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# The Facts Behind GMO Food

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# THE FACTS BEHIND GMO FOOD

*The good, the bad, and the ugly about GMO*

## ABSTRACT

**A controversial debate lasting 20 years more, where is the answer? If it continues for next 20 years, can we afford that?**

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Paul College Honor Thesis

Advisor: Prof. Shuili Du

University of New Hampshire

May. 1, 2019

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## Executive Summary:

This thesis is from Paul Honor Program of Peter T. Paul College of Business and Economics of the University of New Hampshire. This thesis is showing the culminating experience of Paul Honors. Students apply what they have learned and undertake their own research with the help of a faculty mentor.

Genetically Modified Organism food, hereinafter referred to as “GMO food”, also known as Genetically modified (GM) or genetically engineered (GE) foods, is a kind of food being changed their DNA sequence by genetic engineering in order to developing some specific traits, or having more control about this species, such as resistance to pathogens and herbicides, yields increase, and shape change.

This thesis mainly discusses the issues of GMO food in several aspects, including public knowledge level, consumer’s attitude, consumer’s perception, buyers’ behavior, government role, and society expectation regarding this not-so-new term.

The data used in this thesis is composed of secondary and primary research. The secondary research includes government regulations, public media reports, and publications, most of this information comes from the congress website, public media website, and UNH library. The primary research includes a questionnaire survey and a one-to-one interview.

Professor Shuili Du from the Marketing Department in UNH supplies all specialized knowledge and modifications.

## Introduction:

While people are talking about GMO food, they have different understandings on their own, but not everyone is biologist, therefore, before starting the research, we need to be clear what is GMO?

According to Non-GMO Project website, which is a nonprofit organization committed to preserving and building sources of non-GMO products, educating consumers, and providing verified non-GMO choices, “GMO, or genetically modified organism, is a plant, animal, microorganism or other organisms whose genetic makeup has been modified in a laboratory using genetic engineering or transgenic technology. This creates combinations of plant, animal, bacterial and virus genes that do not occur in nature or through traditional crossbreeding methods (Non-GMO Project, web)”. Although there is fewer GM lives selling in the market, the animals who eat GMO fodder are considered as Non-Organic meat. The first genetically modified food approved for release was the Flavr Savr tomato in 1994 (GMO, Wikipedia). Based on a newest report, *Global Genetically Modified Food Market 2018*, which is published in 2019, until 2018, over 70% of packaged food contained GMOs in the United States, and the five most prevalent GMO crops are Corn, Soy, Cotton, Sugar Beets, and Canola (Global GMO Market Report, 2019).

So, GMO food is not a new term for public people, but the debate about it has been continuing for 10 years even 20 years. The question like "Is it healthy or not?" has no accurate and clear answer for a long time. In other words, people don't know who they should believe, neither expert nor governor stands out to speak for this significant issue. In some case, what we eat today will affect our future, our next generation, even affect the entire human being.

## Research Questions:

The primary focus of this thesis is to detect and identify the accurate situation of GMO food, the knowledge of the US consumer, and the activities of the US government. Thus, this thesis specifically addressed the following questions:

1. What's the US consumer's knowledge of GMO food now?
2. What are consumers' beliefs, attitude, and behavioral intention toward GMO food?
3. What is consumers' expectation about the government's role in the regulation of GMO food?

These questions were answered mainly through primary research, some supplements retrieved from secondary research and data collection. For the primary research, there was a survey questionnaire conducted using Qualtrics. There were 13 questions, including 10 perceptual questions and 3 demographic questions. This survey was distributed through multiple methods. These included a link to Marketing classes of Paul college, a link shared to UNH student Facebook groups, a paper survey to a random customer in front of the door of grocery. Finally, the survey closed at 137 responses, after organizing, 93 records could be used to analyze.

## Part One: Consumer's Knowledge

The first and most significant assumption in this thesis is that public people lack knowledge about GMO foods. Basically, most people have no clear information about the food they eat every day, the results from the survey can prove that.

The first question in the survey, people were asked to declare the knowledge level they know about GMO food, including all kinds of information, such as food-related news, technologies, and policies, etc. There were 17 of 93 responses (19%) saying they know much about GMO food, however, more than half of the responses (55%) said they received a little information about GMO, even they never cared about it. The rest responses (26%) had a moderate answer, they said they know some information base on their knowledge level (see exhibit 1&2).

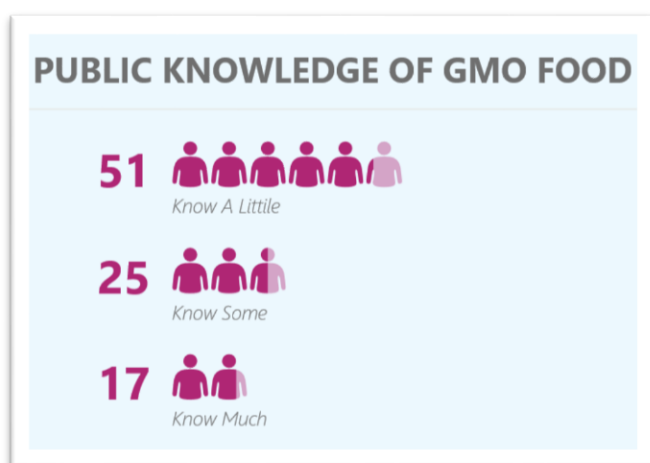


Exhibit 1: Number Responses of Public knowledge

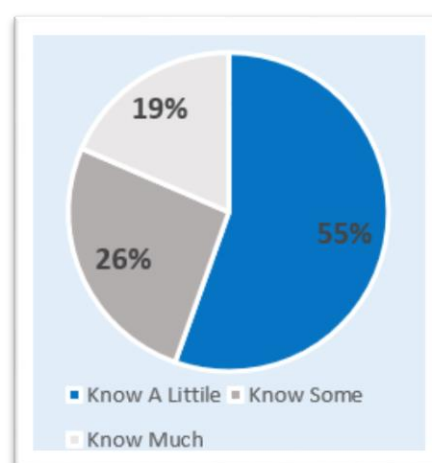


Exhibit 2: Percentage Responses

Furthermore, people's knowledge level about GMO food is related to their living habits. For example, if a person reads the news every day, he/she might notice some reports about the safety issue of GMO food; if a person works in the biological science area, he/she might notice more on the technology updating of GMO. In order to know the frequency of people on following this kind of news or information, there

was a question been set as "How often do you follow news about 'GMO' food?"

Additional explanations were given under this question, the responses could follow all kinds of information like technology updating, safety issue report, public policy, and price change, etc.

The result could tell us why most people had low knowledge level about GMO because they were rarely or never pay attention to this part. According to the records of the survey, there were just 1/3 responses having a positive frequency to follow the news (see exhibit 3), more than 1/3 (35%) responses said they were rarely to read the news about GMO food, and the rest of 1/3 (33%) responses chose the "Never" option.

The results also could tell us the possibility regarding how many percentages of people would like to learn the GMO issue in the future. This is a crucial problem, and the data indicate that informing the knowledge of GMO to public people is a hard thing for authority, since more than 68 % Americans, based on the survey, have lower interests to accept and learn GMO, even though the issue might affect themselves.

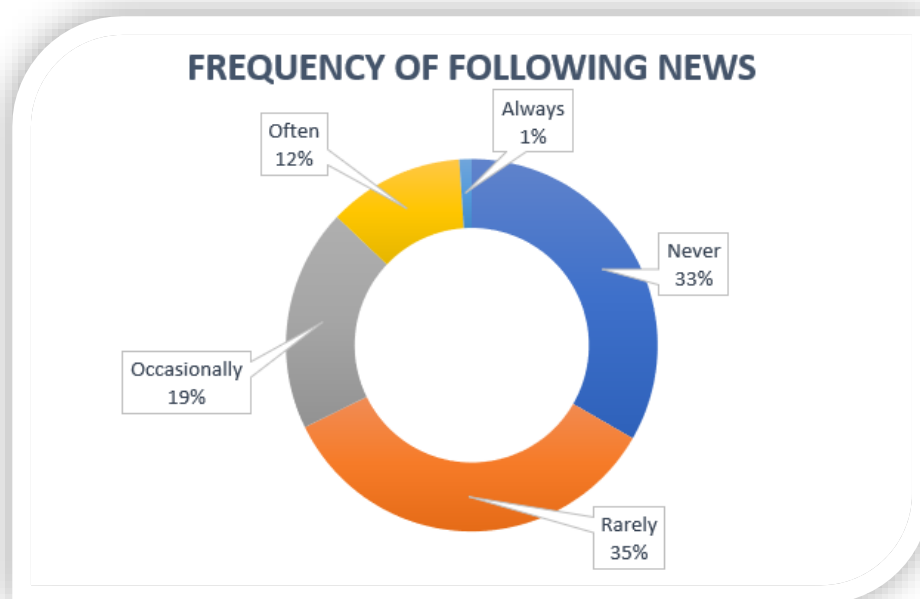


Exhibit 3: Frequency of Following News



## Part Two: The Public Perception

Although people have different knowledge level about GMO food, they have their own understandings or perceptions. A common assumption is that people don't like GMO food, they prefer buying Non-GMO or Organic food if the price and quantity are as same as normal. The results of the survey have evidence of that.

In the questionnaire survey, people's perceptions of GMO food had been split to five terms, those were healthy or unhealthy, environmentally friendly or unfriendly, expensive or inexpensive, usual or unusual, and acceptable or unacceptable. The responses could give their beliefs in separate terms. Answers could be put in three pools. First, the most confident pool, which had a high percentage response. In this pool, 70% responses believed in GMO food were unhealthy (see exhibit 4), and 61% responses believed GMO food were environment unfriendly, which meant it was harmful. In the second pool, a moderate percentage response was recorded, including 63% responses thought the GMO food was usual to see or buy in the market, and 53% responses thought it was inexpensive. The people in the last pool, who were confusing about the term of GMO, called struggling pool. 39% responses thought that were acceptable, there were another 36% responses thought unacceptable as well.

Unacceptable	36%	Environmental Unfriendly	61%
Moderate	26%	Moderate	22%
Acceptable	39%	Environmental Friendly	18%
Unhealthy	70%	Usual	63%
Moderate	18%	Moderate	23%
Healthy	13%	Unusual	14%
Expensive	27%		
Moderate	21%		
Inexpensive	53%		

*Exhibit 4: Consumer's Perception of GMO Food*

From the pool one, the answer for the front part assumption is yes, people don't like GMO food. But considering the similar percentages in pool three, why do those responses be struggling or confusing about GMO food? Combining the pool two, that will make sense that though people believe the GMO food is unhealthy for their body and it will hurt the environment, but they still consume GMO food and eat it without much consideration because it is cheaper and easier to buy in the grocery. That is also a common phenomenon that there is just a small part of shelf space for Organic food in the grocery shop, but the GMO food is all over around (see exhibit 5). There are just two rows Organic & Natural goods in total fifteen rows, and there are just three sections of the entire frozen rows for Organic & Natural.



*Exhibit 5: Organic Goods Section in Shaw's at Dover*

For the second half of that assumption, which is people prefer buying Non-GMO food, the answer can be found from the consumer's buying behavior. There was a question in the survey asking about the frequency of buying GMO food or Non-GMO food. 81% responses were occasionally, often, or always buying Non-GMO/Organic food, and only 61% responses for GMO food (see exhibit 6). But there was a significant point that we have 10 % responses always buying Organic, but just

1% always buying GMO, on the contrary, 10% responses never buy GMO food, and just 2% never buy Organic food.

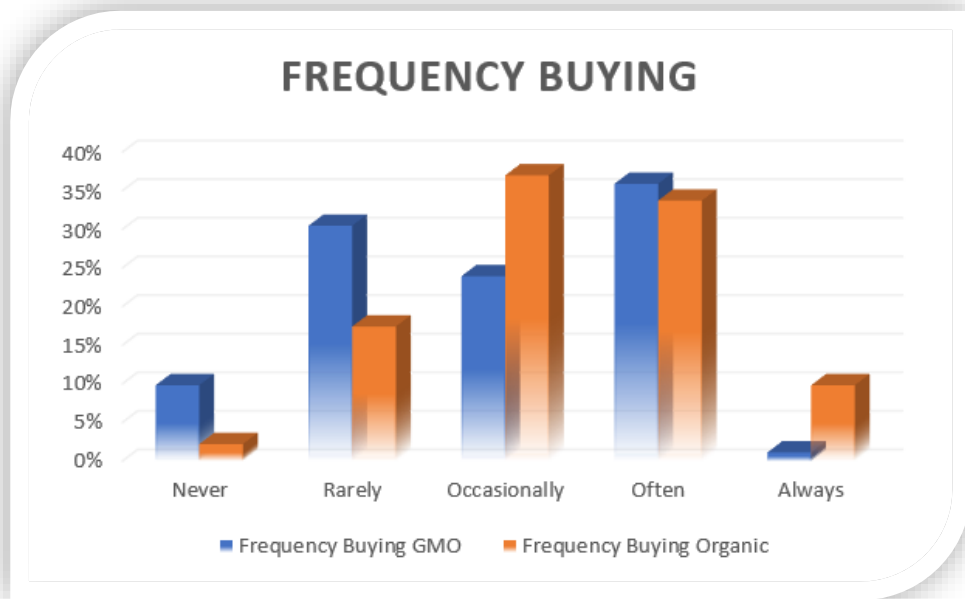
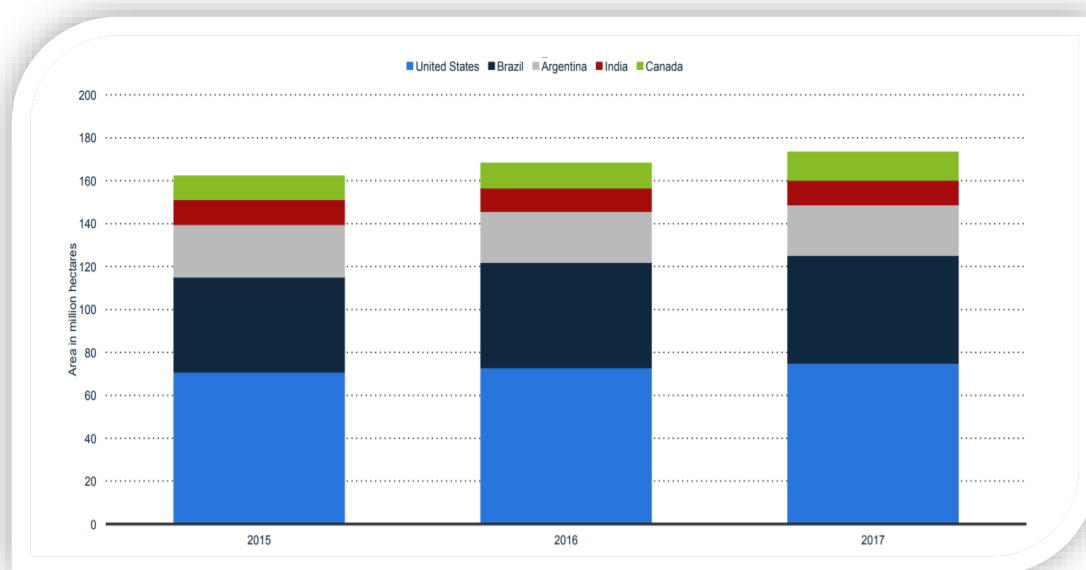


Exhibit 6: Frequency of Buying

## Part Three: Consumers' Expectation About the Government's Role

The United States is a giant producer of crops and also a great consumer. With the genetically engineering technology development in the US, around 40% of genetically modified crops are coming from the US (see exhibit 7). Between 2015 and 2017, the acreage of genetically modified crops in the US was almost equal to the sum of other countries. Meanwhile, there has the biggest market for those crops. According to the *Global Genetically Modified Food Market 2018*, 86% corns and 93% soybeans are GMOs in the US (Global GMO Market Report, 2019). These data indicate an important fact, GMO food is a matter for the US people.



*Exhibit 7: Acreage of genetically modified crops worldwide from 2015 to 2017, by leading country. Retrieved from Statista*

On the other hand, a statement from an authority in 2015 pointed out that the US government had no clear attitude for GMO food (Congress 2015). “The United States does not have any federal legislation that is specific to genetically modified organisms (GMOs). Rather, GMOs are regulated pursuant to health, safety, and

environmental legislation governing conventional products. The US approach to regulating GMOs is premised on the assumption that regulation should focus on the nature of the products, rather than the process in which they were produced (Congress 2015).”

The circumstance was changing fast. President Obama signed a bill in July 2016, which called Bill 764. Under this bill, the producers need to label the GMO ingredients on the product package. But there is a report doubting that "Unlike (for example) allergen statements, GMO ingredients do not have to be explicitly mentioned on a food label. Instead, the manufacturer can opt to direct the consumer to an external source to receive information about the GMO status of the product, including a website URL, phone number, or a scannable QR code (Emmerson Packaging, 2016)." There was previous research about labeling rule for the US people in 2014 (see exhibit 8). 92% responses said that it (GMO ingredient) should be

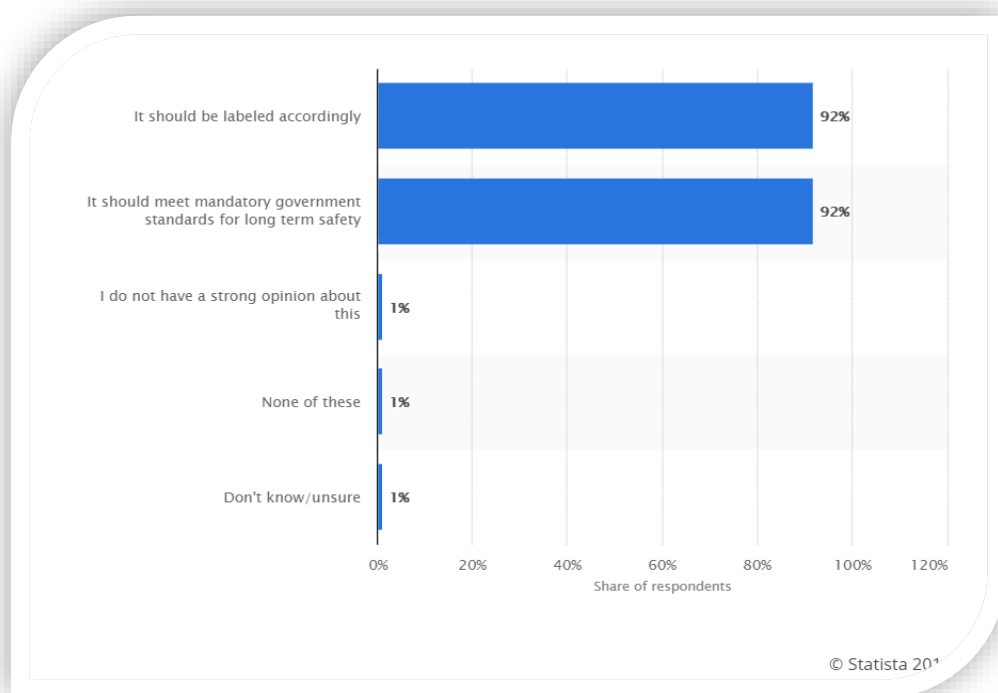


Exhibit 8: Consumer preferences for standards for genetically engineered food in the United States in 2014. Retrieved from Statista

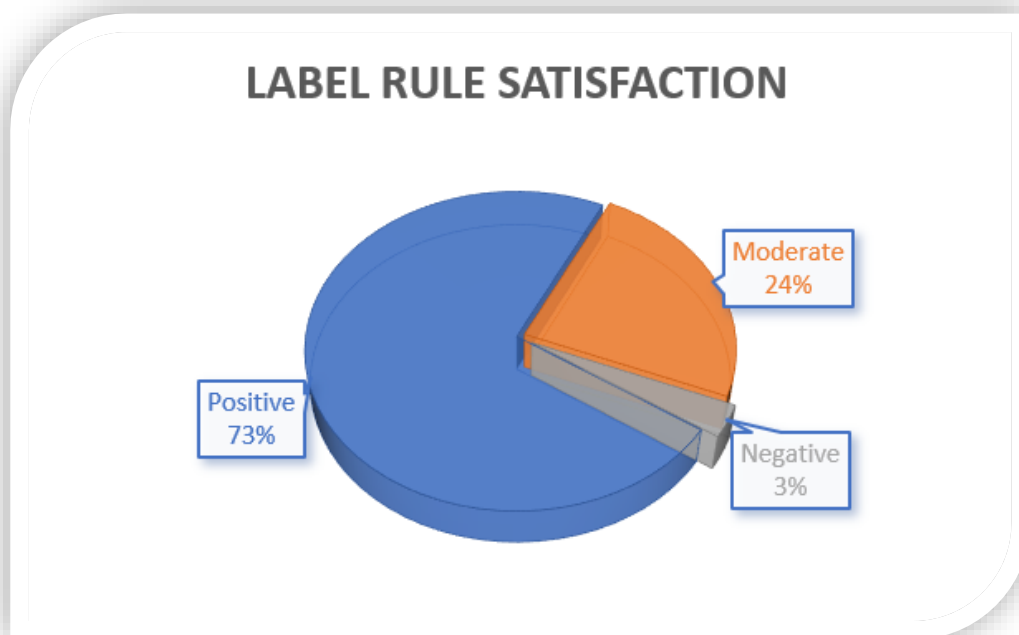
labeled accordingly, and the same percentage responses also believed that it should meet mandatory government standards for long term safety. So, people have been worried about the safety issue for a long time.

After the Bill 764 publishing, consumers can normally find two things on the food package, the GMO food labeling or organic certification seal. Actually, the similar bills have been carried out in many countries, like the European Union was the first leader government to implement organic certification rule. Same things happen in China, India, Canada, and Korea, etc. (see exhibit 9).



Exhibit 9: New Packages after Bill 764. Retrieved from Online.

In general, the labeling rule has a positive effect around the world. Based on the survey (see exhibit 10), 73% responses had a positive satisfaction for the labeling rule, 24% responses said they would consider the cost increase because of labeling rule, so they gave it a moderate satisfaction about it, and 3% responses had a negative satisfaction because they felt the labeling rule increasing their fair about GMO food,



*Exhibit 10: Labeling Rule Satisfaction.*

or they might have relationships with a producer.

The consumer's buying behavior is also changed directly by the organic certification seal. In the question "How likely are you to buy products WITH an 'Organic' or 'Non-GMO' label? (Assuming the price and quantity are same with others)?" 65 of 93 responses were willing to buy the product which had an organic seal, and only 9 responses were unwilling to buy it. Besides, in the question "How likely are you to buy products WITHOUT an 'Organic' or 'Non-GMO' label? (Assuming the price and quantity are the same with others)?" there were only 28 of 93 responses were willing to buy the product, and 1/3 responses (35) were unwilling to buy it (see exhibit 11). The big difference between the willingness and unwillingness can be a piece of strong evidence to affirm that the organic seal gives a large advantage on the sales of the product because people have been educated to recognize the food with this seal are better than others.

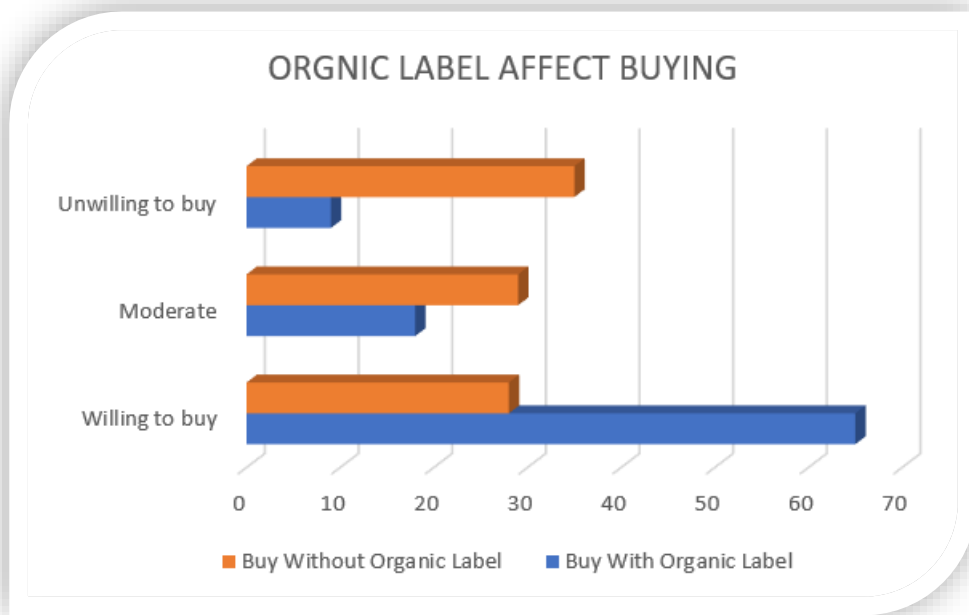


Exhibit 11: Consumer New Buying Behavior Affected by Organic Seal.



## Conclusions and Recommendations:

The public might have different knowledge levels about GMO food, various perceptions, and diverse attitudes of government rule, overall, people are standing at the middle side of the river, they are afraid of unclear items, but they still have a connection with that every day. Therefore, most responses in the survey gave a moderate attitude about GMO food in general (see exhibit 12).

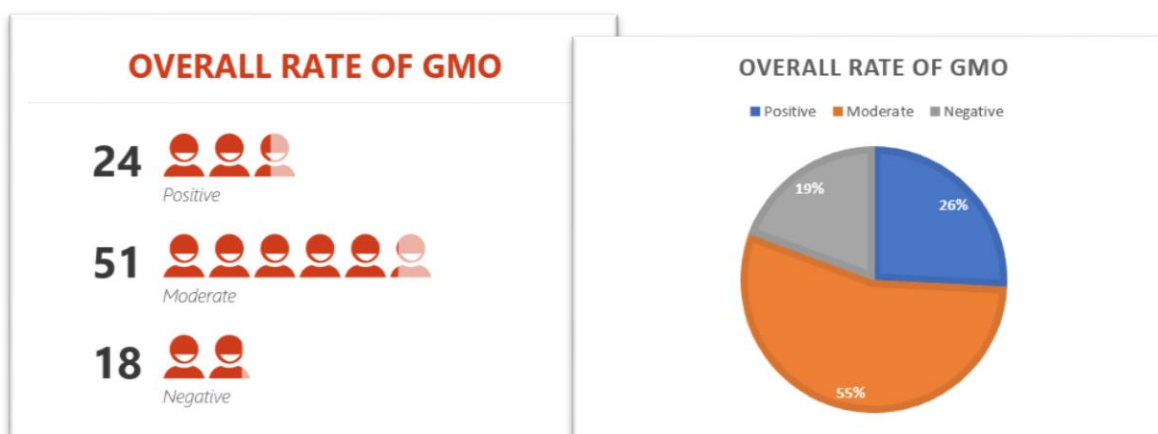


Exhibit 9: Overall Attitude of GMO Food.

Based on all information researching and survey result analysis, there are three consequences and advice:

1. People have accepted GMO food in their daily life. Although some people are worried about its such-and-such issues, they eat it. Thus, people need more protection. In this case, the legislation department ought to make more regulations about GMO food, in details like from the seed to plate, it should be clear in every link.
2. The public is lacking knowledge about GMO food, despite it has been made for more than 20 years. This is not only a failure of the authority, but it also illustrates that people need to strengthen learning. The related

department should keep informing the information on common issues to public people, indeed, if people have a positive attitude to learn and accept knowledge, the effect will be better.

3. There are still some people adopting a wait-to-see attitude. When people have no idea about one thing, they fear it to take any action to it, as time passes, that will cause widespread panic. To avoid this situation, the government should take more responsibilities. The authority or governor cannot adopt a wait-to-see attitude, because they are not normal people, and they are elected as a leader because people believe those can protect them. That's why they need to step out to take responsibilities.

GMO food issue has existed for 20 years, and we cannot let it continue to the next 20 years. 20 years is a circle of a generation if we don't resolve it as soon as possible, the unknown effect will pass to the next generation, so far as passing to the entire human being. Can we afford that?

## Appendix

### Questionnaire Survey & Results

#### Welcome Page:

Dear Participant,

I am a student enrolled in the Paul Honors Program at the University of New Hampshire. I am conducting research involving GMO Food (Genetically Modified Organism). You are invited to participate in our short survey and your responses are greatly appreciated. The survey will require approximately 2-4 minutes to complete. I appreciate you taking the time to complete our survey, if you have any question, please contact me by email: [w11003@wildcats.unh.edu](mailto:w11003@wildcats.unh.edu)

#### Introduction:

What is "**GMO**" food?

A GMO, or genetically modified organism, is a plant, animal, microorganism or other organisms whose genetic makeup has been modified in a laboratory using genetic engineering or transgenic technology. This creates combinations of plant, animal, bacterial and virus genes that do not occur in nature or through traditional crossbreeding methods. (Ref: [Nongmoproject.org](http://Nongmoproject.org) )

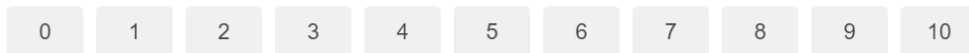
The first genetically modified food approved for release was the Flavr Savr tomato in 1994. Until now, over 70% of packaged food contained GMOs in the United States, and the five most prevalent GMO crops are Corn, Soy, Cotton, Sugar Beets, and Canola. (Ref: Wikipedia)

#### Question 1:

How much do you know about "**GMO**" food, including GMO food-related news, technologies, and policies etc.? please rate from 0 (not at all) to 10 (know a lot).

Not at all

Know a lot



Know A Little	51
Know Some	25
Know Much	17

Question 2:

Base on the information you know, what is your perception of "GMO" food?

Unhealthy	<input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>	Healthy
Envioronmentally unfriendly	<input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>	Environmentally friendly
Expensive	<input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>	Inexpensive
Usual	<input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>	Unusual
Unacceptable	<input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>	Acceptable

Unhealthy	70%
Moderate	18%
Healthy	13%

Question 3:

How often do you buy "GMO" food?

Never
Rarely
Occasionally
Often
Always

Frequency Buying GMO	
Never	10%
Rarely	30%
Occasionally	24%
Often	36%
Always	1%

Question 4:

How often do you buy "**Organic/Non-GMO**" food?

Never

Rarely

Occasionally

Often

Always

	Frequency Buying Organic
Never	2%
Rarely	17%
Occasionally	37%
Often	34%
Always	10%

Question 5:

How often do you follow news about "**GMO**" food (Like technology updating, safety issue, public policy, and price change, etc.)?

Never

Rarely

Occasionally

Often

Always

	Frequency Following News
Never	31
Rarely	32
Occasionally	18
Often	11
Always	1

Question 6:

President Obama signed Bill 764 in July 2016, creating a new federal standard in the USA for GMO labeling rules and overriding preexisting state laws, that mandated uniform labeling of all food products containing genetically engineered ingredients. The new GMO labeling rules are fairly controversial, earning criticism from both pro- and anti-GMO groups. The federally mandated obligation to report GMO ingredients means that manufacturers must now obtain assurances (via certificates of analysis, etc.) from their suppliers that all ingredients are non-GMO, which some manufacturers say will be costly. (Ref: Emmerson Packaging)

What is your opinion about this GMO labeling rule?



GMO Label Rule	
Positive	67
Moderate	22
Negative	3

Question 7:

How likely are you to buy products **WITH "Organic" or "Non-GMO" Label**? (Assuming the price and quantity are same with others).



Buy With Organic Label	
Willing to buy	65
Moderate	18
Unwilling to buy	9

**Question 8:**

How likely are you to buy products **WITHOUT "Organic" or "Non-GMO" Label?** (Assuming the price and quantity are same with others).

Not at all likely Extremely likely

0 1 2 3 4 5 6 7 8 9 10

Buy Without Organic Label	
Willing to buy	28
Moderate	29
Unwilling to buy	35

**Question 9:**

Overall, what is your attitude about **"GMO"** food?

Very unfavorable Very favorable

0 1 2 3 4 5 6 7 8 9 10

Overall Rate of GMO	
Positive	24
Moderate	51
Negative	18

**Question 10:**

Please select the option that best applies to you  
I am currently .....

Student

Full time employed

Part time employed

Retired

Other

Student	73
Part time employed	5
Full time employed	11
Retired	3
Other	1

Question 11:

How old are you ?

< 20

20-29

30-39

40-49

50-59

60 and above

<20	12
20-29	68
30-39	5
40-49	5
50-59	0
60 and above	3

Question 12:

How do you describe your gender?

Male

Female

Other

Male	45
Female	49
Other	1





# THE GOOD, THE BAD, AND THE UGLY ABOUT GMO

Peter T Paul College Honor Program

Wenbin Liu

Advisor: Prof. Shuili Du



The Global Genetically Modified Food Market Report 2018

**Background**

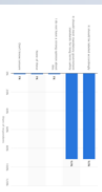
GMO food or genetically modified organism food became a controversial issue in the last decade. Is it healthy or not? The public cannot get an answer from anybody, because they don't know who they should believe, whether you are an expert or a governor.

**Research Questions**

1. What's the consumer's knowledge of GMO food now?
2. What are consumers' beliefs, attitude, and behavioral intention toward GMO food?
3. What's consumer's expectation about the government's role in the regulation of GMO food?

**Government Policy**

President Obama signed a bill in 2016 about GMO food labeling rules, called Bill 764. It was a federal standard for GMO food label in the entire USA, overriding pre-existing state laws.



**Previous Research**

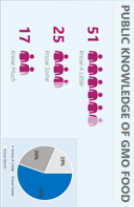
Consumer preference for labels by product type (based on the survey data in 2018)

**Final Survey**

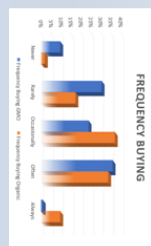
137 Responses  
93 Available Responses

**Research Finding**

1. How much do you know about "GMO" food, including GMO?

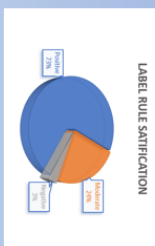
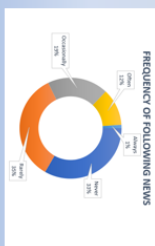


2. Base on the information you know, what's your perception of "GMO" food?

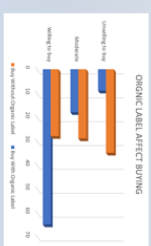


3. How often do you buy "GMO" or "Organic/Non-GMO" food?

4. How often do you follow news about "GMO" food (like technology updating, safety issue, public policy, and price change, etc.)?



5. What is your opinion about GMO labeling rule?



6. How likely would you buy a product with "Organic" label effect? (assuming the price and quantity are same with others).



7. Overall, what is your attitude about "GMO" food?

**Conclusions & Recommendations**

- People have accepted GMO food in their daily life
- Public lacks knowledge about GMO
- Many people adopt a wait-to-see attitude
- Administration make more regulations
- People should keep learning about GMO
- Government should take responsibilities

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