PUBLIC PERCEPTION OF AGRICULTURAL BIOTECHNOLOGY

16 Years After the Public Debates on GM Crops

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Cleofe S. Torres
Ma. Teresita B. Osalla
Juvy Leonarda N. Gopela
Dannah Mae S. Torres

Department of Agriculture Biotech Program Office
International Service for the Acquisition of Agri-biotech Applications, Inc.
College of Development Communication, University of the Philippines Los Baños
Southeast Asian Regional Center for Graduate Study and Research in Agriculture

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List of Abbreviations

Agri-biotech	Agricultural biotechnology
Biotech	Biotechnology
Bt	*Bacillus thuringiensis*
CDC	College of Development Communication
DA	Department of Agriculture
DOST	Department of Science and Technology
EU	European Union
GM	Genetically Modified
GMO	Genetically Modified Organism
GE	Genetic engineering
IRRI	International Rice Research Institute
ISAAA	International Service for the Acquisition of Agri-biotech Applications
MNC	Multinational Companies
NCBP	National Committee on Biosafety of the Philippines
NGO	Non-government Organization
R & D	Research and Development
SEARCA	Southeast Asian Regional Center for Graduate Study and Research in Agriculture
SC	Supreme Court
SUC	State Universities and Colleges
UK	United Kingdom
UPLB	University of the Philippines Los Baños
US	United States
USDA	United States Department of Agriculture

Foreword

The narrative of biotech perception in the Philippines paints a favorable attitude among the public toward biotech crops. This is supported by the results of the first perception study in 2002 and the follow-up study in 2006. Since then, no other study encompassing various stakeholders has been conducted to monitor how the Filipino public responds to the progress and challenges of venturing into these wonder crops.

Thus, this 2022 perception study aims to fill the gap during the 16 years when public debates about GM crops have occupied the national agenda concerning biotech. Its new findings present evidence that the narrative has not changed—the Philippines remains pro-biotech as it continues to progress and develop products to contribute to food sustainability and climate change resiliency.

While perception studies with their intrinsic limitations are not the be-all and end-all of biotech development, they serve as helpful tools in weighing in the good and the bad about the technology. So far, these studies have helped surface candid opinions, uncover gaps, and identify bottlenecks in how the technology is being disseminated to the public. These can then be used to understand the dynamics and nuances of creating behavioral change in society.

Furthermore, when these results are diligently attended to, the narrative of biotech perception may even be enhanced and become instrumental in facilitating biotech acceptance and adoption in the country.

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Rhodora Romero-Aldemita, Ph.D.
Executive Director, ISAAA Inc.

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Coordinating with respondents from nine stakeholder groups and from 10 provinces in various regions of the country was no mean feat. The tough job was successfully completed by our able field coordinators, who dared to brave the threats, risks, and uncertainty of the COVID-19 pandemic. Salute to the following:

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Executive Summary

Sixteen years after the public debates on GM crops, the study looks into the current scenario on public perception of agri-biotech in the country. A total 1180 respondents representing 10 provinces and nine stakeholder groups all over the country were purposively selected using stratified sampling. Due to restrictions imposed by the health protocols of COVID-19 at the time of the study, Google survey and field administered survey were used to gather data. Data were analyzed using frequency counts, percentages, weighted mean, and word cloud.

Filipino stakeholders in general are supportive of biotech in crop production and consider it as beneficial to society in terms of food and medicines. Support, however, is not as solid in terms of biotech in animal production. Scientists, are the most trusted sources of information, but are ironically not that accessible and visible in the community. So social media, even if not highly trusted, are resorted to because they are the most accessible and omnipresent in many areas.

Stakeholders need to be enlightened more about genes and viruses as these are the most misunderstood aspects that might have caused some stakeholders to be wary of biotech. The most supportive and optimistic about biotech among the stakeholder groups are the scientists and journalists/ media persons. Issues that register high in stakeholders' decision making on biotech in crops are safety and impacts on health. In animal biotech, it is the moral dimension.

After almost 16 years, improvement of perception occurred in the following areas: (a) biotech information as being more useful, of better quality and better understood; (b) biotech regulations as protective of public safety and health, (c) higher motivation to join biotech-related activities that do not involve much of their time and money, and (d) more emphasis on end uses of biotech as food and medicines as primary consideration in making decisions about biotech.

There is not much difference in the perception of stakeholders in areas with and without GMO ban. Stakeholders in both areas remain optimistic and supportive of biotech in crops with some reservations on biotech in animals.


Vijay Kreationz

INTRODUCTION

Background and Rationale

Biotechnology (biotech) as applied to crops and animals has been part and parcel of human and societal evolution. As history tells it, humans progressed from harvesting food from the wild until they learned how to domesticate plants and animals (Wieczorek and Wright, 2012). Domestication further led humans to improve food crops and animals in accordance to their needs as well as pleasure. Hence, food crops with great taste, that are good for the health, and that contribute to optimal nutrition were preferred over others.

In the process, humans have become selective of traits that plants, particularly agricultural crops, should exhibit as they are raised in the farms. Thus, plant selection became driven by the following preferred traits: shortened growing season, increased resistance to pests and diseases, larger seeds and fruits, better nutritional content, better shelf life, and better adaptation to diverse environments (Wieczorek and Wright, 2012).

Agri-biotech and its Benefits

Since then and until today, these desired traits drive the direction of the science of plant genetics especially in the area of agricultural biotechnology (agri-biotech). Biotech refers to a set of tools that uses living organisms (or parts of organisms) to make or modify a product, improve plants, trees or animals, or develop micro-organisms for specific uses (ISAAA, 2014).

The more specific field of agri-biotech refers to the crop and livestock improvement using biotech tools. USDA (undated) further defines agri-biotech as a range of tools, including traditional breeding techniques that alter living organisms or parts of organisms to make or modify products, improve plants or animals, or develop microorganisms for specific agricultural uses.

Agri-biotech includes the tools of genetic engineering. This process results to the development of products now called genetically modified organisms (GMO) or genetically modified crops (GMC). In the United States (US), more than 90 percent of soybeans, corn, cotton, and canola come from genetically engineered seeds, and GM ingredients are widely used in processed foods from corn chips and pizza to cooking oils, baking powder, breakfast cereals, or ice cream (Pew Research Center, 2016).

Through the years, progress in agri-biotech work has continued generating global and local benefits to mankind. These benefits include the following (USDA, undated):

- Enables farmers to have high produce with less inputs
- Makes insect and pest control as well as weed management safer and easier while safeguarding crops against diseases
- Protects crops from devastating diseases
- Makes farming more profitable
- Enhances desired quality traits
- Unlocks doors in improving plant and animal varieties produced by conventional means and genetic engineering

The above benefits, however, are not enough to put the general public at ease particularly with the application of biotech in food production. This is despite the fact that the government has the legal basis, scientific means, procedures, and safeguards to insure that biotech crops are safe to be cultivated by farmers; safe to be used as food by humans or as feed by animals; and have no critical adverse impact on the environment (USDA, undated).

Ensuring the Safety of Agri-biotech

A fundamental concern that has haunted agri-biotech since its inception is its safety for human use and consumption. Such has cast a lot of doubt on its trustworthiness as a promising solution to the world's food security and hunger.

In our country, the agency tasked to implement the biosafety system is the National Committee on Biosafety of the Philippines (NCBP). It is responsible for identifying and evaluating the potential hazards in genetic engineering experiments or in the introduction of GMOs into the country. The Philippines is in fact the first country in Southeast Asia to adopt a national biosafety guideline. The guideline defines biosafety as a condition in which the probability of harm, injury, and damage resulting from the intentional and unintentional introduction and/or use of a regulated article is kept within acceptable and manageable levels. The guideline, published in 1991, focuses on genetic engineering and other activities that require the importation, introduction, field release, and breeding of non-indigenous organisms.

Based on the Biosafety Regulations in the Philippines, GM crops actually go through the rigid process of review (DOST,1991). They are assessed so that when grown in proximity to related plants, the potential for the two plants to exchange traits via pollen are evaluated before release. Government bodies perform risk assessment to evaluate and minimize the crops' potential harmful consequences. Other risks considered are their environmental effects on birds, mammals, insects, worms, and other organisms especially on beneficial ones. Also reviewed are environmental impacts of pest-resistant biotech crops before their commercial release. For food applications, biotech crops and products are first tested for their toxicity and potential to cause allergies.

Global Status of Biotech Crops Adoption

The progress in agri-biotech adoption is being monitored yearly and diligently by ISAAA. The institution issues a yearly report on the Global Status of Commercialized Biotech/GM Crops using a publication series called ISAAA Brief. Its Brief 55 shows that in 2019, a total of 29 countries planted GM crops covering 190.4 million hectares. Such a feat has benefited 17 million farming households or 1,95 billion people at the global level.

Leading the adoption rate among the continents is Africa where the number of adopting countries doubled from three to six. On a country level, high adoption performers include US, Brazil, Argentina, Canada, and India. GM crops planted have likewise expanded to sugar beet, alfalfa, papaya, squash, and potato, especially in the US. Philippines is among the countries with double digit growth in areas planted to GM crops together with Vietnam and Colombia (ISAAA, 2020).

Status of Biotech Crops Adoption in the Philippines

To keep track of agri-biotech adoption in the country, past studies focused on Bt corn farming as point of reference. Bt corn was the only GM crop approved for commercialization in the country since 2002.

It was developed to control the highly destructive insect pest Asian corn borer that can destroy up to 80 percent of the crop. It was first planted in 2003 and since then its adoption has increased at an average of 5 percent annually (Aldemita et al., 2015). The most recent study covering 2002-2019 period cited the amount of acreage to be increasing by a yearly average of 31.24% (Conrow, 2021). The same study noted that some 460,000 farm families or one-third of all corn famers in the country have been planting Bt corn over about 835 hectares of farmlands during that period.

The adoption of Bt corn has brought about significant economic benefits to Filipino corn farmers. Noteworthy was the finding that Bt corn planting can double or triple the average 3 metric tons harvest per hectare. More importantly, the lower income households benefited more than richer households with the middle class benefiting the most from this GM crop (Conrow, 2021).

A more detailed study was conducted by Torres et al. (2013) to probe on the dynamics of adoption and uptake pathway among Filipino farmers engaged in Bt corn farming. Principal triggers for adoption included high yield and income, freedom from pest infestation, dramatic reduction in inputs cost (as pesticides were reduced significantly), and presence of traders who provided the initial inputs and sure markets for their harvest. Income increased twice among lowland farmers and thrice among upland farmers. Peers, relatives, and friends served as strong influencers for adoption of Bt corn.

In the last two years, two more GM crops were approved for commercial cultivation: Golden Rice in July 2021 and Bt eggplant in October 2022. Golden Rice, is a GM crop that contains additional level of beta carotene which the body converts to Vitamin A (IRRI website, July 23, 2021). The latter helps prevent Vitamin A deficiency that causes blindness among children. Bt eggplant, on the other hand, is an insect-resistant variety that contains natural protein from the soil bacterium (USDA, 2022). This makes it resistant to eggplant fruit and shoot borer, considered to be the most destructive pest of eggplant.

In 2019, the Philippines ranked 12th among the 29 countries in the world planting biotech crops (ISAAA, 2022). The country has earned the title “regional biotechnology leader in Asia,” it being the first to allow the planting of Bt

corn in 2003 and being the first to set up the regulatory framework for GM crops in the region. The work of research and development (R&D) institutions continues to expand to other potential GM crops such as cotton and papaya both resistant to virus. The country is moving towards developing one for genetically engineered animals.

Perception Studies on Agri-Biotech

Public perception is the aggregate views of people about issues or events (Dowler et al., 2006). This aggregate of views can be a synthesis of views and attitudes of all or a certain segment of society or a collection of differing or opposing views.

Dowler et al. (2006) identified risk as one of the key areas of public perception studies. They enumerated the purposes for getting public perception of risk to include: assessing public needs, specifically the latter's priorities for policy actions; evaluating policy or assessing the impact of current policies; formulating or assessing various policy options; assessing the effectiveness of information (or public understanding) about a policy; and implementing policy or devising communication strategies.

At the practical level, results of public perception studies can surface the factors that influence the viability of the technology and its acceptability to the consuming public. They provide the baseline on the consumers' views and attitudes, which help the experts and scientists configure the technology better (Weldon and Laylock, 2009). Perception studies further help the consumers choose their future use of that technology.

Perception studies are highly acceptable means for drawing out people's inner thoughts and feelings which they would not otherwise express voluntarily. Thus, these are systematically explored. The public and the various stakeholder groups are the typical targets of perception studies. And this is rightly so because at the end of the day, stakeholders would have the final say on whether or not they will use or adopt the technology.

Any new technology such as agri-biotech deserves to be scrutinized and discussed by the affected public. To do so is but a normal response by the lay public. Public perception, favorable or not, can have immense influence on the behavior of the entire population towards agri-biotech. But since perception is often marred with biases, prejudices, and misinformation, it has to be counteracted with solid evidence and more scientific claims. Only when this perception is known can the proper social strategies in terms of content and methods be identified and worked out for acceptance, use, and eventual adoption of agri-biotech.

Dramatic Events and Public Debates Involving Agri-biotech

The road to progress of biotech crops in the country has been met with a number of challenges. Among these is the persistent opposition from anti-GMO groups. During the past years and even before the 2006 study, the anti-GMO groups have staged a number of dramatic acts and debates to draw public attention and sympathy. Among these events were: (1) negative publicities by the mass media, (2) uprooting of Bt corn in a field test site in South Cotabato, (3) hunger strike by anti-Bt corn groups, (4) protests by the religious sector and other stakeholders, (5) allegation on the presence of toxins in the blood samples of B'laans exposed to Bt corn, and (6) resolution and petition to ban field trials and planting of Bt corn (Panopio and Navarro, 2011).

In fact, nationwide movements, especially those organized and led by Greenpeace, have led the two provinces of Negros Occidental and Negros Oriental to jointly establish the Negros Organic Island. This was a move to ban the entry of GM crops into the island. With the backing of Greenpeace and the petition signed by various stakeholders, Negros Occidental in 2009 banned the entry and use of GMOs in the province (Gomez, 2007).

The more recent dramatic events have something to do with the new GM crops in the country: Bt eggplant and Golden Rice. Essentially, the anti-sentiment tactics for these two crops remained the same as with Bt corn.

In 2011, a group of activists uprooted and destroyed the Bt eggplant multilocation field trial by UP Los Baños in its experimental farms in Bay, Laguna (Fernandez, 2011). The same event was repeated later that year in the Bt eggplant experimental field at UP Mindanao. With members of foreign and local media in tow, these acts were meant obviously to dampen the government's effort to propagate Bt eggplants in the country commercially. Bt eggplant is a GM crop made resistant to fruit and shoot borer that commonly attack eggplants, causing significant losses during the crop harvest (UPLB-CAFS, n.d.).

Another drama about Bt eggplant took center stage in 2015. The case was initiated by a group of farmers and environmental activists who earlier asked the Supreme Court (SC) to stop the government from introducing genetically engineered eggplants to Philippine soil, citing their health and environmental hazards. On December 8, 2015, the high court ordered a full stop on the government's field testing of Bt eggplant and declared the Department of Agriculture Administrative Order No. 8 covering such tests null and void (Rappler, 2015).

This decision was petitioned by a number of pro-GMO institutions, mostly leading the work on Bt eggplant. On July 26, 2016, the SC then reversed its ruling on Bt eggplant on the ground of being moot (Mañalac, 2016). At that time, there was no longer field test to stop. The biosafety permits issued by the Bureau of Plant Industry have already expired, practically also terminating the field trials in question.

A similar event happened to Golden Rice. This is another GM crop developed to address Vitamin A deficiency, a cause of blindness among Filipino children (IRRI, 2021). In 2013, a group of local farmer-protestors attacked the experimental plots planted for Golden Rice plants in Bicol, just like what was done earlier to Bt corn and Bt eggplants (Mcgrath, 2013). Arguments against Golden Rice revolve around its inability to produce beta-carotene enough to eradicate vitamin A deficiency, its questionable ties with large biotech industries, and the cultural acceptability of "yellow rice" in the kitchen and on the dining tables of the Filipinos (NYU, n.d.).

The public debates are not just about the specific GM crops mentioned in particular instances. In essence, these are about biotech crops or GMOs in general. Both the pro and anti groups have their line of arguments and evidences being convincingly crafted from time to time. And yet no immediate resolution seems to be in sight; the debate still rages on.

Development of GM crops in the country has been stalled time and again by dramatic protests of activist groups. A very common tactic was for them to uproot the plants of GM crops planted on field plots to draw public attention and sympathy.

Gaps to be Addressed

Perception studies on agri-biotech in the Philippines have already generated data and findings helpful in designing programs for public information and science education. So the next logical step is to find out whether these programs and activities have served their purpose of enhancing public awareness and knowledge of agri-biotech and whether such knowledge has changed public perception.

Along this track, this study aims to answer the following questions: What happened to public perception after 16 years of public information and education as well as public debate about agri-biotech? Have the perception and attitude toward agri-biotech changed? What remains unchanged? Why?

Since there are now provinces in the country where GMO is banned, the study also includes a question about the difference between the perception of the public from areas where GMO is banned and where GMO is allowed.

Objectives

Given the gaps above, the study was conducted to:

1. Determine the current scenario of stakeholders' perception of agri-biotech after 16 years of public information and debates;
2. Identify the similarities and differences between the 2006 and 2022 agri-biotech perception studies;
3. Compare and contrast the perception of stakeholders in provinces with GMO ban and those in provinces where GMO is allowed; and
4. Recommend actions and policies that will enhance stakeholders' favorable perception of biotech in general and agri-biotech in particular.

Significance and Limitations

Significance

The study aims to analyze the latest trends in public perception of agri-biotech in the Philippines after almost 20 years of commercial planting of the first GM crop in the country. With the public first hand exposure and experience on the crop, it is noteworthy to know the changes in the trends, if any, and contribute to the understanding of such changes in perception trends. Likewise, results of the study can provide specific information on the aspects where public appreciation of biotech is smooth sailing and where certain bumpy areas may need to be navigated better to bring a better informed public.

A replication study such as this also serves as a monitoring mechanism for the progress being achieved or problems being encountered and thus help modify current actions on public education and information about agri-biotech.

While the study focuses on the public as a collective group, the data can also be disaggregated to give a picture of individual stakeholder group's perception. Hence, better targeting of audience can be designed to give priority to the ultimate end users of the product who are supposed to be more knowledgeable about it.

Results can guide scientists, researchers, and partners in developing future initiatives on increasing public understanding and acceptance of biotech crops and products in sync with the realities on the ground.

Just like the 2006 study, the current study includes a few questions about the stakeholders' awareness and attitude towards animal biotech even if actual work on this area has yet to start. Results can shed light on the public's thoughts and response when biotech is now applied not only to crops but to animals as well. This new challenge can help prepare in advance those working on animal biotech so that they can better address public doubts, misinformation, and knowledge gaps. This can pave the way for a better public appreciation and acceptance of animal biotech. This can also help minimize the costly uphill battle that can stall the progress of a promising technology like agri-biotech.

Limitations

Some uncontrolled bottlenecks were encountered during the study's implementation that led to the revision of the original methodology. COVID-19 pandemic was still at its peak when data gathering was started in early part of 2022. So there were restrictions on travel and on-site visits, and face-to-face encounters.

Time lapse. Sixteen years have lapsed between the 2006 and 2022 studies. During this period, many changes in the study areas could have occurred. Some of the original respondents might have passed away, migrated, or aged and not be able to respond to the survey questions. Hence, another set of respondents for each stakeholder group was selected, but still they came from the same provinces tapped in the 2006 study.

Purposive sampling. The original design of using random sampling did not materialize due to the occurrence of COVID-19 pandemic. Government health protocols required social distancing and avoidance of physical contacts during that time. So instead of stratified random sampling, stratified purposive sampling was resorted to. To insure safety and to give respect to some of the stakeholders' decision to remain in isolation, respondents were chosen based on their accessibility (as travel was still limited), availability, and willingness to answer the survey questionnaire. In the absence of

random sampling, the data were not anymore amenable to statistical testing. So the study dropped the aspect of determining relationships between variables selected in the 2006 study.

Method and tool for data gathering. The intention was to gather data using field survey and interviews similar to the 2006 study. But due to the constraints brought about by the Covid-19 pandemic, the study shifted to the use of Google survey. The very nature of Google survey allowed only the use of close-ended questions for the most part wherein the respondents were asked to tick the items that correspond to their answers. There was not much leeway to do probing questions that address the whys and hows.

Unfortunately, the online survey was affected by the unstable Internet connectivity in many target provinces and municipalities. So restricted face-to-face interviews using the same Google survey forms were used to minimize the risk posed by Covid-19 pandemic. Enumerators who administered the questionnaires were provided guidelines for their safety and were advised not to prolong the activity beyond what was necessary. To achieve some degree of uniformity in the way data would be processed later, responses from completed questionnaires were eventually entered in the Google survey. All data were then processed as Google survey data, with built-in automation in generating the tables for frequency counts, percentages, and weighted mean.

Comparing the 2006 and 2022 studies. Similarities and differences between the 2006 and 2022 studies should consider the fact and limitation that results of the latter study are not statistically conclusive, its sampling being non-random. Thus, the 2022 results are not generalizable to the entire population of the public in the country. The most that the 2022 study can do is to present the current trends as the new case scenario for public perception of agri-biotech in the country based on purposive sampling.

REVIEW OF LITERATURE

Biotechnology

Through the years, the word biotech has stirred interest, curiosity, concern, and even fear among the public. It finds favor generally among stakeholders who are aware and knowledgeable about its scientific merits. But it is regarded with suspicion by a public that has limited knowledge and more exposure to unscientific facts and myths. Thus, the public must first be made aware of what it is and how it works.

Definitions of Biotech and Agri-biotech

Biotech is the controlled and deliberate manipulation of biological systems for the efficient manufacturing or processing of useful products (DCU, n.d.). It is also a set of biological techniques developed through basic research and applied to research with the aim to produce development (Bartoszek et al., 2006). The Organization of Economic Cooperation and Development (OECD), as cited by Langer and Sharma (2020), defines biotech as the application of scientific and engineering principles to the processing of materials by biological agents to provide goods and services. ISAAA (2014) refers to it as set of tools that uses living organisms or parts of living organisms for modifying a product; improving plants, trees, or animals; or developing microorganisms for some uses.

Bartoszek et al. (2006) enumerate three types of biotech: (a) green biotech, (b) red biotech, and (c) white biotech. Green biotech involves agricultural processes and is meant for crop improvement

and plant products production. It is achieved by introducing foreign genes to plant species. Green biotech includes plant tissue culture, plant genetic engineering, and plant molecular marker assisted breeding. Red biotech, on the other hand, is about health care processes, wherein the human body's own tools and weapons are used to fight diseases. It includes cell/tissue therapy, stem cell, and gene therapy. Meanwhile, white biotech refers to industrial and environmental processes that utilize molds, yeasts, bacteria, and enzymes to produce environment-friendly or eco-efficient goods and services. Examples are bio-products such as detergents, vitamins, antibiotics, biodegradable plastics, and biofuels among others.

When biotech tool is applied in crops and livestock improvement, this is called agricultural biotech. Biotech tools used for agri-biotech include conventional plant breeding, tissue culture and micropropagation, molecular breeding, genetic engineering, and molecular diagnostic tools (ISAAA, 2014).

Agri-biotech is categorized according to product lines: the first wave, second wave, and third wave bioengineered products (Knight, 2006). The first wave bioengineered products are plant and animal products where specific traits are added or enhanced to increase production. The second wave biotech products, or the so called "nutraceuticals" or "functional foods", involves adding or enhancing specific traits to increase nutrients, improve the taste of food, or reduce browning of crops that leads to food wastage. And the third wave biotech products include plants and animals that are grown for pharmaceutical, cosmetic, and industrial by-products and, thus, are meant to be processed into drugs, chemical compounds, and plastics.

Benefits of Biotech

Biotech offers a lot of benefits to people. It is being used to address various global challenges such as environmental degradation, pollution, hunger, malnutrition as well as the spread of infectious diseases (Langer and Sharma, 2020). Biotech helps address these issues through improved product characteristics such as: fruits or vegetables with better taste, that retain their flavor and texture longer, and enhance health; crops resistant to pests and viruses; plants tolerant to stressful conditions such as extremes of temperature and soil salinity; and animal vaccines that control diseases. Biotech also leads to the production of enzymes for food processing and the production of pharmaceuticals to treat various diseases (UC Davis Center for Consumer Research, n.d).

For farmers, agri-biotech helps reduce their production cost and makes farming more manageable. By planting crops resistant to diseases and insect pests, they are able to reduce the use of synthetic chemicals. Furthermore, with plants tolerant to herbicides, weed control becomes simpler and more efficient (USDA, n.d.).

In a more profound way, ISAAA Brief 55 (2019) captures the contributions of agri-biotech at the global level using the chart below.

Issues Concerning Biotech

The more persistent issues on agri-biotech are related to health, environment, biodiversity, and equality. The most prevalent and perhaps most debated issue pertains to the risks associated with it. One is the possible accidental release of GMO into the environment which is believed to affect the ecosystem and human health (Pengue, 2022). Another are health risks. Some people have been reported to develop allergic reactions after consuming GM foods (Haroon and Ghazanfar, 2016), though this has never been proven to be conclusive. A trend observed is that people who are more supportive of GM foods are more likely to feel that these foods are safe; the opposite is true for people who do not support GM food products (Lauxs et al., 2010).

Another issue raised against agri-biotech is the possible exclusive control over it by the private sector. People are apprehensive that the private companies would own the technology exclusively, having the full capacity to produce and sell it to the farmers at the price they command. Hence, farmers would need to buy seeds only from the company every sowing season, thereby, threatening their access to seeds and biotech crops. In the long term, they envision that once farmers could no longer afford the price, they would lose their livelihood and income (Jamil, n.d.).

The lack of public confidence in government regulatory system regarding biotech is another concern. In Ghana, for example, people perceive that government institutions are not well equipped to handle GM technology and that establishing a special body to regulate ethical and moral issues associated with biotechnology research is needed (Quaye et al., 2009).

Media play can magnify biotech risks, some unfounded, and this may heighten perception of risks that would result to decreased demand for GM products (Curtis et al., 2008). Examples are the coverage of the mad cow disease (Bovine Spongiform Encephalopathy or BSE) in the European Union, Japan, and Canada. This resulted in the decline of beef demand and the discovery of cows with BSE in south-central Washington State that in turn led to the closure of several overseas markets for US beef. Other examples are the anti-GM groups' protests on GM foods in the US, which forced companies such as McDonalds, Wendy's, and Frito Lay to stop using GM potatoes for fear that consumers would stop patronizing their products.

Similarly, Curtis et al. (2008) reported that media coverage greatly influences people's risk attitude toward technologies. Based on their study, consumers in less developed nations tend to be more positive towards GM foods. This is because governments in these nations have more control over media while the consumers have less access to them.

Public Knowledge and Acceptance of Biotech Crops and GM Foods

Knowledge and Informed Decisions on Biotech Crops and GM Foods

Different countries have investigated the association between the public's knowledge, attitude, and acceptance of biotech crops and GM foods. There is a general trend that majority of the public is aware of biotech in food production and regard it as beneficial to society. So the more knowledgeable the public is, the higher is the chance for it to be more accepting of GM foods.

In 2006, Sheikhha et al. studied the knowledge and perception of educated and ordinary people regarding GM foods. Involved were 300 university students and 300 individuals without university education in Iran. Their findings revealed that 79 percent of students and 18 percent of non-students had read or heard about GM foods. A little over one-third (36%) and only 8 percent of the non-students believed that biotech is beneficial because it produces food with better taste, it is profitable to farmers, it increases the production of agricultural products, and it utilizes less pesticides.

McHughen's (2007) review of studies on public knowledge of agri-biotech showed that consumers from both North America and Europe had very low knowledge about food and agriculture. One question that was asked the respondents was whether or not ordinary tomatoes contain genes. Of course, tomatoes regardless of whether or not they are ordinary or products of biotech have genes. Surprisingly, only 40 percent of the respondents from North America answered correctly, while one-third of the European respondents answered "No" and another third said "Don't know." This failure of the respondents to recognize genes or DNA as a natural component of tomatoes already indicates their lack of knowledge of basic biology. And they also failed to answer correctly other questions such as: *Would a tomato with a fish gene taste "fishy"? If you eat a GM fruit, might it alter your genes? Can animal genes be inserted into a plant?*

The researcher, therefore, pointed out that this lack of underlying knowledge among the citizens for making rational comparison is the very reason why they cannot also make informed decisions and choices about biotech. McHughen (2007) suggested that public educators then should teach ordinary consumers about food and food production and must help them also to unlearn all the incorrect information that they have come to believe as true, such as those about genes.

According to Wheeler (2008), the lack of knowledge among consumers and their negative attitude towards genetic engineering were among the most cited barriers to further diffusion of biotech. Consumers were viewed as not having fully understood the complexity of genetic engineering, thus, they tended to reject the technology. Likewise, professionals perceived the media as the key reason why the public has such a negative attitude towards the technology. Professionals believed that the media's portrayal is often inaccurate and biased against genetic engineering in general.

Professionals would often cite the need for increased education of consumers to overcome the media's portrayal and to change how consumers view genetic engineering. The professionals' responses in naming a 'lack of consumer knowledge' and 'media portrayal of genetic engineering' were also similar to the common response by the scientific community. Many scientists argued that the public does not understand genetic engineering and that consumers' reluctance to accept biotech, therefore, stems from ignorance and not wisdom.

In Ghana, according to Quaye et al., knowledge of biotech and GM foods in 2009 was high, with 100 percent and 95.3 percent, respectively. However, 50 percent of stakeholders were not in favor of GM foods. Those who refused GM foods were mostly from the academia, while those who accepted were from government institutions such as food research institutions, foods and drug boards, and the Ghana standards board. The farmers were not in favor of biotech and were worried about their looming dependence on foreign seed companies and the eventual death of their traditional farming systems. Acceptance of GM foods, on the other hand, was due to some health and economic benefits. However, despite the advantages, all the respondents would not be in favor of biotech if it will go against nature.

Laux, Mosher, and Freeman (2010) found that positive opinions about GM foods were more common among American-born college students and those studying physical science-based curriculum than those born outside of US and those taking non-physical science-based curriculum. Moreover, those who held positive views about the technology had higher level of acceptance of GM foods.

A study on the public perception, knowledge, and factors associated with the acceptability of GM foods in Kampala City, Uganda (Nowamukama, 2022) revealed that 65 percent of respondents had basic knowledge about GM foods, although with a lot of misinformation. A little less than one-half were concerned about the safety of GM foods for human health and the environment. Their acceptance of GM foods was significantly influenced by the female gender, high education level, and perceived nutritional value of GM foods.

When results of various studies on public acceptance of biotech were put together, they indicated these general trends: (a) objection to biotech tends to focus on its applications rather than on the technology per se, and (b) the plant-to-plant transfer is more acceptable than the animal-to-plant or human-animal gene transfer when it comes to type of gene transfer involved.

Public Perception Studies

Studies on public perception of biotech started in the early 1990s and continued through the years straddling the first and second decades of the 20th century. These studies allowed stakeholders to anonymously give their views about GM crops, the process involved in their production, and the system by which these are regulated and distributed.

As the ultimate users of biotech crops and consumers of GM foods, public acceptance or rejection of biotech is a crucial decision. Public rejection of biotech can hamper its commercial roll out and eventual adoption (Latifah et al., 2007) even if it could be the most promising technology in the history of agricultural development. In the long run, the public's unfavorable attitude on concerns about safer crop production, food security, and nutrition can stall not only biotech's progress but that of science as well.

Perception studies have been conducted globally and at country level to determine how society as a whole and specific groups or stakeholders take and respond to new biotech crops. These studies typically probe with questions such as the following: (a) What do stakeholders know or understand about biotech?; (b) What are their views and opinions about the impact and role of biotech in their lives?; (c) Where do they obtain information and what information do they get?; and (d) Who do they trust to tell the truth about biotech?

In various parts of the world, some trends on biotech perception can be observed (Hoban, 1998). More favorable attitude towards biotech crops and GM foods was noted in the US, Canada, and Japan. Their public's concerns dealt more on taste, nutrition, price, safety, and convenience. On the other hand, the anti-sentiment was more prominent in European countries like Germany and Austria where stakeholders were bothered more by the environmental, political, and social impacts of biotech.

A similar study was undertaken by Hoban (2004) after six years. Some trends remained the same while others changed. US still led industrialized countries in supporting GM crops, while Europe remained negative towards it. Japan, which used to be positive, has joined the anti-GM countries together with South Korea. People in developing countries, like Philippines tended to be supportive of GM crops. Support for food with GM ingredients could be found in China, India, US, Brazil, and Canada. Europe and Australia would reject GM foods even if they are more nutritious. And when it came to biotech applications to animals, the trend in many countries was to oppose it.

More favorable attitude towards GM foods is noted in the US, Canada, Brazil, China, and India.

Negative attitude towards GM foods prevails more in Europe, Australia, Japan, and South Korea.

In the Philippines, some studies on stakeholders' perception of agri-biotech were conducted in 2002, 2006, and 2008. Stakeholders consisted of eight groups, namely: (1) businessmen and traders, (2) consumers, (3) extension workers, (4) farmer leaders and community leaders, (5) journalists, (6) policy makers, (7) religious leaders, and (8) scientists. The study in 2002 captured the public perception of Bt corn even before the crops' actual planting in the field. Findings revealed that even with low exposure to information sources and moderate level of knowledge, the stakeholders had considerable interest and favorable attitude towards agri-biotech. They viewed agri-biotech as good for Philippine agriculture and one that does not pose a high risk to public health and food safety (Juanillo, 2002). They considered moral and ethical issues as important factors affecting attitude towards agri-biotech.

In 2006, three years after approval of the commercial planting of Bt corn in the Philippines, another perception study was conducted by Torres and her team. Using the same stakeholder groups, they found that not much changed about the public attitude towards agri-biotech. All stakeholder groups exhibited favorable attitude towards it even if they had low exposure to information sources. University-based scientists were regarded as the most trusted sources of information despite that they were hardly accessed by the public. Among the eight stakeholder groups, the journalists and scientists stood out as most optimistic about agri-biotech, while the religious group was the least optimistic. Food safety and environmental impacts were considered as two important factors affecting decisions about agri-biotech.

A 2008 study focused only on the consumers in the Philippines (AFIC, 2008). The trends on perception and attitude remained the same. Consumers highly believed and supported the potential of agri-biotech crops to provide high quality nutritional foods and sustain food production. They were willing to buy agri-biotech products and foods derived from them.

In the same year, scientists and researchers from DA were tapped as the respondents of a similar perception study. Having a common understanding of biotech, they regarded it as beneficial in producing improved/better quality products. However, most of them were concerned about the environmental impact of biotech crops.

Results of the above perception studies indicated that countries in various countries had selectively accepted or rejected agri-biotech based on certain grounds. In the Philippines, the public had generally supported it due to the benefits derived. Despite this, there remains some concerns about its safety and environmental impacts. However, based on number and intensity of voices heard, such concerns appeared to be not that crucial to derail the progress of agri-biotech development in the country and other parts of the world.

In the Philippines, the public generally supports agri-biotech.

Among the various stakeholders, the scientists and journalists are the most optimistic about biotech crops.

Factors Affecting Perception of Biotech

Poortinga and Pidgeon (2003) discussed the key events that influenced the change in public perception of agri-biotech in the United Kingdom (UK) based on various sources. When the first GM product (tomato paste made from Flavr SavrTM tomatoes) was launched in UK in the mid-1990s, the product was favorably received by the consumers even if it was labeled as a GM product. This was because of its cheaper price and better taste.

Then, in autumn of 1996, when Monsanto sent to Europe its first shipment of Roundup Ready soya (a mix of GM and non-GM soya beans), many NGOs launched a high profile campaign for the labeling of GM products. This started the era of negative opinions about GM foods in the UK. Consumers viewed the shipment of non-segregated product as a violation of their right to choose

the product that they would consume. When "Dolly," the first cloned sheep by the Roslin Institute in Edinburgh, UK was introduced in February 1997, intense debates on the ethics of biotech sparked. At the same time though, it demonstrated the scientific potential of modern biotech.

Another controversy on GM foods arose in August 1998 when a researcher at the Rowett Research Institute in Aberdeen claimed on UK television that his rat experiments had shown that eating GM potatoes could lead to intestinal changes. This led people to think of the health risks of GM foods when consumed by humans.

Other issues emerged after 1998. Hence, at the end of the 1990s, the public became strongly opposed to GM foods to the extent that supermarkets were forced to remove GM products from their shelves. Furthermore, trust in the government's risk regulation on food production was low at that time.

In Spain, Lujan and Moreno (1994) captured the people's tendencies and ambivalence towards biotech. The Spanish public considered research in human genetic engineering as valuable, but viewed its application as questionable from an ethical perspective. People considered biotech as useful to humanity, yet they were not in favor of its application to food production. Also, because of lack of information about the topic, there was not much debate about it. Thus, discourse is considered important as the processes of discussion, debate, and negotiation can lead to a better shaping of the technology.

In 2003, a survey on perception of biotech crops and GM foods was conducted in Britain. It was found that there were more people who had negative attitude than those who supported GM foods and crops. A large number believed that GM foods have unknown consequences and risks to people. However, it could not be concluded outright that the people opposed GM foods because majority still appreciated its benefits. So while the people were critical about the government and the industry as reliable sources of information about GM foods, they still believed that these bodies have important roles to play in decision-making. Hence, there was more ambivalence and uncertainty among the public regarding their support for GM food.

In China, a nationwide consumer study on public perception of GM food was conducted in 2016 (Cui and Shoemaker, 2018). It involved all provinces in China. Apparent changes were noted when results were compared with the study conducted in 2002. The initial positive attitude of people towards GM foods in 2002 generally decreased through the years. Correlation tests indicated that respondents who held negative attitude towards GM foods were born before 1969; came from Western China compared with those from the center and northern China; and earned an annual income of more than

one million Chinese Yuan (RMB) compared to those whose annual income were below 80,000 RMB. Further, those with positive attitude had science backgrounds rather than liberal arts. Overall, the study showed a need to overcome the rising percentage of those who opposed GM foods. It was suggested that the Chinese government should strengthen its communication to the public regarding GM technologies and its benefits, and should put up a transparent system for evaluating GM technologies while upholding the peoples' right to make their own choices about GM foods.

In an article published in the journal *Trends in Biotechnology*, Wozniak et al. (2020) described the views held by Europeans about biotech and genetic engineering over the last 20 years. The Eurobarometer reports between 1999 and 2010 were compared with a study conducted in 2019. The change in the level of Europeans' acceptance of genetic engineering and the various biotech applications over 20 years was not at all significant and remained at a relatively low level.

Wozniak et al. (2020) further noted that the low level of acceptance of genetic engineering was due to biotech applications rather than to the technology itself. The public still had moderately optimistic perception about the contribution of science and technology to humanity. Their approval of genetic engineering applications in the medical field was higher than the social acceptance of GM crops and GM foods. In particular, they had reservations regarding GM plants that help reduce greenhouse gas, are resistant to pests and herbicides, improve yield, maintain the nutritional needs of humans and animals, and increase the economic benefit of farmers because of the risks associated with them.

The public's approval of genetic engineering is higher if it is applied in the medical field than when it is used for GM foods.

Based on these outcomes, Wozniak et al. (2020) recommended taking these actions: (a) further inform/educate the people about biotech and GE, as well as the risks and opportunities of new scientific ideas that can address their social, economic, and environmental challenges; (b) for the academia, breeders, and retailers to communicate a common message that is supported by science; and (c) label GM foods to allow the people to make their own choices about GM products.

In 2021, Sendhil et al. conducted a bibliometric analysis on consumer perception and preference of GM foods. They analyzed 616 documents composed of research articles, reviews, proceedings, early access, editorial materials, book chapters, meeting abstracts, and news items published between 1989 to 2021. They reported that consumers in EU had more negative perception and low purchase intention of GM foods than those from North America. The public support was higher with the following conditions: the benefits of GM are well-articulated; there is price discount; people trust the government; and the public believes in science. On the other hand, negative attitude was influenced by media information, stringent production and trade regulations, and fear of health risks.

Other trends were reported by Hoban (1998). He noted that American and Canadian markets were more accepting and calm as biotech started arriving in their stores. But in European markets, biotech applications were still controversial with the German and Austrian consumers opposed to biotech. US consumers were interested to learn more about how biotech is used, its safety, benefits, food applications, nutritional value, and how much it will cost. On the contrary, Europeans were more interested on the environmental, political, and social impacts of biotech.

The study of Hoban also noted that there was generally higher acceptance of biotech when applied to human genetic testing, development of medicines, as well as in the development of new types of insect-resistant crops. But consumers are less likely to accept the use of biotech with animals.

The drivers of biotech acceptance as shown in Hoban's study were the following: (a) its benefits, (b) low level of risk, (c) morally acceptable to society, and (d) endorsed by credible third party experts. In Hossain et al.'s study (2002), additional factors included: (a) moral and ethical views, (b) knowledge of science, and (c) trust in government.

Hoban undertook another study on the same topic in 2004 in various countries across continents. Findings indicated that some trends have changed while others remained the same. More negative about biotech were those from Europe, Japan, and South Korea while the US led industrialized countries in supporting biotech. Likewise, those from developing countries tended to be more supportive of biotech especially when used for medicines and food. Support for food with GM ingredients came from China, India, US, Brazil, and Canada. GM crops also found support in Spain, Portugal, Ireland, Belgium, United Kingdom, Finland, Germany, and Netherlands. In contrast, those from Europe and Australia rejected GM foods even if these were more nutritious. Countries in Europe that opposed GM crops were France, Italy, Greece, Luxembourg, and Denmark.

Consistent with early studies, anything that had to do with animal application caused the support to biotech to drop in all countries. People did not agree that genetic modification should be done on animals even for increasing productivity or for medical research (Hoban, 2004).

Biotech applied to animals can cause the support to biotech to drop in many countries.

In Spain, Lujan and Moreno captured in 1994 the tendencies and ambivalence towards biotech.The Spanish public considered research in human genetic engineering as valuable, but viewed its application as questionable from an ethical perspective. People considered biotech as useful to humanity, yet they were not in favor of its application to food production. Also, because of lack of information about the topic, there was not much debate about it. Hence, discourse should be considered important as the processes of discussion, debate, and negotiation lead to a better shaping of the technology.

A similar study focused on Asian trends in consumer perception of biotech covering China, Indonesia, and the Philippines (Cairns, 2005). Respondents accepted agri-biotech because : (a) they are aware of biotech and were less worried about it; (b) they appreciated the potential benefits especially the nutritional value of GM crops; and (c) the GM foods approved for human consumption were trusted as safe. An interesting observation was that acceptance proceeded quite rapidly. Initial disinterest and resistance proceeded to acceptance as benefits to human health became more apparent.

Biotech Perception in the Philippines

As early as 2002 when planting of Bt corn, the first GM crop to be approved for commercial planting in the country, had yet to be proclaimed, Juanillo (2002) was already exploring the social and cultural dimensions of agri-biotech. His study covered some Asian countries including the Philippines.

Major questions raised to stakeholders in the study elicited answers meant to gauge their public understanding, perception, and attitude towards agri-biotech. Questions raised were as follows:
(a) What do stakeholders know or understand about biotech?; (b) Where do they obtain information and what kind of information do they get?; (c) Who do they trust or have confidence in to tell the truth about biotech?; and (d) What are their views and opinions about the impact and role of biotech in their lives?

Key findings of the above study showed that the stakeholders had only moderate factual knowledge about biotech. Very few, mostly policymakers, asserted that they had a good grasp of biotech. Religious leaders were the least knowledgeable about biotech. Those with better factual knowledge tended to have positive attitude towards biotech.

Those with better factual knowledge tend to have positive attitude towards biotech.

Further, stakeholders relied mostly on mass media for information. Information obtained were rated as "somewhat scientific and somewhat useful" indicating that stakeholders did not get what they desired. Nonetheless, their most trusted sources were the scientists because they were convinced that latter possessed scientific knowledge for the job and conviction to protect the public from any harm through the use of biotech (Juanillo, 2002).

As to views and opinions on impact, Juanillo found that the public was not very keen on the promised benefits of biotech as indicated by their moderate rating of the item. Religious leaders had the most number of negative feelings and opinions about biotech, viewing it as an ultimate interference with God's design of creation.

In 2006, another study was conducted by Torres et al. on public perception of biotech, essentially adopting the questions and stakeholder groups used in the 2002 study by Juanillo. By early 2003, some Filipino farmers were already planting Bt corn in the Philippines. It was deemed an opportune time to assess public perception again, after farmers had experienced the real thing or the commercial planting of Bt corn in their fields.

Torres et al. found that the public perception of biotech became more favorable in later years. Mass media remained as the main sources of biotech information and the scientists as the most trusted information source. Despite the stakeholders' low exposure to sources of information on agricultural biotech, they expressed more favorable rather than 'moderate' attitude, primarily due to their trust in government agencies working on biotech. They perceived that that the government was doing its best to ensure the safety of the public through the regulations in place and the expertise and ethics of scientists doing biotech work. The stakeholders' level of factual knowledge also increased, except for the wrong notion that genes are only found in GMOs and can be transferred to other humans by eating.

A consumer survey by the Asian Food Information Center in 2018 showed that 59 percent of Filipino consumers had positive perception of biotech crops. In fact, 73 percent believed that they would benefit from biotech because of improved quality and more affordable prices of goods. On the other hand, public awareness of animal biotech remained low, and people associated it with issues related to food safety, environmental safety, animal welfare, and product efficacy (FAS-USDA, 2018).

Based on the Agricultural Biotechnology Annual of 2022 (USDA, 2022), agricultural biotech is both supported and opposed in the Philippines. The local corn farmers, hog and poultry raisers, feed millers, food processors, and the academe had positive opinions about it. On the other hand, non-government organizations (NGOs), environmental groups, organic agriculture advocates, and some civil society groups had negative opinions about GM products. Meanwhile, large domestic food and agribusiness companies, although already using GM products, were silent about biotech issues.

Majority of Filipinos remained indifferent and market acceptance of GM products was being hindered by the misinformation campaign of anti-GM advocates. This was despite the established safety of GM products. However, the expansion of areas planted to Bt corn, from 10,700 hectares in 2003 to about 602,000 hectares in the first half of 2021, is being considered as evidence of market acceptance of plant biotech (Agricultural Biotechnology Annual, 2022).

Theoretical Underpinnings

This study is guided by the two similar concepts and their corresponding theories: public opinion and perception. To a certain extent, the two overlap: public opinion is shaped by perception, and perception is influenced by public opinion. Both are important aspects in the continuous development of biotech. Taking the social viewpoint, the study adopts the definition of public opinion as the collective views of people on matters affecting them (Moy and Bosch, 2013). These views are relative and subjective. Individually, they can say their piece but these pieces of thoughts, feelings, or ideas when put together represent a particular group's sense of reality about something.

Opinions are usually formed based on what people empirically experience: what they see, hear, taste, or feel. In other words, it is based on what have been communicated to them, intentionally or unintentionally. These then can be a strong force that can influence people's behavior towards something like biotech, even if these opinions are false or are simply myths. It is for this reason that studies about opinion matter a lot in designing communication and education.

Since the study is tied up to communicating biotech, it is biased towards the definition of opinion that relates to communication. Here, public opinion is conceived as a product of social interaction whereby members of the public communicate with each other (Moy and Bosch, 2013). “Even if their individual opinions are quite similar to begin with, their beliefs will not constitute a public opinion until they are conveyed to others in some form, whether through television, radio, e-mail, social media, print media, phone, or in-person conversation.” If not conveyed publicly, then there is no public opinion at all.

The very nature of public opinion, according to the American researcher Crespi (1997), is to be interactive, multidimensional, and continuously changing. No opinion is written on stone. It can change and be swayed favorably or otherwise. As such, stakeholders’ attitudes toward biotech is a legitimate area for exploring public opinion.

To count as public opinion, scholars agree that there must be at least four conditions to be met: (1) there must be an issue, (2) there must be a significant number of individuals who express opinions on the issue, (3) at least some of these opinions must reflect some kind of a consensus, and (4) this consensus must directly or indirectly exert influence. All these have been aptly met in this study.

On the other hand, perception as defined in the Oxford Dictionary refers to the “ability to see, hear, or become aware of something through the senses. Just like opinion, it is relative and subjective.
Perception is an important concept in understanding and modifying behavior change, especially when applied in the context of stakeholders’ behavior towards biotech. It is a form of cognition that enables a person to form his impression about biotech and influence his options for food, health, environment, and other social choices.

Perception as a form of cognition is something not visible but can be readily inferred from a person’s verbal responses to a series of questions that aim at eliciting one’s ideas, opinions, beliefs, predisposition, preferences, and the like. In communication, perception is an important baseline factor to consider. Perception studies can form certain trends when done among groups. Such can lead to actionable recommendations towards a more strategic approach in designing a communication process that can help modify people’s behavior towards one that is more favorable and supportive of technological products like agri-biotech.

Based on their definitions, there is a hairline difference between opinions and perception as each constitutes the other. In this study, the concept of perception was chosen over opinion.

METHODOLOGY

The occurrence of Covid-19 pandemic during the first quarter of 2020 and its persistence until the early half of 2022 dramatically impacted on the methodology of the study. To comply with the health protocols of the Covid-19 pandemic, the initial plan for random survey was replaced with non-random survey. Also, instead of in-depth on-site field interviews as originally planned, a self-administered questionnaire was used online for those with Internet access and printed form for those who did not have Internet access.

Research Design

The study employed the survey research design. Inherent to survey is its intent to describe the trends about pre-determined variables such as socio-demographic characteristics, knowledge, awareness, information sources, perception, and attitude towards agri-biotech, among others.

This study was meant to replicate the face-to-face field survey and random sampling done in 2006 study by a team of researchers headed by the author. But the occurrence of Covid-19 pandemic prevented the initial plan from being carried out.

Locales of the Study

The sampling of locales adopted the same scheme used in the 2006 perception study, except that three more provinces were added in the 2022 study. This was to intentionally cover representative provinces with GMO ban

ordinances, namely: Mondoro Oriental in Luzon, Negros Occidental in Visayas, and North Cotabato in Mindanao.

The country as the entire project area was divided into three major island groups: Luzon, Visayas, and Mindanao. From each island group, sample provinces were chosen as follows: 4 in Luzon, 3 each from Visayas and Mindanao, or a total of 10 provinces in all. From each province a city and an adjacent municipality were chosen for better representation of various stakeholders who may be found more in urban areas (like media people, policy makers, and scientists, among others) and those most likely based in less urbanized and rural areas (like farmers, traders, extension workers, etc.). Likewise, adjacent areas allowed for a more efficient data gathering in view of the limitations of physical movement due to Covid-19 pandemic. The two main criteria for choosing the key city and adjacent municipality were the following:

- People are familiar with or have some knowledge of biotech.
- There is an existing institution linked to UP Los Baños or the SEARCA Biotechnology Information Center (SEARCA BIC) such as a state university or college (SUC) through which data gathering might be coordinated and commissioned.

The 10 locales are summarized below including the SUCs and a government agency whose staff were tapped as field coordinators for data collection (Table 1).

Table 1. Locales of the study and partner organizations in data gathering

Region	Province, City/Municipality	Partner Institution
National Capital Region	Metro Manila Manila City, Tondo, Sta. Mesa, Sta. Ana, Sampaloc, Quiapo Bulacan Pulilan	Polytechnic University of the Philippines Sta. Mesa, Manila
Region II Cagayan Valley	Cagayan Tuguegarao City Iguig	Cagayan State University Tuguegarao, Cagayan

Region	Province, City/Municipality	Partner Institution
IV-A CALABARZON	Laguna Calamba City Los Baños	Laguna State Polytechnic College College of Arts and Sciences, Los Baños
IV MIMAROPA	Mindoro Oriental (with GMO ban) Calapan City Baco	DSWD Field Office Region IV-B Calapan, Oriental Mindoro
VI Western Visayas	Iloilo Iloilo City Pototan	West Visayas State University La Paz, Iloilo
VI Western Visayas	Negros Occidental (with GMO ban) Bacolod City La Carlota	UPLB-CAFS La Granja Research and Training Station La Carlota City
VI Central Visayas	Cebu Cebu City Minglanilla	University of San Carlos Cebu City
X Northern Mindanao	Bukidnon Malaybalay City Lantapan	Central Mindanao University Musuan, Bukidnon
XI Davao Region	Davao Mati City Banaybanay	Davao Oriental State College of Science and Technology Mati, Davao Oriental
XII SOCCSKARGEN	North Cotabato (with GMO ban) Kidapawan City Kabacan	University of Southern Mindanao Kabacan, Cotabato

Respondents

The study adopted the original eight stakeholder groups identified in 2006 study. Another group was added in the 2022 study for the students (Table 2). They were considered as interest groups whose decision pertaining to agri-biotech would impact on their concerns. Students (junior/senior high school and college level) were included as they also are expected to play a major role as future leaders of society.

Table 2. Stakeholder groups in agri-biotech as respondents of the study

Stakeholder Category	Definition
1. Businessmen and traders	Individuals who are directly involved in the food and agricultural industry
2. Consumers	Market goers; the market may be a supermarket or a wet market
3. Extension workers	Personnel working in universities, colleges, agriculture departments or offices or state research institutes whose responsibilities include information dissemination, technology transfer, assisting farmers and providing feedback to universities and research institutes on the needs of farmers and their communities
4. Farmer leaders and community leaders	Officers of farmers associations and cooperatives and non-elected members of community councils at the municipal and barangay levels, whose opinions and ideas tend to influence the overall dynamics of community debates or discussion on crop biotech and/or science related topics
5. Journalists	Media writers and broadcasters on national and local TV, radio, and print whose beat (area of reporting) includes agriculture, science, and/or technology; may also include prominent columnists and commentators in major national dailies, radio, and TV programs who may have covered biotech, science, and/or technology topics

Stakeholder Category	Definition
6. Policy makers	Individuals whose decisions and opinions would have significant influence or impact on national policies, laws, and regulations on the overall direction of the country's agricultural development programs including production, research, and trade May include senators, congressmen, parliamentarians, elected national representatives, members of legislative agricultural committees, officials in agriculture departments or ministries at the national or regional level such as directors and heads of units, and local government officials such as mayors, vice mayors, and councilors
7. Religious leaders	People who are recognized leaders of major religious groups in the country; may include Roman Catholic priests and nuns, Protestant and Baptist pastors and elders, preachers from Born Again groups, Iglesia ni Cristo, and Muslim imams
8. Scientists	Individuals who are not part of the country's crop biotech research consortium and who conduct research or develop technologies related to agricultural production and are based in universities and R&D institutions
9. Students	Enrolled individuals in the junior and senior high school under the STEM strand as well as those from the college level in colleges or universities offering agriculture courses.

Sampling

Stratified sampling was done from the major island group down to the province or city, municipality and down to the various stakeholder groups. The sample size of 423 in 2006 derived using Slovin's formula was used as reference. This was determined assuming a margin of error of 0.05 and a design effect of 2.0 to account for the use of a stratified sampling design.

The sample size used for each stakeholder group in 2006 was doubled. Then 20 more were added to groups that theoretically would have bigger populations, and 10 more to groups that theoretically would have smaller population vis-a- vis the other groups. There was no student group in the 2006 study but considering its population size nationwide, a total of 200 samples was allotted making it comparable with the population size of consumers. The final distribution of samples for the nine stakeholder groups is shown in Table 3.

Table 3. Sample size for the various stakeholder groups

Stakeholder Category	2006 Sample Size	2022 Re-Computed Sample Size	2022 Final Sample Size
Businessmen and traders	50	50 x 2= 100+20	120
Consumers	100	100 x 2 = 200 +20	220
Extension workers	60	60 x 2 = 120 +20	140
Farm leaders and community leaders	70	70 x 2 = 140 +20	160
Journalists/media persons	35	35 x 2 = 70 +10	80
Policymakers	35	35 x 2 = 70 +10	80
Religious leaders	35	35 x 2 = 70 + 10	80
Scientists	35	35 x 2 = 70 +10	80
Students	-	-	200
Total	**423**	**1,180**	**1,180**

The choice of place where the respondents were drawn, i.e., province or city, depended on where the targeted stakeholders are typically found. Specifically, scientists, journalists, religious leaders, and policy makers were drawn mostly from the city. Farmer leaders/community leaders and extension workers were drawn from the adjacent municipality. Businessmen/traders, consumers, and students were drawn from both the city and the municipality.

Method and Instrument for Data Collection

Instead of the study team travelling to the study sites, one faculty member each from locally-based SUCs and one staff from a government agency were tapped as field coordinators in each province. Totaling 10, they were selected based on their experience in social research and their official connection with with UPLB and/or SEARCA. They coordinated and managed the data gathering in the different locales.

Online survey was the method used for data gathering due to the restrictions imposed by Covid-19 pandemic. The link to the Google survey was given to all the field coordinators for them to take charge of the uploading and monitoring of the online data gathering process. Unfortunately, there were areas where Internet connectivity was unstable and electricity was supplied only at definite hours of the day. Hence, face-to-face administration of printed survey questionnaires was taken as alternative. At the end of the day, these completed questionnaires were also entered into the Google survey to maintain consistency in data format.

The instrument used was the same questionnaire used in the 2006 study. Its format was modified to make it more self-explanatory and user-friendly, much like those being used in poll surveys. Instructions for filling out were written out and question items had a priori or pre-determined selection of choices so that the respondents would just tick their answers. The questionnaire had only one open-ended question—that on the issues/concerns about biotech in crops and animals.

Predetermined categories and themes based on results of past studies were used, and respondents were asked to indicate their choices. A pop quiz about biotech and science containing statements answerable by true or false measured their understanding or knowledge. On the other hand, a five-point rating scale for given statements on world views and values were used to generate data on attitude.

Questionnaires were distributed to the respondents through the organizations where they belonged or using any agreed upon distribution points. After a few days, the questionnaires were picked up at the agreed date and time by the field coordinator or his/her enumerators. All data were entered into the Google survey for automated tabulations and processing.

Data Analysis

Data were subjected to descriptive analysis making use of frequency counts, percentages, weighted mean, scores, and word cloud. Answers to the lone open-ended question were categorized into themes. Correlation tests were scrapped in the absence of probability sampling.

FINDINGS

Socio-demographic Characteristics of Stakeholders

The stakeholders' socio-demographic profile is summarized in Table 4. Stakeholders were almost equally divided into female (51%) and male (49%) implying a good representation of both genders in the study. This trend is consistent with that at the national level.

Males outnumbered females mostly among policy makers (71.3%) and religious leaders (70.0%). Females, on the other hand, dominated in the groups of students (61.8%), consumers (60.9%), and extension workers (57.9%) (Appendix Table 1).

Single respondents (48.4%) were slightly higher than the married ones (46.0%). This trend could have been affected by the students included as samples in this study. Mostly married were the farmer leaders (83.1%) and policy makers (67.5%) (Appendix Table 2).

In terms of education, stakeholders were mostly college graduates (53.1%) with degrees in technical courses. Technical courses included agriculture, engineering, biology, botany, forestry, physics, computer science, information technology, architecture, chemistry, veterinary medicine, nursing, and medical technology, among others. Agriculture topped the list (Figure 1). These courses should have provided the stakeholders good background about science and, thus, a better appreciation of biotech.

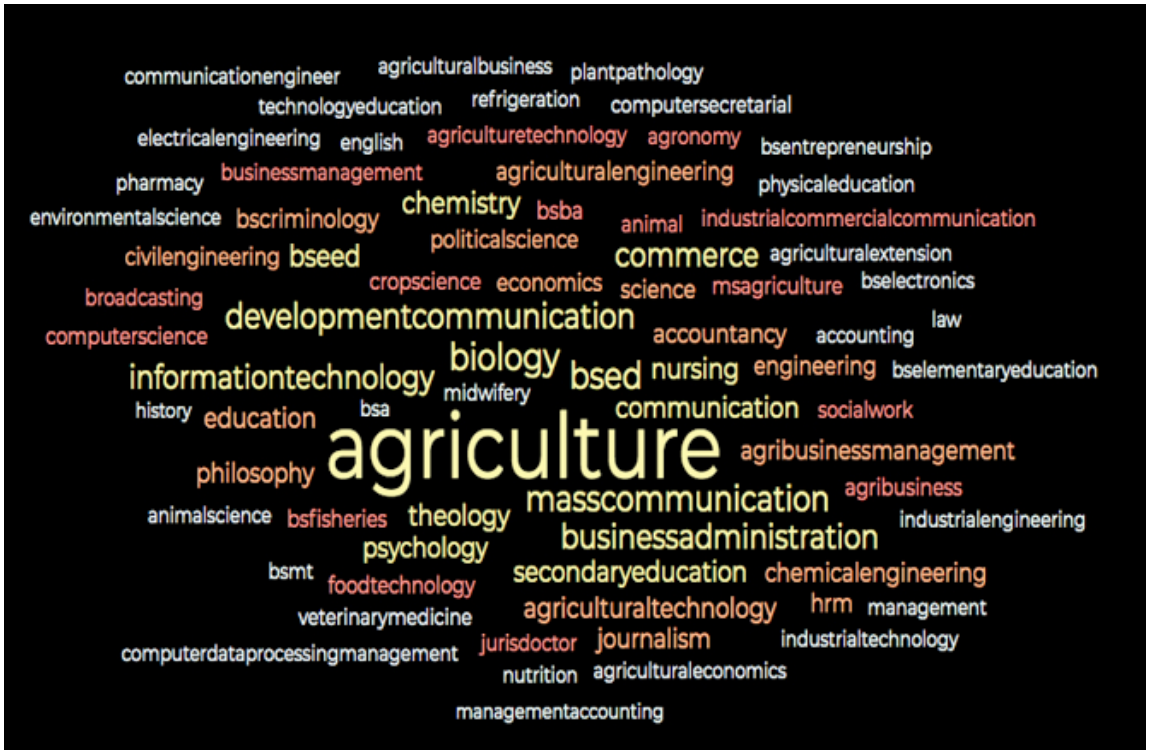

Figure 1. Word cloud capturing the responses on college degrees taken up

The lone group with a high number of post-graduate degrees, as expected, were the scientists (71.3%), as a higher degree is a must in their profession. College degrees were likewise common among white collar jobs like journalists/media persons (71.3%) and extension workers (60.0%) (Appendix Table 3).

As also expected, the stakeholders were overwhelmingly Roman Catholics (75.2%), Philippines being dominated by this religion. All other religions lumped together constituted only about one-third of the stakeholder population (Appendix Table 4).

Information Sources and Level of Trust

Information Sources

Information sources were categorized into three major groups: (a) social media, (b) print, broadcast, online, and (c) person sources. Stakeholders had multiple sources of information and used all types of information sources (Table 5). As in previous perception studies, stakeholders tended to mention information sources in general (or for all or any information they need) and not the ones used only for biotech information.

Table 4. Socio-demographic characteristics

Demographic Characteristics	Frequency (n = 1,180)	%
Sex		
Female	601	50.9
Male	579	49.1
Total	1,180	100
Civil Status		
Single	571	48.4
Married	543	46,0
Others (separated, live-in, widow)	66	5.6
Total	1,180	100
Educational Attainment		
Elementary	33	2.8
High school	250	21.2
Vocational	25	2.1
College	627	53.1
Post graduate	245	20.8
Total	1,180	100
Religion		
Roman Catholic	887	75.2
Protestant, Presbyterian, Baptist, Born again, Evangelical	178	15.1
Others (Aglipay, 7th Day Adventist, Iglesia ni Cristo, Islam)	115	9.7
Total	1,180	100

Social Media. Among these sources, social media topped the list with Facebook (81.2%) and YouTube (70.3%) as the most popularly accessed. An overwhelming majority in all stakeholder groups were using Facebook (range 67.5% - 87.5%) and YouTube (range: 43.8% - 79.1%) as their major sources of information (Appendix Table 5).

This trend towards usage of social media could have been a carryover of the worldwide Covid-19 pandemic that started in March 2020. Due to health protocols requiring people to maintain physical/social distance and isolate as required, social media has become the primary mode of communication among people all over the world. At the time the study was conducted from March to June 2022, health protocols for Covid-19 pandemic were still in place in the Philippines and this could explain the stakeholders' high reliance on social media for many of the information they needed.

Table 5. Information sources on biotech and level of trust on these sources

Source	Frequency (n = 1,180)	%	Level of Trust Weighted Mean/ Adjectival Rating
Social Media			
Facebook	958	81.2	2.83 some trust
YouTube	830	70.3	2.96 some trust
Print, Broadcast, Online			
Websites	647	54.8	3.48 some trust
Newspapers (print, online)	561	47.8	3.25 some trust
Newsletters, pamphlets	365	30.9	3.18 some trust
Television	564	47.8	3.20 some trust
Radio	327	27.7	3.14 some trust
Persons (Individuals/Groups)			
Farmers/farmer groups	421	35.7	2.95 some trust
University-based scientists	393	33.3	3.41 some trust
Scientists from R&D institutions	387	32.8	3.58 total trust
Religious groups	117	9.9	2.69 some trust

Rating scale: 4 = total trust, 3 = some trust, 2 = no trust, and 1 = not sure

Broadcast and Web Sources. Biotech websites (54.8%) were the second most preferred sources. Though almost all stakeholders were using websites, the bulk of users came from scientists (81.3%), journalists/media persons (71.3%), extension workers (65.7%), and students (65%) (Appendix Table 6). For reason of low access to connectivity, farmer leaders/community leaders had the lowest use of websites (28.8%) (Appendix Table 6).

TV accounted for only 47.8 percent in terms of overall usage, and radio did poorly with only 27.7 percent acknowledging it as source. Despite this, TV and radio remained the journalists'/media persons' well accessed sources (65% and 58.8%, respectively), these being related to their professions. There may be a need to rethink about using radio as a source of information about biotech considering its low usage among stakeholders.

Print Sources. Other sources of information were the mass media such as newspapers (print/online; 47.8%). Journalists patronized the newspapers (56.3%) the most, while scientists were the biggest users of other printed materials, namely: science magazines (62.5%) and books (52.5%) (Appendix Table 7). These two groups of stakeholders by virtue of their jobs are strongly reliant on printed words.

Person Sources. The person sources ranked third because at the time the study was conducted, the Covid 19 pandemic protocol of social distancing was still in effect. Hence, people were prohibited to meet face-to-face. Nevertheless, farmer/farmer groups were more sought after, as they belong to the circle of kinship and influence among many farmers (Table 5). The latter were also regarded as having the same worldviews, thus, can be trusted. This was closely followed by scientists from universities (33.3%) or R&D institutions (32.8%).

Scientists, whether university-based, or working in either private and R&D institutions were not as highly accessed (range: 15.4% - 33.3%); though they were popular among their fellow scientists (75%) and journalists (58.3%) (Appendix Table 8a) as information sources. This could be because scientists rarely interact with and are not very visible in the local communities.

Likewise, religious leaders/groups were rarely considered as information source (9.9%), especially for a technical topic like biotech (Table 5).

Scientists were the most trusted source of information on biotech, and yet stakeholders accessed them the least.

For interpersonal sources, a common thread was for the stakeholders to seek out their peers as information source. That is, farmer leaders sought farmer groups (72.9%); religious leaders, their religious groups (62.5%); extension workers, the agriculture service (64.3%); and food consumers, the consumer groups (43.9%). While scientists also accessed their fellow scientists, there was a high preference for those based in government R&D institutions (79.2%) and universities (75.0%) as compared to those from private companies (37.5%) (Appendix Tables 8a and 8b).

Level of Trust

As to level of trust on these sources, and using the 4-point rating scale (4 = total trust, 3 = some trust, 2 = no trust, and 1 = not sure), the one that topped the list and the lone source to obtain a rating of 3.58 or "total trust" were the scientists from R&D institutions (Table 5). The irony, however, is that they were among those who were rarely sought by stakeholders. This suggests that stakeholders do not necessarily source their information from those they trust about the subject matter; an important factor is the source's accessibility to them.

The high trust on scientists can be taken advantage of by making them more visible and accessible to the public. One way of doing it is by establishing a pool of scientist-speakers all over the country and tapping them as frontline speakers and advocates of biotech. For the long term, the mandate of scientists may perhaps include being able to explain to the public the works that they do in their laboratories. Thus, they also need to go out and interact with the public and communities.

While the rest of the information sources have been rated with "some trust", it is notable that those who held higher stakeholders' trust were the websites (3.48) and university-based scientists (3.41). Once again, scientists were favored sources because of their reputation to be objective and highly knowledgeable about the subject matter. Websites have become more highly accessible due to the pandemic, and are usually managed by professional groups, hence, they have also acquired a considerable level of trust among the stakeholders.

Facebook and YouTube, while highly accessed, were only given a rating of "some trust". This could be because stakeholders were aware about these media's vulnerability to "fake news" and misinformation.

Knowledge About Biotech

Information, Knowledge, and Understanding of Biotech

Using a 4-point rating scale (4 = excellent, 3 = very good, 2 = good, 1 = poor), stakeholders found the (a) usefulness, (b) quality, and (c) understanding of available information about agri-biotech as "very good", with weighted mean of 3.10, 2.63, and 2.99, respectively (Table 6). These ratings suggest that whatever information stakeholders have obtained about biotech, factual or not, even if not excellent, are perceived as helpful to them.

Table 6. Information, knowledge, and understanding of biotech

Statement	Weighted Mean/ Adjectival Rating
Usefulness of information about biotech	3.10 very good
Quality of available scientific information about biotech	2.99 very good
Understanding of biotech science	2.63 very good
Knowledge on use of biotech in food production	2.59 very good

Rating scale: 4 = excellent, 3 = very good, 2 = good, and 1 = poor

As noted by a previous study (Wunderlich and Gatto, 2015), a distinction must be made between familiarity or mere awareness and full understanding of scientific facts. This is because those with scientific knowledge tend to be more positive about biotech, and those who are merely familiar tend to oppose biotech.

Journalists and media persons were the most optimistic about biotech information as they rated both its usefulness (52.5%) and quality (53.8%) as very good (Appendix Tables 9 and 10).

Scientists (50.0%), as expected, registered the highest understanding of biotech science and a very good understanding of the use of biotech in food production (Appendix Tables 11 and 12, respectively).

The data could mean that journalists/media persons are benefiting the most from information about biotech, it being an important input to the content of their news stories. Scientists, on the other hand, are right in claiming to have very good understanding of biotech science and use of biotech in food production, being the ones immersed in this kind of work.

Specific Knowledge about Biotech in Crops and Food Production

Based on the answers to the 11 true-or-false statements, stakeholders seemed to have acquired better understanding of certain aspects of biotech crops and their application in food production.

Specifically, stakeholders were firmly aware of the following facts about biotech crops and their use in food production as supported by the majority saying that these statements were true (Table 7):

- Emerging technologies in food production involve potential risks.
- Products from GM crops are now being sold in the country.
- Yeast for brewing consists of living organisms.
- GM crops are now being commercially grown in the country.
- Genetic engineering involves transfer of genes from one organism to another.
- All crops have been genetically modified through domestication, selection, and controlled breeding.

a. Risks in Emerging Technologies

A high percentage of stakeholders (89.3%) said that there will always be risks associated with any new emerging technology (Table 7). Similarly, majority (69.9%) labeled as “false” the statement that food science can guarantee zero risk. Any science for that matter cannot know everything, but upon knowing the risks, science’s typical response is to study these risks and find ways by which these risks can be prevented or mitigated, or managed safely in the interest of protecting human lives.

Majority in all stakeholder groups acknowledged that risks are inevitably associated with new technologies. Leading the pack were the same optimistic groups of journalists/media persons (98.8%) and scientists (96.3%) (Appendix Table 13). Similarly, more of the scientists (83.8%), students (77.7%), and journalists/media persons (78.8%) agreed that food science cannot guarantee zero risk (Appendix Table 14).

Table 7. Specific knowledge about biotech in crops and food production

Statement	True	False	Do Not Know
	%	%	%
With every emerging technology in food production, there are potential risks.	89.3	3.8	6.9
Products from GM crops are now being sold in the Philippines.	75.3	4.7	20.0
Yeast for brewing consists of living organisms.	71.8	5.6	22.6
GM crops are now being commercially grown in the Philippines.	71.1`	5.7	23.2
In genetic engineering, genes of interest are transferred from one organism to another.	67.5	8.4	24.2
All crops have been genetically modified from their original state through domestication, selection, and controlled breeding over long period of time.	56.4	23.1	20.5
Golden Rice (GM rice) contains beta carotene.	54.6	8.1	37.4
Food science can guarantee zero risk.	14.0	69.9	16.1
Plant viruses are transferred to humans when they eat vegetables and fruits infected with plant viruses.	32.4	37.9	29.7
Ordinary tomatoes do not contain genes, while GM tomatoes do.	24.7	46.2	29.2
By eating GM food, a person's genes could be modified.	23.1	47.7	29.2

b. GM Crops and Products now Being Grown and Sold in the Philippines

Likewise, stakeholders were aware that GM crops are now being commercially grown (71.1%) and GM products are now being sold (75.5%) in the country (Table 7). The fact is that only Bt corn was being commercially grown at the time of the study. But two more GM crops (i.e., Bt eggplant and Golden Rice)

have been approved recently for commercial growing in the Philippines. Certainly, there were already products from GM crops being sold in the country such as those derived from GM tomatoes, GM potatoes, and others. However, these crops have been imported and have not been commercially grown yet in the country.

Knowledge about GM crops being commercially grown in the country was highest among the scientists (88.8%) and extension workers (80.7%) (Appendix Table 15). The same trend can be observed with knowledge of GM crops being sold in the country, where scientists (95.0%) and extension workers (84.3%) consistently garnered the highest percentages (Appendix Table 16). This is quite expected since scientists are at the forefront of biotech development and extension workers are at the forefront of disseminating information about technologies to the farmers and local communities. The nature of their jobs gives them the privilege to acquire such knowledge ahead of the other stakeholders.

c. Yeasts for Brewing as Living Organisms

That "yeasts are living organisms" was a statement quite known to the stakeholders (71.8%) (Table 7). Yeasts are known to have two major uses in food: for baking and making alcohol beverages. Yeasts are single-celled microorganisms classified along with molds and mushrooms. Topping the list with high frequency of being aware about yeasts as living organisms were again the scientists (96.3%) and extension workers (80.7%) with policy makers (73.8%) and consumers (71.8%) joining the rank this time (Appendix Table 17). This may be because anything related to food as a basic necessity is popular among a broader range of stakeholders especially consumers.

d. Genetic Engineering as Involving Transfer of Genes

Majority of stakeholders (67.5%) claimed knowing genetic engineering as involving the transfer of genes of interest from one organism to another using laboratory techniques (Table 7). Genetic engineering, however, may also involve modification of genes of the same organism.

Even if considered a highly technical concept, genetic engineering appears to be a topic all stakeholder groups knew something about. Most knowledgeable groups about it were, of course, the scientists (83.8%), followed closely by students (72.7%), extension workers (70.0%), and journalists/media persons (70.0%) (Appendix Table 18). These are the stakeholder groups whose nature of work feeds on facts and information about genetic engineering or biotech.

e. Gene Modification of Crops through Domestication, Selection, and Controlled Breeding

Majority of the stakeholders (56.4%) believed this statement to be true (Table 7). The fact is that throughout humankind's history, they have been dealing with domestication of plants and animals to meet their food needs. As explained by Wieczorek and Wright (2012), people through the years have learned how to domesticate plants and animals. This paved the way for them to choose and breed plants that meet their desired characteristics: short growing period, resistant to pests, bigger fruits, better nutritional content, and longer shelf life, among others. Again, scientists (65.0%) got the highest percentage share for this item followed by businessmen/traders (60.0%) (Appendix Table 19).

f. Golden Rice Contains Beta Carotene

Golden Rice is genetically modified to produce beta carotene which is not normally present in rice grains (IRRI,2021). Beta carotene is converted to vitamin A when metabolized by the human body. Hence, Golden Rice is also biofortified as its nutritional value is enhanced by the presence of Vitamin A. This vitamin helps prevent blindness among children.

Stakeholders were apparently familiar with Golden Rice as indicated by 54.6 percent knowing that the crop contains beta carotene (Table 7). As with other statements about biotech in food production, more scientists (85%) labeled this statement as true followed by extension workers (63.6%), and students (62.3%) (Appendix Table 20). As a recent GM crop approved for commercial growing in the country, Golden Rice must have been a constant topic of discussion among extension workers making them highly aware about it at this point. And this goes for students as well, many of whom were taking agriculture courses.

g. Plant Viruses Being Transferred to Humans

Stakeholders seemed to be struggling about the truth pertaining to plant viruses. As to the statement "plant viruses are transferred to humans when they eat vegetables and fruits infected with plant viruses," about one-third believed it to be true (32.4%); a little more than a third (37.9) believed it to be false; and the remaining 29.7% did not know the answer. Of course, the statement is false and majority of the scientists (60%) got the answer right.

The scientific fact is that none of the viruses that infect plant has so far served as pathogen (organism that can cause disease) to animals and humans. Plant viruses are believed to infect only plants. They do not present potential

pathogenicity to humans (Mandal and Jain, 2010). This knowledge needs to be explained more to the public so that those who have no idea or have the wrong idea about viruses can better understand this vital concern about GM crops.

h. Ordinary and GM Tomatoes Both Having Genes

The scientific fact is that genes are made up of DNA and is hereditary. So all tomatoes, whether GM or ordinary, have genes. Hence, it is still worrisome that over 50 percent believed in the statement that "GM tomatoes, and not ordinary tomatoes, have genes." Those who were most knowledgeable about genes were of course the scientists (76.3%) (Appendix Table 22).

i. Eating GM food as Modifying a Person's Genes

Corollary to the above statement about tomato genes, eating GM foods cannot modify a person's genes as genes are hereditary. A little less than one half (47.7%) of the respondents got the correct answer for this item (Table 7). Scientists (80%) and journalists (65%) scored high on this aspect (Appendix Table 23). A concern, however, is that when the number of those who thought otherwise (24.7%) (i.e., GM foods can modify a person's genes) and those who did not know are combined (29.2%), they constitute the majority (59%).

Two misconceptions need to be corrected among stakeholders:

1. ***Eating GM foods will modify their genes.***
2. ***Eating plants infected with viruses will infect humans who eat them.***

On the whole, what can be figured out based on the trends on knowledge about biotech are the following:

1. Scientists, as expected, are the most knowledgeable about biotech crops and biotech in food production. Being actually engaged in scientific studies and laboratory experiments mostly in agriculture, they are well equipped with scientific facts related to biotech.

2. Closely following the scientists are the journalists/media persons, extension workers, and students. It is inevitable for extension workers to acquire more and more knowledge about biotech as this is an input to their work concerning technology dissemination and adoption. For some journalists, probably nothing can be more important than news stories especially about unfolding technologies for the benefit of the country. Hence, they are always on the lookout for information about something new and important, particularly those that are controversial like biotech, as these make for news. Since many of the student-stakeholders are taking agriculture courses, biotech could have been taken up in their subjects, making them more knowledgeable about it than the other groups of stakeholders.

3. Stakeholder groups with comparatively lower level of knowledge include the religious leaders, policy makers, businessmen/traders, consumers, and farmer leaders/ community leaders. The first four groups have very limited engagement in activities about biotech as they have other mandates to attend to. But the finding for farmer leaders/ community leaders is a bit disturbing. As the group being approached for help by farmers and other community members, they seem to be ill equipped to respond on biotech matters. This a red flag indicating that farmer leaders/community leaders need to be prioritized for information and education about biotech. This is to maximize farmers' access to them as well as their influence among their peers.

Leading in terms of knowledge about biotech were the scientists, journalists/media persons, extension workers, and students.

Lagging behind were the religious leaders, policy makers, businessmen/ traders, consumers, and farmer leaders/ community leaders.

Perception about Biotech

Perception of Biotech in Relation to Societal Views and Values

Based on a given set of statements reflecting respondents' views and values, stakeholders did not give this aspect the highest possible rating of 5 (strongly agree). But they remained to have a favorable attitude towards biotech as indicated by the weighted mean ratings that ranged from 3.81 (Agree) to 4.27 (Agree) for the various perception statements indicated in Table 8.

Specifically, all stakeholder groups agreed that the use of biotech especially in food production is consistent with their moral values. The highest frequencies came from students (61.8%), farmer leaders (61.3%), and scientists (60.0%) (Appendix Table 24).

Majority favored distributing biotech foods when approved as safe, with the journalists/media persons (67.5%) topping the list (Appendix Table 25). They saw nothing wrong if man modifies nature, and this perception was highly evident among the scientists (61.3%) (Appendix Table 26). In all these, scientists stood out as having the strongest conviction that biotech is in accordance with society's views and moral values.

Table 8. Perception of biotech in relation to societal views values

Statement	Weighted Mean/ Adjectival Rating
The use of biotechnology in food production is in accordance with my moral values.	4.21 agree
When genetically modified foods are totally safe, they can be distributed.	4.27 agree
Men may be allowed to modify nature.	3.90 agree
The regulation of modern biotechnology should be left to the industry.	3.81 agree

Rating scale: 5= strongly agree, 4= agree, 3 = disagree, 2= strongly disagree, and 1= do not know

One misperception though was the belief that the regulation of biotech should be left to the industry, with more food consumers (51.4%) and community leaders/farmer leaders (51.3%) agreeing to such statement (Appendix Table 27). Hence. stakeholders may need to be made more aware that regulations about food and its safety are primarily vested on the government, and not on the industry. The industry though may be involved in the process of crafting such regulations.

Stakeholders need to be educated on the fact that regulations about food and its safety is vested by law on the government, and not on the industry.

Prevailing Views About Biotech

Given six prevailing views about agri-biotech, stakeholders were asked to rate their degree of agreement or disagreement using a 5-point rating scale, with 5 as the highest and 1 as the lowest.

Using weighted mean as the measure, results showed that stakeholders were generally inclined to "agree" (3.5 - 4.0) and not "strongly agree" (4.5 - 5.0) about the prevailing views on biotech (Table 9). As with the other items in the study, they tended to refrain from giving the highest or extreme positive rating about biotech (Appendix Tables 28-33). They settled in choosing the second highest level rating which was nonetheless positive. This implies that indeed some reservations still persist among the stakeholders concerning their full trust on biotech.

Based on Table 9, stakeholders looked upon the government as a reliable agency for ensuring that the food we eat is safe (4.18). It was mostly the policy makers (52.5%) (Appendix Table 28) who strongly supported this view, understandably because they are the ones formulating the policies on food safety in the country.

Similarly, stakeholders believed on the objectivity of biotech information knowing these are based on scientific data and analysis (3.9). The strongest agreement came from the scientists themselves (45.0%) (Appendix Table 29) as they are actually engaged in this task.

Table 9. Prevailing views about biotech

View About Biotech	Weighted Mean/ Adjectival Rating
Favorable views	
Government agencies are doing their best to ensure that the food we eat is safe.	4.18 agree
Expert statements on biotech are based on scientific analysis, and are therefore, objective.	3.90 agree
Biotech is good for Philippine agriculture.	3.88 agree
The risks of genetic engineering have been greatly exaggerated.	3.50 agree
Unfavorable views	
Genetic engineering of food products could create unexpected new allergens or contaminate products in an unanticipated way, resulting in threats to public health.	3.66 agree
Biotech in food production benefits only large agricultural companies.	3.62 agree

Rating scale: 5= strongly agree, 4= agree, 3 = disagree, 2= strongly disagree, and 1= do not know

Stakeholders were also convinced that biotech benefits the country's agriculture sector (3.88 = agree). Strong agreement came from the scientists (41.3%) (Appendix Table 30). Majority of stakeholders gave an "agree" rating, with the highest percentage from the farmer leaders/community leaders (58.1%).

There was also a show of support to the view that the risks of genetic engineering have been greatly exaggerated (3.5 = agree). Again, it was the group of scientists that garnered the highest percentage for giving the item an "agree" rating (61.3%) (Appendix Table 31).

On the other hand, there were aspects of biotech that the stakeholders were negative about. These included their perception that GM foods could create new allergens that could threaten public health (3.66 = agree). Journalists/ media persons (63.8%) and scientists (55.0%) (Appendix Table 32) constituted

the top supporters of this view despite their optimism earlier towards biotech. This reflects some ambivalence again among these two groups and that a tinge of suspicion still prevails when it comes to risks associated with biotech, especially if concerning health issues like allergy. This finding about perceived health risks has been consistently coming out in the results of this study.

Stakeholders' two major issues about biotech involved health risks and the perception that only big agricultural companies are benefiting from it.

In the same vein, stakeholders felt that biotech in food production benefits only large agricultural companies (3.62 = agree). The bigger voice came from the farmer leaders/community leaders (45%) (Appendix Table 33), they being the ones directly affected by the purchase of seeds of GM crops from commercial companies. This stems from the current practice that only commercial agricultural companies can produce, distribute, or sell biotech seeds. While farmers can set aside their own seeds from the harvest, this second generation of GM seeds do not uniformly contain all of the desired traits of the original seeds, thus, will fail to produce crops with the desired traits. Also, when farmers buy GM seeds, they are expected to abide by the contract to buy new seeds from these same companies during the next planting cycle.

These last two unfavorable views may need to be addressed by public information and education as these have remained sticky issues that create some reservations among the stakeholders to fully embrace biotech.

Perception of Uses of Biotech Crops

Stakeholders' views on biotech uses were explored using nine biotech crops, namely:

- tomatoes resistant to virus
- papaya resistant to virus
- eggplant resistant to insect borer infestation
- corn tolerant to herbicide
- corn resistant to insect borer infestation
- rice resistant to blight disease
- rice with more vitamin A
- papaya that takes longer to ripen
- cotton resistant to insect infestation

Depending on the stakeholders' views and current knowledge, the above GM crops may be used for any or a combination the following: (a) for growing crops, (b) for food, (c) for animal feed, and (d) for industrial by-product.

GM crops have been perceived as to be used principally for food; hence, stakeholders were highly concerned about the issue of safety.

Overall, the stakeholders regarded GM crops as principally for commercial growing and for human food (Table 10). Few considered GM crops for animal feed and for industrial by-products.

Specifically, rice with more vitamin A was viewed highly (73.6%) as meant for food. GM tomatoes (48.3%, 45.0%), papaya (43.1%, 47%), and eggplant (44.0%, 46.4%) were considered both for growing crops and for food, respectively. GM corn, one tolerant to herbicide (40.9%, 32.3%) and the other resistant to insect borer infestation (39.9%, 34.1%) followed the same pattern. Both GM corn varieties, however, obtained some considerable percentages (23.7% and 23.4%, respectively) for being considered also for animal feed. "None" as a response was scarce.

"Don't know" response ranged from 12.1 percent to 21.2 percent. While these may be quite low, this indicates the need for some more efforts to educate the rest of the stakeholders about the broader uses of biotech crops. This is to nullify the common tendency to view biotech crops only as food, and thus, perceive these as always risky for humans.

There was, however, one seemingly dubious result about cotton resistant to insect infestation being considered for food. Majority saw it as meant for growing crops (65.8%), which was correct. Generally, people will not consider cotton for food. And yet, a few respondents said it is used for food (10.8%) and animal feed (7.4%). It may not be a common knowledge, and perhaps it is mostly just the scientists who would know that cotton seeds are used as source of edible oil, thus, for food. China is a well-known producer of cottonseed oil. This oil is used for mayonnaise, salad dressing, sauce, marinades, cooking oil, margarine or shortening for baked goods (Chen, 2013).

Referring to Appendix Tables 34-42, more students, among the stakeholders, knew about the uses of biotech crops especially for growing crops and for food. They could have taken up this topic in their courses, as most of them were taking up agriculture.

Table 10. Perception of uses of biotech crops

Biotech Crop	Growing	Food	Animal Feed	Industrial By-product	None	Don't Know	Total
	%	%	%	%	%	%	%
Tomatoes resistant to virus	48.3	45.0	6.7	14.6	0.8	15.8	100
Papaya resistant to virus	43.1	47.9	7.8	13.9	1.1	17.1	100
Eggplant resistant to insect borer infestation	44.5	46.4	8.0	13.5	0.7	14.3	100
Corn tolerant to herbicide	40.9	32.3	23.7	20.6	1.3	15.4	100
Corn resistant to insect borer infestation	39.9	34.1	23.4	18.6	1.4	15.4	100
Rice resistant to blight disease	37.7	49.7	9.7	14.4	1.3	17.2	100
Rice with more vitamin A	23.1	73.6	8.0	7.9	0.6	12.1	100
Papaya that takes longer to ripen	30.8	48.3	8.4	20.8	1.9	14.3	100

Interest and Concern in the Use of Biotech in Food Production

Majority (53.6%) of the stakeholders were "very interested" or curious about the use of agri-biotech in food production (Table 11). The high level of interest may have been stirred up by the more frequent focus, publicities, and debates about biotech or GM foods particularly in the last two decades. Majority of the scientists (66.3%) expressed such interest (Appendix Table 43), biotech being at the heart of their work.

Table 11. Interest in the use of biotech in food production

Response	Frequency (n = 1,180)	%
Very interested	633	53.6
Somewhat interested	504	42.7
Not at all	43	3.6
Total	1,180	100

An increased level of interest could be driven by more knowledge gaps or questions emerging from the increase of knowledge choices brought to public attention. On the other hand, lowered interest could be due to acquisition of sufficient information that have met or have already addressed their earlier information gaps or needs.

Stakeholders' interest in agri-biotech as applied to food production can logically translate to their concern about it. In this study, majority (60.4%) expressed high concern about the matter (Table 12). Consistent with the finding on interest about biotech, it was again the scientists (70.0%) (Appendix Table 44) that ranked highest on this aspect.

Table 12. Concern about the use of biotech in food production

Response	Frequency (n = 1,180)	%
Very much concerned	713	60.4
Somewhat concerned	428	36.3
Not at all concerned	39	3.3
Total	1,180	100

Concern (60.4%), however, was rated higher than interest (53.6%) implying that stakeholders still have some degree of precaution about the use of biotech in food production despite them agreeing to the idea.

Characteristics/Considerations in Using Biotech in Food Production

For GM foods to be accepted and consumed, stakeholders considered all the listed characteristics as important. They are listed from highest to lowest in Table 13.

Table 13. Characteristics/considerations in using biotech for food production

Rank	Characteristic/consideration deemed Important	%
1	Nutritional quality	95.8
2	Non-poisonous	94.8
3	Non-allergenic	94.3
4	Better taste	90.3
5	Price	89.2
6	Pesticide residue	81.4
7	Food appearance	79.2

Based on percentages, all considerations were viewed as important by all the stakeholder groups. But regardless of the other characteristics, biotech food should first and foremost be safe to eat or is non-poisonous; though this ranked only second in the list. Food appearance was last in the rank implying that while also considered important, it was the least that stakeholders were worried about.

Appendix Tables 45 – 51 show no glaring result about a particular stakeholder group preferring certain characteristics. All of them were unanimous in saying that all the characteristics were deemed important when talking about developing GM foods.

Perception of How Beneficial Biotech is in Food Production

Those who considered biotech as beneficial in food production were nearly a majority (Table 14). The highest 48 percent rated this item as “very beneficial”, and following closely were those who rated it “moderately beneficial” (44.8%). As the former suggests some considerable gains, the latter points to a greater challenge to make biotech totally acceptable to a wider public. Hence, there is a need to continuously target those reservations about the risks and benefits of biotech in food production that still persist among the stakeholders.

Table 14. Perception of how beneficial the use of biotech is for food production

Perception of Benefits	Frequency (n = 1,180)	%
Very beneficial	570	48.3
Moderately beneficial	529	44.8
Not at all beneficial	36	3.1
No opinion	45	3.8
Total	1,180	100

When data were disaggregated, those who viewed biotech in food production as "very beneficial" were mostly students (63.2%); and those who viewed it as "moderately beneficial" were mostly consumers (52.7%) (Appendix Table 52). Somehow, there was an observed ambivalence among students in viewing biotech food as somewhat hazardous yet very beneficial.

Perception of How Risky Biotech is in Food Production

Majority of the stakeholders (55.6%) found the risks associated with the use of biotech in food production as "somewhat hazardous" (Table 15). This could mean that stakeholders still hold some reservations about the safety of GM foods despite the fact that these foods have gone through a rigorous process of ensuring that they are safe to eat. While there have been efforts to explain to the stakeholders the biosafety assessment process involved, there is a need to make this a continuing effort until the affected public is fully convinced that GM foods are totally safe to eat.

Table 15. Perception of risks in using biotech in food production

Perception of Risk	Frequency (n = 1,180)	%
Very hazardous	116	9.8
Somewhat hazardous	656	55.6
Not at all hazardous	315	26.7
No opinion	93	7.9
Total	1,180	100

A bigger percentage who still sensed GM crops as "somewhat hazardous" were the students (65.9%) and religious leaders (60.0%) (Appendix Table 53). This finding was quite bothersome because students, mostly in agriculture and science courses were supposed to be more knowledgeable about biotech and the processes involved to make its products safe. As for religious leaders, this stance was aligned with their earlier worldview that biotech is against God's design.

Only one third (26.7%) perceived biotech in food as "not at all hazardous" (Table 15) and these were the extension workers (37.9%) and scientists (31.3%) (Appendix Table 53). Still this less than 50 percent figure was intriguing considering that these were the very people supposed to be most knowledgeable about GM foods as being safe.

There was only a very small percentage (9.8%) who still regarded biotech food as "very hazardous" (Table 15). This provides a glimpse of hope that as stakeholders become more aware about scientific facts, biotech will be considered more of a boost rather than a threat to the continuous development of biotech food development in the country.

Perception of Regulations on Biotech

Using a 5-point rating scale, stakeholders expressed their agreement or disagreement with current views on agri-biotech regulations in the country (Table 16). This was meant to gauge their familiarity as well as attitude towards such regulations.

Results show that the stakeholders agreed with all the four positively stated views about biotech (Table16). Again, majority of the stakeholders tended to cluster on the "agree" and not on the "strongly agree" response indicating that something was still holding them back from fully agreeing with the statement pertaining to the regulations on biotech in the country.

Specifically, they were confident in the way regulatory system covering agri-biotech in the country is being implemented because the agencies concerned are equipped with needed scientific facts (4.02 = agree). Leading the pack with favorable perception on the item were the policy makers (56.3%) and farmer leaders/community leaders (55.0%) (Appendix Table 54).

However, stakeholders gave a precaution that inputs from non-government sector must also be sought in the formulation of biotech regulations (4.12 = agree). Thus, it was not surprising that those who strongly agreed came from the civil society groups like journalists/ media persons (57.5%), religious leaders (52%), and farmer leaders/community leaders (52.5%) (Appendix Table 55).

Table 16. Perception of regulations on biotech

View of Biotech Regulation	Weighted Mean/ Adjectival Rating
Regulations on biotech should include inputs from non-government sector.	4.12 agree
Government regulatory agencies have scientific facts and technical information needed in order to make good decisions about biotech in food.	4.02 agree
The public is provided with vital information about the health effects of GM foods.	3.77 agree

Rating scale: 5= strongly agree, 4= agree, 3 = disagree, 2= strongly disagree, and 1= don't know

Stakeholders were quite dispersed into answering 'strongly agree', 'agree', and 'disagree' to the statement that "the public is provided with vital information about the health effects of GM foods." This means that the public encounters information less than desired about the topic. The policy makers (42.5%) (Appendix Table 56) made up the group with the highest percentage who agreed on this matter.

Despite the perceived lapses in information dissemination on impacts of GM foods on health, stakeholders believed that current regulations in the country are sufficient to protect the public from risks associated with modern biotech (3.55 = agree). Majority of those who supported this statement were extension workers (53.6%) (Appendix Table 57).

Perceived Concern about Public Health and Safety Issues of Agri-biotech

Out of 11 individuals/groups/organizations, seven were perceived by the stakeholders as very concerned about public health and safety issues of agri-biotech (Table 17). Among them, the university-based scientists (65.8%) topped the list followed by international research institutions (63.6%), agri-biotech companies (60.3%), and government research institutions (59.8%). All these groups are engaged in research. As such, they have a direct hand in the development and experimentation of biotech crops. Their reliance on a

body of knowledge and empirical evidence as well as compliance with rigid protocols and procedures could have made them appear "very concerned" with the impact of biotech on health and safety of the public.

Table 17. Perceived concern about public health and safety issues of biotech

Individual, Group, Organization	Very Concerned (%)
University -based scientists	65.8
International research institutions	63.6
Agri-biotech companies	60.3
Government research institutions	59.8
Local farmer leaders	57.5
Consumers/general public	54.0
Consumer groups	52.7
	Somewhat Concerned (%)
Mass media/journalists	47.5
NGOs	44.7
Students	42.9
Religious groups	41.3

Other stakeholders who were regarded as very concerned about public safety and health impacts of GM crops were the local farmer leaders (57.5%) and the consumers/general public (54%). Farmer leaders have a big stake in agri-biotech crops as these are the main commodity in their livelihood. Thus, they will consider greatly the impact of biotech crops on people's safety. Consumers and the general public being the end users of agri-biotech crops and products will certainly be very concerned of what they will be eating or using.

Individuals and groups with lesser stake on agri-biotech and who were fulfilling more an advocacy role were perceived as "somewhat concerned". They included the mass media/journalists (47.5%), NGOs (44.7%), students (42.9%), and religious groups (41.3%).

Stakeholders were rather divided when they assessed the NGOs—the latter were equally perceived as very concerned (44.7%) and somewhat concerned (44.6%). Hence, NGOs may not really hold a solid ground when it comes to being perceived as highly concerned about the safety of agri-biotech crops; a certain level of doubt still persists among the public.

Perception of Science as Being Part of Agricultural Development

There was an overwhelming response among the stakeholders (81.3%) that science should be a part of agricultural development (Table 18). Majority had college background with degrees in technical courses like agriculture and this could have influenced their way of thinking about science and biotech. Thus, as a scientific endeavor itself, biotech was perceived as having a big part in the country's agricultural growth. Trust in science could be an important indicator that stakeholders in general will be more accepting of biotech.

Table 18. Perceived extent by which science should be a part of agricultural development

Response	Frequency (n = 1,180)	%
Very much	959	81.3
Somewhat a part	214	18.1
Should not be a part	7	0.6
Total	1,180	100

The biggest supporter of this statement, surprisingly, were the journalists/media persons (91.3%), followed by extension workers (88.6%). The scientists who were expected to be supportive upfront of the matter ranked only third (87.5%) (Appendix Table 58). This further confirms the earlier finding that scientists seem to be lagging behind other stakeholders when openly advocating for biotech.

Attitude Towards Participation in Biotech-related Activities

On the whole, stakeholders exhibited positive attitude towards participating in activities that would promote GM foods. All statements pertaining to this have been well supported by the stakeholders (Table 19).

Table 19. Attitude towards participation in agri-biotech related activities

Activity Statement	% of Majority Rating
Foods that have been genetically modified should be labeled.	57.8 strongly agree
The public should be consulted in formulating food regulations and laws.	56.9 strongly agree
The public should be directly consulted in approving R&D in agri-biotech.	50.8 strongly agree
If my community, would hold an information session on biotech in food production, I will attend.	46.5 agree
I would contribute my time or money to an organization that promotes GM foods.	45.5 agree

There was a high demand among stakeholders that GM foods should be labeled (57.8%). The highest specifically came from the scientists (70.0%) and journalists/media persons (68.8%) (Appendix Table 59). This might have been triggered by the early controversies hurled against GM foods. The public sees it fair to keep the people informed about what they buy (i.e., GM or non-GM) and to give everyone the freedom of choice. This is despite the results indicating that the public generally favors and supports the production and distribution of GM foods in the country.

Stakeholders also expressed strong agreement about the need for the public to be consulted in the formulation of food laws and regulations (56.9%). The journalists/media persons were the strongest advocates for this (65.0%) (Appendix Table 60). The same trend was observed for the setting of R&D agenda on biotech. Majority of the stakeholders (50.8%) (Appendix Table 61) felt the need for the public to be consulted in these two aspects. These signal the need to do more public consultations concerning R&D and regulations on biotech as GM foods impact greatly on public rights and safety.

Almost half (46.5%) of the respondents agreed to participate in sessions on the use of biotech in food production held in the community. Most wiling were the scientists (57.5%) and the journalists/media persons (56.3%) (Appendix Table 62). As scientists indicated willingness, this may be the opportune time to bring them more actively in public information and education activities about biotech.

As to contributing time and money to organizations advocating for GM foods, less than a majority agreed and no group indicated strong agreement. The only groups where majority agreed were the scientists (51.3%) and consumers (50.9%) (Appendix Tables 63). Stakeholders were seemingly reluctant to participate in biotech-related activities where time and money are involved. Here again lies an ambivalence on their part: they demand for more involvement in regulations and setting of R&D agenda, but they are not that willing to spend time and money for organizations doing the work.

Decision Making Involving Biotech

Various Applications/Research Focus that Affect Decision Making

Stakeholders considered "almost always" (one notch lower than "all the time") the end uses and benefits of biotech when making decisions on the matter. This was especially true when these uses have something to do with the improvement of food quality, crop resistance or pest/disease, and medical breakthroughs. This was indicated by the weighted mean ranging from 3.61 to 4.11 (almost always) for the five related items, as against the highest possible mean rating of 5.0 (all the time) (Table 20).

Specifically, they looked into whether or not biotech can: (a) make the food more nutritious, taste better, and stay fresh longer (4.11 = almost always); (b) make the crops more pest/disease-resistant (4.00 = almost always); (c) help detect and treat inherited human diseases (3.88 = almost always); (d) produce vaccines and medicines like insulin (3.75 = almost always); and (e) modify genes to study human diseases like cancer (3.61 = almost always).

Among the stakeholders, the journalists/media persons and scientists exhibited the highest concern for many of the above items in making decision about biotech. Specifically, the journalists/media persons figured prominently when the concern was about improving food quality (52.5%) in terms of nutritional value, taste, and shelf life; making crops more pest/disease-resistant (61.3%); and producing vaccines and medicines like insulin (67.0%) (Appendix Tables 64, 65, and 66, respectively).

Table 20. Various applications/research foci and how often stakeholders consider these in making decisions about biotech

Application/Research Foci	Weighted Mean/ Adjectival Rating
Use of modern biotechnology in the production of foods to make them more nutritious, better-tasting, and longer-lasting	4.11 almost always
Taking genes from plant species and transferring them into crops in order to make the crops more resistant to pests and diseases	4.00 almost always
Using genetic testing to detect and treat diseases we might have inherited from our parents	3.88 almost always
Introducing human genes into bacteria to produce medicines and vaccines, for example to produce insulin for diabetes	3.75 almost always
Modifying genes of laboratory animals such as a mouse to study human diseases like cancer	3.61 almost always
Introducing fish genes into strawberries to resist extreme freezing temperature	3.38 seldom

Rating scale: 5=all the time, 4 = almost always, 3 = seldom , 2 = never, and 1 = don't know

On the other hand, the scientists scored the highest in terms of: considering genetic testing to detect and treat diseases inherited from parents (50.0%); modifying genes of laboratory animals to study diseases like cancer (61.3%); and introducing genes from fish to strawberries to enable the latter to withstand cold temperature (55%) (Appendix Tables 67, 68, and 69, respectively).

The lone item that was "seldom" considered had something to do with developing strawberries resistant to extreme freezing temperatures by introducing fish genes into them (Table 20). For many of the respondents, this biotech application topic may be quite new and unfamiliar to them. As indicated in Appendix Table 69, only the scientists (55.0%) would likely consider it in decision making and as a research focus.

Factors that Affect Decision Making about Biotech

Stakeholders considered a number of factors "almost always" but not "all the time" when deciding about biotech. These factors included the following: (a) farmers' access to it (4.14 = almost always); (b) promise of better income (4.03 = almost always); (c) tested safe by regulatory bodies (3.82 = almost always); and (d) not a threat to native species (3.57 = almost always) (Table 21).

Table 21. Issues about biotech and how often stakeholders consider these in making decisions

Issue About Biotech	Weighted Mean/ Adjectival Rating
Plant breeders and farmers want access to modern biotech to improve their crops.	4.1 almost always
Farmers want GM crops because they make crop production cheaper, increase yield, and increase income.	4.03 almost always
GM foods are as safe as conventional ones and have undergone testing by regulatory bodies.	3.82 almost always
GM crops will be so resistant to pests and diseases that they would become weeds themselves and push native plants into extinction.	3.57 almost always
There is no evidence that GM crops harm the environment or have potential harm to the environment any more than conventional agricultural farming methods.	3.35 seldom
Groups that oppose modern biotech have no factual evidence for their claims of negative health consequences or environmental impact.	3.35 seldom
Pest-resistant GM crops would also harm non-target organisms like butterflies.	3.32 seldom
Pollen from GM crops will contaminate native plant species and further reduce biodiversity.	3.30 seldom

Rating scale: 5=all the time, 4 = almost always, 3 = seldom , 2 = never, and 1 = don't know

Stakeholders tended to support biotech because they believed that farmers and plant breeders demand for it in order to improve their crops. They knew that biotech will not solve world hunger and that it is simply another tool to increase productivity. Supporting this stance the most were the journalists/media persons (50.0%), policy makers (50.0%), and scientists (50.0%) (Appendix Table 70).

Aside from improved productivity, farmers were inclined to adopt GM crops because these are cheaper to cultivate in the long run. Thus, stakeholders were supportive of the farmers' goal to earn a higher income. Those who strongly believed in this statement were the scientists (55.0%), followed closely by the journalists/media persons (53.8%) (Appendix Table 71).

Of greater, if not equal concern, was that biotech crops or products should have been tested safe by regulatory bodies as a foolproof assurance that they are indeed safe. This issue was of greatest concern among journalists/media persons (57.5%) and the scientists (56.3%) (Appendix Table 72).

Stakeholders also gave premium to the claim that biotech does not affect negatively the existence of native species. The scientists (56.3%) had a majority supporting this (Appendix Table 73).

With lesser weight and "seldom" considered were the following factors: (a) no potential harm on the environment (3.35); (b) with factual evidence of its claims (3.35); (c) no harm on biodiversity (3.30); and (d) no harm to other species like butterflies.

Based on all the above, it can be summed up that environmental concerns are not in the top list of factors that affect Filipino stakeholders' decision making on biotech. The economic and health/safety concerns have the bigger weight.

Economic and health/safety concerns topped the list of factors that affect the stakeholders' decision making about biotech. Environmental concerns were not as prominent.

Perception of Biotech in Animal Production

Awareness of Biotech in Animal Production

Majority (66%) of the stakeholders were aware of animal biotech (Table 22). In all the nine stakeholder groups, those who were aware ranged from 58.2 to 87.5 percent (Appendix Table 74).

When disaggregated, data revealed that majority of those who were aware came from the scientist group (87.5%), followed closely by extension workers (76.4%). There is logic to this finding since animal biotech is part of the agricultural scientists' research. Similarly, extension workers, being the bearers of new technologies for sharing to farmers and the local communities, are also be expected to be familiar with animal biotech. On the other hand, consumers (58.2%) were the least aware about animal biotech possibly because of limited information being disseminated on the topic (Appendix Table 74).

Table 22. Awareness of biotech in animal production

Response	Frequency (n=1,180)	%
Aware	779	66
Not aware	401	34
Total	**1,180**	**100**

Attitude Towards Animal Biotech

To gauge the attitude of stakeholders towards animal biotech, they were asked to rate four statements using a 5-point rating scale: 5 = strongly agree, 4 = agree, 3 = disagree, 2 = strongly disagree, 1 = don't know.

The weighted mean of 4.42 for the first statement meant that the stakeholders agreed about their need for more information about animal biotech (Table 23). This was despite their claim to be already aware about it. Awareness here can thus mean that they have heard about animal biotech but were not deeply familiar of what it is and how it works.

Among the various stakeholders, more scientists (53.8%) and farmer leaders/ community leaders (52.5%) said they needed more information about animal biotech (Appendix Table 75). This was quite surprising for the scientists

who are supposed to be exposed to this kind of work. For farmer leaders/ community leaders, the need for more information about animal biotech could be justified. Being laymen, they have limited exposure to it in terms of information and experience.

Table 23. Attitude towards animal biotech

Statement	Weighted Mean
I need more information about animal biotech.	4.42 agree
I trust that our scientists are working on animal biotech for the benefit of the people.	4.08 agree
I support the use of animal biotech for human medical treatments.	3.53 agree
I support animal biotech unreservedly.	3.40 disagree

Rating scale: 5= strongly agree, 4= agree, 3 = disagree, 2= strongly disagree, and 1= don't know

Despite this perceived lack of knowledge about animal biotech, there was a prevailing sense of trust that scientists working on it are doing it for societal good (4.08 = agree). Top supporters of this statement were the journalists/ media persons (52.5%) and scientists (50.0%) (Appendix Table 76).

On application of animal biotech for medical treatments of humans, stakeholders "agreed" (3.53) but did not "strongly agree" with it, suggesting certain level of reservation on their part even if they supported it. Highest frequencies again came from the scientists (66.3%) (Appendix Table 77).

This was supported by another response that they only "moderately agreed" (3.4) on allowing animal biotech to go on without any reservation. This suggests that stakeholders believe, as with any other technology, that some valid reservations should remain depending on how the technology impacts on the people and the environment through time. The scientists (53.8%) led the groups of those who moderately agreed on this matter (Appendix Table 78).

All the above results on attitude indicate a moderate level of acceptance. Stakeholders could not fully and strongly support animal biotech yet because they need more information about it. Nevertheless, with indications showing

that their attitude is leaning favorably towards animal biotech, they should now be given more information and knowledge to help clear their doubts and establish a more solid ground on why they should fully support the technology. More information based on scientific facts are also needed to educate the public about animal biotechnology.

Grounds for Having Reservations About Animal Biotech

There were two major grounds as to why stakeholders had some reservations about animal biotech:
(a) respect for animal rights to life and welfare (75.6%) and presence of unknown risks (73.7%) (Table 24). A little less than half (48.1%) viewed it similarly with crop biotech as interfering with nature.

Table 24. Grounds for having reservations about animal biotech

Ground for Reservation	Frequency n= 1,180	%
Respect for animal rights and welfare	892	75.6
Presence of unknown risks	870	73.7
Interfering with nature	568	48.1
Religious ground	258	21.9
Don't know	11	0.9
Not applicable	5	0.4

Note: Multiple answers

The moral ground is anchored on the recognition of animal life as sacred similar to that of human beings. Any GM method when applied to animals are perceived as a form of cruelty by others because animals are not given any choice. This is covered by the Animal Welfare Act in the country (RA 8485), which regulates the treatment of animals in research and exhibition. There are, however, animals exempted from this law like rats, mice, fish, and birds. Consideration of the moral ground was highest among students (84.1%) (Appendix Table 79).

Another highly cited reason for not going all the way for animal biotech was the presence of unknown risks associated with biotech. Surprisingly, this was highly noted by a rather "silent" group, the businessmen/traders (83.3%) (Appendix Table 75). Specifically, genetic engineering being known as involving transfer of genes might have raised the alarm towards unpredictable results that could impact on humans, environment, and biodiversity.

Nearly half (48.1%) still embraced their conviction that any biotech is tantamount to interfering with nature. Since biotech involves the transfer of genes (or DNA) from one organism to another, some stakeholders might have considered this not a "natural" phenomenon anymore.

In this study, religion was only cited by 21.9 percent as a ground for maintaining reservation about animal biotech. Even the religious group itself accounted only for less than half (47.5%) (Appendix Table 75) supporting this view. This indicates that religion may not be a significant influencer of one's attitude towards animal biotech.

Issues and Concerns about Biotech in Crops and Animals

Stakeholders gave multiple answers when asked to enumerate issues and concerns about biotech as applied to crops and animals (Appendix Table 80). Unfortunately, almost half (42.5%) gave no answer Possible reasons for no answer could be that: (a) stakeholders found it burdensome to recall and explain; (b) they were not interested in the question at all; (c) they considered biotech as fine and just did not have any issue to say at all; or (d) they just did not know much about it.

For almost half of the respondents who enumerated issues and concerns, their responses can be grouped together into seven categories: (1) negative impacts on farmers, (2) health, (3) environmental/ ecological, (4) moral/ ethical/religious, (5) biosafety, (6) genetic pollution, and (7) animal welfare (Table 25). These categories brought the responses into a wider distribution so that not one category stood out prominently in terms of frequency. Nonetheless, in terms of ranking, the item on disease or health risk of biotech in crops and animals topped the list.

The details of the seemingly minor issues stated above merit discussion as they could deepen in the future when more experiences on biotech crops and animals are encountered by the stakeholders. Hence, it pays to address them this early to negate other debates in the future.

Table 25. Issues and concerns about biotech in crops and animals

Issue/Concern	Detail
Negative impacts on farmers	GMOs will lead to unemployment and poverty; big companies/multinational agribusiness corporations producing biotech seeds will eventually be in control. High cost of seeds may not be affordable and is less profitable for farmers. There are problems on availability of the technology and farmers' lack of knowledge/ training on its use.
Health	Genetic modification results in adverse health effects (genetic disorder, cancer, being zombie, sterility) on humans. It can trigger allergies, asthma, and other illnesses as people have varying response to genetic alteration GM crops could possibly introduce new pathogens and new diseases.
Environmental/Ecological	Biotech damages the environment or disrupts the ecosystem leading to the extinction of native species, loss of genetic diversity in crops and animals, insurgence of pests, and damage of useful insects GM can lead to soil contamination and infertility; it makes soil acidic and low in microorganisms activity.
Moral/Ethical/Religious	Interfering with genes, biotech goes against God's law, natural selection, and evolution; it's an alteration/disturbance of nature. Animal biotech can lead to animal cloning.

Issue/Concern	Detail
Bioterrorism	Viruses released to the environment will be harmful to humans, animals, and crops. GMOs can be used in pursuing negative motives among corrupt and influential people. There is the tendency for private companies to aim for excessive profit which can lead to underground/black market operations.
Biosafety	There seems to be a deliberate non-disclosure of risks associated with GMOs. During production and laboratory work/ trials, some harmful chemicals and toxins are being released. Biotech can help spread virus during its production.
Genetic Pollution	Genetic engineering can result to mutations in plants/crops and animals; this can modify the genetic makeup of people who consume them. Release of altered genes to the natural environment can result to breeding with wild plants and animals and the uncontrollable spread of altered species.
Risk to Animal Welfare	Animal biotech is simply animal abuse/ cruelty. It will inevitably affect animal health, thus resulting to abnormalities in animals.

Negative Impacts on Farmers

Being an agricultural technology, the foremost concern was on the impact of biotech on farmers. Some stakeholders believed that biotech application can lead to poverty and unemployment of farmers in the long run. They were aware that biotech seeds are currently being produced only by private multinational companies (MNCs), which control laboratories and facilities to do so. Thus, they alleged that farmers will have to buy seeds of biotech crops perpetually from these MNCs.

The cost of biotech seeds is also much higher than what farmers are currently paying for non-biotech crops. Being so and perhaps without much knowledge and proof of the profitability of biotech crops, despite higher cost of seeds, stakeholders feared that venturing into biotech can be outrightly unprofitable for farmers.

The perceived cycle of seed dependency by the farmers on MNCs is something that should be addressed to calm down the stakeholders' worries and fears about biotech applied in crops. This is compounded by the farmers' need to be trained on the proper management of this new technology.

Health Issues

A typical concern about a new technology would be its impacts on people's health. As biotech deals with genetic alteration in a particular crop or animal, stakeholders feared that this could also alter the genetic makeup of humans who consume them. This points to the need to educate the public more on the nature of genes. The scientific fact is that genetic makeup of humans is hereditary and cannot be modified by mere food consumption, be it biotech-based food or otherwise.

Likewise, there was a false assumption that plant pathogens may cause diseases in people. Biotech has been readily associated with allergies, asthma, cancer, sterility, and other forms of abnormal body changes and responses. The fact is that none of the viruses that infects plant has so far served as pathogen (organism that can cause disease) to animals and humans (Mandal and Jain, 2010).

Environmental/Ecological Impacts

Another concern on biotech was its adjudged negative impacts on the environment. Stakeholders noted that release of biotech crops in the field, it being a new and different organism, can trigger concomitant alterations in the environment and the ecosystem. These changes could include extinction of native species, loss of genetic diversity in crops and animals,

insurgence of pests, and damage to useful insects (Saravanan, 2012). Others noted that biotech crops can make the soil acidic, which in turn causes low microorganisms activity, thus, decreasing soil fertility (Lebedev et al., 2022).

Moral/Ethical/Religious Grounds

The moral aspect was among the earliest issues hurled against biotech. Involving transfer of human genes, biotech has always been questioned as interference with God's law and does not conform to the laws of natural selection and evolution. Any change it brings about was considered to be a disturbance to nature, and was, thus, sacrilegious. Given the broad possibilities that gene alteration can do, there was also the fear that biotech could lead to cloning of animals, which was considered as the height of human's ungodly ambition.

In addition, stakeholders were equally concerned about the possibility of using biotech for bioterrorism where viruses are intentionally released to the environment to harm humans, animals, and other living things (Moorchung et al., 2009). This idea was strengthened by the Covid 19 pandemic where a suspicion arose that the Covid virus could have been intentionally released to the environment by a powerful nation to destroy its enemies and competitors for world power.

Because of what biotech can achieve, there was also the fear that this can be used as an instrument by unscrupulous politicians and other influential people or groups for their own selfish gains. Or it can induce the rise of an underground or black market operation such as the selling of genuine GM seeds.

A nagging issue brought forth mostly by anti-GM groups was the failure of GM promoters not to openly disclose the risks associated with biotech crops or animals. They alleged that information circulating about biotech has been loaded with its advantages and rarely (or none at all) about its risks and disadvantages.

Biosafety Concerns

Stakeholders believed that they had acquired "very good" knowledge about biotech through the years. And yet they were fearful that the process involved in biotech could release harmful chemicals and toxins, or could lead to the unintentional spread of virus during production trial and laboratory work. This irony has to be addressed by continuous public education about scientific facts and focusing on building the stakeholders' trust on the safety of agri-biotech.

Genetic Pollution

Genetic engineering was looked upon as a possible source and cause of mutations in crops and animals. Given the broad and endless possibilities, there were even thoughts that biotech might create monster plants and animals in the future.

Animal Welfare

Some respondents viewed biotech in animals as a form of abuse and cruelty. They perceived that tinkering with animal genes can affect animal health and could even result to their deformities and abnormalities. And because animals become helpless victims in the process, some respondents also considered animal biotech as an immoral act.

Similarities and Differences Between the 2006 and 2022 Perception Studies

Similarities

There were more similarities than differences in the findings of the 2006 and 2022 agri-biotech perception studies. The similarities were observed more in the: (a) socio-demographic profile, (b) information sources, (c) trust on information sources, (d) societal views and values, (e) knowledge about biotech in food production, (f) knowledge about biotech that stakeholders need to know more about, (g) views on the use of biotech crops, (h) considerations deemed important for biotech in food production, (i) perception regarding biotech in food production, (j) perception of prevailing views about agricultural biotech, (k) participation in biotech-related activities, and (l) consideration of applications in making judgments about biotech.

All tables supporting the findings can be found in Appendix Tables 81-117.

Demographic Profile

In both the 2006 and 2022 studies, male and female were almost equally represented. Majority of the respondents had college degrees and belonged to the Roman Catholic faith.

Information Sources

In terms of interpersonal information sources, the top three were the scientists, families/friends/neighbors, and agricultural workers. Mass media emerged as the second most accessed in both studies. These included print, broadcast, and Internet sources,

Trust on Information Sources

Respondents had 'total trust' on scientists, 'no trust' to 'some trust' on social media sources, and 'some trust' on all other information sources.

Societal Views and Values

In both studies, the respondents agreed with these statements:

a. Biotech in food production is consistent with their moral values.
b. GM foods when totally safe can be distributed.
c. Nothing is wrong if man modifies nature.
d. Regulation of modern biotech should be left to the industry.

Knowledge about Biotech in Food Production

Out of 11 items about biotech in food production, stakeholders were able to get 7 correct answers based on actual scientific facts. These were as follows:

a. Potential risks are associated with every new emerging technology.
b. Products from GM crops are now being sold in the Philippines.
c. GM crops are now being commercially grown in the Philippines.
d. Food science cannot guarantee zero risk.
e. In genetic engineering, genes of interest are transferred from one organism to another.
f. All crops have been genetically modified from their original state through domestication, selection, and controlled breeding over long period of time.
g. Golden Rice contains beta carotene.

Knowledge about Biotech that Stakeholders Need to Know More

Only about a third of the respondents (35.5% in 2006 and 32.4% in 2022) got the correct answer when asked about the following statement: plant viruses are transferred to humans when they eat vegetables and fruits infected with plant viruses. This statement was of course false.

Views on the Use of Biotech Crops

The respondents in both 2006 and 2022 studies viewed biotech crops to be used mainly for commercial growing and for food. Very few acknowledged its other uses for animal feed and industrial by-product.

Considerations Deemed Important for Biotech in Food Production

Respondents viewed the following considerations to be important for biotech in food production:

a. nutritional quality
b. non-poisonous
c. non-allergenic
d. better taste
e. price
f. pesticide residue
g. food appearance

Perception Regarding Biotech in Food Production

In terms of interest, respondents expressed that they were either “very interested” or “somewhat interested” in biotech in food production. Likewise, they perceived biotech for food production to be “somewhat hazardous” in terms of risks and “moderately beneficial” terms of its benefits.

Perception of Prevailing Views about Agricultural Biotech

Respondents agreed on the following favorable views about agri-biotech:

a. Government agencies are doing their best to ensure that the food we eat is safe.
b. Expert statements on biotech are based on scientific analysis and are, therefore, objective.
c. Biotech is good for Philippine agriculture.
d. The risks of genetic engineering have been greatly exaggerated.

On the other hand, they agreed on the following unfavorable views about agricultural biotech:

a. Genetic engineering of food products could create unexpected new allergens or contaminate products in an unanticipated way, resulting in threats to public health.
b. Biotech in food production benefits only large agricultural companies.

Participation in Biotech-related Activities

Respondents agreed that the public should be consulted in formulating food regulations and laws, and that the public should be directly consulted in approving R&D in agri-biotech.

Consideration of Applications in Making Judgments about Biotech

Among applications considered in making judgments about biotech, respondents seldom considered the one involving the transfer of fish genes into strawberries for the latter to acquire the trait of being able to resist extreme freezing temperature.

Differences

Socio-demographic Profile

In the 2006 study, most of the respondents were married. Meanwhile, in the 2022 study, respondents were composed of an almost equal distribution of single and married respondents.

Information Sources

In the 2006 study, print, broadcast and online sources (mass media) emerged as the most common information sources followed by interpersonal sources. In the 2022 study, social media came out as the topmost information source, with mass media second, and interpersonal sources ranking last. The bias towards social media could be attributed to the occurrence of Covid-19 pandemic in 2020 and onwards. The pandemic imposed restrictions on face-to-face communication making the social media as the popular alternative. For social media sources in the 2022 study, Facebook emerged as the most common information source, followed by YouTube.

Information, Knowledge, and Understanding of Biotech

The respondents had improved their perception, from good to very good, of the following factors related to information, knowledge, and understanding of biotech: (a) usefulness of biotech information, (b) quality of biotech information, (c) understanding of agri-biotech science, and (d) knowledge on use of biotech in food production.

Knowledge About Biotech that Stakeholders Need to Know About

In the 2022 study, the number of respondents with correct knowledge about the following was lower than that of the 2006 study: (a) ordinary tomatoes do not contain genes while GM tomatoes do, and (b) by eating GM food, a person's genes could be modified. This means that respondents retrogressed on their knowledge about genes.

Perception of Regulations About Agricultural Biotech

Results showed that respondents had favorably shifted their perception from "disagreed" during the 2006 study to "agreed" during the 2022 study for the following: (a) regulations on biotech should include inputs from the non-government sector, (b) government regulatory agencies have scientific facts and technical information needed in order to make good decisions about biotech in food, (c) the public is provided with vital information about the health effects of GM foods, and (d) current regulations in the Philippines are sufficient to protect people from any risks linked to modern biotech. This means that stakeholders now have better regard for biotech regulations in the country.

Perception of Stakeholders' Concern Over Public Health and Safety Impact of Agricultural Biotech

In the 2006 study, none of the stakeholder groups was "very concerned" about public health and safety impact of agricultural biotech. Local farm leaders and religious leaders/groups were "not concerned" at all, while all the other stakeholder groups were only "somewhat concerned."

On the other hand, in the 2022 study, all stakeholder groups showed some increased level of concern. Among the "very concerned" were local farm leaders, agricultural biotech companies, international research institutions, government research institutions, and university-based scientists. All the other remaining stakeholder groups were only "somewhat concerned."

Participation in Biotech-related Activities

Compared to the 2006 study, respondents in the 2022 study had lower intention to push for labeling of GM foods and to attend information session on biotech. Likewise, they had remained consistently unwilling to contribute time and money to organizations that promote GM foods.

Consideration of Biotech Applications in Making Judgments

Compared to the 2006 study, respondents in the 2022 study had improved level of consideration for the following applications in making judgments about biotech (from seldom to almost always):

a. production of foods to make them more nutritious, better-tasting, and longer-lasting
b. make the crops more resistant to pests and diseases
c. detect and treat diseases we might have inherited from our parents
d. produce medicines and vaccines; for example, to produce insulin for diabetes
e. study human diseases like cancer

In summary, the areas where major progress in perception about biotech had been achieved were on the following:

a. usefulness, quality, and understanding of biotech in food production
b. agreement to include non-government sector in the formulation of biotech regulations
c. more favorable perception of government regulations as protecting people from risks
d. higher concern over public health and safety impacts of biotech.

Major trends that remained unchanged were:

a. scientists as most trusted sources of information on biotech
b. view of biotech crops as mainly for commercial growing and for food
c. unfavorable perception of crop biotech was mainly due to two reasons: fear of allergen arising from GM foods, and the control over biotech seed production and distribution by big agricultural companies

The lone item which may indicate retrogression among stakeholders was the nagging misperception about genes and viruses as being transferred to humans when they consume GM foods. This notion was supported by more stakeholders in the 2022 study than in the 2006 study.

Comparison of Biotech Perception Between GMO and Non-GMO Provinces

In this study, non-GMO areas refer to three provinces in the country where GMOs are not allowed entry by virtue of a provincial resolution. They are Oriental Mindoro, Negros Occidental, and North Cotabato. With 118 respondents from each province, a total of 354 respondents represented the nine stakeholder groups in these non-GMO provinces (Table 26).

Table 26. Provinces with GMO ban, study sites, and number of respondents

Province	Municipality	Number of Respondents
Oriental Mindoro	Calapan City and Baco	118
Negros Occidental	Bacolod City and La Carlota	118
North Cotabato	Kabacan and Kidapawan	118
	Total	354

There were overwhelming similarities than differences among respondents in GMO and non-GMO areas. In fact, being in an area where GMO was banned had no effect at all on the public's perception and attitude towards biotech.

Ironically, those from non-GMO areas showed better knowledge on biotech in food production than those from GMO areas. More stakeholders in the non-GMO areas were also more optimistic and interested in biotech and less stakeholders regarded biotech as being hazardous.

Appendix Tables 96-112 capture the details of comparison between the two areas.

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The study aims to determine the current Philippine scenario on public perception of biotech in general, and agri-biotech in particular. A total of 1,180 sample respondents representing 10 provinces and nine stakeholder groups all over the country were purposively selected using stratified sampling. They were chosen based on their accessibility, availability, and willingness to participate in the survey. Due to restrictions imposed by the health protocols of Covid-19 during the time of the study, Google survey and field administered survey were used to gather data. Data were analyzed using frequency counts, percentages, weighted mean, and word cloud. No test of relationships was done due to the non-random sampling employed as brought about by the restrictions of the Covid-19 pandemic.

Salient Findings

1. Stakeholders were almost equally female and male, single and married, and were college graduates of technical courses with agriculture as the most prominent course.

2. Information sources included the social media, especially Facebook and Youtube, followed by mass media, and person sources in that order. The most trusted sources of information were scientists from government R&D institutions who were believed to be the most knowledgeable and protective of public interest, safety, and welfare when it comes to biotech.

3. Trends on public perception of biotech in general and agri-biotech in particular were as follows:

    a. Stakeholders perceived themselves as having very good information, knowledge, and understanding of biotech though a distinction must be made between scientific and non-scientific ones.

    b. Leading the pack in terms of knowledge of biotech were the scientists, journalists/media persons, extension workers, and students. Lagging behind with comparatively lower level of knowledge were the religious leaders, policy makers, businessmen/traders, consumers, and farmer leaders/community leaders in that order.

    c. While stakeholders were fairly aware of a number of facts about biotech and their application in food production, they showed misperception about three aspects: (1) genes being misconstrued as present only in GM foods; (2) human genes being modified by mere eating of GM foods; and (3) plant viruses being transferred to humans when they eat vegetables and fruits infected with virus.

    d. Stakeholders found biotech being in accordance with society's views and moral values.

    e. On uses of biotech for food, the top factors considered were nutritional quality, non-toxicity, and being non-allergenic.

    f. Stakeholders found the use of biotech in food production as highly beneficial and the risks involved as only somewhat hazardous.

    g. Regulations on biotech were viewed favorably as based on scientific facts and as sufficient to protect the public from known risks.

    h. Research institutions, public and private, were the ones regarded as very concerned about health and safety issues of biotech. However, there was a perceived bias that information being disseminated to the public were focusing only on the benefits of GM foods. There was a perceived apparent lack of adequate information on health risks and impacts of GM foods.

i. There was an overwhelming conviction that science should be part of agricultural development in the country.

j. Stakeholders were more interested and concerned about health and safety issues of biotech than its environmental impacts.

k. Considered almost always in making decisions about biotech were its benefits especially its end uses as food and medicines.

l. There was willingness to support and participate in biotech-related activities among stakeholders but some degree of hesitation persists if it would involve their time and money.

m. Stakeholders were aware of biotech in animal production but had some reservations in fully supporting it. Reservations were rooted more on moral ground, i.e., respect for animal rights and welfare.

n. Issues/concerns on biotech applied to both crops and animals involved at least six factors: health, environmental, moral/ethical, bioterrorism, biosafety, and genetic pollution.

4. There were more similarities than differences in the 2006 and 2022 perception studies, implying that not much has changed after 16 years of public information and debates on biotech. In general, Filipino stakeholders are actually supportive of agri-biotech.

5. Scientists remained as the most trusted sources of information on biotech but they were hardly accessed.

6. The public was fairly supportive of biotech in food production. However, wrong knowledge about genes and viruses still remains to be addressed as these could have possibly made the stakeholders wary about GM foods.

7. Major differences between the 2006 and 2022 studies revolved around information sources: stakeholders have shifted from mass media to social media (Facebook). In the recent study, they also exhibited better appreciation of the usefulness, quality, and understanding of biotech information.

8. On a positive note, the public has become more confident that biotech regulations are protective of public health and safety.

9. While support to biotech in crops was evidently high, stakeholders were more conservative when it came to supporting biotech in animal production on moral grounds. Safety and impacts on health were the main considerations in making decisions about biotech in both crops and animals.

10. The GMO ban in some provinces did not have much influence on the stakeholders' perception and attitude towards biotech. With or without GMO ban, stakeholders remained optimistic and supportive of biotech in crops with some reservations on biotech in animals.

Conclusions

1. Filipino stakeholders in general are supportive of biotech in crop production and consider it as beneficial to society in terms of food and medicines. Support, however, is not as definite in terms of biotech in animal production.

2. Scientists, are the most trusted sources of information, but are ironically not that accessible and visible in the community. So social media, even if not highly trusted, are resorted to because they are the most accessible and omnipresent in many areas.

3. Stakeholders need to be enlightened more about genes and viruses as these are the most misunderstood aspects that might have caused some stakeholders to be wary of biotech.

4. The most supportive and optimistic about biotech among the stakeholder groups are the scientists and journalists/media persons.

5. Issues that register high in stakeholders' decision making on biotech in crops are safety and impacts on health. In animal biotech, it is the moral dimension.

6. After almost 16 years, improvement of perception occurred in the following areas: (a) biotech information as being more useful, of better quality and better understood; (b) biotech regulations as protective of public safety and health, (c) higher motivation to join biotech-related activities that do not involve their time and money, and (d) more emphasis on end uses of biotech as food and medicines as primary consideration in making decisions about biotech.

7. There is not much difference in the perception of stakeholders in areas with and without GMO ban. Stakeholders in both areas remain optimistic and supportive of biotech in crops with some reservations on biotech in animals.

Recommendations

A. For enhancing favorable perception of agri-biotech

1. Tap scientists as key information sources and talkers

This is a glaring and persistent finding that needs to be seriously paid attention to by those engaged in doing public information and education on biotech. Being the most trusted, the scientists' statements can make a lot of difference in swaying public opinion and perception. This is more than merely citing their work but making them do the talking to the public about biotech.

Unfortunately, scientists are not that accessible and visible to the public. So some strategic moves need to be done. Among these is the establishment of a pool of scientist- speakers who are willing to move around the country to talk about biotech and address the doubts and wrong information that the public has. Scientists can work together with communication professionals who can provide them assistance in material production and techniques in communicating science to the lay people.

As Alan McHughen (2007) remarked, it is crucial to recognize that ordinary laymen who are not scientifically trained cannot be expected to learn all the intricacies of biotech to enable them to decide whether or not to accept biotech products. What they need is somebody whom they can trust to give them an honest advice. The scientists can certainly perform this role, being perceived experts who are well equipped with scientific facts and genuinely working for public interest and safety.

2. Improve the public knowledge about genes and viruses

A bigger part of the stakeholder population needs to be educated more on genes and viruses. The wrong notion that genes and viruses are transferred to humans who consume them might have contributed to the public's fear about the impacts of biotech foods on their health and well-being. It is high time that this be addressed by a focused and intense campaign to replace it with more scientific facts. Materials explaining what genes and viruses are and how they work can be produced and distributed. Just like the Covid 19, the public has to be educated on such topics no matter how "technical" they may sound. There are science communication principles and techniques that can readily address this need.

3. Expand level of optimism to other key stakeholders

The current scenario points to the scientists and media people as the most optimistic and supportive of biotech. But the desired scenario is to have those on-ground and direct users of biotech products to have this kind of optimism. For example, the community leaders, farmer leaders and consumers do not figure out as well informed about biotech, and yet they are the ones who are very accessible to the farmers and local community for information and other forms of assistance. Hence, communication and public education activities may need to give more attention to them, instead perhaps to religious leaders, who are after all the least accessed and least trusted when it comes to biotech.

4. Make biotech reporting more balanced

There is a sentiment among the public that the information presented about biotech tends to be biased towards its benefits and advantages. Results show a clamor for openness about risks especially those pertaining to health and safety so that stakeholders can better understand and decide on biotech. While those engaged in promoting biotech may need to be biased in favor of it, there is merit in being open to discuss the known risks of biotech. The safeguard though is to explain simply and clearly how these risks are being assessed and managed by concerned authorities for the utmost safety of people. In communication, a trustworthy and objective source tends to gain people's confidence better than one who is obviously hard selling the product.

5. Enlighten the stakeholders more on animal biotech

Appreciation for biotech in animal production can be more challenging as stakeholders express some reservations on it due to moral or ethical ground. Animals have been regarded as like humans whose sanctity of life must be respected. The breeding of animals in order for their organs to benefit humans is frowned upon as going against life as ordained by a divine power (Brothers, 2020). Crop biotech started with this bottleneck in the early years, but through time and right information, this view eventually subsided.

This reservation on biotech in general is also exacerbated by the common belief that things that are natural or organic are less risky and safer than those that are man-made. This of course is not always true. There are many cases when human intervention did the society good. People's views can change as long as trustworthy proofs are presented and explained. Certainly, learning does not happen overnight and takes sustained repetition to occur. It may even take decades and a generation for learning to take place. Hence, deliberate efforts must now be strengthened to address this concern. As in past efforts, empathy is the key. Stakeholders trust and side with people whom they believe are after their safety and have the same values as theirs.

6. Nurture students as corp of biotech advocates

Students rank very closely with scientists and media people in being supportive of biotech. Earlier efforts to train them in science communication and as advocates for biotech must be continued and expanded to succeeding generations. As these students graduate and join the work force, they are in a better position to influence the public about biotech, some of them being future scientists themselves.

Also, being embedded more broadly in circles of families, friends, peers, and co-workers, students have a high multiplier effect than other stakeholders in sharing scientific facts. Organizing them into active networks and federations nationwide will make their contributions more impactful. Of course, some incentives that appeal to youth should be put in place to attract them to be involved and stay on. They may be consulted on the types of incentives they prefer.

7. Maximize the role of national mass media in public information and education

The media people (national and local) are the second most optimistic group about biotech. They also have the highest multiplier effect in terms of reach among the information sources. Hence, their continuous education and updating on biotech in the country must be well supported. There is wisdom investing on national media (primarily TV, less on radio as shown in the study) even if they are more expensive because of their broad reach/exposure and immediate impact. In the long run, the TV's reach (e.g., GMA news, ABS-CBN TV Patrol) will be many times, wider, and cheaper. The local or community media can then help amplify what the national media have aired. Effort should be exerted to establish strategic links with national TV programs while also maintaining ties with the local media.

8. Establish a trustworthy social media platform manned by a credible source

The social media, especially Facebook and YouTube, are the highly accessed platforms by the stakeholders. However, the public has 'low trust' on them because of their susceptibility to misinformation. If ever social media will be used for public information, it is advised that a credible sources like scientists from the academe or a government R&D institution be assigned to handle them. It should be like running a regular program of posting (similar to Dr. Willy Ong's laymanized blogs on health) that the public consistently awaits everyday.

B. For policy consideration

1. Give considerable weight to public service in the scientists' promotion system

Scientists in the academe and government R&D institutions are the most trusted information sources on biotech among the stakeholders. And yet, they rarely go out in the public to do the talking. Since, their promotion rests on their research and teaching accomplishments, public service has taken a backseat or they have little time left for it. If we want a science literate society, and not necessarily on biotech only, the career system of scientists may need to be revised to give premium also to public service, i.e., educate the public about science.

2. Include science communication in the curriculum of agriculture and other relevant courses

Corollary to the above, scientists should have time to interact and communicate with the public who will be the end users of their technologies. Such regular interaction can help in educating the public, and thus, lessen doubts and opposition early on. To prepare the next generations of scientists for this, a course on science communication should be included in the BS curriculum of technical courses like agriculture, forestry, and environmental science. The principles and techniques of science communication will surely help prepare the scientists for the job and erase the misconception that scientists are too technical to be understood. The current agricultural extension subject may be reviewed and be complemented by science communication.

C. For Future Study

1. Conduct a follow up study that will probe more on the why's and how's of changes in biotech perception through time

Due to restrictions of the Covid 19 pandemic, the study was tied up to the Google survey as method for data gathering. Just like a poll survey, this method cannot ask open-ended questions like "why" and "how" to the respondents. The questionnaire can only ask respondents to tick from among the pre-determined choices of answers as their response to given items. With the easing out of Covid 19, there is now a better opportunity to probe further on selected questions that would shed light on what changes in the perception of biotech occurred, why and how those changes happened, and why certain items remained unchanged.

The survey may further ask the respondents how the ban or no ban on GMOs in their areas affect their perception and actual behavior towards biotech in crops and food production. Then the low acceptance of animal biotech can be looked into more deeply. In depth field interviews, focus group discussions, and key informant interviews may be used as the methods for the sequel study.

2. Explore potential role of traders/businessmen

Traders and businessmen seem to be silent players in the biotech game. Yet as shown in a previous study, they play a critical role in sustaining biotech corn farmers to persist in their farming (Torres et al., 2014). They provide the farmers with necessary inputs and starters on loan basis to enable farmers to plant and maintain their farms. And yet when farmers harvest, these are the same traders who buy their produce and bring them to markets. As farmers' harvest increases, the traders' income also increases. This surely would make the traders happy as they can be more certain that farmers can pay back their loan.

So how can they help in openly in advocating for biotech? Or is it too much that they get involved in the task? At this point, it may be difficult to provide answers to these questions. For one, traders have rarely been studied. They are not visible though they are part of the value chain. Second, it can be presumed that their goal and values are different from that of farmers and other stakeholders. A simple study about how the dynamics between the traders and Bt corn farmers operate may be explored. This can provide insights on how the trader-farmer relationship can be tapped to advance agri-biotech learning and crop adoption among farmers.

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Appendix Tables

Appendix Table 1. Gender

Stakeholder Group	Male		Female		Total	
	n	%	n	%	n	%
Businessmen and traders	63	52.5	57	47.5	120	10.2
Consumers	86	39.1	134	60.9	220	18.6
Extension workers	59	42.1	81	57.9	140	11.9
Farmer leaders and community leaders	98	61.3	62	38.8	160	13.6
Journalists	37	46.3	43	53.8	80	6.8
Policy makers	57	71.3	23	28.8	80	6.8
Religious leaders	56	70.0	24	30.0	80	6.8
Scientists	39	48.8	41	51.3	80	6.8
Students	84	38.2	136	61.8	220	18.6
Total	**579**	**49.1**	**601**	**50.9**	**1,180**	**100.0**

Appendix Table 2. Civil status

Stakeholder Group	Single		Married		Others*		Total	
	n	%	n	%	n	%	n	%
Businessmen and traders	39	32.5	71	59.2	10	8.3	120	10.2
Consumers	105	47.7	100	45.5	15	6.8	220	18.6
Extension workers	51	36.4	75	53.6	14	10.0	140	11.9
Farmer leaders and community leaders	15	9.4	133	83.1	12	7.5	160	13.6
Journalists and media persons	46	57.5	32	40.0	2	2.5	80	6.8
Policy makers	20	25.0	54	67.5	6	7.5	80	6.8
Religious leaders	44	55.0	32	40.0	4	5.0	80	6.8
Scientists	35	43.8	42	52.5	3	3.8	80	6.8
Students	216	98.2	4	1.8	0	0.0	220	18.6
Total	**571**	**48.4**	**543**	**46.0**	**66**	**5.6**	**1,180**	**100.0**

**Others = Widow, separated, and live-in*

Appendix Table 3. Educational attainment

Stakeholder Group	Elementary		High School		College		Post-grad		Total	
	n	%	n	%	n	%	n	%	n	%
Businessmen and traders	5	4.2	28	23.3	67	55.8	18	15.0	120	10.2
Consumers	6	2.7	24	10.9	140	63.6	39	17.7	220	18.6
Extension workers	0	0.0	4	2.9	84	60.0	50	35.7	140	11.9
Farmer leaders and community leaders	11	6.9	73	45.6	66	41.3	6	3.8	160	13.6
Journalists and media persons	0	0.0	1	1.3	57	71.3	22	27.5	80	6.8
Policy makers	2	2.5	6	7.5	49	61.3	22	27.5	80	6.8
Religious leaders	4	5.0	7	8.8	36	45.0	29	36.3	80	6.8
Scientists	0	0.0	1	1.3	22	27.5	57	71.3	80	6.8
Students	5	2.3	106	48.2	106	48.2	2	0.9	220	18.6
Total	**33**	**2.8**	**250**	**21.2**	**627**	**53.1**	**245**	**20.8**	**1,180**	**100.0**

Appendix Table 4. Religion

Stakeholder Group	Roman Catholic		Protestant, Baptist, Born- again, Evangelicals, Presbyterian		Islam		Others (INC, 7th day Adventist, etc.)		Total	
	n	%	n	%	n	%	n	%	n	%
Businessmen and traders	90	75.0	17	14.2	4	3.3	9	7.5	120	10.2
Consumers	185	84.1	16	7.3	6	2.7	13	5.9	220	18.6
Extension workers	108	77.1	20	14.3	1	0.7	11	7.9	140	11.9
Farmer leaders and community leaders	122	76.3	23	14.4	5	3.1	10	6.3	160	13.6
Journalists and media persons	58	72.5	13	16.3	1	1.3	8	10.0	80	6.8
Policy makers	67	83.8	10	12.5	0	0.0	3	3.8	80	6.8
Religious leaders	37	46.3	28	35.0	2	2.5	13	16.3	80	6.8
Scientists	58	72.5	14	17.5	0	0.0	8	10.0	80	6.8
Students	162	73.6	32	14.5	7	3.2	19	8.6	220	18.6
Total	**887**	**75.2**	**173**	**14.7**	**26**	**2.2**	**94**	**8.0**	**1,180**	**100.0**

Appendix Table 5. Social media sources

Stakeholder Group	Facebook		YouTube		Twitter		Tiktok		Others		Total	
	n	%	n	%	n	%	n	%	n	%	n	%
Businessmen and traders	92	76.7	87	72.5	9	7.5	10	8.3	17	14.2	120	10.2
Consumers	182	82.7	151	68.6	25	11.4	27	12.3	31	14.1	220	18.6
Extension workers	115	82.1	109	77.9	13	9.3	12	8.6	26	18.6	140	11.9
Farmer leaders and community leaders	125	78.1	86	53.8	11	6.9	5	3.1	19	11.9	160	13.6
Journalists and media persons	70	87.5	56	70.0	15	18.8	8	10.0	19	23.8	80	6.8
Policy makers	66	82.5	53	66.3	6	7.5	7	8.8	7	8.8	80	6.8
Religious leaders	54	67.5	60	75.0	1	1.3	6	7.5	7	8.8	80	6.8
Scientists	63	78.8	54	67.5	9	11.3	7	8.8	18	22.5	80	6.8
Students	191	86.8	174	79.1	59	26.8	57	25.9	73	33.2	220	18.6
Total	**958**	**81.2**	**830**	**70.3**	**148**	**12.5**	**139**	**11.8**	**217**	**18.4**	**1,180**	**100.0**

Appendix Table 6. Broadcast and web sources

Stakeholder Group	TV		Radio		Web		Total	
	n	%	n	%	n	%	n	%
Businessmen and traders	61	50.8	27	22.5	52	43.3	120	10.2
Consumers	105	47.7	55	25.0	110	50.0	220	18.6
Extension workers	65	46.4	33	23.6	92	65.7	140	11.9
Farmer leaders and community leaders	70	43.8	52	32.5	46	28.8	160	13.6
Journalists and media persons	52	65.0	47	58.8	57	71.3	80	6.8
Policy makers	34	42.5	22	27.5	44	55.0	80	6.8
Religious leaders	33	41.3	23	28.8	38	47.5	80	6.8
Scientists	33	41.3	14	17.5	65	81.3	80	6.8
Students	111	50.5	54	24.5	143	65.0	220	18.6
Total	**564**	**47.8**	**327**	**27.7**	**647**	**54.8**	**1,180**	**100**

Appendix Table 7. Print sources

Stakeholder Group	Newspaper		Science Magazine		Book		Newsletter, Pamphlet, Brochure		Total	
	n	%	n	%	n	%	n	%	n	%
Businessmen and traders	48	40.0	31	25.8	17	14.2	25	20.8	120	10.2
Consumers	84	38.2	43	19.5	51	23.2	53	24.1	220	18.6
Extension workers	62	44.3	41	29.3	37	26.4	59	42.1	140	11.9
Farmer leaders and community leaders	49	30.6	23	14.4	20	12.5	47	29.4	160	13.6
Journalists and media persons	45	56.3	31	38.8	15	18.8	35	43.8	80	6.8
Policy makers	30	37.5	22	27.5	12	15.0	27	33.8	80	6.8
Religious leaders	37	46.3	23	28.8	18	22.5	19	23.8	80	6.8
Scientists	29	36.3	50	62.5	42	52.5	39	48.8	80	6.8
Students	104	47.3	68	30.9	94	42.7	61	27.7	220	18.6
Total	**488**	**41.4**	**332**	**28.1**	**306**	**25.9**	**365**	**30.9**	**1,180**	**100**

Appendix Table 8a. Person sources

Stakeholder Group	Family/Friend/ Neighbor		Dealer of Agric. Inputs		Private Sector Scientist		University-based Scientist		Total	
	n	%	n	%	n	%	n	%	n	%
Businessmen and traders	52	43.3	34	28.3	12	10.0	22	18.3	120	10.2
Consumers	114	51.8	29	13.2	15	6.8	47	21.4	220	18.6
Extension workers	40	28.6	36	25.7	33	23.6	71	50.7	140	11.9
Farmer leaders and community leaders	61	38.1	32	20.0	20	12.5	30	18.8	160	13.6
Journalists and media persons	26	32.5	18	22.5	16	20.0	43	53.8	80	6.8
Policy makers	35	43.8	18	22.5	18	22.5	26	32.5	80	6.8
Religious leaders	34	42.5	11	13.8	14	17.5	25	31.3	80	6.8
Scientists	22	27.5	15	18.8	30	37.5	56	70.0	80	6.8
Students	131	59.5	38	17.3	24	10.9	73	33.2	220	18.6
Total	**515**	**43.6**	**231**	**19.6**	**182**	**15.4**	**393**	**33.3**	**1,180**	**100**

Appendix Table 8b. Person sources

Stakeholder Group	Farmer/ Farmer Group		Religious Leader/ Group		Consumer Group		Agric. Worker/ Service		Total	
	n	%	n	%	n	%	n	%	n	%
Businessmen and traders	50	41.7	10	8.3	42	35.0	45	37.5	120	10.2
Consumers	64	29.1	18	8.2	94	42.7	59	26.8	220	18.6
Extension workers	40	28.6	9	6.4	28	20.0	81	57.9	140	11.9
Farmer leaders and community leaders	94	58.8	10	6.3	16	10.0	69	43.1	160	13.6
Journalists and media persons	31	38.8	9	11.3	30	37.5	42	52.5	80	6.8
Policy makers	27	33.8	3	3.8	19	23.8	40	50.0	80	6.8
Religious leaders	24	30.0	36	45.0	19	23.8	26	32.5	80	6.8
Scientists	10	12.5	4	5.0	15	18.8	34	42.5	80	6.8
Students	81	36.8	18	8.2	55	25.0	96	43.6	220	18.6
Total	**421**	**35.7**	**117**	**9.9**	**318**	**26.9**	**492**	**41.7**	**1,180**	**100**

Appendix Table 9. Usefulness of available information about biotech

Stakeholder Group	Excellent		Very Good		Good		Poor		Total		Weighted
	n	%	n	%	n	%	n	%	n	%	Mean
Businessmen and traders	41	34.2	40	33.3	29	24.2	10	8.3	120	10.2	2.93
Consumers	90	40.9	93	42.3	31	14.1	6	2.7	220	18.6	3.21
Extension workers	54	38.6	60	42.9	24	17.1	2	1.4	140	11.9	3.19
Farmer leaders and community leaders	49	30.6	69	43.1	29	18.1	13	8.1	160	13.6	2.96
Journalists and media persons	20	25.0	42	52.5	14	17.5	4	5.0	80	6.8	2.98
Policy makers	24	30.0	36	45.0	19	23.8	1	1.3	80	6.8	3.04
Religious leaders	13	16.3	36	45.0	27	33.8	4	5.0	80	6.8	2.73
Scientists	30	37.5	36	45.0	13	16.3	1	1.3	80	6.8	3.19
Students	104	47.3	86	39.1	26	11.8	4	1.8	220	18.6	3.32
Total	**425**	**36.0**	**498**	**42.2**	**212**	**18.0**	**45**	**3.8**	**1,180**	**100**	**3.10**

Appendix Table 10. Quality of available information about biotech

Stakeholder Group	Excellent		Very Good		Good		Poor		Total		Weighted Mean
	n	%	n	%	n	%	n	%	n	%	
Businessmen and traders	37	30.8	31	25.8	39	32.5	13	10.8	120	10.2	**2.77**
Consumers	73	33.2	99	45.0	42	19.1	6	2.7	220	18.6	**3.09**
Extension workers	49	35.0	52	37.1	36	25.7	3	2.1	140	11.9	**3.05**
Farmer leaders and community leaders	35	21.9	78	48.8	33	20.6	14	8.8	160	13.6	**2.84**
Journalists and media persons	16	20.0	43	53.8	19	23.8	2	2.5	80	6.8	**2.91**
Policy makers	16	20.0	41	51.3	23	28.8	0	0.0	80	6.8	**2.91**
Religious leaders	11	13.8	35	43.8	28	35.0	6	7.5	80	6.8	**2.64**
Scientists	24	30.0	39	48.8	17	21.3	0	0.0	80	6.8	**3.09**
Students	92	41.8	92	41.8	35	15.9	1	0.5	220	18.6	**3.25**
Total	**353**	**29.9**	**510**	**43.2**	**272**	**23.1**	**45**	**3.8**	**1,180**	**100**	**2.99**

Appendix Table 11. Understanding of biotech science

Stakeholder Group	Excellent		Very Good		Good		Poor	
	n	%	n	%	n	%	n	%
Businessmen and traders	18	15.0	38	31.7	40	33.3	24	20.0
Consumers	41	18.6	86	39.1	79	35.9	14	6.4
Extension workers	31	22.1	56	40.0	48	34.3	5	3.6
Farmer leaders and community leaders	28	17.5	64	40.0	45	28.1	23	14.4
Journalists and media persons	6	7.5	31	38.8	37	46.3	6	7.5
Policy makers	14	17.5	28	35.0	29	36.3	9	11.3
Religious leaders	3	3.8	31	38.8	31	38.8	15	18.8
Scientists	17	21.3	40	50.0	22	27.5	1	1.3
Students	37	16.8	90	40.9	84	38.2	9	4.1
Total	**195**	**16.5**	**464**	**39.3**	**415**	**35.2**	**106**	**9.0**

Appendix Table 12. Knowledge of the use of biotech in food production

Stakeholder Group	Excellent		Very Good		Good		Poor	
	n	%	n	%	n	%	n	%
Businessmen and traders	19	15.8	34	28.3	40	33.3	27	22.5
Consumers	40	18.2	95	43.2	62	28.2	23	10.5
Extension workers	24	17.1	62	44.3	42	30.0	12	8.6
Farmer leaders and community leaders	28	17.5	57	35.6	48	30.0	27	16.9
Journalists and media persons	5	6.3	32	40.0	36	45.0	7	8.8
Policy makers	12	15.0	29	36.3	25	31.3	14	17.5
Religious leaders	4	5.0	28	35.0	27	33.8	21	26.3
Scientists	17	21.3	40	50.0	22	27.5	1	1.3
Students	42	19.1	83	37.7	79	35.9	16	7.3
Total	**195**	**16.5**	**464**	**39.3**	**415**	**35.2**	**106**	**9.0**

Appendix Table 13. Knowledge that with every new emerging technology in food production, there will always be potential risks

Stakeholder Group	True		False		Don't Know		Total	
	n	%	n	%	n	%	n	%
Businessmen and traders	101	84.2	7	5.8	12	10.0	120	10.2
Consumers	200	90.9	4	1.8	16	7.3	220	18.6
Extension workers	120	85.7	7	5.0	13	9.3	140	11.9
Farmer leaders and community leaders	133	83.1	11	6.9	16	10.0	160	13.6
Journalists and media persons	79	98.8	0	0.0	1	1.3	80	6.8
Policy makers	69	86.3	5	6.3	6	7.5	80	6.8
Religious leaders	73	91.3	3	3.8	4	5.0	80	6.8
Scientists	77	96.3	2	2.5	1	1.3	80	6.8
Students	202	91.8	6	2.7	12	5.5	220	18.6
Total	**1,054**	**89.3**	**45**	**3.8**	**81**	**6.9**	**1,180**	**100**

Appendix Table 14. Knowledge about food science can guarantee zero risk

Stakeholder Group	True		False		Don't Know		Total	
	n	%	n	%	n	%	n	%
Businessmen and traders	22	18.3	78	65.0	20	16.7	120	10.2
Consumers	32	14.5	150	68.2	38	17.3	220	18.6
Extension workers	19	13.6	99	70.7	22	15.7	140	11.9
Farmer leaders and community leaders	33	20.6	90	56.3	37	23.1	160	13.6
Journalists and media persons	6	7.5	63	78.8	11	13.8	80	6.8
Policy makers	15	18.8	54	67.5	11	13.8	80	6.8
Religious leaders	13	16.3	53	66.3	14	17.5	80	6.8
Scientists	8	10.0	67	83.8	5	6.3	80	6.8
Students	17	7.7	171	77.7	32	14.5	220	18.6
Total	**165**	**14.0**	**825**	**69.9**	**190**	**16.1**	**1,180**	**100**

Appendix Table 15. Knowledge that GM crops are now being grown in the Philippines

Stakeholder Group	True		False		Don't Know		Total	
	n	%	n	%	n	%	n	%
Businessmen and traders	79	65.8	4	3.3	37	30.8	120	10.2
Consumers	150	68.2	13	5.9	57	25.9	220	18.6
Extension workers	113	80.7	7	5.0	20	14.3	140	11.9
Farmer leaders and community leaders	104	65.0	15	9.4	41	25.6	160	13.6
Journalists and media persons	60	75.0	2	2.5	18	22.5	80	6.8
Policy makers	55	68.8	6	7.5	19	23.8	80	6.8
Religious leaders	53	66.3	2	2.5	25	31.3	80	6.8
Scientists	71	88.8	5	6.3	4	5.0	80	6.8
Students	154	70.0	13	5.9	53	24.1	220	18.6
Total	**839**	**71.1**	**67**	**5.7**	**274**	**23.2**	**1,180**	**100**

Appendix Table 16. Knowledge about GM crops now being sold in the Philippines

Stakeholder Group	True		False		Don't Know		Total	
	n	%	n	%	n	%	n	%
Businessmen and traders	80	66.7	1	0.8	39	32.5	120	10.2
Consumers	157	71.4	14	6.4	49	22.3	220	18.6
Extension workers	118	84.3	5	3.6	17	12.1	140	11.9
Farmer leaders and community leaders	112	70.0	11	6.9	37	23.1	160	13.6
Journalists and media persons	65	81.3	3	3.8	12	15.0	80	6.8
Policy makers	59	73.8	5	6.3	16	20.0	80	6.8
Religious leaders	57	71.3	5	6.3	18	22.5	80	6.8
Scientists	76	95.0	3	3.8	1	1.3	80	6.8
Students	164	74.5	9	4.1	47	21.4	220	18.6
Total	**888**	**75.3**	**56**	**4.7**	**236**	**20.0**	**1,180**	**100**

Appendix Table 17. Knowledge about yeasts for brewing as consisting of living organisms

Stakeholder Group	True		False		Don't Know		Total	
	n	%	n	%	n	%	n	%
Businessmen and traders	77	64.2	12	10.0	31	25.8	120	10.2
Consumers	158	71.8	11	5.0	51	23.2	220	18.6
Extension workers	113	80.7	7	5.0	20	14.3	140	11.9
Farmer leaders and community leaders	96	60.0	8	5.0	56	35.0	160	13.6
Journalists and media persons	60	75.0	3	3.8	17	21.3	80	6.8
Policy makers	59	73.8	3	3.8	18	22.5	80	6.8
Religious leaders	56	70.0	4	5.0	20	25.0	80	6.8
Scientists	77	96.3	1	1.3	2	2.5	80	6.8
Students	151	68.6	17	7.7	52	23.6	220	18.6
Total	**847**	**71.8**	**66**	**5.6**	**267**	**22.6**	**1,180**	**100**

Appendix Table 18. Knowledge about genetic engineering as involving transfer of genes of interest are transferred from one organism to another

Stakeholder Group	True		False		Don't Know		Total	
	n	%	n	%	n	%	n	%
Businessmen and traders	68	56.7	12	10.0	40	33.3	120	10.2
Consumers	139	63.2	13	5.9	68	30.9	220	18.6
Extension workers	98	70.0	15	10.7	27	19.3	140	11.9
Farmer leaders and community leaders	104	65.0	12	7.5	44	27.5	160	13.6
Journalists and media persons	56	70.0	6	7.5	18	22.5	80	6.8
Policy makers	52	65.0	14	17.5	14	17.5	80	6.8
Religious leaders	52	65.0	5	6.3	23	28.8	80	6.8
Scientists	67	83.8	7	8.8	6	7.5	80	6.8
Students	160	72.7	15	6.8	45	20.5	220	18.6
Total	**796**	**67.5**	**99**	**8.4**	**285**	**24.2**	**1,180**	**100**

Appendix Table 19. Knowledge about all crops as having been genetically modified from their original state through domestication, selection, and controlled breeding over long period of time

Stakeholder Group	True		False		Don't Know		Total	
	n	%	n	%	n	%	n	%
Businessmen and traders	72	60.0	21	17.5	27	22.5	120	10.2
Consumers	125	56.8	47	21.4	48	21.8	220	18.6
Extension workers	79	56.4	39	27.9	22	15.7	140	11.9
Farmer leaders and community leaders	85	53.1	28	17.5	47	29.4	160	13.6
Journalists and media persons	43	53.8	20	25.0	17	21.3	80	6.8
Policy makers	45	56.3	13	16.3	22	27.5	80	6.8
Religious leaders	41	51.3	23	28.8	16	20.0	80	6.8
Scientists	52	65.0	24	30.0	4	5.0	80	6.8
Students	124	56.4	57	25.9	39	17.7	220	18.6
Total	**666**	**56.4**	**272**	**23.1**	**242**	**20.5**	**1,180**	**100**

Appendix Table 20. Knowledge about golden rice as containing beta-carotene

Stakeholder Group	True		False		Don't Know		Total	
	n	%	n	%	n	%	n	%
Businessmen and traders	53	44.2	7	5.8	60	50.0	120	10.2
Consumers	101	45.9	18	8.2	101	45.9	220	18.6
Extension workers	89	63.6	18	12.9	33	23.6	140	11.9
Farmer leaders and community leaders	73	45.6	14	8.8	73	45.6	160	13.6
Journalists and media persons	46	57.5	5	6.3	29	36.3	80	6.8
Policy makers	43	53.8	8	10.0	29	36.3	80	6.8
Religious leaders	34	42.5	8	Th	38	47.5	80	6.8
Scientists	68	85.0	7	8.8	5	6.3	80	6.8
Students	137	62.3	10	4.5	73	33.2	220	18.6
Total	**644**	**54.6**	**95**	**8.1**	**441**	**37.4**	**1,180**	**100**

Appendix Table 21. Knowledge about viruses being transferred to humans when they eat vegetables and fruits infected with plant viruses

Stakeholder Group	True		False		Don't Know		Total	
	n	%	n	%	n	%	n	%
Businessmen and traders	41	34.2	34	28.3	45	37.5	120	10.2
Consumers	83	37.7	71	32.3	66	30.0	220	18.6
Extension workers	39	27.9	66	47.1	35	25.0	140	11.9
Farmer leaders and community leaders	48	30.0	60	37.5	52	32.5	160	13.6
Journalists and media persons	12	15.0	38	47.5	30	37.5	80	6.8
Policy makers	26	32.5	31	38.8	23	28.8	80	6.8
Religious leaders	28	35.0	23	28.8	29	36.3	80	6.8
Scientists	23	28.8	48	60.0	9	11.3	80	6.8
Students	82	37.3	76	34.5	62	28.2	220	18.6
Total	**382**	**32.4**	**447**	**37.9**	**351**	**29.7**	**1,180**	**100**

Appendix Table 22. Knowledge about ordinary tomatoes as not containing genes, while GM tomatoes do

Stakeholder Group	True		False		Don't Know		Total	
	n	%	n	%	n	%	n	%
Businessmen and traders	33	27.5	51	42.5	36	30.0	120	10.2
Consumers	54	24.5	92	41.8	74	33.6	220	18.6
Extension workers	24	17.1	78	55.7	38	27.1	140	11.9
Farmer leaders and community leaders	55	34.4	54	33.8	51	31.9	160	13.6
Journalists and media persons	16	20.0	40	50.0	24	30.0	80	6.8
Policy makers	21	26.3	38	47.5	21	26.3	80	6.8
Religious leaders	20	25.0	26	32.5	34	42.5	80	6.8
Scientists	15	18.8	61	76.3	4	5.0	80	6.8
Students	53	24.1	105	47.7	62	28.2	220	18.6
Total	**291**	**24.7**	**545**	**46.2**	**344**	**29.2**	**1,180**	**100**

Appendix Table 23. Knowledge about a person's genes being modified by eating GM food

Stakeholder Group	True		False		Don't Know		Total	
	n	%	n	%	n	%	n	%
Businessmen and traders	41	34.2	40	33.3	39	32.5	120	10.2
Consumers	71	32.3	77	35.0	72	32.7	220	18.6
Extension workers	31	22.1	72	51.4	37	26.4	140	11.9
Farmer leaders and community leaders	47	29.4	58	36.3	55	34.4	160	13.6
Journalists and media persons	5	6.3	52	65.0	23	28.8	80	6.8
Policy makers	21	26.3	36	45.0	23	28.8	80	6.8
Religious leaders	22	27.5	33	41.3	25	31.3	80	6.8
Scientists	7	8.8	64	80.0	9	11.3	80	6.8
Students	28	12.7	131	59.5	61	27.7	220	18.6
Total	**273**	**23.1**	**563**	**47.7**	**344**	**29.2**	**1,180**	**100**

Appendix Table 24. Agreement with the view that the use of biotech in food production is in accordance with their moral values

Stakeholder	Strongly Agree		Agree		Disagree		Strongly Disagree		Don't Know		Total		Weighted Mean
	n	%	n	%	n	%	n	%	n	%	n	%	
Businessmen/traders	39	32.5	55	45.8	13	10.8	2	1.7	11	9.2	120	10.2	3.91
Extension workers	38	27.1	77	55.0	17	12.1	5	3.6	3	2.1	140	11.9	4.01
Farmer leaders and community leaders	40	25.0	98	61.3	13	8.1	1	0.6	8	5.0	160	13.6	4.01
Food consumers	65	29.5	118	53.6	27	12.3	5	2.3	5	2.3	220	18.6	4.06
Journalists	26	32.5	47	58.8	3	3.8	0	0.0	4	5.0	80	6.8	4.14
Policy-makers	28	35.0	45	56.3	5	6.3	1	1.3	1	1.3	80	6.8	4.23
Religious leaders	16	20.0	43	53.8	17	21.3	2	2.5	2	2.5	80	6.8	3.86
Scientists	26	32.5	48	60.0	5	6.3	1	1.3	0	0.0	80	6.8	4.24
Students	61	27.7	136	61.8	12	5.5	1	0.5	10	4.5	220	18.6	4.08
Total	**339**	**28.7**	**667**	**56.5**	**112**	**9.5**	**18**	**1.5**	**44**	**3.7**	**1,180**	**100.0**	**4.05**

Appendix Table 25. Agreement with the view that when GM Foods are totally safe, they can be distributed

Stakeholder	Strongly Agree		Agree		Disagree		Strongly Disagree		Don't Know		Total		Weighted Mean
	n	%	n	%	n	%	n	%	n	%	n	%	
Businessmen/traders	48	40.0	51	42.5	15	12.5		0.0	6	5.0	120	10.2	4.13
Extension workers	47	33.6	70	50.0	18	12.9	2	1.4	3	2.1	140	11.9	4.11
Farmer leaders and community leaders	48	30.0	85	53.1	17	10.6	3	1.9	7	4.4	160	13.6	4.03
Food consumers	78	35.5	115	52.3	22	10.0	5	2.3	0	0.0	220	18.6	4.21
Journalists	22	27.5	54	67.5	2	2.5	1	1.3	1	1.3	80	6.8	4.19
Policy-makers	29	36.3	41	51.3	7	8.8	0	0.0	3	3.8	80	6.8	4.16
Religious leaders	20	25.0	42	52.5	13	16.3	5	6.3	0	0.0	80	6.8	3.96
Scientists	31	38.8	44	55.0	5	6.3	0	0.0	0	0.0	80	6.8	4.33
Students	104	47.3	96	43.6	8	3.6	4	1.8	8	3.6	220	18.6	4.29
Total	**427**	**36.2**	**598**	**50.7**	**107**	**9.1**	**20**	**1.7**	**28**	**2.4**	**1,180**	**100.0**	**4.17**

Appendix Table 26. Agreement with the view that man may be allowed to modify nature

Stakeholder	Strongly Agree		Agree		Disagree		Strongly Disagree		Don't Know		Total		Weighted Mean
	n	%	n	%	n	%	n	%	n	%	n	%	
Businessmen/traders	30	25.0	51	42.5	23	19.2	8	6.7	8	6.7	120	10.2	3.73
Extension workers	20	14.3	61	43.6	39	27.9	13	9.3	7	5.0	140	11.9	3.53
Farmer leaders and community leaders	33	20.6	76	47.5	28	17.5	10	6.3	13	8.1	160	13.6	3.66
Food consumers	36	16.4	112	50.9	48	21.8	13	5.9	11	5.0	220	18.6	3.68
Journalists	9	11.3	39	48.8	24	30.0	4	5.0	4	5.0	80	6.8	3.56
Policy-makers	16	20.0	38	47.5	18	22.5	1	1.3	7	8.8	80	6.8	3.69
Religious leaders	14	17.5	31	38.8	20	25.0	9	11.3	6	7.5	80	6.8	3.48
Scientists	14	17.5	49	61.3	11	13.8	5	6.3	1	1.3	80	6.8	3.88
Students	47	21.4	94	42.7	51	23.2	8	3.6	20	9.1	220	18.6	3.64
Total	**219**	**18.6**	**551**	**46.7**	**262**	**22.2**	**71**	**6.0**	**77**	**6.5**	**1,180**	**100.0**	**3.65**

Appendix Table 27. Agreement with the view that regulation of modern biotech should be left to the industry

Stakeholder	Strongly Agree		Agree		Disagree		Strongly Disagree		Don't Know		Total		Weighted Mean
	n	%	n	%	n	%	n	%	n	%	n	%	
Businessmen/traders	18	15.0	54	45.0	29	24.2	8	6.7	11	9.2	120	10.2	3.50
Extension workers	15	10.7	63	45.0	45	32.1	11	7.9	6	4.3	140	11.9	3.50
Farmer leaders and community leaders	23	14.4	82	51.3	40	25.0	5	3.1	10	6.3	160	13.6	3.64
Food consumers	35	15.9	113	51.4	46	20.9	11	5.0	15	6.8	220	18.6	3.65
Journalists	10	12.5	35	43.8	27	33.8	7	8.8	1	1.3	80	6.8	3.58
Policy-makers	10	12.5	36	45.0	20	25.0	3	3.8	11	13.8	80	6.8	3.39
Religious leaders	11	13.8	26	32.5	26	32.5	9	11.3	8	10.0	80	6.8	3.29
Scientists	9	11.3	30	37.5	32	40.0	8	10.0	1	1.3	80	6.8	3.48
Students	36	16.4	102	46.4	49	22.3	10	4.5	23	10.5	220	18.6	3.54
Total	**167**	**14.2**	**541**	**45.8**	**314**	**26.6**	**72**	**6.1**	**86**	**7.3**	**1,180**	**100.0**	**3.53**

Appendix Table 28. Agreement with the view that government agencies are doing their best to ensure that the food we eat is safe

Stakeholder Group	Strongly Agree		Agree		Disagree		Strongly Disagree	
	n	%	n	%	n	%	n	%
Businessmen and traders	39	32.5	56	46.7	16	13.3	4	3.3
Consumers	85	38.6	121	55.0	9	4.1	0	0.0
Extension workers	55	39.3	69	49.3	8	5.7	6	4.3
Farmer leaders and community leaders	47	29.4	92	57.5	12	7.5	3	1.9
Journalists and media persons	35	43.8	37	46.3	6	7.5	1	1.3
Policy makers	42	52.5	31	38.8	5	6.3	0	0.0
Religious leaders	20	25.0	48	60.0	7	8.8	3	3.8
Scientists	33	41.3	42	52.5	4	5.0	1	1.3
Students	78	35.5	116	52.7	16	7.3	2	0.9
Total	**434**	**36.8**	**612**	**51.9**	**83**	**7.0**	**20**	**1.7**

Appendix Table 29. Agreement with the view that expert statements on biotech are based on scientific analyses and are therefore objective

Stakeholder Group	Strongly Agree		Agree		Disagree		Strongly Disagree	
	n	%	n	%	n	%	n	%
Businessmen and traders	33	27.5	59	49.2	12	10.0	2	1.7
Consumers	66	30.0	119	54.1	14	6.4	5	2.3
Extension workers	46	32.9	72	51.4	11	7.9	0	0.0
Farmer leaders and community leaders	32	20.0	93	58.1	20	12.5	3	1.9
Journalists and media persons	27	33.8	47	58.8	3	3.8	0	0.0
Policy makers	28	35.0	40	50.0	6	7.5	0	0.0
Religious leaders	20	25.0	41	51.3	4	5.0	0	0.0
Scientists	36	45.0	38	47.5	6	7.5	0	0.0
Students	88	40.0	101	45.9	11	5.0	1	0.5
Total	**376**	**31.9**	**610**	**51.7**	**87**	**7.4**	**11**	**0.9**

Appendix Table 30. Agreement with the view that biotech is good for Philippine agriculture

Stakeholder Group	Strongly Agree		Agree		Disagree		Strongly Disagree	
	n	%	n	%	n	%	n	%
Businessmen and traders	28	23.3	61	50.8	14	11.7	7	5.8
Consumers	63	28.6	109	49.5	22	10.0	9	4.1
Extension workers	44	31.4	66	47.1	15	10.7	5	3.6
Farmer leaders and community leaders	31	19.4	93	58.1	16	10.0	6	3.8
Journalists and media persons	22	27.5	45	56.3	4	5.0	3	3.8
Policy makers	23	28.8	45	56.3	6	7.5	0	0.0
Religious leaders	17	21.3	41	51.3	6	7.5	6	7.5
Scientists	33	41.3	39	48.8	7	8.8	0	0.0
Students	65	29.5	116	52.7	15	6.8	6	2.7
Total	**326**	**27.6**	**615**	**52.1**	**105**	**8.9**	**42**	**3.6**

Appendix Table 31. Agreement with the view that the risks of genetic engineering have been greatly exaggerated

Stakeholder Group	Strongly Agree		Agree		Disagree		Strongly Disagree	
	n	%	n	%	n	%	n	%
Businessmen and traders	18	15.0	52	43.3	26	21.7	3	2.5
Consumers	28	12.7	110	50.0	45	20.5	3	1.4
Extension workers	21	15.0	63	45.0	36	25.7	5	3.6
Farmer leaders and community leaders	26	16.3	78	48.8	30	18.8	5	3.1
Journalists and media persons	14	17.5	39	48.8	14	17.5	2	2.5
Policy makers	13	16.3	42	52.5	16	20.0	0	0.0
Religious leaders	10	12.5	33	41.3	22	27.5	1	1.3
Scientists	16	20.0	49	61.3	13	16.3	1	1.3
Students	30	13.6	109	49.5	45	20.5	9	4.1
Total	**176**	**14.9**	**575**	**48.7**	**247**	**20.9**	**29**	**2.5**

Appendix Table 32. Agreement with the view that genetic engineering of food products could create unexpected new allergens or contaminate products in unanticipated ways

Stakeholder Group	Strongly Agree		Agree		Disagree		Strongly Disagree	
	n	%	n	%	n	%	n	%
Businessmen and traders	30	25.0	53	44.2	12	10.0	4	3.3
Consumers	59	26.8	101	45.9	20	9.1	7	3.2
Extension workers	28	20.0	75	53.6	19	13.6	3	2.1
Farmer leaders and community leaders	29	18.1	82	51.3	21	13.1	8	5.0
Journalists and media persons	11	13.8	51	63.8	7	8.8	2	2.5
Policy makers	18	22.5	42	52.5	12	15.0	0	0.0
Religious leaders	18	22.5	40	50.0	6	7.5	2	2.5
Scientists	20	25.0	44	55.0	8	10.0	6	7.5
Students	49	22.3	108	49.1	30	13.6	4	1.8
Total	**262**	**22.2**	**596**	**50.5**	**135**	**11.4**	**36**	**3.1**

Appendix Table 33. Agreement with the view that biotech in food production benefits only large agricultural companies

Stakeholder Group	Strongly Agree		Agree		Disagree		Strongly Disagree	
	n	%	n	%	n	%	n	%
Businessmen and traders	33	27.5	47	39.2	26	21.7	4	3.3
Consumers	49	22.3	96	43.6	55	25.0	4	1.8
Extension workers	27	19.3	54	38.6	47	33.6	7	5.0
Farmer leaders and community leaders	42	26.3	72	45.0	29	18.1	5	3.1
Journalists and media persons	8	10.0	34	42.5	30	37.5	4	5.0
Policy makers	12	15.0	29	36.3	32	40.0	1	1.3
Religious leaders	9	11.3	35	43.8	26	32.5	1	1.3
Scientists	12	15.0	35	43.8	25	31.3	7	8.8
Students	34	15.5	81	36.8	73	33.2	16	7.3
Total	**226**	**19.2**	**483**	**40.9**	**343**	**29.1**	**49**	**4.2**

Appendix Table 34. Perceived uses of tomato resistant to tomato virus

Stakeholder Group	Grow/Plant	Food	Animal Feed	Industrial By-products	None	Don't Know
	n	n	n	n	n	n
Businessmen and traders	50	46	9	21	3	27
Consumers	95	84	15	32	2	47
Extension workers	73	70	15	22	0	18
Farmer leaders and community leaders	79	66	3	12	2	21
Journalists and media persons	42	39	3	10	0	10
Policy makers	34	39	5	12	1	12
Religious leaders	29	33	4	11	0	22
Scientists	50	53	4	9	0	0
Students	118	101	21	43	2	30
Total	**570**	**531**	**79**	**172**	**10**	**187**

Appendix Table 35. Perceived uses of virus disease-resistant papaya

Stakeholder Group	Grow/Plant	Food	Animal Feed	Industrial By-products	None	Don't Know
	n	n	n	n	n	n
Businessmen and traders	43	58	10	13	5	25
Consumers	84	88	16	34	2	49
Extension workers	72	73	17	20	1	19
Farmer leaders and community leaders	59	78	5	16	2	21
Journalists and media persons	44	41	4	6	1	10
Policy makers	29	36	5	17	0	15
Religious leaders	28	34	5	10	0	24
Scientists	47	54	5	10	0	0
Students	102	103	25	38	2	39
Total	**508**	**565**	**92**	**164**	**13**	**202**

Appendix Table 36. Perceived uses of eggplant resistant to insect borer infestation

Stakeholder Group	Grow/Plant	Food	Animal feed	Industrial By-products	None	Don't Know
	n	n	n	n	n	n
Businessmen and traders	47	120	120	120	3	17
Consumers	81	220	220	220	1	42
Extension workers	65	140	140	140	0	14
Farmer leaders and community leaders	70	160	160	160	2	19
Journalists and media persons	41	80	80	80	0	10
Policy makers	28	80	80	80	0	12
Religious leaders	25	80	80	80	0	19
Scientists	50	80	80	80	0	0
Students	118	220	220	220	2	36
Total	**525**	**1,180**	**1,180**	**1,180**	**8**	**169**

Appendix Table 37. Perceived uses of corn tolerant to herbicide

Stakeholder Group	Grow/Plant	Food	Animal Feed	Industrial By-products	None	Don't Know
	n	n	n	n	n	n
Businessmen and traders	51	33	10	13	5	25
Consumers	68	63	16	34	2	49
Extension workers	60	52	17	20	1	19
Farmer leaders and community leaders	69	43	5	16	2	21
Journalists and media persons	31	24	4	6	1	10
Policy makers	24	32	5	17	0	15
Religious leaders	27	20	5	10	0	24
Scientists	48	39	5	10	0	0
Students	105	75	25	38	2	39
Total	**483**	**381**	**92**	**164**	**13**	**202**

Appendix Table 38. Perceived uses of corn resistant to insect borer infestation

Stakeholder Group	Grow/Plant	Food	Animal feed	Industrial By-products	None	Don't know
	n	n	n	n	n	n
Businessmen and traders	42	38	24	24	2	21
Consumers	81	62	42	43	5	41
Extension workers	60	57	49	27	2	11
Farmer leaders and community leaders	69	38	34	20	3	22
Journalists and media persons	33	27	19	16	1	12
Policy makers	21	34	15	23	0	16
Religious leaders	24	21	12	16	3	22
Scientists	42	47	28	8	0	0
Students	99	78	53	42	1	37
Total	**471**	**402**	**276**	**219**	**17**	**182**

Appendix Table 39. Perceived uses of rice resistant to blight disease

Stakeholder Group	Grow/Plant	Food	Animal Feed	Industrial By-products	None	Don't Know
	n	n	n	n	n	n
Businessmen and traders	41	52	14	16	4	21
Consumers	74	91	24	30	3	49
Extension workers	62	78	15	19	0	17
Farmer leaders and community leaders	61	73	4	18	5	24
Journalists and media persons	29	44	7	9	1	12
Policy makers	24	45	9	17	0	14
Religious leaders	18	35	7	11	2	27
Scientists	45	56	9	6	0	0
Students	91	113	25	44	0	39
Total	**445**	**587**	**114**	**170**	**15**	**203**

Appendix Table 40. Perceived uses of rice with more Vitamin A

Stakeholder Group	Grow/Plant	Food	Animal Feed	Industrial By-products	None	Don't Know
	n	n	n	n	n	n
Businessmen and traders	26	87	12	9	1	16
Consumers	50	147	15	17	1	34
Extension workers	37	113	12	10	1	11
Farmer leaders and community leaders	46	105	6	6	1	21
Journalists and media persons	10	63	3	2	1	11
Policy makers	17	58	10	11	1	12
Religious leaders	16	52	4	6	1	15
Scientists	22	74	5	6	0	1
Students	49	170	27	26	0	22
Total	**273**	**869**	**94**	**93**	**7**	**143**

Appendix Table 41. Perceived uses of papaya that takes longer to ripen

Stakeholder Group	Grow/Plant	Food	Animal Feed	Industrial By-products	None	Don't Know
	n	n	n	n	n	n
Businessmen and traders	27	55	10	27	2	24
Consumers	70	88	20	44	3	36
Extension workers	41	78	17	28	3	16
Farmer leaders and community leaders	49	77	4	31	4	20
Journalists and media persons	20	42	3	18	1	12
Policy makers	22	41	8	16	2	12
Religious leaders	22	29	9	17	5	17
Scientists	27	61	6	14	0	0
Students	86	99	22	51	3	32
Total	**364**	**570**	**99**	**246**	**23**	**169**

Appendix Table 42. Perceived uses of cotton resistant to insect borer infestation

Stakeholder Group	Grow/Plant	Food	Animal Feed	Industrial By-products	None	Don't Know
	n	n	n	n	n	n
Businessmen and traders	75	9	7	11	2	34
Consumers	135	24	18	17	4	52
Extension workers	97	13	14	18	2	27
Farmer leaders and community leaders	99	17	4	5	6	40
Journalists and media persons	55	12	3	8	0	14
Policy makers	52	9	9	9	1	17
Religious leaders	45	9	11	10	2	22
Scientists	73	9	3	18	0	0
Students	146	26	18	39	1	44
Total	**777**	**128**	**87**	**135**	**18**	**250**

Appendix Table 43. Interest in the use of biotech in food production

Stakeholder Group	Very Much Interested		Somewhat Interested		Not Interested at All		Total	
	n	%	n	%	n	%	n	%
Businessmen and traders	65	54.2	48	40.0	7	5.8	120	10.2
Consumers	117	53.2	96	43.6	7	3.2	220	18.6
Extension workers	78	55.7	54	38.6	8	5.7	140	11.9
Farmer leaders and community leaders	87	54.4	70	43.8	3	1.9	160	13.6
Journalists and media persons	46	57.5	31	38.8	3	3.8	80	6.8
Policy makers	37	46.3	40	50.0	3	3.8	80	6.8
Religious leaders	35	43.8	42	52.5	3	3.8	80	6.8
Scientists	53	66.3	27	33.8	0	0.0	80	6.8
Students	115	52.3	96	43.6	9	4.1	220	18.6
Total	**633**	**53.6**	**504**	**42.7**	**43**	**3.6**	**1,180**	**100**

Appendix Table 44. Concern on the use of biotech in food production

Stakeholder Group	Very Much Concerned		Somewhat Concerned		Not at All Concerned		Total	
	n	%	n	%	n	%	n	%
Businessmen and traders	72	60.0	42	35.0	6	5.0	120	10.2
Consumers	129	58.6	82	37.3	9	4.1	220	18.6
Extension workers	94	67.1	42	30.0	4	2.9	140	11.9
Farmer leaders and community leaders	93	58.1	66	41.3	1	0.6	160	13.6
Journalists and media persons	52	65.0	26	32.5	2	2.5	80	6.8
Policy makers	45	56.3	34	42.5	1	1.3	80	6.8
Religious leaders	46	57.5	30	37.5	4	5.0	80	6.8
Scientists	56	70.0	23	28.8	1	1.3	80	6.8
Students	126	57.3	83	37.7	11	5.0	220	18.6
Total	**713**	**60.4**	**428**	**36.3**	**39**	**3.3**	**1,180**	**100**

Appendix Table 45. Nutritional quality as consideration in decision making

Stakeholder Group	Important		Unimportant		Don't Know		Total	
	n	%	n	%	n	%	n	%
Businessmen and traders	113	94.2	5	4.2	2	1.7	120	10.2
Consumers	210	95.5	8	3.6	2	0.9	220	18.6
Extension workers	135	96.4	2	1.4	3	2.1	140	11.9
Farmer leaders and community leaders	151	94.4	6	3.8	3	1.9	160	13.6
Journalists and media persons	79	98.8	0	0.0	1	1.3	80	6.8
Policy makers	76	95.0	3	3.8	1	1.3	80	6.8
Religious leaders	78	97.5	0	0.0	2	2.5	80	6.8
Scientists	78	97.5	2	2.5	0	0.0	80	6.8
Students	210	95.5	3	1.4	7	3.2	220	18.6
Total	**1,130**	**95.8**	**29**	**2.5**	**21**	**1.8**	**1,180**	**100**

Appendix Table 46. Non-poisonous as consideration in decision making

Stakeholder Group	Important		Unimportant		Don't Know		Total	
	n	%	n	%	n	%	n	%
Businessmen and traders	111	92.5	5	4.2	4	3.3	120	10.2
Consumers	208	94.5	5	2.3	7	3.2	220	18.6
Extension workers	135	96.4	1	0.7	4	2.9	140	11.9
Farmer leaders and community leaders	153	95.6	4	2.5	3	1.9	160	13.6
Journalists and media persons	79	98.8		0.0	1	1.3	80	6.8
Policy makers	77	96.3	2	2.5	1	1.3	80	6.8
Religious leaders	75	93.8	3	3.8	2	2.5	80	6.8
Scientists	78	97.5	2	2.5	0	0.0	80	6.8
Students	203	92.3	4	1.8	13	5.9	220	18.6
Total	**1,119**	**94.8**	**26**	**2.2**	**35**	**3.0**	**1,180**	**100**

Appendix Table 47. Non allergenic as consideration in decision making

Stakeholder Group	Important		Unimportant		Don't Know		Total	
	n	%	n	%	n	%	n	%
Businessmen and traders	110	91.7	4	3.3	6	5.0	120	10.2
Consumers	208	94.5	8	3.6	4	1.8	220	18.6
Extension workers	134	95.7	2	1.4	4	2.9	140	11.9
Farmer leaders and community leaders	150	93.8	3	1.9	7	4.4	160	13.6
Journalists and media persons	75	93.8	3	3.8	2	2.5	80	6.8
Policy makers	77	96.3	2	2.5	1	1.3	80	6.8
Religious leaders	77	96.3	1	1.3	2	2.5	80	6.8
Scientists	77	96.3	3	3.8	0	0.0	80	6.8
Students	205	93.2	3	1.4	12	5.5	220	18.6
Total	**1,113**	**94.3**	**29**	**2.5**	**38**	**3.2**	**1,180**	**100**

Appendix Table 48. Better taste as consideration in decision making

Stakeholder Group	Important		Unimportant		Don't Know		Total	
	n	%	n	%	n	%	n	%
Businessmen and traders	103	85.8	14	11.7	3	2.5	120	10.2
Consumers	206	93.6	10	4.5	4	1.8	220	18.6
Extension workers	131	93.6	6	4.3	3	2.1	140	11.9
Farmer leaders and community leaders	150	93.8	9	5.6	1	0.6	160	13.6
Journalists and media persons	74	92.5	5	6.3	1	1.3	80	6.8
Policy makers	73	91.3	6	7.5	1	1.3	80	6.8
Religious leaders	72	90.0	6	7.5	2	2.5	80	6.8
Scientists	78	97.5	2	2.5	0	0.0	80	6.8
Students	178	80.9	27	12.3	15	6.8	220	18.6
Total	**1,065**	**90.3**	**85**	**7.2**	**30**	**2.5**	**1,180**	**100**

Appendix Table 49. Price as consideration in decision making

Stakeholder Group	Important		Unimportant		Don't Know		Total	
	n	%	n	%	n	%	n	%
Businessmen and traders	108	90.0	9	7.5	3	2.5	120	10.2
Consumers	196	89.1	19	8.6	5	2.3	220	18.6
Extension workers	126	90.0	11	7.9	3	2.1	140	11.9
Farmer leaders and community leaders	149	93.1	9	5.6	2	1.3	160	13.6
Journalists and media persons	69	86.3	10	12.5	1	1.3	80	6.8
Policy makers	71	88.8	8	10.0	1	1.3	80	6.8
Religious leaders	71	88.8	7	8.8	2	2.5	80	6.8
Scientists	71	88.8	9	11.3	0	0.0	80	6.8
Students	192	87.3	20	9.1	8	3.6	220	18.6
Total	**1,053**	**89.2**	**102**	**8.6**	**25**	**2.1**	**1,180**	**100**

Appendix Table 50. Pesticide residue as consideration in decision making

Stakeholder Group	Important		Unimportant		Don't Know		Total	
	n	%	n	%	n	%	n	%
Businessmen and traders	93	77.5	13	10.8	14	11.7	120	10.2
Consumers	182	82.7	24	10.9	14	6.4	220	18.6
Extension workers	119	85.0	13	9.3	8	5.7	140	11.9
Farmer leaders and community leaders	136	85.0	19	11.9	5	3.1	160	13.6
Journalists and media persons	59	73.8	15	18.8	6	7.5	80	6.8
Policy makers	68	85.0	10	12.5	2	2.5	80	6.8
Religious leaders	67	83.8	4	5.0	9	11.3	80	6.8
Scientists	72	90.0	7	8.8	1	1.3	80	6.8
Students	165	75.0	22	10.0	33	15.0	220	18.6
Total	**961**	**81.4**	**127**	**10.8**	**92**	**7.8**	**1,180**	**100**

Appendix Table 51. Food appearance as consideration in decision making

Stakeholder Group	Important		Unimportant		Don't Know		Total	
	n	%	n	%	n	%	n	%
Businessmen and traders	93	77.5	23	19.2	4	3.3	120	10.2
Consumers	173	78.6	44	20.0	3	1.4	220	18.6
Extension workers	123	87.9	14	10.0	3	2.1	140	11.9
Farmer leaders and community leaders	134	83.8	23	14.4	3	1.9	160	13.6
Journalists and media persons	51	63.8	28	35.0	1	1.3	80	6.8
Policy makers	67	83.8	11	13.8	2	2.5	80	6.8
Religious leaders	64	80.0	14	17.5	2	2.5	80	6.8
Scientists	63	78.8	17	21.3	0	0.0	80	6.8
Students	166	75.5	42	19.1	12	5.5	220	18.6
Total	**934**	**79.2**	**216**	**18.3**	**30**	**2.5**	**1,180**	**100**

Appendix Table 52. How beneficial is the use of agri-biotech in food production

Stakeholder Group	Very Beneficial		Moderately Beneficial		Not at All Beneficial		No Opinion	
	n	%	n	%	n	%	n	%
Businessmen and traders	51	42.5	56	46.7	4	3.3	9	7.5
Consumers	90	40.9	116	52.7	7	3.2	7	3.2
Extension workers	64	45.7	60	42.9	9	6.4	7	5.0
Farmer leaders and community leaders	71	44.4	79	49.4	3	1.9	7	4.4
Journalists and media persons	47	58.8	27	33.8	4	5.0	2	2.5
Policy makers	34	42.5	41	51.3	3	3.8	2	2.5
Religious leaders	28	35.0	41	51.3	6	7.5	5	6.3
Scientists	46	57.5	34	42.5	0	0.0	0	0.0
Students	139	63.2	75	34.1	0	0.0	6	2.7
Total	**570**	**48.3**	**529**	**44.8**	**36**	**3.1**	**45**	**3.8**

Appendix Table 53. How hazardous/risky is the use of agricultural biotech in food production

Stakeholder Group	Very Hazardous		Somewhat Hazardous		Not at All Hazardous		No Opinion	
	n	%	n	%	n	%	n	%
Businessmen and traders	20	16.7	67	55.8	25	20.8	8	6.7
Consumers	21	9.5	122	55.5	56	25.5	21	9.5
Extension workers	8	5.7	68	48.6	53	37.9	11	7.9
Farmer leaders and community leaders	14	8.8	80	50.0	52	32.5	14	8.8
Journalists and media persons	5	6.3	42	52.5	27	33.8	6	7.5
Policy makers	11	13.8	38	47.5	24	30.0	7	8.8
Religious leaders	8	10.0	48	60.0	14	17.5	10	12.5
Scientists	4	5.0	46	57.5	25	31.3	5	6.3
Students	25	11.4	145	65.9	39	17.7	11	5.0
Total	**116**	**9.8**	**656**	**55.6**	**315**	**26.7**	**93**	**7.9**

Appendix Table 54. Perception that government regulatory agencies have the scientific facts and technical information needed in order to make good decisions about biotech

Stakeholder Group	Strongly Agree		Agree		Disagree		Strongly Disagree	
	n	%	n	%	n	%	n	%
Businessmen and traders	36	30.0	51	42.5	11	9.2	5	4.2
Consumers	78	35.5	112	50.9	15	6.8	3	1.4
Extension workers	48	34.3	66	47.1	13	9.3	5	3.6
Farmer leaders and community leaders	50	31.3	88	55.0	14	8.8	0	0.0
Journalists and media persons	35	43.8	38	47.5	5	6.3	1	1.3
Policy makers	22	27.5	45	56.3	8	10.0	0	0.0
Religious leaders	20	25.0	41	51.3	11	13.8	4	5.0
Scientists	31	38.8	37	46.3	11	13.8	1	1.3
Students	65	29.5	120	54.5	16	7.3	1	0.5
Total	**385**	**32.6**	**598**	**50.7**	**104**	**8.8**	**20**	**1.7**

Appendix Table 55. Perception that regulations on biotech should include inputs from the non-government sector

Stakeholder Group	Strongly Agree		Agree		Disagree		Strongly Disagree	
	n	%	n	%	n	%	n	%
Businessmen and traders	41	34.2	56	46.7	7	5.8	1	0.8
Consumers	91	41.4	101	45.9	12	5.5	1	0.5
Extension workers	60	42.9	66	47.1	7	5.0	1	0.7
Farmer leaders and community leaders	51	31.9	84	52.5	14	8.8	1	0.6
Journalists and media persons	46	57.5	30	37.5	3	3.8	1	1.3
Policy makers	25	31.3	40	50.0	8	10.0	0	0.0
Religious leaders	26	32.5	42	52.5	7	8.8	0	0.0
Scientists	37	46.3	37	46.3	5	6.3	1	1.3
Students	87	39.5	91	41.4	22	10.0	6	2.7
Total	**464**	**39.3**	**547**	**46.4**	**85**	**7.2**	**12**	**1.0**

Appendix Table 56. Perception that vital information on health effects of GM foods is being provided to the public

Stakeholder Group	Strongly Agree		Agree		Disagree		Strongly Disagree	
	n	%	n	%	n	%	n	%
Businessmen and traders	37	30.8	40	33.3	13	10.8	10	8.3
Consumers	60	27.3	90	40.9	39	17.7	17	7.7
Extension workers	36	25.7	54	38.6	29	20.7	15	10.7
Farmer leaders and community leaders	54	33.8	62	38.8	31	19.4	6	3.8
Journalists and media persons	14	17.5	32	40.0	27	33.8	5	6.3
Policy makers	20	25.0	34	42.5	17	21.3	3	3.8
Religious leaders	18	22.5	29	36.3	17	21.3	11	13.8
Scientists	22	27.5	30	37.5	24	30.0	3	3.8
Students	77	35.0	80	36.4	43	19.5	9	4.1
Total	**338**	**28.6**	**451**	**38.2**	**240**	**20.3**	**79**	**6.7**

Appendix Table 57. Perception that current regulations in the Philippines are sufficient to protect the people from any risks linked to modern biotech

Stakeholder Group	Strongly Agree		Agree		Disagree		Strongly Disagree	
	n	%	n	%	n	%	n	%
Businessmen and traders	19	15.8	51	42.5	20	16.7	9	7.5
Consumers	38	17.3	106	48.2	48	21.8	8	3.6
Extension workers	18	12.9	75	53.6	25	17.9	9	6.4
Farmer leaders and community leaders	41	25.6	68	42.5	32	20.0	6	3.8
Journalists and media persons	8	10.0	40	50.0	25	31.3	4	5.0
Policy makers	14	17.5	34	42.5	21	26.3	2	2.5
Religious leaders	7	8.8	32	40.0	29	36.3	4	5.0
Scientists	10	12.5	38	47.5	29	36.3	2	2.5
Students	42	19.1	93	42.3	51	23.2	6	2.7
Total	**197**	**16.7**	**537**	**45.5**	**280**	**23.7**	**50**	**4.2**

Appendix Table 58. Perceived extent by which science should be a part of agricultural development

Stakeholder Group	Very Much a Part		Somewhat a Part		Should Not be Part at All		Total	
	n	%	n	%	n	%	n	%
Businessmen and traders	92	76.7	26	21.7	2	1.7	120	10.2
Consumers	185	84.1	33	15.0	2	0.9	220	18.6
Extension workers	124	88.6	16	11.4	0	0.0	140	11.9
Farmer leaders and community leaders	120	75.0	38	23.8	2	1.3	160	13.6
Journalists and media persons	73	91.3	7	8.8	0	0.0	80	6.8
Policy makers	62	77.5	18	22.5	0	0.0	80	6.8
Religious leaders	61	76.3	19	23.8	0	0.0	80	6.8
Scientists	70	87.5	10	12.5	0	0.0	80	6.8
Students	172	78.2	47	21.4	1	0.5	220	18.6
Total	**959**	**81.3**	**214**	**18.1**	**7**	**0.6**	**1,180**	**100**

Appendix Table 59. Attitude towards labeling of foods that have been genetically modified

Stakeholder Group	Strongly Agree		Agree		Disagree		Strongly Disagree	
	n	%	n	%	n	%	n	%
Businessmen and traders	76	63.3	34	28.3	3	2.5	1	0.8
Consumers	120	54.5	83	37.7	13	5.9	1	0.5
Extension workers	82	58.6	48	34.3	6	4.3	1	0.7
Farmer leaders and community leaders	73	45.6	73	45.6	11	6.9	1	0.6
Journalists and media persons	55	68.8	20	25.0	3	3.8	0	0.0
Policy makers	43	53.8	30	37.5	4	5.0	1	1.3
Religious leaders	45	56.3	32	40.0	1	1.3	0	0.0
Scientists	56	70.0	20	25.0	4	5.0	0	0.0
Students	132	60.0	67	30.5	10	4.5	2	0.9
Total	**682**	**57.8**	**407**	**34.5**	**55**	**4.7**	**7**	**0.6**

Appendix Table 60. Attitude towards consulting the public in formulating food regulation and laws

Stakeholder Group	Strongly Agree		Agree		Disagree		Strongly Disagree	
	n	%	n	%	n	%	n	%
Businessmen and traders	73	60.8	33	27.5	7	5.8	1	0.8
Consumers	120	54.5	87	39.5	7	3.2	1	0.5
Extension workers	80	57.1	51	36.4	7	5.0	0	0.0
Farmer leaders and community leaders	88	55.0	64	40.0	5	3.1	1	0.6
Journalists and media persons	52	65.0	25	31.3	2	2.5	0	0.0
Policy makers	48	60.0	23	28.8	7	8.8	0	0.0
Religious leaders	44	55.0	28	35.0	8	10.0	0	0.0
Scientists	45	56.3	32	40.0	3	3.8	0	0.0
Students	122	55.5	78	35.5	10	4.5	1	0.5
Total	**672**	**56.9**	**421**	**35.7**	**56**	**4.7**	**4**	**0.3**

Appendix Table 61. Attitude towards directly consulting the public in approving R&D in biotech

Stakeholder Group	Strongly Agree		Agree		Disagree		Strongly Disagree	
	n	%	n	%	n	%	n	%
Businessmen and traders	62	51.7	39	32.5	6	5.0	3	2.5
Consumers	109	49.5	85	38.6	18	8.2	3	1.4
Extension workers	75	53.6	49	35.0	12	8.6	1	0.7
Farmer leaders and community leaders	78	48.8	70	43.8	6	3.8	1	0.6
Journalists and media persons	51	63.8	23	28.8	4	5.0	1	1.3
Policy makers	39	48.8	32	40.0	7	8.8	1	1.3
Religious leaders	41	51.3	32	40.0	6	7.5	1	1.3
Scientists	38	47.5	34	42.5	7	8.8	0	0.0
Students	107	48.6	77	35.0	18	8.2	2	0.9
Total	**600**	**50.8**	**441**	**37.4**	**84**	**7.1**	**13**	**1.1**

Appendix Table 62. Attitude towards attending information session on biotech in food production that their community will hold

Stakeholder Group	Strongly Agree		Agree		Disagree		Strongly Disagree	
	n	%	n	%	n	%	n	%
Businessmen and traders	40	33.3	57	47.5	6	5.0	5	4.2
Consumers	89	40.5	110	50.0	14	6.4	0	0.0
Extension workers	61	43.6	65	46.4	8	5.7	0	0.0
Farmer leaders and community leaders	71	44.4	71	44.4	6	3.8	4	2.5
Journalists and media persons	45	56.3	31	38.8	1	1.3	2	2.5
Policy makers	34	42.5	31	38.8	4	5.0	0	0.0
Religious leaders	24	30.0	47	58.8	5	6.3	0	0.0
Scientists	46	57.5	33	41.3	1	1.3	0	0.0
Students	95	43.2	104	47.3	10	4.5	1	0.5
Total	**505**	**42.8**	**549**	**46.5**	**55**	**4.7**	**12**	**1.0**

Appendix Table 63. Attitude towards contributing their time and money to an organization that promotes GM foods

Stakeholder Group	Strongly Agree		Agree		Disagree		Strongly Disagree	
	n	%	n	%	n	%	n	%
Businessmen and traders	20	16.7	39	32.5	27	22.5	15	12.5
Consumers	26	11.8	112	50.9	48	21.8	12	5.5
Extension workers	16	11.4	59	42.1	39	27.9	13	9.3
Farmer leaders and community leaders	34	21.3	76	47.5	27	16.9	5	3.1
Journalists and media persons	11	13.8	34	42.5	20	25.0	7	8.8
Policy makers	8	10.0	34	42.5	19	23.8	4	5.0
Religious leaders	6	7.5	37	46.3	17	21.3	9	11.3
Scientists	14	17.5	41	51.3	16	20.0	4	5.0
Students	24	10.9	105	47.7	53	24.1	8	3.6
Total	**159**	**13.5**	**537**	**45.5**	**266**	**22.5**	**77**	**6.5**

Appendix Table 64. Application/research focus of modern biotech in the production of foods to make them more nutritious, better-tasting, and longer lasting: how frequent is this application/research focus used for making decision

Stakeholder Group	All the Time		Almost Always		Seldom		Never	
	n	%	n	%	n	%	n	%
Businessmen and traders	55	45.8	42	35.0	17	14.2	1	0.8
Consumers	88	40.0	83	37.7	33	15.0	3	1.4
Extension workers	55	39.3	55	39.3	23	16.4	3	2.1
Farmer leaders and community leaders	60	37.5	79	49.4	13	8.1	2	1.3
Journalists and media persons	27	33.8	42	52.5	8	10.0	0	0.0
Policy makers	38	47.5	27	33.8	12	15.0	2	2.5
Religious leaders	27	33.8	34	42.5	10	12.5	3	3.8
Scientists	37	46.3	35	43.8	6	7.5	2	2.5
Students	84	38.2	93	42.3	29	13.2	2	0.9
Total	**471**	**39.9**	**490**	**41.5**	**151**	**12.8**	**18**	**1.5**

Appendix Table 65. Taking genes from plant species and transferring them into crops in order to make the crops more resistant to pest and disease: how frequent is this application/research focus used for making decision

Stakeholder Group	All the Time		Almost Always		Seldom		Never	
	n	%	n	%	n	%	n	%
Businessmen and traders	42	35.0	47	39.2	15	12.5	3	2.5
Consumers	77	35.0	85	38.6	35	15.9	6	2.7
Extension workers	54	38.6	57	40.7	21	15.0	2	1.4
Farmer leaders and community leaders	50	31.3	82	51.3	11	6.9	5	3.1
Journalists and media persons	20	25.0	49	61.3	9	11.3	0	0.0
Policy makers	32	40.0	34	42.5	10	12.5	2	2.5
Religious leaders	25	31.3	37	46.3	11	13.8	2	2.5
Scientists	36	45.0	39	48.8	5	6.3	0	0.0
Students	81	36.8	88	40.0	28	12.7	3	1.4
Total	**417**	**35.3**	**518**	**43.9**	**145**	**12.3**	**23**	**1.9**

Appendix Table 66. Introducing human genes into bacteria to produce medicines and vaccines: how frequent is this application/research focus used for making decision

Stakeholder Group	All the Time		Almost Always		Seldom		Never	
	n	%	n	%	n	%	n	%
Businessmen and traders	32	26.7	49	40.8	15	12.5	3	2.5
Consumers	69	31.4	85	38.6	34	15.5	12	5.5
Extension workers	36	25.7	53	37.9	25	17.9	5	3.6
Farmer leaders and community leaders	43	26.9	76	47.5	12	7.5	5	3.1
Journalists and media persons	23	28.8	45	56.3	4	5.0	0	0.0
Policy makers	29	36.3	31	38.8	8	10.0	6	7.5
Religious leaders	19	23.8	36	45.0	12	15.0	0	0.0
Scientists	28	35.0	39	48.8	6	7.5	4	5.0
Students	81	36.8	78	35.5	26	11.8	7	3.2
Total	**360**	**30.5**	**492**	**41.7**	**142**	**12.0**	**42**	**3.6**

Appendix Table 67. Using genetic testing to detect and treat diseases we might have inherited from our parents: how frequent is this application/research focus used for making decision

Stakeholder Group	All the Time		Almost Always		Seldom		Never	
	n	%	n	%	n	%	n	%
Businessmen and traders	40	33.3	49	40.8	11	9.2	5	4.2
Consumers	79	35.9	84	38.2	28	12.7	7	3.2
Extension workers	46	32.9	56	40.0	27	19.3	2	1.4
Farmer leaders and community leaders	39	24.4	79	49.4	12	7.5	3	1.9
Journalists and media persons	26	32.5	38	47.5	10	12.5	2	2.5
Policy makers	24	30.0	35	43.8	11	13.8	3	3.8
Religious leaders	26	32.5	33	41.3	8	10.0	2	2.5
Scientists	34	42.5	40	50.0	3	3.8	2	2.5
Students	93	42.3	79	35.9	18	8.2	4	1.8
Total	**407**	**34.5**	**493**	**41.8**	**128**	**10.8**	**30**	**2.5**

Appendix Table 68. Modifying genes of laboratory animals such as a mouse to study human diseases like cancer: how frequent is this application/research focus used for making decision

Stakeholder Group	All the Time		Almost Always		Seldom		Never	
	n	%	n	%	n	%	n	%
Businessmen and traders	37	30.8	40	33.3	18	15.0	4	3.3
Consumers	52	23.6	75	34.1	52	23.6	14	6.4
Extension workers	31	22.1	57	40.7	28	20.0	5	3.6
Farmer leaders and community leaders	43	26.9	63	39.4	19	11.9	9	5.6
Journalists and media persons	19	23.8	43	53.8	11	13.8	3	3.8
Policy makers	17	21.3	40	50.0	12	15.0	3	3.8
Religious leaders	21	26.3	28	35.0	13	16.3	4	5.0
Scientists	23	28.8	49	61.3	7	8.8	0	0.0
Students	62	28.2	80	36.4	30	13.6	14	6.4
Total	**305**	**25.8**	**475**	**40.3**	**190**	**16.1**	**56**	**4.7**

Appendix Table 69. Introducing fish genes into strawberries to resist extreme freezing temperature: how frequent is this application/research focus used for making decision

Stakeholder Group	All the Time		Almost Always		Seldom		Never	
	n	%	n	%	n	%	n	%
Businessmen and traders	28	23.3	40	33.3	17	14.2	5	4.2
Consumers	53	24.1	70	31.8	43	19.5	15	6.8
Extension workers	28	20.0	48	34.3	35	25.0	3	2.1
Farmer leaders and community leaders	32	20.0	72	45.0	17	10.6	8	5.0
Journalists and media persons	14	17.5	38	47.5	19	23.8	2	2.5
Policy makers	15	18.8	34	42.5	17	21.3	3	3.8
Religious leaders	14	17.5	31	38.8	8	10.0	7	8.8
Scientists	19	23.8	44	55.0	7	8.8	6	7.5
Students	45	20.5	70	31.8	47	21.4	11	5.0
Total	**248**	**21.0**	**447**	**37.9**	**210**	**17.8**	**60**	**5.1**

Appendix Table 70. Plant breeders and farmers want access to modern biotech to improve their crops: how frequent is this issue used for making decision

Stakeholder Group	All the Time		Almost Always		Seldom		Never	
	n	%	n	%	n	%	n	%
Businessmen and traders	57	47.5	45	37.5	10	8.3	2	1.7
Consumers	82	37.3	98	44.5	19	8.6	5	2.3
Extension workers	63	45.0	54	38.6	16	11.4	3	2.1
Farmer leaders and community leaders	63	39.4	73	45.6	15	9.4	2	1.3
Journalists and media persons	29	36.3	40	50.0	9	11.3	0	0.0
Policy makers	28	35.0	40	50.0	8	10.0	1	1.3
Religious leaders	35	43.8	31	38.8	6	7.5	3	3.8
Scientists	33	41.3	40	50.0	3	3.8	1	1.3
Students	85	38.6	104	47.3	19	8.6	4	1.8
Total	**475**	**40.3**	**525**	**44.5**	**105**	**8.9**	**21**	**1.8**

Appendix Table 71. Farmers want GM crops because they make crop production cheaper, increase yield, and increase income: how frequent is this issue used for making decision

Stakeholder Group	All the Time		Almost Always		Seldom		Never	
	n	%	n	%	n	%	n	%
Businessmen and traders	59	49.2	40	33.3	13	10.8	2	1.7
Consumers	81	36.8	88	40.0	27	12.3	3	1.4
Extension workers	54	38.6	59	42.1	19	13.6	2	1.4
Farmer leaders and community leaders	67	41.9	63	39.4	18	11.3	1	0.6
Journalists and media persons	24	30.0	43	53.8	9	11.3	0	0.0
Policy makers	30	37.5	35	43.8	8	10.0	1	1.3
Religious leaders	28	35.0	36	45.0	8	10.0	2	2.5
Scientists	24	30.0	44	55.0	8	10.0	2	2.5
Students	75	34.1	101	45.9	24	10.9	4	1.8
Total	**442**	**37.5**	**509**	**43.1**	**134**	**11.4**	**17**	**1.4**

Appendix Table 72. GM foods are as safe as conventional ones and have undergone testing by regulatory bodies: how frequent is this issue used for making decision

Stakeholder Group	All the Time		Almost Always		Seldom		Never	
	n	%	n	%	n	%	n	%
Businessmen and traders	34	28.3	50	41.7	16	13.3	3	2.5
Consumers	57	25.9	103	46.8	36	16.4	4	1.8
Extension workers	41	29.3	63	45.0	21	15.0	4	2.9
Farmer leaders and community leaders	36	22.5	84	52.5	23	14.4	3	1.9
Journalists and media persons	16	20.0	46	57.5	13	16.3	1	1.3
Policy makers	21	26.3	36	45.0	19	23.8	0	0.0
Religious leaders	16	20.0	36	45.0	18	22.5	4	5.0
Scientists	23	28.8	45	56.3	10	12.5	1	1.3
Students	64	29.1	98	44.5	36	16.4	4	1.8
Total	**308**	**26.1**	**561**	**47.5**	**192**	**16.3**	**24**	**2.0**

Appendix Table 73. GM crops will be so resistant to pests and diseases that they would become weeds themselves and push native plants into extinction: how frequent is this issue used for making decision

Stakeholder Group	All the Time		Almost Always		Seldom		Never	
	n	%	n	%	n	%	n	%
Businessmen and traders	26	21.7	49	40.8	17	14.2	4	3.3
Consumers	46	20.9	101	45.9	40	18.2	4	1.8
Extension workers	41	29.3	52	37.1	27	19.3	5	3.6
Farmer leaders and community leaders	30	18.8	75	46.9	30	18.8	8	5.0
Journalists and media persons	14	17.5	34	42.5	17	21.3	4	5.0
Policy makers	17	21.3	39	48.8	14	17.5	0	0.0
Religious leaders	15	18.8	27	33.8	20	25.0	5	6.3
Scientists	13	16.3	45	56.3	13	16.3	6	7.5
Students	38	17.3	107	48.6	41	18.6	6	2.7
Total	**240**	**20.3**	**529**	**44.8**	**219**	**18.6**	**42**	**3.6**

Appendix Table 74. Awareness about animal biotech

Stakeholder Group	No		Yes		Total	
	n	%	n	%	n	%
Businessman/trader	45	37.5	75	62.5	120	100.0
Extension worker	33	23.6	107	76.4	140	100.0
Farmer leader	63	39.4	97	60.6	160	100.0
Food consumer	92	41.8	128	58.2	220	100.0
Journalist	21	26.3	59	73.8	80	100.0
Policy-maker	23	28.8	57	71.3	80	100.0
Religious leader	32	40.0	48	60.0	80	100.0
Scientist	10	12.5	70	87.5	80	100.0
Student	82	37.3	138	62.7	220	100.0
Total	401	34.0	779	66.0	1180	100.0

Appendix Table 75. Attitude: I need more information about animal biotech

Stakeholder Group	Strongly Agree		Agree		Disagree		Strongly Disagree	
	n	%	n	%	n	%	n	%
Businessmen and traders	77	64.2	32	26.7	5	4.2	3	2.5
Consumers	132	60.0	66	30.0	17	7.7	0	0.0
Extension workers	76	54.3	50	35.7	9	6.4	1	0.7
Farmer leaders and community leaders	74	46.3	63	39.4	10	6.3	4	2.5
Journalists and media persons	53	66.3	23	28.8	1	1.3	1	1.3
Policy makers	43	53.8	24	30.0	7	8.8	1	1.3
Religious leaders	49	61.3	21	26.3	4	5.0	2	2.5
Scientists	33	41.3	35	43.8	11	13.8	1	1.3
Students	164	74.5	41	18.6	10	4.5	1	0.5
Total	**701**	**59.4**	**355**	**30.1**	**74**	**6.3**	**14**	**1.2**

Appendix Table 76. Attitude: I trust that our scientists are working on animal biotech for the benefit of the people

Stakeholder Group	Strongly Agree		Agree		Disagree		Strongly Disagree	
	n	%	n	%	n	%	n	%
Businessmen and traders	50	41.7	46	38.3	15	12.5	4	3.3
Consumers	98	44.5	87	39.5	26	11.8	2	0.9
Extension workers	53	37.9	52	37.1	26	18.6	2	1.4
Farmer leaders and community leaders	57	35.6	65	40.6	19	11.9	4	2.5
Journalists and media persons	42	52.5	28	35.0	5	6.3	1	1.3
Policy makers	23	28.8	35	43.8	13	16.3	2	2.5
Religious leaders	23	28.8	31	38.8	17	21.3	2	2.5
Scientists	33	41.3	40	50.0	5	6.3	0	0.0
Students	106	48.2	78	35.5	22	10.0	0	0.0
Total	**485**	**41.1**	**462**	**39.2**	**148**	**12.5**	**17**	**1.4**

Appendix Table 77. Attitude: I support the use of animal biotech for human medical treatments

Stakeholder Group	Strongly Agree		Agree		Disagree		Strongly Disagree	
	n	%	n	%	n	%	n	%
Businessmen and traders	24	20.0	51	42.5	22	18.3	9	7.5
Consumers	33	15.0	103	46.8	48	21.8	11	5.0
Extension workers	20	14.3	66	47.1	34	24.3	6	4.3
Farmer leaders and community leaders	23	14.4	75	46.9	37	23.1	9	5.6
Journalists and media persons	15	18.8	37	46.3	14	17.5	6	7.5
Policy makers	6	7.5	40	50.0	18	22.5	2	2.5
Religious leaders	7	8.8	40	50.0	16	20.0	7	8.8
Scientists	15	18.8	53	66.3	9	11.3	2	2.5
Students	52	23.6	85	38.6	49	22.3	12	5.5
Total	**195**	**16.5**	**550**	**46.6**	**247**	**20.9**	**64**	**5.4**

Appendix Table 78. Attitude: I support animal biotechnology unreservedly

Stakeholder Group	Strongly Agree		Agree		Disagree		Strongly Disagree	
	n	%	n	%	n	%	n	%
Businessmen and traders	20	16.7	47	39.2	26	21.7	6	5.0
Consumers	34	15.5	82	37.3	62	28.2	12	5.5
Extension workers	15	10.7	61	43.6	41	29.3	9	6.4
Farmer leaders and community leaders	26	16.3	84	52.5	23	14.4	8	5.0
Journalists and media persons	13	16.3	34	42.5	20	25.0	3	3.8
Policy makers	7	8.8	40	50.0	18	22.5	2	2.5
Religious leaders	5	6.3	35	43.8	24	30.0	6	7.5
Scientists	10	12.5	43	53.8	21	26.3	4	5.0
Students	35	15.9	82	37.3	56	25.5	11	5.0
Total	**165**	**14.0**	**508**	**43.1**	**291**	**24.7**	**61**	**5.2**

Appendix Table 79. Grounds for having reservation towards animal biotech

Stakeholder Group	Presence of Unknown Risks		Respect for Animal Rights & Welfare		Interfering with Nature		Religious Ground	
	n	%	n	%	n	%	n	%
Businessmen and traders	100	83.3	91	75.8	58	48.3	34	28.3
Consumers	148	67.3	162	73.6	88	40.0	38	17.3
Extension workers	107	76.4	111	79.3	83	59.3	35	25.0
Farmer leaders and community leaders	101	63.1	122	76.3	67	41.9	37	23.1
Journalists and media persons	62	77.5	55	68.8	34	42.5	9	11.3
Policy makers	63	78.8	60	75.0	40	50.0	22	27.5
Religious leaders	62	77.5	52	65.0	46	57.5	38	47.5
Scientists	58	72.5	54	67.5	37	46.3	18	22.5
Students	169	76.8	185	84.1	115	52.3	27	12.3
Total	**870**	**73.7**	**892**	**75.6**	**568**	**48.1**	**258**	**21.9**

Table 80. Issues and concerns about biotech as applied in crops and animals

Issues and Concerns	Frequency	Percentage
Biosafety	30	2.5
Bioterrorism	7	0.6
Cruel methods to animals	52	4.4
Environmental effects	61	5.2
Expensive	6	0.5
Genetic Engineering	29	2.5
GMO are superior	72	6.1
Increase awareness	61	5.2
Many to mention	4	0.3
May cause disease in humans	167	14.2
Negative effects not monitored	91	7.7
No answer	501	42.5
No issue	15	1.3
Politics in GMO	18	1.5
Public resistance to GMO	66	5.6
Total	**1,180**	**100**

Appendix Tables for Similarities and Differences between 2006 and 2022 Studies

Appendix Table 81. Similarities on socio-demographic profile: 2006 and 2022 perception studies

Characteristic	2006	2022
Gender	Male: 53%	Female: 51%
	Female: 47%	Male: 49%
Educational attainment	Largest percentage are with college degrees followed by those with postgraduate degrees	
Religion	Roman Catholics	

Appendix Table 82. Similarities on person information sources: 2006 and 2022 perception studies

Rank	Information Source
1st	Scientist
2nd	Family/friend/neighbor
3rd	Agricultural worker/service

Appendix Table 83. Similarities on trust on information sources: 2006 and 2022 perception studies

Information Source	Level of Trust
Scientist	Total trust
Social Media Sources	No trust - Some trust
All Other Sources	Some trust

Appendix Table 84. Similarities on societal views and values: 2006 and 2022 perception studies

Statement	Level of Agreement
Biotech in food production consistent with their moral values.	Agree
GM foods when totally safe can be distributed.	Agree
Nothing wrong if man modifies nature.	Agree
Regulation of modern biotech should be left to the industry.	Agree

Appendix Table 85. Similarities on knowledge about biotech in food production: 2006 and 2022 perception studies

Statement	Perception
Potential risks are associated with every new emerging technology.	Correct
Products from GM crops are now being sold in the Philippines .	Correct
GM crops are now being commercially grown in the Philippines.	Correct
In genetic engineering, genes of interest are transferred from one organism to another.	Correct
All crops have been genetically modified from their original state through domestication, selection, and controlled breeding over long period of time.	Correct
Golden rice contains beta carotene.	Correct

Appendix Table 86. Similarity on knowledge about biotech that stakeholders need to know more about: 2006 and 2022 perception studies

Statement	Correct Answers (%)	
	2006	2022
Plant viruses are transferred to humans when they eat vegetables and fruits infected with plant viruses.	35.5	32.4

Appendix Table 87. Similarities on views on the use of biotech crops: 2006 and 2022 perception studies

Biotech Crop	Use
Virus disease-resistant tomatoes	For growing and For food
Virus disease-resistant papaya	For growing and For food
Eggplant resistant to insect borer infestation	For growing and For food
Corn tolerant to herbicide	For growing and For food
Corn resistant to insect borer infestation	For growing and For food
Rice resistant to blight disease	For growing and For food
Rice with more vitamin A	For growing and For food
Papaya that takes longer to ripen	For growing and For food
Cotton resistant to insect infestation	For growing and For food

Appendix Table 88. Similarities on perception regarding biotech in food production: 2006 and 2022 perception studies

Factors	2006		2022	
	Perception	%	Perception	%
Interest	Somewhat interested	48.8	Somewhat interested	42.7
	Very interested	45.7	Very interested	53.6
Risk associated	Somewhat hazardous	55.6	Somewhat hazardous	49.3
How beneficial	Moderately beneficial	48.2	Moderately beneficial	44.8
	Very Beneficial	40.7	Very beneficial	48.3

Appendix Table 89. Similarities on perception of prevailing views about agricultural biotechnology: 2006 and 2022 perception studies

View about Agricultural Biotechnology	Perception
a. Favorable View	
Government agencies are doing their best to ensure that the food we eat is safe.	Agree
Expert statements on biotech are based on scientific analysis and are, therefore, objective.	Agree
Biotech is good for Philippine agriculture.	Agree
The risks of genetic engineering have been greatly exaggerated.	Agree
b. Unfavorable View	
Genetic engineering of food products could create unexpected new allergens or contaminate products in unanticipated way, resulting in threats to public health.	Agree
Biotech in food production benefits only large agricultural companies.	Agree

Appendix 90. Similarities on participation in biotech-related activities: 2006 and 2022 perception studies

Activity Statement	Perception
The public should be consulted in formulating food regulations and laws.	Agree
The public should be directly consulted in approving R&D in agri-biotech.	Agree

Appendix Table 91. Difference on sociodemographic profile: 2006 and 2022 perception studies

	2006		2022	
Civil status	Married:	71.2%	Married:	46.0%
			Single:	48.4%

Appendix Table 92. Differences on most common information source: 2006 and 2022 perception studies

Source	2006	2022
Interpersonal Sources	2nd	3rd
Social Media Sources	-	1st
Print, Broadcast, and Online Sources	1st	2nd

Appendix Table 93. Differences on ranking of print, broadcast and online source: 2006 and 2022 perception studies

Rank	2006	2022
1st	Newsletter, pamphlet, brochure	Websites
2nd	Mass media	Mass media (TV, newspaper)
3rd	Book	Newsletter, pamphlet, brochure

Appendix Table 94. Social media sources ranking: 2006 and 2022 perception studies

Rank	2006	2022
1st	(NA)	Facebook
2nd		YouTube

Appendix Table 95. Differences on information, knowledge and understanding of biotech: 2006 and 2022 perception studies

Factors	2006	2022
Usefulness of biotech info	Good	Very good
Quality of biotech info	Good	Very good
Understanding of agri-biotech science	Good	Very good
Knowledge on use of biotech in food production	Good	Very good

Appendix Table 96. Differences on knowledge about biotech that stakeholders need to know about: 2006 and 2022 perception studies

Statement	Correct Answers (%)	
	2006	2022
Plant viruses are transferred to humans when they eat vegetables and fruits infected with plant viruses.	35.5	32.4
Ordinary tomatoes do not contain genes while GM tomatoes do.	67.4	46.2
By eating GM food, a person's genes could be modified.	73.4	47.7

Appendix Table 97. Differences on perception of regulations about agricultural biotechnology: 2006 and 2022 perception studies

Statement	2006	2022
Regulations on biotech should include inputs from non-government sector.	Disagree	Agree
Government regulatory agencies have scientific facts and technical information needed in order to make good decisions about biotech in food.	Disagree	Agree
The public is provided with vital information about the health effects of GM foods.	Disagree	Agree
Current regulations in the Philippines are sufficient to protect people from any risks linked to modern biotech.	Disagree	Agree

Appendix Table 98. Differences on perception of stakeholder's concern over public health and safety impact of agricultural biotechnology: 2006 and 2022 perception studies

Level of Concern	2006	2022
Very concerned	-	Local farm leaders Agri. biotech companies International research institutions Gov't. research institutions University-based scientists
Somewhat concerned	All other stakeholder groups	All other stakeholder groups
Not at all concerned	Local farm leaders Religious leader/group	-

Appendix Table 99. Differences on participation in biotech-related activities: 2006 and 2022 perception studies

Statement	2006	2022
Foods that have been genetically modified should be labeled.	Strongly agree	Agree
If my community would hold an information session on biotech in food production, I will attend.	Strongly agree	Agree
I would contribute my time or money to an organization that promotes GM foods.	Strongly disagree	Moderately disagree

Appendix Table 100. Differences on consideration of applications in making judgments about biotechnology: 2006 and 2022 perception studies

Application	2006	2022
Production of foods to make them more nutritious, better-tasting, and longer-lasting	Seldom	Almost always
Make the crops more resistant to pests and diseases	Seldom	Almost always
Detect and treat diseases we might have inherited from our parents	Seldom	Almost always
Produce medicines and vaccines, for example to produce insulin for diabetes	Seldom	Almost always
Study human diseases like cancer	Seldom	Almost always

Appendix Tables for Comparison between GMO and non-GMO Areas

Appendix Table 101. Comparison of socio-demographic characteristics: GMO vs non-GMO areas

Socio-demographics	GMO Area	Non-GMO Area
	%	%
Gender		
Female	51	14
Male	49	16
Civil Status		
Single	48.4	16.4
Married	46.0	11.8
Educational Attainment		
High School	0	16.9
College graduate	53.1	64.7
Post-graduate	20.8	12.4
Religion		
Roman Catholic	75.2	18.7

Appendix Table 102. Comparison of social media sources: GMO vs non-GMO areas

Social Media	GMO Area	Non-GMO Area
	%	%
Facebook	81.2	85
YouTube	70.3	72
Websites	54.8	56

Appendix Table 103. Comparison of print, broadcast, and online sources: GMO vs non-GMO areas

Source	GMO Areas	Non-GMO Area
	%	%
Website on biotech	54.8	56.5
Television	47.8	49
Newspapers (print, online)	41.4	33.3
Radio	27.7	33.6

Appendix Table 104. Comparison of interpersonal sources: GMO vs non-GMO areas

Person Source	GMO Area	Non-GMO Area
	%	%
Family/neighbors/ friend	43.6	40.1
Agric worker	41.7	44.9
Farmer group	35.7	40.7

Appendix Table 105. Perception of biotech vis a vis societal views and values: GMO vs non-GMO areas

Perception of Biotech	Weighted Mean	
	GMO Area	Non-GMO Area
When genetically modified foods are totally safe, they can be distributed.	4.27 (agree)	5.3 (agree)
The use of biotech in food production is in accordance with my moral values.	4.21 (agree)	6.3 (agree)
Man may be allowed to modify nature.	3.90 (agree)	4.6 (agree)
The regulation of modern biotech should be left to the industry.	3.81 (agree)	5.5. (agree)

Appendix Table 106. Information, knowledge and understanding of biotech: GMO vs non-GMO areas

Statement	Weighted Mean	
	GMO Area	Non-GMO Area
Usefulness of information about agri-biotech	3.10 (very good)	4.44 (very good)
Quality of available scientific information about agri-biotech	2.99 (very good)	4.49 (very good)
Understanding of agri-biotech science	2.63 (very good)	3.87 (very good)
Knowledge on use of biotech in food production	2.59 (very good)	4.01 (very good)

Appendix Table 107. Correct knowledge about biotech in food production: GMO vs non-GMO areas

Knowledge about Biotech	GMO Area	Non-GMO Area
	%	%
Potential risks are associated with every new emerging technology.	89.3	92.1
Products from GM crops are now being sold in the Philippines .	75.3	75.7
GM crops are now being commercially grown in the Philippines.	71.1	70.86
In genetic engineering, genes of interest are transferred from one organism to another.	67.5	75.1
All crops have been genetically modified from their original state through domestication, selection, and controlled breeding over long period of time	56.4	59.0
Golden rice contains beta carotene	54.6	60.7

Appendix Table 108. Knowledge on biotech that stakeholders have to know more about: GMO vs non-GMO areas

Statement	True (%)		False (%)		Do Not Know (%)	
	GMO Area	Non-GMO Area	GMO Area	Non-GMO Area	GMO Area	Non-GMO Area
Plant viruses are transferred to humans when they eat vegetables and fruits infected with plant viruses.	32.4	33.9	37.9	36.7	29.7	29.4
Ordinary tomatoes do not contain genes while GM tomatoes do.	24.7	24.0	46.2	48.3	29.2	27.7
By eating GM food, a person's genes could be modified.	23.1	29.1	47.7	45.8	29.2	25.1

Appendix Table 109. Views on use of biotech crops: GMO vs non-GMO areas

Biotech Crop	Growing (%)		Food (%)		Animal Feed (%)		Industrial by-Product (%)	
	GMO Area	Non-GMO Area	GMO Area	Non-GMO Area	GMO Area	Non-GMO Area	GMO Area	Non-GMO Area
Virus disease-resistant tomatoes	48.3	49.2	45.0	36.7	6.7	2.8	14.6	13.8
Virus disease-resistant papaya	43.1	42.9	47.9	42.9	7.8	4.2	13.9	11.0
Eggplant resistant to insect borer infestation	44.5	44.4	46.4	47.5	8.0	5.6	13.5	11.3
Corn tolerant to herbicide	40.9	39.8	32.3	27.7	23.7	19.8	20.6	20.9
Corn resistant to insect borer infestation	39.9	39.8	34.1	29.4	23.4	19.8	18.6	18.9
Rice resistant to blight disease	37.7	40.1	49.7	43.8	9.7	5.1	14.4	14.4
Rice with more vitamin A	23.1	22.0	73.6	74.3	8.0	3.7	7.9	5.4
Papaya that takes longer to ripen	30.8	29.4	48.3	44.9	8.4	7.9	20.8	19.5
Cotton resistant to insect infestation	65.8	74.0	10.8	8.5	7.4	5.1	11.4	9.6

Appendix Table 110. Considerations deemed important for biotech in food production: GMO vs non-GMO areas

Rank	Consideration	GMO Area	Non-GMO Area
		%	%
1st	Nutritional quality	95.8	95.2
2nd	Non-poisonous	94.8	92.7
3rd	Non-allergenic	94.3	92.4
4th	Better taste	90.3	92.9
5th	Price	89.2	87.3
6th	Pesticide residue	81.4	78.5
7th	Food appearance	79.2	81.1

Appendix Table 111. Perception of prevailing views about biotech: GMO vs non-GMO areas

View about Agri-biotech	Weighted Mean	
	GMO Area	Non-GMO Area
a. Favorable views		
Government agencies are doing their best to ensure that the food we eat is safe.	4.2 (agree)	4.3 (agree)
Expert statements on biotech are based on scientific analysis and are, therefore, objective.	3.9 (agree)	4.0 (agree)
Biotech is good for Philippine agriculture.	3.9 (agree)	5.0 (agree)
The risks of genetic engineering have been greatly exaggerated.	3.5 (agree)	4.3 (agree)
b. *Unfavorable views*		
Genetic engineering of food products could create unexpected new allergens or contaminate products in unanticipated way, resulting in threats to public health.	3.7 (agree)	3.7 (agree)
Biotech in food production benefits only large agricultural companies.	3.7 (agree)	3.7 (agree)

Appendix Table 112. Perception of regulations about biotech: GMO vs non-GMO areas

View about Regulation of Biotech	Weighted Mean	
	GMO Area	Non-GMO Area
Regulations on biotech should include inputs from non-government sector.	4.12 (agree)	4.12 (agree)
Government regulatory agencies have scientific facts and technical information needed in order to make good decisions about biotech in food.	4.02 (agree)	4.12 (agree)
The public is provided with vital information about the health effects of GM foods.	3.77 (agree)	3.83 (agree)
Current regulations in the Philippines are sufficient to protect people from any risks linked to modern biotech.	3.55 (agree)	3.72 (agree)

Appendix Table 113. Perception of stakeholders' concerns over public health and safety impact of biotech: GMO vs non-GMO areas

Individual, Group, Organization	Very Concerned (%)	
	GMO Area	Non-GMO Area
University -based scientists	65.8	61.0
International research institutions	63.6	59.9
Agri-biotech companies	60.3	62.4
Government research institutions	59.8	55.9
Local farm leaders	57.5	55.9
Consumers/general public	54.0	54.2
Consumer groups	52.7	50.8
	Somewhat Concerned (%)	
	GMO Area	**Non-GMO Area**
Mass media/journalists	47.5	29.1
Students	42.9	37.0
Religious leaders	41.5	34.7
NGOs	44.6	42.7

Appendix Table 114. Participation in biotech-related activities: GMO vs non-GMO areas

Activity Statement	Strongly Agree (%)	
	GMO Area	Non-GMO Area
Foods that have been genetically modified should be labeled.	57.8	52.3
The public should be consulted in formulating food regulations and laws.	56.9	59.3
The public should be directly consulted in approving R&D in agri-biotech.	50.8	47.5
	Agree (%)	
	GMO Area	**Non-GMO Area**
If my community, would hold an information session on biotech in food production, I will attend.	46.5	56.2
I would contribute my time or money to an organization that promotes GM foods.	45.5	48.3

Appendix Table 115. Consideration of biotech applications in making judgment about it: GMO vs non-GMO areas

Application/Research Foci	Weighted Mean		Consideration
	GMO Area	Non-GMO Area	
Production of foods to make them more nutritious, better-tasting, and longer-lasting	4.11	4.15	almost always
Make the crops more resistant to pests and diseases	4.00	4.08	almost always
Detect and treat diseases we might have inherited from our parents	3.88	3.88	almost always
Produce medicines and vaccines, for example to produce insulin for diabetes	3.75	3.67	almost always
Study human diseases like cancer	3.61	3.4	almost always
Resist extreme freezing temperature (i.e., Introducing fish genes into strawberries)	3.38	3.26	seldom

Appendix Table 116. Awareness on animal biotechnology: GMO vs non-GMO areas

Statement	Weighted Mean			
	GMO Area		Non-GMO Area	
I need more information about animal biotech.	4.42	(agree)	4.51	(strongly agree)
I trust that our scientists are working on it for the benefit of the people.	4.08	(agree)	4.15	(strongly agree)
I support the use of animal biotech for human medical treatments.	3.53	(agree)	3.51	(agree)
I support animal biotech unreservedly.	3.4	(moderately disagree)	3.44	(agree)
I currently do not see the need for animal biotech.	2.96	(moderately disagree)	2.89	(agree)

Appendix Table 117. Reasons for having reservations about animal biotech: GMO vs non-GMO areas

Ground for Reservation	GMO Area		Non-GMO Area	
	n	%	n	%
Respect for animal rights and welfare	892	75.6	288	81.4
Presence of unknown risks	870	73.7	224	63.3
Interfering with nature	568	48.1	145	41.0
Religious ground	258	21.9	74	20.9


Vijay Kreationz