension workers, consumers, journalists and farmer leaders for example, who have expressed an overwhelming support for labeling GM food now find these numbers down to 51.70% (\pm 6.45), 66.00% (\pm 4.74), 46.90% (\pm 8.82), and 48.00% (\pm 7.06).

Remarkably, policy makers who disagree for the most part on labeling are the ones who tend to agree most with paying the extra cost for labeling GM foods.

Most of the "Don't know" answers come from 26% of businessmen, 22% of farmer leaders, 15.60% of journalists, and 11.60% of extension workers.

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

Stakeholder (n=365)	Mean score (\pm s.e, max 4)	Agree	Disagree
Consumers (100)	2.57 \pm 0.101	66.00 \pm 4.74 ^{b,e,f,j,p}	26.00 \pm 4.39
Businessmen (50)	2.04 \pm 0.20	46.00 \pm 7.05 ^{c,p}	28.00 \pm 6.35
Extension Workers (60)	2.28 \pm 0.148	51.70 \pm 6.45 ^{c,p}	36.70 \pm 6.22
Farmer Leaders (50)	2.14 \pm 0.19	48.00 \pm 7.06 ^{c,p}	30.00 \pm 6.48
Journalists (32)	2.13 \pm 0.21	46.90 \pm 8.82 ^{c,p}	37.50 \pm 8.56
Policy Makers (43)	2.93 \pm 0.13	81.40 \pm 5.93 ^{c,b,e,f,j}	16.30 \pm 5.63
Scientists (30)	Not Asked	-0-	-0-

H. Information sources: Use, Exposure, and Trust

Types and frequency of media used. The surveys ask respondents about their sources of information on biotechnology and what sources of information they trust most. Looking at the top three most frequently used or consulted information sources of the seven stakeholders¹⁰, it appears that Thailand's stakeholders do not generally seek and use information relating to biotechnology (Table 18a). On using the general mass media (i.e., radio, television, and newspapers), policy makers are the most exposed to agri-biotech news with 62.80% (± 7.37) giving responses in the high category. Less than half of farmer leaders (44.00%, ± 7.02) and scientists (40.00%, ± 8.94) say that they are high users of the tri-media when seeking information on biotechnology. Even fewer extension workers (33.30%, ± 6.08), consumers (26.00%, ± 4.39) and businessmen (14.00%, ± 4.91) are exposed to the media. Ironically, journalists have the lowest exposure to agri-biotech in the media at 12.50% (± 5.85).

In terms of talking to family, friends, neighbors or colleagues about agri-biotech, less than half of policy makers (46.50%, ± 7.61) and scientists (43.30%, ± 9.05) report discussing it with family, friends or neighbors frequently. Only 30.00% (± 6.48) of farmer leaders and 20.00% (± 5.66) of businessmen talk about the topic highly with their social circle. Even less journalists (12.50%, ± 5.85) and consumers (8.00%, ± 2.71) discuss the topic highly and no extension worker discussed or heard about it highly.

Religious figures are not a source of agri-biotech information for Thailand stakeholders. Only 8.00% (± 3.84) of farmers, 3.30% (± 3.26) of scientists and 1.00% (± 0.99) of consumers have talked to or heard a religious figure talk about it positively. The other stakeholders claim that they do not hear or talk to a religious figure about the topic.

Another possible source of information is talking to or hearing from experts, professionals or scientists about agri-biotech. The highest percentage of respondents who give a high answer comes from policy makers (48.80%, ± 7.62), followed by scientists (30.00%, ± 8.37) and businessmen (22.00% ± 5.86). Only 11.70% (± 4.15) of consumers, 9.40% (± 5.16) of journalists

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

and 6.00% (± 3.36) give a high answer in this category. The least number of high answers comes from consumers (5.00%, ± 2.18).

Contrary to a wide belief that NGOs rule the discourse on biotechnology, only 27.90% (± 6.84) of policy makers and 26.00% (± 6.20) of businessmen talk to or hear from NGOs highly. There is even less interaction between NGOs and scientists (16.70%, ± 6.81), farmer leaders (10.00%, ± 4.24) and journalist (9.40%, ± 5.16). The least amount of interaction is with consumers (4.00%, ± 1.96) and extension workers (3.30%, ± 2.31).

Politicians appear to be even less active than NGOs with only 12.00% (± 4.60) of farmer leaders saying that they talk to or hear from politicians highly. Even less policy makers (4.70%, ± 3.23) and businessmen (2.00%, ± 1.98) have given high answers to this variable. None of the other stakeholders say that they have seriously (highly) consulted with politicians on biotechnology.

In terms of accessing a website on biotechnology, slightly less than half (48.80%, ± 7.62) of policy makers have accessed a website on biotechnology often (highly). A significantly less number of scientists (26.70%, ± 8.08) and businessmen (20.00%, ± 5.66) have done the same. Only a few extension workers (6.70%, ± 3.24), consumers (5.00%, ± 2.18) and journalists (3.10%, ± 5.66) access a website highly. The least number comes from farmer leaders at 2.00% (± 1.98).

Policy makers have read the most with 27.90% (± 6.84) saying they have read books on biotechnology (highly rate this source), closely followed by extension workers (26.70%, ± 5.71) and scientists (26.70%, ± 8.08). A significantly less number of businessmen (14.00%, ± 4.91), farmer leaders (10.00%, ± 4.24) and journalists (9.40%, ± 5.16) read books on biotechnology highly. The least number of consumers (4.00%, ± 1.96) do the same.

The highest percentage of stakeholders who read newsletters, pamphlets or brochures on biotechnology, and rate them highly as a source of information, comes from policy makers (34.90%, ± 7.27), scientists (26.70%, ± 8.08) and businessmen (20.00%, ± 5.66), but all are at relatively low levels. Significantly lower responses come from extension workers (10.00%, ± 3.87), farmer leaders (8.00%, ± 3.84) and consumers (4.00%, ± 1.96). The least number of respondents have highly read newsletters, pamphlets, or brochures on biotechnology come from journalists at 3.10% (± 3.06).

Only 27.90% (± 6.84) of policy makers talk to or hear from food regulators frequently (highly) with farmer leaders coming next at 10.00% (± 4.24). Food regulators have also interacted with 6.70% (± 4.56) of scientists, 6.30% (± 4.30) of journalists and 4.00% (± 2.77) of businessmen highly. The least number of high responses came from extension workers (1.70%, ± 1.67) and consumers (1.00, ± 0.99).

Policy makers attend the most number of seminars with 20.90% (± 6.20) saying they do so often (highly), with scientist (13.30%, ± 6.20) and journalists (9.40%, ± 5.16) coming next. The number of farmer leaders (8.00%, ± 3.84), businessmen (8.00%, ± 3.84) and extension workers (6.70% ± 3.23) are close to each other. The least number of consumers (2.00%, ± 1.40) have attended seminars (highly only).

Only a small number of Thailand's stakeholders talk to or hear from agri-biotech companies (as rated highly). The highest percentage comes from policy makers (8.00%, ± 3.84) followed by extension workers (11.70%, ± 4.15). An even smaller number of farmer leaders (8.00%, ± 3.84), businessmen (8.00%, ± 3.84), scientists (6.70%, ± 4.56) and journalists (6.30%, ± 4.30) interact with agri-biotech companies highly. The least number comes from consumers at 3.00% (± 1.71).

TABLE 18A: INFORMATION SOURCES USED¹¹ (REPORT ON HIGHEST USAGE ONLY)

Information sources used	Stakeholder						
	Consumers	Businessmen	Extension	Farmer leaders	Journalists	Policy makers	Scientists
Tri-media	26.00 ± 4.39 ^{b,f,j,p,s}	14.00 ± 4.91 ^{c,e,f,p,s}	33.30 ± 6.08 ^{b,j,p}	44.00 ± 7.02 ^{c,b,j,p}	12.50 ± 5.85 ^{c,e,f,p,s}	62.80 ± 7.37 ^{c,b,e,f,j,s}	40.00 ± 8.94 ^{c,b,j,p}
Family/friends	8.00 ± 2.71 ^{b,f,p,s}	20.00 ± 5.66 ^{c,p,s}	-0-	30.00 ± 6.48 ^{c,j,p,s}	12.50 ± 5.85 ^{f,p,s}	46.50 ± 7.61 ^{c,b,f,j}	43.30 ± 9.05 ^{c,b,f,j}
Religious groups	1.00 ± 0.99 ^f	-0-	-0-	8.00 ± 3.84 ^{c,s}	-0-	-0-	3.30 ± 3.26 ^f
Experts	5.00 ± 2.18 ^{b,p,s}	22.00 ± 5.86 ^{c,e,f,j,p}	11.70 ± 4.15 ^{b,p,s}	6.00 ± 3.36 ^{b,p,s}	9.40 ± 5.16 ^{b,p,s}	48.80 ± 7.62 ^{c,b,e,f,j,s}	30.00 ± 8.37 ^{c,e,f,j,p}
NGOs	4.00 ± 1.96 ^{b,p,s}	26.00 ± 6.20 ^{c,e,f,j}	3.30 ± 2.31 ^{b,p,s}	10.00 ± 4.24 ^{b,p,s}	9.40 ± 5.16 ^{b,p}	27.90 ± 6.84 ^{c,e,f,j,s}	16.70 ± 6.81 ^{c,b,e,p}
Politicians	-0-	2.00 ± 1.98 ^f	-0-	12.00 ± 4.60 ^{b,p}	-0-	4.70 ± 3.23 ^f	-0-
Websites	5.00 ± 2.18 ^{b,p,s}	20.00 ± 5.66 ^{c,f,j,p,s}	6.70 ± 3.24 ^{b,p,s}	2.00 ± 1.98 ^{c,b,j,p,s}	3.10 ± 3.06 ^{b,p,s}	48.80 ± 7.62 ^{c,b,e,f,j}	26.70 ± 8.08 ^{c,e,f,j,p}
Books	4.00 ± 1.96 ^{b,e,p,s}	14.00 ± 4.91 ^{c,e,p,s}	26.70 ± 5.71 ^{c,b,j}	10.00 ± 4.24 ^{e,p,s}	9.40 ± 5.16 ^{c,p,s}	27.90 ± 6.84 ^{c,b,f,j}	26.70 ± 8.08 ^{c,b,f,j}
Pamphlets	4.00 ± 1.96 ^{b,p,s}	20.00 ± 5.66 ^{c,e,f,j,p,s}	10.00 ± 3.87 ^{b,p,s}	8.00 ± 3.84 ^{b,p,s}	3.10 ± 3.06 ^{b,p,s}	34.90 ± 7.27 ^{c,b,e,f,j}	26.70 ± 8.08 ^{c,e,f,j}
Regulators	1.00 ± 0.99 ^{f,p}	4.00 ± 2.77 ^p	1.70 ± 1.67 ^{f,p}	10.00 ± 4.24 ^p	6.30 ± 4.30 ^p	27.90 ± 6.84 ^{c,b,e,f,j,s}	6.70 ± 4.56 ^p
Seminars	2.00 ± 1.40 ^{b,f,j,p,s}	8.00 ± 3.84 ^{c,p,s}	6.70 ± 3.23 ^{p,s}	8.00 ± 3.84 ^{c,p,s}	9.40 ± 5.16 ^{c,p}	20.90 ± 6.20 ^{c,b,e,f,j,s}	13.30 ± 6.20 ^{c,b,e,p}
Ag companies	3.00 ± 1.71 ^{c,p}	8.00 ± 3.84 ^p	11.70 ± 4.15 ^{c,p}	8.00 ± 3.84 ^p	6.30 ± 4.30 ^p	18.60 ± 2.31 ^{c,b,e,f,j,s}	6.70 ± 4.56 ^p

Table 18b shows the average number, within a two-month period, that each of the stakeholders uses or receives 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.

¹¹ 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.

The results show that policy makers are the highest information seekers. They have the most number of contacts with special interpersonal sources of biotechnology information (9.93 times), special media contacts (5.91 times), proximate interpersonal contacts (2.77 times), and general media (2.77 times).

Businessmen, scientists, and journalists likewise exhibit high information-seeking behaviors. Businessmen report having sought out biotechnology information from special interpersonal contacts nearly 6 times and special media contacts nearly 4 times within the past two months. Scientists seek out biotechnology information from special interpersonal contacts 5.37 times and from special media contacts 4 times within the past two months.

Journalists use special interpersonal contacts 4.91 times and special media contacts 2.44 times in gathering information on biotechnology. Compared to other stakeholders, Thailand’s farmer leaders seek out information on biotechnology the least number of times, i.e. 3.74 times from special interpersonal contacts and 1.36 times from special media contacts.

*TABLE 18B: CATEGORIZED INFORMATION SOURCES USED¹²
(AVERAGE NUMBER OF TIMES SOURCES WERE USED WITHIN THE PAST TWO MONTHS)*

Stakeholder (n=365)	General media (Max. = 3)	Proximate interpersonal contacts (Max. = 3)	Special media contacts (Max. = 9)	Special interpersonal contacts (Max. = 21)
Consumers	1.79 ± 0.098	1.23 ± 0.093	2.58 ± 0.208	4.79 ± 0.427
Businessmen	1.86 ± 0.131	1.42 ± 0.151	3.98 ± 0.550	5.86 ± 0.730
Extension workers	1.95 ± 0.120	0.97 ± 0.098	3.93 ± 0.545	5.78 ± 0.728
Farmer leaders	1.76 ± 0.184	1.40 ± 0.174	1.36 ± 0.330	3.74 ± 0.728
Journalists	2.51 ± 0.112	2.16 ± 0.141	2.44 ± 0.431	4.91 ± 0.727
Policy makers	2.77 ± 0.124	2.77 ± 0.114	5.91 ± 0.352	9.93 ± 0.595
Scientists	1.79 ± 0.098	1.23 ± 0.093	4.00 ± 0.534	5.37 ± 0.725

¹² 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.

The use of or exposure to special media contacts is strongly associated with the use of or exposure to special interpersonal contacts as shown by the significant correlations between these two variables among all stakeholders (Table 18c). However, the use of these special media and interpersonal contacts are not always related to interest, concern, perceived risks and perceived benefits of biotechnology (Tables 18d and 18e).

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

Stakeholder (n=365)	General media & Proximate interpersonal contacts	Special media contacts & General media	Special interpersonal contacts & Proximate contacts	Special media & Special interpersonal contacts
Consumers	0.64328^a	0.41701^a	0.61765^a	0.32516^a
Businessmen	0.71592^a	0.28062^c	0.29607^c	0.54490^a
Extension workers	0.58895^a	0.02508	0.24286	0.13041
Farmer leaders	0.62269^a	0.24629	0.19951	0.44069
Journalists	0.77268^a	0.68062^a	0.55011^b	0.73526^a
Policy makers	0.58332^a	0.45987^b	0.34169^c	0.27354
Scientists	0.55808^b	0.12613	0.08127	0.00111

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

Stakeholder (n=365)	SMC & Interest	SMC & Concern	SMC & Perceived Risks	SMC & Perceived Benefits	SMC & Factual knowledge	SMC & Attitudes
Consumers	0.30427^b	0.14378	0.29154^b	-0.08223	0.03987	0.48386^a
Businessmen	0.11052	0.13616	-0.03622	-0.12862	0.19775	0.29075^c
Extension Workers	-0.16673	-0.05548	-0.10996	-0.04069	0.31483^c	0.28704
Farmer Leaders	0.17403	0.11833	0.16715	0.16198	0.09540	0.28172
Journalists	0.33340	-0.09338	0.19566	0.05041	0.07619	0.36057^c
Policy Makers	0.01879	-0.15836	-0.29714	-0.27846	0.41477^b	0.27402
Scientists	0.46059^c	0.29240	0.01860	0.16849	Not asked	Not asked

Is the usage of specialized sources of information on biotechnology related to stakeholders' interest, concern, perceptions of risks and benefits, knowledge and attitudes towards biotechnology? Looking at Tables 18d and 18e, it appears that special media and special interpersonal sources have a strong influence on how all stakeholders view biotechnology. It can only mean that active information seeking behaviors via these special channels do have an impact

on their assessments of biotechnology. The correlations between their use of special information sources and these key variables merit further examination about the specific types of media, social networks, and information that they seek in order to form their judgments about biotechnology. On the other hand, it should also be considered that these stakeholders are already predisposed to searching for information. Communication interventions will need to focus on encouraging extension workers, farmer leaders, and consumers to be more attentive to biotechnology issues.

Among consumers and scientists, strong and significant associations exist between their use of special media and their level of interest, perceived benefits and factual knowledge about biotechnology. It shows that the regularity of contact and presumably information search in specialized media have a bearing on how they think about biotechnology. The use of these special media sources particularly influence what consumers know about biotechnology and is associated with perceived risks of biotechnology suggesting that an increase in use of special media sources is accompanied by lower perceptions of the risks of biotechnology (Table 18e).

Special media contacts likewise have a bearing on the level of interest, factual knowledge, and attitudes towards biotechnology held by extension workers and policy makers.

TABLE 18E: CORRELATION BETWEEN SPECIAL INTERPERSONAL CONTACTS (SIC) AND KEY VARIABLES

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

Stakeholder (n=365)	SIC & Interest	SIC & Concern	SIC & Perceived Risks	SIC & Perceived Benefits	SIC & Factual Knowledge	SIC & Attitudes
Consumers	0.17967	0.15001	0.32008^b	0.04417	-0.06340	0.52430^a
Businessmen	0.23449	0.19251	0.02066	-0.05453	0.12804	0.10061
Extension Workers	-0.01591	0.01147	0.02568	-0.03490	0.29331^c	0.22081
Farmer Leaders	0.31375^c	-0.06026	-0.01523	0.40681^b	-0.03796	0.26964
Journalists	0.47020^b	-0.07591	0.37205^c	0.20746	0.17561	0.17561
Policy Makers	0.07730	0.02298	-0.20928	-0.26570	0.31049^c	0.15556
Scientists	0.45891^b	0.33440	0.07659	0.48348^b	Not asked	Not asked

Perceived trust in information sources. Amongst the most trusted information sources concerning biotechnology are university scientists and science magazines. University scientists are moderately to highly trusted by the stakeholders. They are most trusted by policy makers (76.80%, ± 6.25) and businessmen (76.00%, ± 6.04). Consumers (63.00%, ± 4.82), extension

workers (58.30%, ± 6.36) and journalists (53.20%, ± 8.82) still show relatively high trust in university scientists. Less than 50.00% of farmer leaders have indicated that they highly trust university scientists as sources of information on biotechnology.

Science publications enjoy highly trust as sources of information on biotechnology especially among businessmen (82.00%, ± 5.43) of businessmen and 80.00% (± 6.45) of extension workers signifying high trust. Still more than half of policy makers (58.20%, ± 7.52) and consumers (52.00%, ± 5.00) show high trust. However, only a relatively small number of journalists (± 7.52) and farmer leaders (± 7.52) trust science publications highly.

Private sector scientists do not enjoy as much trust than university scientists, although they still enjoy the confidence of policy makers (48.90%, ± 7.62) and consumers (47.00%, ± 3.75). Journalists and extension workers trust them the least.

Consumer groups/NGOs are trusted the most by consumers with 51.00% (± 5.00) signifying high trust. A significantly smaller number of extension workers 33.30% (± 6.08) and businessmen (32.00%, ± 6.60) indicate a high trust in these groups. Farmer leaders trust consumer groups and NGOs the least (16.00%, ± 5.18).

Biotech websites are trusted most by businessmen (62.00%, ± 6.86) and consumers (56.00%, ± 4.97). Less than half of policy makers (44.20%, ± 7.57), extension workers (31.70%, ± 6.01) and journalists (25.10%, ± 7.66) have reported high trust in agri-biotech websites. A very small number of farmer leaders (8.00%, ± 3.84) say they trust biotech websites highly.

*TABLE 19: TRUST IN SOURCES OF INFORMATION¹³
(PERCENTAGE REPORT ON HIGH TRUST)*

Information Sources (n=365)	Stakeholder					
	Consumers	Businessmen	Extension	Farmer leaders	Journalists	Policy makers
Agri-biotech companies	37.00 ± 4.83 ^{e,f,j,p}	32.00 ± 6.60 ^{e,f,j}	10.00 ± 3.87 ^{c,b,p}	10.00 ± 4.24 ^{c,b,p}	15.60 ± 6.41 ^{c,b,p}	41.90 ± 7.52 ^{e,f,j}
University scientists	63.00 ± 4.82 ^{b,p}	76.00 ± 6.04 ^{c,e,f,j}	58.30 ± 6.36 ^{b,f,p}	40.00 ± 6.93 ^{c,b,e,j,p}	53.20 ± 8.82 ^{b,f,p}	76.80 ± 6.25 ^{c,e,f,j}
Private scientists	47.00 ± 3.75 ^{b,e,j}	32.00 ± 6.60 ^{c,p}	21.60 ± 5.31 ^{c,f,p}	38.00 ± 6.86 ^e	28.20 ± 7.95 ^{c,p}	48.90 ± 7.62 ^{b,e,j}
Television	47.00 ± 4.99 ^{b,e,f,j,p}	28.00 ± 6.35 ^{c,j}	35.00 ± 6.16 ^{c,j,p}	32.00 ± 6.60 ^{c,j,p}	15.60 ± 6.41 ^{c,b,e,f}	18.60 ± 5.93 ^{c,b,e,f}
Radio	45.00 ± 4.97 ^{b,e,f,j,p}	18.00 ± 5.43 ^c	18.30 ± 4.99 ^c	24.00 ± 6.04 ^c	15.60 ± 6.41 ^c	16.20 ± 5.62 ^c
Newspapers	44.00 ± 4.93 ^{e,f,j,p}	34.00 ± 6.70 ^{i,p}	28.30 ± 5.82 ^{c,p}	24.00 ± 5.51 ^c	18.70 ± 7.02 ^{c,b}	20.90 ± 6.20 ^{c,b}
Websites	56.00 ± 4.97 ^{e,f,j,p}	62.00 ± 6.86 ^{e,f,j,p}	31.70 ± 6.01 ^{c,b,f,p}	8.00 ± 3.84 ^{c,b,e,j,p}	25.10 ± 7.66 ^{c,b,f,p}	44.20 ± 7.57 ^{c,b,e,f,j}
Religious groups	19.00 ± 3.92 ^{e,f,p}	14.00 ± 4.91	10.00 ± 3.87 ^c	6.00 ± 3.36 ^{c,j}	15.60 ± 6.41 ^f	9.30 ± 4.43 ^c
Science magazines	52.00 ± 5.00 ^{b,e,f,j}	82.00 ± 5.43 ^{c,f,j,p}	80.00 ± 6.45 ^{c,f,j,p}	20.00 ± 5.66 ^{c,b,e,j,p}	34.40 ± 8.40 ^{c,b,e,f}	58.20 ± 7.52 ^{b,e,f,j}
NGOs	51.00 ± 4.54 ^{b,f,j,p}	32.00 ± 5.43 ^{c,f,j,p}	33.30 ± 5.92 ^{c,j,p}	16.00 ± 6.93 ^{c,b}	21.80 ± 4.30 ^{c,e}	21.00 ± 4.43 ^c
Family	29.00 ± 4.54 ^{b,f,j,p}	18.00 ± 5.43 ^{c,e,f,j}	30.00 ± 5.92 ^{b,j,p}	40.00 ± 6.93 ^{c,b,j,p}	6.30 ± 4.30 ^{b,e,j}	9.30 ± 4.43 ^{c,e,f}

¹³ The top three trusted information sources of each stakeholder are in bold.

I. *Quality of information*

Thailand's stakeholders have been asked to assess the usefulness of the information they are getting on biotechnology from various sources. Overall, they have given it an above moderate rating of 4.66. Policy makers and businessmen, in particular, have found the information very useful. On the other hand, journalists tend to have a lower assessment of the usefulness of the information they get about biotechnology. Only 53.40% (± 9.11) of Thailand's scientists have rated the information as very useful and nearly 20% of those surveyed think that it is not useful.

Among the stakeholders who are expected to frequently make use of biotechnology information materials such as extension workers and farmer leaders, no more than one-half of these stakeholders have found the information useful.

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

Stakeholder (n=365)	Mean score (\pm s.e., max 7)	Not useful (1-3)	Somewhat useful (4)	Very useful (5-7)
Consumers (100)	4.32 \pm 0.142	18.00 \pm 3.84	29.00 \pm 4.54	50.00 \pm 5.00
Businessmen (50)	4.96 \pm 0.181	8.00 \pm 3.84	32.00 \pm 6.60	60.00 \pm 6.93
Extension Workers (60)	4.62 \pm 0.211	11.70 \pm 4.15	36.70 \pm 6.22	48.40 \pm 6.45
Farmer Leaders (50)	4.58 \pm 0.262	20.00 \pm 5.66	38.00 \pm 6.86	42.00 \pm 6.98
Journalists (32)	4.31 \pm 0.212	21.90 \pm 7.31	43.80 \pm 8.77	34.40 \pm 8.40
Policy Makers (43)	5.12 \pm 0.167	2.30 \pm 2.29	34.90 \pm 7.27	62.80 \pm 7.37
Scientists (30)	4.72 \pm 0.287	19.90 \pm 7.29	26.70 \pm 8.08	53.40 \pm 9.11

Stakeholders have also been asked to rate whether the information they receive on biotechnology is scientific (Table 21). Thailand's stakeholders think that much of the information they get about biotechnology is somewhat scientific. The overall mean rating is 4.36.

Businessmen believe that the information they have received so far about biotechnology is quite scientific (\bar{x} =5.00 \pm .167). Two-thirds of the businessmen (66.00%) surveyed claim that the information they are receiving about biotechnology is highly scientific. Policy makers share almost similar assessments (\bar{x} = 4.47 \pm .180; 51.20% \pm 7.62).

On the other hand, nearly 27% of the scientists think that the information they are getting on biotechnology is not at all scientific. Only 40% (± 8.94) claim that it is highly scientific.

Journalists, extension workers, and farmer leaders also believe that much of the information they receive on biotechnology is not very scientific. This implies that other types of arguments or concerns are being discussed or presented in biotechnology discourses.

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

<i>Stakeholder (n=365)</i>	<i>Mean score (\pm s.e., max 7)</i>	<i>Not at all</i>	<i>Moderately</i>	<i>Highly</i>
Consumers (100)	4.40 \pm 0.146	17.00 \pm 3.76	35.00 \pm 4.77	46.00 \pm 4.98
Businessmen (50)	5.00 \pm 0.167	10.00 \pm 4.24	24.00 \pm 6.04	66.00 \pm 6.70
Extension Workers (60)	4.13 \pm 0.172	18.40 \pm 5.00	45.00 \pm 6.42	34.90 \pm 6.15
Farmer Leaders (50)	4.04 \pm 0.198	16.00 \pm 5.18	56.00 \pm 7.02	24.00 \pm 6.04
Journalists (32)	4.09 \pm 0.145	15.60 \pm 6.41	62.50 \pm 8.56	21.90 \pm 7.31
Policy Makers (43)	4.47 \pm 0.180	14.00 \pm 5.29	34.90 \pm 7.27	51.20 \pm 7.62
Scientists (30)	4.43 \pm 0.261	26.70 \pm 8.08	33.30 \pm 8.60	40.00 \pm 8.94

Table 22 shows the correlations between special media contacts, special interpersonal contacts, and quality of information. There is a significant relationship between use of special media contacts and perceived usefulness of biotechnology information and this can be noted among extension workers ($r=0.31$; $p\leq 0.05$) and scientists ($r=0.50$; $p\leq 0.001$). Among consumers, a significant relationship is noted between the consumers' use of special media and their assessment of biotechnology information as useful ($r=.043$; $p\leq 0.001$).

There is a significant correlation between special interpersonal contacts and perceived usefulness of biotechnology information and this can be observed among consumers ($r=.050$; $p\leq 0.001$), journalists ($r=.060$; $p\leq 0.001$), and policy makers ($r=.036$; $p\leq 0.05$). There is also a significant relationship between consumers' special interpersonal contacts and the perceived scientific quality of biotechnology information ($r=.039$; $p\leq 0.001$).

There is no significant association between the scientific quality of the information stakeholders get and their interest, concern, perceived risks and benefits, and knowledge of biotechnology (Table 23).

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)

Stakeholder (n=365)	SMC & Info as useful	SMC & Info as scientific	SIC & Info as useful	SIC & Info as scientific
Consumers	0.48720	0.43039^a	0.50716^a	0.3899^a
Businessmen	0.19564	0.17002	0.22725	0.05739
Extension Workers	0.31293^c	0.14276	0.11623	0.1635
Farmer Leaders	0.05729	0.28168 ^c	0.26528	0.1263
Journalists	0.41149^c	0.31985	0.60029^a	0.15296
Policy Makers	0.23516	-0.10980	0.35817^c	-0.13746
Scientists	0.49918^a	0.30948	0.35122	0.26303

^a Significant at .001 level; ^b Significant at .01 level; ^c 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=365)	Scientific & Interest	Scientific & Concern	Scientific & Perceived risks	Scientific & Perceived benefits	Scientific info & Factual knowledge	Scientific info & Attitudes
Consumers	0.18860	0.18996	0.25135	-0.05721	0.08100	0.25000
Businessmen	0.24445	0.16354	0.11065	0.18446	0.08135	0.28805
Extension Workers	0.10135	-0.16194	-0.09510	0.03528	0.16236	0.17646
Farmer Leaders	0.12677	-0.05779	-0.07775	0.00019	0.43203	0.17500
Journalists	0.26997	-0.21489	-0.28081	0.04558	0.18038	0.17684
Policy Makers	-0.15519	0.15432	0.16815	-0.01892	-0.16330	-0.10758
Scientists	0.20512	0.16040	0.30922	0.15863	Not asked	Not asked

^a Significant at .001 level; ^b Significant at .01 level; ^c Significant at .05 level

TABLE 24: OTHER TYPES OF ISSUES/CONCERNS THEY HAVE HEARD OR KNOWN ABOUT BIOTECHNOLOGY¹⁴

<i>Stakeholder (n=365)</i>	<i>Political</i>	<i>Religious</i>	<i>Moral/Ethics</i>	<i>Cultural</i>
Consumers (100)	22.00	13.00	53.00	46.00
Businessmen (50)	54.00	26.00	48.00	36.00
Extension Workers (60)	40.00	11.66	53.33	21.66
Farmer Leaders (50)	26.00	4.00	28.00	28.00
Journalists (32)	65.23	15.63	43.75	40.63
Policy Makers (43)	53.49	20.93	39.53	39.53
Scientists (30)	76.66	-0-	56.66	13.33

On average, 48.00% of stakeholders in Thailand say that they have heard or know most about the political concerns surrounding biotechnology (Table 24). A good number of scientists (76.66%) claim to have heard or known about political issues relating to biotechnology. Over 50% of businessmen and policy makers have also said that they know about the political issues surrounding biotechnology.

About 46% of the stakeholders have also heard or known about moral and ethical concerns relating to biotechnology. Nearly 57% of the scientists and 53.33% of extension workers report having heard or known about these issues.

In terms of cultural issues, there are more consumers (46%), journalists (40%), and policy makers (39.53%) who say that they have heard or known about this dimension on biotechnology discourse. Only 13.33% of the scientists have reported hearing about cultural concerns on biotechnology.

Stakeholders have cited religious concerns least. None of the scientists claims to have heard religious issues being related to biotechnology. However, policy makers (20.93%) and businessmen (26%) say that they have heard religion being brought into public discussions on biotechnology.

¹⁴ 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.

TABLE 25: ISSUES THAT WOULD INFLUENCE JUDGMENT¹⁵

<i>Stakeholder (n=365)</i>	<i>Political</i>	<i>Religious</i>	<i>Moral/Ethics</i>	<i>Cultural</i>
Consumers (100)	20.00	7.00	66.00	40.00
Businessmen (50)	28.00	8.00	52.00	30.00
Extension Workers (60)	43.33	8.33	51.66	36.67
Farmer Leaders (50)	32.00	8.00	28.00	28.00
Journalists (32)	43.75	6.25	62.50	25.00
Policy Makers (43)	34.88	36.98	46.51	23.25
Scientists (30)	43.33	6.67	53.33	26.67

Stakeholders in Thailand have differing notions about the types of issues that would influence their judgment about biotechnology (Table 25). Although, they have heard or known more about political issues on biotechnology, most stakeholders have deemed moral and ethical issues as a key influence in their process of making judgments or decisions on biotechnology.

Political issues rank next to moral and ethical concerns. Stakeholders have reported that religious issues or concerns will have the least influence on their judgments about biotechnology.

¹⁵ 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 TEND TO 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	7.00 (± 3.89)	27.90 (± 6.83)	62.80 (± 7.37)	0	2.30 (± 2.28)
2. Make crops resistant to pests & diseases	20.90 (± 6.20)	27.90 (± 6.83)	46.50 (± 7.60)	0	4.70 (± 3.22)
3. Produce medicines & vaccines	18.60 (± 5.93)	2.30 (± 2.28)	0	0	79.10 (± 6.20)
4. Study human diseases like cancer	18.60 (± 5.93)	30.20 (± 7.00)	48.80 (± 7.62)	0	2.30 (± 2.28)
5. Introduce fish genes into strawberries for resistance to freezing	23.30 (± 6.44)	34.90 (± 7.26)	27.90 (± 6.83)	0	14.00 (± 5.29)
6. Detect & treat diseases inherited from parents	34.90 (± 7.26)	23.30 (± 6.44)	4.70 (± 3.22)	0	37.20 (± 7.37)
7. GM foods are safe & tested	27.90 (± 6.83)	18.60 (± 5.93)	48.80 (± 7.62)	0	4.70 (± 3.22)
8. GM crops will be so resistant to pests and diseases but will push native plants into extinction	27.90 (± 6.83)	23.30 (± 6.44)	18.60 (± 5.93)	43.00 (± 7.54)	30.20 (± 7.00)
9. No evidence GM crops can harm environment	23.30 (± 6.44)	30.20 (± 7.00)	27.90 (± 6.83)	0	18.60 (± 5.93)
10. GM crops will contaminate native plant species and further reduce biodiversity	2.30 ±2.28	2.30 ±2.28	14.00 ±5.29	11.60 ±4.88	69.80 ±7.00
11. Farmers want GM crops because they make crop production cheaper, increase yield, and increase income.	18.60 ±5.93	44.20 ±7.57	34.90 ±7.26	0	2.30 ±2.28
12. Opponents of modern biotechnology have no factual evidence for their claims of negative health consequences or environmental impact.	27.90 (± 6.83)	30.20 (± 7.00)	27.90 (± 6.83)	0	14.00 (± 5.29)
13. For plant breeders and farmers, modern biotechnology is simply another tool to increase productivity.	27.90 (± 6.83)	39.50 (± 7.45)	20.90 (± 6.20)	0	11.60 (± 4.88)
14. Pest-resistant GM crops would also harm non-target organisms like butterflies.	0	2.30 (± 2.28)	2.30 (± 2.28)	4.70 (± 3.22)	90.70 (± 4.42)

Policy makers in Thailand seem to approach decisions about biotechnology with a lot of caution. When asked about specific applications of biotechnology that they are most likely to focus on, policy makers tend to be either undecided or non-committal to issues or specific positions.

For example, while 62.80% of policy makers say that they are most likely to zero in on the use of biotechnology to make food more nutritious, taste better, and keep longer, a sizeable 28% have also reported that they will seldom consider this application when making a decision about biotechnology. This pattern seems to hold true for most other statements.

Policy makers are divided over the issue of the use of biotechnology to make crops resistant to pests and diseases. Nearly 47% have some intention to frequently focus on it when making decisions. On the other hand, about 49% will either seldom focus on it or never consider it at all. Similar rates of responses can be seen in the matter of using biotechnology to study human diseases like cancer, where policy makers are practically split two ways on how best to take this into account in the decision making process. On the issue of the safety of GM foods, 48.80% will almost always consider it in their decisions, but 46.50% have also said that they will either seldom use it or not use it at all.

Remarkably, even in matters of increased farm productivity and other medical applications, no more than 30% of policy makers intend to use these potential benefits as an input to decision making. Only 20.90% say that they will frequently center on the use of biotechnology to increase productivity and only 4.70% intend to focus on the use of biotechnology to detect and treat diseases inherited from parents.

On the other hand, 61.6% of the policy makers say that they are most likely to frequently focus on the issue that GM crops will push native plants into extinction. Nearly 60% of the policy makers also report that it is unlikely that they will consider the issue that opponents of biotechnology have no factual evidence for their claims of negative health consequences or environmental impact. A little over half of those surveyed also say that they will either seldom or never bring into the decision making process the issue that there is no evidence GM crops can harm the environment. Clearly, for issues that are most likely to stir up more debates or controversies, Thailand's policy makers would rather take a quiet, "wait-and-see" position.

Not surprisingly, 90.70% have said that they do not know if they will focus on the issue that pest-resistant crops will also harm non-target organisms like butterflies. About 70% have said that

they do not know as well about the issue that GM crops will contaminate native plant species and further reduce biodiversity. Neither have policy makers taken a position on the application of biotechnology to produce medicines and vaccines.

On the other hand, there is certainly one application that seems to be clear to Thailand's policy makers. About 58% have said that they will unlikely focus on the use of biotechnology to introduce fish genes into strawberries for resistance to freezing.

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

FRAMES FOR MASS MEDIA COVERAGE	Never	Seldom	Almost always	All the time	Don't Know
1. Make food more nutritious, taste better, and keep longer	34.40 (± 8.39)	34.40 (± 8.39)	25.00 (± 7.65)	6.30 (± 4.29)	0
2. Make crops resistant to pests & diseases	28.10 (± 7.29)	37.50 (± 8.55)	28.10 (± 7.94)	6.30 (± 4.29)	0
3. Produce medicines & vaccines	43.80 (± 8.77)	28.10 (± 7.29)	25.00 (± 7.65)	3.10 (± 3.06)	0
4. Study human diseases like cancer	21.90 (± 7.31)	34.40 (± 8.39)	37.50 (± 8.55)	6.30 (± 4.29)	0
5. Introduce fish genes into strawberries for resistance to freezing	46.90 (± 8.82)	31.30 (± 8.19)	15.60 (± 6.41)	6.30 (± 4.29)	0
6. Detect & treat diseases inherited from parents	28.10 (± 7.94)	37.50 (± 8.55)	25.00 (± 7.65)	9.40 (± 5.15)	0
7. GM foods are safe & tested	43.80 (± 8.77)	18.80 (± 6.90)	34.40 (± 8.39)	3.10 (± 3.06)	0
8. GM crops will be so resistant to pests and diseases but will push native plants into extinction	3.10 (± 3.06)	25.00 (± 7.65)	34.40 (± 8.39)	37.50 (± 8.55)	0
9. No evidence GM crops can harm environment	34.40 (± 8.39)	43.80 (± 8.77)	15.60 (± 6.41)	6.30 (± 4.29)	0
10. GM crops will contaminate native plant species and further reduce biodiversity	3.10 (± 3.06)	18.80 (± 6.90)	37.50 (± 8.55)	40.60 (± 8.68)	0
11. Farmers want GM crops because they make crop production cheaper, increase yield, and increase income.	34.40 (± 8.39)	37.50 (± 8.55)	21.90 (± 7.31)	6.30 (± 4.29)	0
12. Opponents of modern biotechnology have no factual evidence for their claims of negative health consequences or environmental impact.	25.00 (± 7.65)	50.00 (± 8.83)	21.90 (± 7.31)	31.00 (± 8.17)	0
13. For plant breeders and farmers, modern biotechnology is simply another tool to increase productivity.	25.00 (± 7.65)	37.50 (± 8.55)	31.30 (± 8.19)	6.30 (± 4.29)	0
14. Pest-resistant GM crops would also harm non-target organisms like butterflies.	3.10 (± 3.06)	34.40 (± 8.39)	28.10 (± 7.94)	34.40 (± 8.39)	0

Thailand's journalists have all come to some decision on whether or not they would focus on certain issues when reporting on biotechnology. Surprisingly 68% will never or seldom report on making food more nutritious, better tasting, and longer lasting whereas only 25% say that they will almost always focus on that subject.

Agricultural concerns are not issues that journalists will frequently focus on when reporting on biotechnology. A majority of journalists will not focus on making crops resistant to pests and diseases (65.60%), or farmers wanting GM crops because they make crop production cheaper, increase yield and increase income (71.90%). Only 34.40% intend to cover with some frequency the use of biotechnology to make crops pest and disease-resistant. Only 28.20% have said that they intend to give some coverage to biotechnology's beneficial effects on crop yields and farm incomes.

Thailand's journalists do not seem to think much of the medical applications of biotechnology as a focus of media coverage. A clear majority (71.90%) has said that they either will seldom or never write or report about the use of biotechnology to produce medicines or vaccines. Two-thirds of the journalists surveyed do not intend to focus on with some frequency on the use of biotechnology to detect and treat diseases inherited from parents. Moreover, 56.30% have said that the role of biotechnology in studying human diseases like cancer will not be a constant topic for reporting or coverage.

Neither do the journalists intend to take into account in their coverage that GM foods are safe and tested. Only 37.50% have said that will frequently cover or report this topic.

What certainly interests journalists most, however, are the environmental issues. About 72% have said that they will focus on the issue that GM crops will push native plants into extinction. Another 78% have stated an intention to look into the issue that GM crops will further reduce biodiversity, and 62.5% have said they will frequently cover the topic about the possible harm GM crops may bring on non-target organisms like butterflies.

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	6.70 (± 4.56)	16.70 (± 6.80)	70.00 (± 8.36)	6.70 (± 4.56)	0
2. Make crops resistant to pests & diseases	6.70 (± 4.56)	13.30 (± 6.19)	76.70 (± 7.71)	3.30 (± 3.26)	0
3. Produce medicines & vaccines	23.30 (± 7.71)	16.70 (± 6.80)	50.00 (± 9.12)	10.00 (± 5.47)	0
4. Study human diseases like cancer	13.30 (± 6.19)	30.00 (± 8.36)	40.00 (± 8.94)	16.70 (± 6.80)	0
5. Introduce fish genes into strawberries for resistance to freezing	40.00 (± 8.94)	30.00 (± 8.36)	30.00 (± 8.36)	0	0
6. Detect & treat diseases inherited from parents	16.70 (± 6.80)	20.00 (± 7.30)	40.00 (± 8.94)	23.30 (± 7.71)	0
7. GM foods are safe & tested	16.70 (± 6.80)	26.70 (± 8.07)	46.70 (± 9.10)	10.00 (± 5.47)	0
8. GM crops will be so resistant to pests and diseases but will push native plants into extinction	16.70 (± 6.80)	40.00 (± 8.94)	26.70 (± 8.07)	16.70 (± 6.80)	0
9. No evidence GM crops can harm environment	30.00 (± 8.36)	30.00 (± 8.36)	33.30 (± 8.60)	6.70 (± 4.56)	0
10. GM crops will contaminate native plant species and further reduce biodiversity	3.30 (± 3.26)	33.30 (± 8.60)	53.30 (± 9.10)	10.00 (± 5.47)	0
11. Farmers want GM crops because they make crop production cheaper, increase yield, and increase income.	6.70 (± 4.56)	33.30 (± 8.60)	56.70 (± 9.04)	3.30 (± 3.26)	0
12. Opponents of modern biotechnology have no factual evidence for their claims of negative health consequences or environmental impact.	26.70 (± 8.07)	43.30 (± 9.04)	20.00 (± 7.30)	3.30 (± 3.26)	6.70 (± 4.56)
13. For plant breeders and farmers, modern biotechnology is simply another tool to increase productivity.	20.00 (± 7.30)	40.00 (± 8.94)	36.70 (± 8.79)	3.30 (± 3.26)	0
14. Pest-resistant GM crops would also harm non-target organisms like butterflies.	3.30 (± 3.26)	26.70 (± 8.07)	53.30 (± 9.10)	16.70 (± 6.80)	0

A good number of Thailand's scientists (77%) will most likely talk about the use of biotechnology to make food nutritious, taste better, and keep longer. They will also highlight the application of biotechnology to make crops resistant to pests and diseases.

No less than 57% of the scientists will most probably deal with some frequency the medical applications of biotechnology. In particular, 63.30% intend to talk about the use of biotechnology to detect and treat diseases inherited from parents.

On the claims that GM foods are safe and tested, about 57% of the scientists surveyed have said that will regularly bring it up in discussions, but 43.40% have said that it is unlikely they will talk about it.

While most scientists have clear intentions to highlight benefits, they have also exercised caution in dealing with some of the claims. For example, in dealing with some of the environmental issues, nearly 57% have said that they will hardly talk about the issue that GM crops will push native plants into extinction. On the other hand, there are questions or issues that they will very likely bring up in discussions such as the issue of GM crops affecting biodiversity and their effects on non-target organisms like butterflies. They are also not willing to totally assert that there is no evidence GM crops can harm the environment or that opponents of biotechnology have no factual evidence for their claims of negative health consequences or environmental impact.

Evidently, the one issue that Thailand's scientists will most unlikely talk about is introducing fish genes into strawberries for resistance to freezing.

TABLE 29: BIOTECHNOLOGY APPLICATIONS AND ISSUES OTHER STAKEHOLDERS SAY THEY WOULD CONSIDER WHEN MAKING JUDGMENTS ON BIOTECHNOLOGY¹⁶

- 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>
Consumers	33.00	21.00	13.00	32.00	1.00
Businessmen	66.00	8.00	28.00	24.00	0
Extension Workers	56.70	23.30	10.00	10.00	0
Farmer Leaders	56.00	10.00	6.00	18.00	10.00

Two-thirds of Thailand's businessmen believe that the use of modern biotechnology in the production of foods to make them more nutritious, taste better and keep longer is useful. A little over half the extension workers and farmer leaders surveyed share the same opinion.

Businessmen and farmer leaders also think that it is not risky. Only 8% of the businessmen and 10% of the farmer leaders surveyed believe that this application poses risks. On the other hand, only one-third of Thailand's consumers say that this particular application of biotechnology is useful, and 21% of the consumers surveyed also believe it is risky.

Moral acceptability, however, is another matter for these four stakeholder groups. No more than 15% of consumers, extension workers, and farmer leaders say that this biotechnology application is morally acceptable. Only 28% of the businessmen think that it is morally acceptable. Neither are the numbers good on their opinion about encouraging this type of biotechnology application. Less than 20% of extension workers and farmer leaders say that this application should be encourage, and no more than 35% of consumers and businessmen have expressed support for this application.

- 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>
Consumers	44.00	26.00	10.00	18.00	1.00
Businessmen	62.00	10.00	22.00	28.00	0
Extension Workers	48.30	30.00	8.30	13.30	0
Farmer Leaders	44.00	22.00	8.00	20.00	6.00

¹⁶ The tables report multiple responses, hence the percentages should not add up to 100 across stakeholders or responses

Thailand's stakeholders seem unanimous on their assessment about the use of biotechnology to make crops more resistant to pests and diseases. Nearly two-thirds of Thailand's businessmen find this application useful. Among the consumers and farmer leaders surveyed, 44% say that this application is useful and nearly half of the extension workers share the same opinion.

No more than 30% of the respondents in the four stakeholder groups think that this particular application is risky. However, positive opinions about the moral acceptability of this application are quite low. No more than 10% of the consumers, extension workers, and farmer leaders surveyed believe that this application is morally acceptable. Neither is there a wide support about encouraging this type of biotechnology application. Only 28% of the businessmen say that this should be encouraged, whereas less than 20% of the consumers, extension workers, and farmer leaders think that this is an application that should be encouraged.

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>
Consumers	36.00	34.00	12.00	17.00	1.00
Businessmen	74.00	12.00	16.00	28.00	0
Extension Workers	43.30	26.70	8.30	18.30	3.30
Farmer Leaders	16.00	32.00	14.00	26.00	12.00

A good majority of Thailand's businessmen (74%) finds useful the application of introducing human genes into bacteria to produce medicines or vaccines, for example, to produce insulin for diabetes. They also do not think that this application poses a lot of risks. However, only 16% of the farmer leaders surveyed think that this application is useful. A little over one-third of consumers and 43% of extension workers also consider it a useful application. About one-third of the consumers and farmer leaders believe that the application may be risky.

Moreover, the question of moral acceptability has not generated as much support. Only 8.30% of extension workers say that this application is morally acceptable, and no more than 15% of consumers and farmer leaders believe that it is morally acceptable. Likewise, no more than one-third of the stakeholders believe that it is an application that 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>
Consumers	40.00	21.00	17.00	20.00	2.00
Businessmen	70.00	20.00	12.00	22.00	0
Extension Workers	65.00	15.00	5.00	15.00	0
Farmer Leaders	48.00	14.00	6.00	24.00	8.00

Thailand’s businessmen and extension workers believe that the application of biotechnology for cancer studies and treatment is useful. At least 40% of the consumers and nearly half of the farmer leaders surveyed have also expressed similar views. Respondents from the four stakeholder groups also do not find this application to be risky. However, the ambivalence shows when faced with the issue of its moral acceptability. Less than 10% of the extension workers and farmer leaders find this application to be morally acceptable, and less than 20% of the consumers and businessmen think that it is morally acceptable. Neither is the support palpable among the four stakeholders on the question of encouraging this type of biotechnology application. No more than a quarter of the respondents say 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>
Consumers	53.00	13.00	2.00	31.00	1.00
Businessmen	68.00	16.00	8.00	26.00	0
Extension Workers	63.30	5.00	6.70	25.00	0
Farmer Leaders	46.00	10.00	4.00	28.00	12.00

The application of biotechnology to detect and treat diseases inherited from parents does not seem to be an issue for most stakeholders. There is much support for this application from businessmen (68%) and extension workers (63.30%). A little over half of the consumers have said that this application is useful, and nearly half of the farmer leaders share the same opinion. The four stakeholders also don’t see risk as an issue, with just find 5% of extension workers and 10% of farmer leaders saying that this application may be risky.

However, there continues to be an apparent unresolved question on the moral acceptability of this application. No more than 10% of the stakeholders surveyed have expressed that this application is morally acceptable, although there is close to one-third of the

stakeholders who tend to affirm that this is one type of biotechnology application that must be encouraged.

IV. SURVEY HIGHLIGHTS

A. Thailand's Consumers¹⁷

- Demographics of survey sample: 49% survey are male and 50% are female; 65% are single and 30% are married; 27% have grad/post grad degree, 64% have a BS degree, 4% have only a high school degree, and 12% have an associate degree; 36% live in suburban areas, 62% in urban, and 0% in rural
- Moderately to highly interested in biotechnology
- Moderately concerned about biotechnology issues
- Perceive the risks of biotechnology to be moderate to low
- Perceive the benefits of biotechnology to be high
- Have a high regard for a) consumer groups and NGOs (71%), b) mass media (49%), and c) research institutes (49%) as being highly concerned about public health and safety issues relating to biotechnology
- Believe that a) agri-biotech companies (85%), b) regulatory bodies (83%), and c) university scientists (79%), and 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 Thailand (92%)
- 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.
- In general, they exhibit moderate attitudes toward biotechnology.
- *On banning GM foods:* In general they are split on whether or not to contribute money and time to ban GM food. 40% agree to do so and 35% disagree to do so.
- *On labeling GM foods:* Agree that GM foods should be labeled (95%)
- *On the benefits of biotechnology to small farmers:* Disagree (60%) that agricultural biotechnology will not benefit small farmers.
- *On the benefits of biotechnology to Thailand's agriculture:* 53% agree that biotech is good for Thailand agriculture.
- *On the adequacy of biotechnology regulations in Thailand:* 60% disagree that current biotechnology regulations in Thailand are sufficient.
- *On paying extra costs for the labeling of GM foods:* 66% agree to pay extra cost for labeling GM foods.
- Use tri-media (26%) as their most highly used sources for biotech information

¹⁷ For complete demographical comparisons across stakeholders, see Appendix 1.

- Trust university scientists (63%) as a high source of information followed by websites (56%), and science magazines (52%).
- Perceive usefulness of biotechnology information from various sources as highly to moderately useful. 50% feel it is very useful, 29% feel it is somewhat useful, and 18% feel it is not useful at all.
- Believe that the quality of agri-biotech information is highly to moderately scientific. 46% think it is highly scientific, 35% think it is moderately scientific, and 17% think it is not at all scientific
- Think that moral concerns about biotechnology will influence most their judgment on the issue.

B. Thailand's Businessmen

- Highly interested in biotechnology
- Very concerned about biotechnology issues
- Perceive the risks of biotechnology to be moderate to low
- Perceive the benefits of biotechnology to be high
- Have a high regard for a) research institutes (90%), b) agri-biotech companies (64%), and c) consumer advocacy groups and NGOs (56%) as being highly concerned about public health and safety issues relating to biotechnology
- Believe that a) research institutes (90%), b) regulatory bodies (78%), b) university scientists (74%), and c) agri-biotech companies (74%) 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 Thailand (92%)
- Rate themselves as having a high understanding of science.
- Rate themselves as having a moderate understanding of biotechnology.
- Generally have high mean score on factual knowledge about biotechnology.
- In general, they exhibit moderate attitudes toward biotechnology.
- *On banning GM foods:* In general they agree (64%) to contribute money and time to ban GM food.
- *On labeling GM foods:* 74% agree that GM foods should be labeled.
- *On the benefits of biotechnology to small farmers:* 58% agree that agricultural biotechnology will not benefit small farmers.
- *On the benefits of biotechnology to Thailand's agriculture:* 68% agree that biotech is good for Thailand agriculture.
- *On the adequacy of biotechnology regulations in Thailand:* Disagree (58%) that current biotechnology regulations in Thailand are sufficient.
- *On paying extra costs for the labeling of GM foods:* Only 46% agree to pay extra cost for labeling GM foods.
- Use NGOs (26%) as their most highly used sources for biotech information
- Trust university scientists (76%) as a high source of information followed by science magazines (82%), and websites (62%).

- Perceive usefulness of biotechnology information from various sources as highly useful
- Believe that the quality of agri-biotech information is highly scientific
- 52% have moral concerns, 30% have cultural concerns, 8% have religious concerns, and 28% have political concerns that would influence judgment.

C. Thailand's Extension Workers

- Highly interested in biotechnology
- Moderately to highly concerned about biotechnology issues
- Perceive the risks of biotechnology to be moderate to low
- Perceive the benefits of biotechnology to be high
- Have a high regard for a) consumer groups and NGOs (76%), b) research institutes (53.4%), and c) the mass media (40%) as being highly concerned about public health and safety issues relating to biotechnology
- Believe that a) regulatory bodies (90.0%), b) agri-biotech companies (86.7%), and c) university scientists (83.4%), and 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 Thailand (96.7%)
- 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.
- In general, they exhibit moderate attitudes toward biotechnology.
- *On banning GM foods:* In general they are split on whether or not to contribute money and time to ban GM food.
- *On labeling GM foods:* Agree (100%) that GM foods should be labeled
- *On the benefits of biotechnology to small farmers:* 55% think that agricultural biotechnology will not benefit small farmers.
- *On the benefits of biotechnology to Thailand's agriculture:* 81.7% believe that *biotechnology is good for Thailand agriculture.*
- *On the adequacy of biotechnology regulations in Thailand:* 55% disagree that current biotechnology regulations in Thailand are sufficient.
- *On paying extra costs for the labeling of GM foods:* 51.7% agree to pay extra cost for labeling GM foods.
- Use tri-media (33.3%) as their most highly used sources for biotech information
- Trust science magazines (80.0%) as a high source of information followed by university scientists (58.3%), and both NGOs and family at (33.3%).
- Perceive usefulness of biotechnology information from various sources as highly to moderately to highly useful
- Believe that the quality of agri-biotech information is highly to moderately scientific 34.9% think it is highly scientific, 45% think it is moderately scientific, and 18.4% think it is not at all scientific

- 51.6% have moral concerns, 36.6% have cultural concerns, 8.3% have religious concerns, and 43.3% have political concerns that would influence judgment.

D. Thailand's Farmer Leaders

- Highly interested in biotechnology
- Moderately concerned about biotechnology issues
- Perceive the risks of biotechnology to be moderate to low
- Perceive the benefits of biotechnology to be high
- Have a high regard for a) farm leaders (54%), b) research institutes (42%), and c) consumer groups and NGOs (32%) as being highly concerned about public health and safety issues relating to biotechnology
- Believe that a) regulatory bodies (80%), b) research institutes (62%), and c) agri-biotech companies (58%) 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 Thailand (64.0%)
- Rate themselves as having a moderate to low understanding of science
- Rate themselves as having a moderate understanding of biotechnology.
- Generally have a low mean score on factual knowledge about biotechnology.
- In general, they exhibit moderate attitudes toward biotechnology
- *On banning GM foods:* In general they are split on whether or not to contribute money and time to ban GM food.
- *On labeling GM foods:* 84% agree that GM foods should be labeled.
- *On the benefits of biotechnology to small farmers:* 64% disagree that agricultural biotechnology will not benefit small farmers.
- *On the benefits of biotechnology to Thailand's agriculture:* 80% agree that biotech is good for Thailand agriculture.
- *On the adequacy of biotechnology regulations in Thailand:* Disagree (50%) that current biotechnology regulations in Thailand are sufficient.
- *On paying extra costs for the labeling of GM foods:* 48% agree to pay extra cost for labeling GM foods.
- Use tri-media (44%) as their top information source
- Trust family (40%) and university scientists (40%) as a high source of information followed by NGOs (16%).
- Perceive usefulness of biotechnology information from various sources as highly to moderately useful, 42% feel it is very useful, 38% feel it is somewhat useful, and 20% feel it is not useful at all.
- Believe that the quality of agri-biotech information is moderately scientific, 24 % think it is highly scientific, 56% think it is moderately scientific, and 16% think it is not at all scientific.
- 28% have moral concerns, 28% have cultural concerns, 8% have religious concerns, and 32% have political concerns that would influence judgment.

E. Thailand's Journalists

- Moderately interested in biotechnology
- Moderately concerned about biotechnology issues
- Perceive the risks of biotechnology to be moderate to low
- Perceive the benefits of biotechnology to be moderate to low
- Have a high regard for a) consumer groups and NGOs (46.9%), b) research institutes (43.8%), and c) university scientists (37.5%) as being highly concerned about public health and safety issues relating to biotechnology
- Believe that a) regulatory bodies (84.4%), b) research institutes (68.8%), and c) agri-biotech companies (68.8%) 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 Thailand (81.3%)
- Rate themselves as having a moderate to low understanding of science
- Rate themselves as having a moderate understanding of biotechnology.
- Generally have a moderate mean score on factual knowledge about biotechnology.
- In general, they exhibit moderate attitudes toward biotechnology.
- *On banning GM foods*: 50% say that they are willing to contribute money and time to ban GM food.
- *On labeling GM foods*: 75% agree that GM foods should be labeled.
- *On the benefits of biotechnology to small farmers*: 68.8% disagree that agricultural biotechnology will not benefit small farmers.
- *On the benefits of biotechnology to Thailand's agriculture*: 50% think that biotech is good for Thailand agriculture.
- *On the adequacy of biotechnology regulations in Thailand*: 65.6% disagree that current biotechnology regulations in Thailand are sufficient.
- *On paying extra costs for the labeling of GM foods*: Are split on whether or not to pay extra cost for labeling GM foods.
- Use family/friends (12.5%) and tri-media (12.5%) as their most highly used sources for biotech information
- Trust university scientist (53.2%) as a high source of information followed by science magazines (34.4%), and private sector scientists (28.2%).
- Perceive usefulness of biotechnology information from various sources as moderately to highly useful, 34.4% feel it is very useful, 43.8% feel it is somewhat useful, and 21.9% feel it is not useful at all.
- Believe that the quality of agri-biotech information is moderately scientific, 21.9% think it is highly scientific, 62.5% think it is moderately scientific, and 15.6% think it is not at all scientific
- 62.5% have moral concerns, 25% have cultural concerns, 6.25% have religious concerns, and 43.7% have political concerns that would influence judgment.

F. Thailand's Policy Makers

- Moderately interested in biotechnology
- Moderately to highly concerned about biotechnology issues
- Perceive the risks of biotechnology to be moderate to low
- Perceive the benefits of biotechnology to be high
- Have a high regard for a) research institutes (83.7%), b) consumer advocacy groups and NGOs (74.4%), and c) agri-biotech companies (62.9%) as being highly concerned about public health and safety issues relating to biotechnology.
- Believe that a) research institutes (95.4%), b) private sector scientists (86.7%), and c) university scientists (86.1%) 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 Thailand (97.7%)
- Rate themselves as having a high understanding of science.
- Rate themselves as having a moderate understanding of biotechnology.
- Generally have a high mean score on factual knowledge about biotechnology.
- In general, they exhibit moderate attitudes toward biotechnology.
- *On banning GM foods:* In general, they agree (62.8%) to contribute money and time to ban GM food.
- *On labeling GM foods:* 58.2% disagree that GM foods should be labeled.
- *On the benefits of biotechnology to small farmers:* Are split on whether or not agricultural biotechnology will not benefit small farmers, 48.8% agree and 48.8% disagree.
- *On the benefits of biotechnology to Thailand's agriculture:* 81.4% that biotech is good for Thailand agriculture.
- *On the adequacy of biotechnology regulations in Thailand:* 48.9% disagree that current biotechnology regulations in Thailand are sufficient.
- *On paying extra costs for the labeling of GM foods:* 81.4% to pay extra cost for labeling GM foods.
- Use experts (48.8%) and websites (48.8%) as their most highly used sources for biotech information
- Trust university scientist (76.8%) as a high source of information followed by science magazines (58.2%), and private sector scientists (48.9%).
- Perceive usefulness of biotechnology information from various sources as highly useful (62.8%)
- Believe that the quality of agri-biotech information is moderately scientific (51.2%)
- 39.5% have moral concerns, 39.5% have cultural concerns, 53.4% have political concerns, and 20.9% have religious issues about biotechnology

G. Thailand's Scientists

- Highly interested in biotechnology
- Highly concerned about biotechnology issues
- Perceive the risks of biotechnology to be moderate to low
- Perceive the benefits of biotechnology to be high
- Have a high regard for a) research institutes (80%), b) consumer advocacy groups and NGOs (66.7%), c) university scientists (53.4%) and d) private sector scientists (53.4%) as being highly concerned about public health and safety issues relating to biotechnology
- Believe that a) university scientists (96.7%), b) private sector scientists (86.7%), and c) research institutes (80%) 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 Thailand (96.7%)
- Rate themselves as having a moderate understanding of biotechnology.
- Use friends/family (43.3%) as their most highly used sources for biotech information
- Perceive usefulness of biotechnology information from various sources as highly useful (53.4%).
- Believe that the quality of agri-biotech information is moderately to highly scientific (40.0%).
- 56.5% have moral concerns, 13.3% have cultural concerns, 76.6% have political concerns, and 0% have religious issues about biotechnology
- 53.3% have moral concerns, 26.6% have cultural concerns, 6.6% have religious concerns, and 43.3% have political concerns that would influence judgment.

V. SUMMARY AND CONCLUSIONS

The surveys among Thailand's stakeholders on their understanding of and attitudes towards agricultural biotechnology are an initial attempt to plot the public facets of the technology in Thailand. Undoubtedly, stakeholders differ in the degree of meanings they attach to biotechnology. Although these surveys cannot fully capture the public character of agricultural biotechnology, they provide a number of important patterns that can be used to have a national profile of Thailand's stakeholders.

Interest and concern. The overall level of interest and concern about biotechnology amongst Thailand's stakeholders is slightly above moderate. Thailand's policy makers, scientists, and businessmen appear to be the stakeholders who are most involved in biotechnology issues. They

have a fairly high interest in biotechnology and they also express most concern about biotechnology issues. On the other hand, consumers and journalists do not see biotechnology as a salient topic to merit enough attention or concern. In particular, Thailand's journalists do not consider biotechnology as a very important news story.

Perceived risks and benefits. The survey results show that, in general, Thailand's stakeholders do not really see biotechnology as posing high risks to public health and food safety which is rather consistent with the generally low concerns they have expressed about biotechnology issues.

Thailand's scientists, policy makers, and businessmen view agricultural biotechnology as having moderate to high benefits. Journalists and consumers who express less interest and less concern about biotechnology appear to have not made up their minds as well on biotechnology's risks and benefits. Thailand's extension workers and farmer leaders have a rather optimistic view of the potential benefits of biotechnology.

Understanding and knowledge of science and agricultural biotechnology. Although an overwhelming number of Thailand's stakeholders express strong belief in central role of science in the country's agricultural development, Thailand's stakeholders give themselves somewhat low to slightly moderate ratings on their understanding of science and knowledge about agricultural biotechnology. Based on a pop-quiz of twelve statements on biotechnology to measure their knowledge on biotechnology, farmer leaders obtained the lowest scores on factual knowledge of biotechnology. Policy makers, extension workers, and businessmen have comparatively higher scores than most other stakeholders, although these scores reflect only modest knowledge of biotechnology.

Attitudes toward agricultural biotechnology. Thailand's stakeholders take a moderate position on agricultural biotechnology. Remarkably, high support for biotechnology does not even go beyond 10% of policy makers, extension workers, and businessmen. Farmer leaders and journalists have either negative or moderate attitudes towards biotechnology. This may stem partly from the fact that while there is some interest in biotechnology, stakeholders do not have enough understanding and knowledge about it in order to make a definite position on the matter. Stakeholders seem to have more questions than answers about biotechnology and this has to be considered in communication-information planning.

Trustworthiness and credibility of institutions. One of the major factors that have a sustaining impact on audiences is the extent to which they perceive sources of information as trustworthy and credible. Expertise is not enough to make an audience believe in the information, but past track records in telling them the truth and siding with public interest make significant marks in the acceptability of a technology. In Thailand, consumer advocacy groups or NGOs and research institutes are perceived to be trustworthy and caring by a majority of stakeholders. Thailand's stakeholders rely on these societal groups for viewpoints that enable the public to rethink its position on biotechnology issues, particularly those that pertain to public health and safety. Whether or not stakeholders heed the advice of these groups is not relevant. It is significant enough to note that most stakeholders use both scientific sources and lay sources of information for viewpoints on biotechnology

On the other hand, when it comes to stakeholders' beliefs on the institutions that can conduct risk assessment and risk management, science-based institutions are ranked way ahead of the other groups. Stakeholders regard regulatory bodies, university scientists, research institutes, and agri-biotech companies as being totally responsible for assessing and managing the risks relating to agricultural biotechnology.

Sources of information. Thailand's stakeholders exhibit rather dismal information seeking behaviors. This can be due to several factors: a) they do not know where to go to for information, b) the mass media does not adequately cover it, c) people do not talk much about biotechnology because it is too complex, and d) issue has not yet reached a level of salience that can motivate people to seek additional information. Among the stakeholders who are most interested in biotechnology such as businessmen, policy makers, and scientists, their common information sources are experts or biotechnology scientists and specialized media such as websites and pamphlets.

Consumers are very low information seekers. No more than 5% of consumers have sought out information about biotechnology from all sources within a two-month period. Interestingly, journalists tend to exhibit low information search behaviors as well. No more than 10% of journalists have reported having consulted information sources on biotechnology.

Asked about the trustworthiness of information sources, stakeholders are unanimous about university scientists and science magazines as highly trustworthy sources of information. Although stakeholders view them as caring about public health and safety, religious groups are

ranked last as trustworthy sources of information on biotechnology. The results do indicate that the public has not lost its confidence on scientific sources to provide them with the kind of information they need in order to aid their judgments about biotechnology. Indeed, Thailand's stakeholders place a premium on university scientists in a number of areas. University scientists are regarded as sympathetic to public health and safety issues, possessing the expertise to conduct risk assessment and risk management, and trustworthy sources of information on biotechnology. The survey data appears to suggest that university scientists can be very effective agents for educating the public about agricultural biotechnology.

Factors that can influence judgments about biotechnology. Although they have heard or know about the scientific aspects of agricultural biotechnology, a majority of the stakeholders have said that they have also heard or know about political arguments being raised on biotechnology much more than cultural, religious or moral/ethical arguments. A majority of the stakeholders also consider moral and ethical issues of biotechnology as having much influence on their judgments of biotechnology followed by cultural considerations.

Making judgments on biotechnology.

a) Policy frames: Policy makers in Thailand are in agreement with what specific types of applications and issues they would focus on when making decisions about biotechnology. There is more interest among policy makers to talk about and focus on the benefits of biotechnology applications in food and agriculture than on the applications of biotechnology in medicine.

b) Journalistic frames: In general, Thailand's journalists seem to take a rather ambivalent or cautious approach to covering biotechnology, especially in terms of highlighting its potential benefits. There seems to be a tendency among journalists, however, to talk much more frequently about specific benefits and topics such as the safety of GM crops, use of biotechnology to improve crop production, use of biotechnology to make crops resistant to pests and diseases and use of biotechnology to increase farm productivity. Thailand's journalists are not quite interested on reporting about medical applications of biotechnology.

Perhaps owing to the nature of the profession to constantly write or talk about both sides of the issue, journalists say that they will talk about the impact of biotechnology on biodiversity, especially on the issue of pest-resistant GM crops as harming non-target organisms like butterflies. They will find it hard not to say anything about the idea that there are no evidence GM crops can harm the environment.

c) Scientific frames: Thailand's scientists clearly support the applications of biotechnology in crop production as well in medicine. On the other hand, scientists tend to balance benefits with questions about the effects of biotechnology particularly on the environment. For instance, they will frequently discuss the issue of pest-resistant GM crops as being harmful to non-targeted organisms like butterflies, biotechnology's negative impact on biodiversity, and the idea that biotechnology might push native plants into extinction.

This monograph aims to provide an empirical profile of key stakeholders in Thailand. 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 Thailand's stakeholders in relation to agricultural biotechnology. The data is 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 direction for research on public representations of agricultural biotechnology.

For now, we hope that this monograph can be a useful reference to both practitioners and scholars interested in learning about some of the key elements that shape public discourse on agricultural biotechnology in Thailand.

APPENDIX 1: SUMMARY OF SOCIO-DEMOGRAPHIC CHARACTERISTICS OF THAILAND'S SURVEY RESPONDENTS

SEX

	Male	Female	No Answer
Consumers (100)	49.0	50.0	1.0
Farmer Leaders (50)	58.0	42.0	0
Extension Workers (60)	58.3	41.7	0
Journalists (32)	37.5	62.5	0
Policy Makers (43)	46.5	53.5	0
Scientists (30)	43.3	56.7	0

MARITAL STATUS

	Single	Married	Separated	Divorced	Widowed	No Answer
Consumers (100)	65.0	30.0	0	3.0	1.0	1.0
Farmer Leaders (50)	14.0	80.0	2.0	0	4.0	0
Extension Workers (60)	33.3	61.7	0	3.3	1.7	0
Journalists (32)	71.9	21.9	3.1	3.1	0	0
Policy Makers (43)	60.5	39.5	0	0	0	0
Scientists (30)	36.7	60.0	0	3.3	0	0

EDUCATIONAL ATTAINMENT

	Elem	High School	Associate Degree	BS Degree	Grad/ Post Grad Degree	No Answer
Consumers (100)	0	4.0	4.0	64.0	27.0	1.0
Farmer Leaders (50)	64.0	12.0	12.0	8.0	0	4.0
Extension Workers (60)	0	1.7	5.0	56.7	36.7	0
Journalists (32)	0	0	12.5	81.3	6.3	0
Policy Makers (43)	23.3	76.7	0	0	0	0
Scientists (30)	0	0	0	0	100.0	0

AREA OF RESIDENCE

	Rural	Suburban	Urban	No Answer
Consumers (100)	0	36.0	62.0	2.0
Farmer Leaders (50)	76.0	18.0	6.0	0
Journalists (32)	12.5	34.4	53.1	0
Policy Makers (43)	11.6	27.9	60.5	0
Scientists (30)	20.0	23.3	56.7	0