ATTITUDE OF CHANTHABURI PEOPLE TOWARD THE GMOs AND BIOLOGICAL TECHNOLOGY

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Abstract

This study aimed to reveal the attitude of Thai's in Chanthaburi province toward GMOs and biological technology in order to suggest the direction to set the policy on agricultural development in Thailand and to be information for the drafting the Biological Safety Act. Both quantitative and qualitative methods were employed to collect the data

The survey revealed that Thais in Chanthaburi province had a moderately positive attitude toward the GMOs and Biological Technology ($\bar{x}$=2.91). When the individual dimensions were considered, knowledge and understanding of GMOs ($\bar{x}$=3.67), impact of GMOs on the nation ($\bar{x}$=3.50), and its impact on food security ($\bar{x}$=3.11) significantly affected the attitude toward GMOs and biological technology at a high level.

It was recommended that before setting a biological safety policy, the government should build its people's body of knowledge on GMOs and biological safety and provide an opportunity for people at all levels to express their opinions on GMOs and biological technology. However, there were still some conflicts of information on GMOs and biological technology. Collection of data from all related fields, such as science, biology, agriculture, economics, and social sciences, should be carried out. There should be zoning for GMO cultivation. Moreover, research should be conducted to find out whether people across the country accept or reject GMOs and biological technology

Keywords: GMOs, Biological Safety, Organic Agriculture.

Introduction

The concept of biological safety is a new issue that has been widely debated, as it is in the process of research and development, so not much information can be given to the public. In addition, there is conflict of information on usefulness, worthiness, harm or risks of GMOs and biological technology.

There has been much controversy on utilizing biological technology. Several issues that have been debated are, for instance, its benefits or usefulness (Narin Ruengpanitch, 2010:132-133), constraints in its adaptation, and its application in

households and large-scale industries. These issues concern some impacts on related systems, i.e., the eco-system and the environment, the economic system, the social system, the health system, including the judicial system (Narin Ruengpanitch, 2010:235-245).

The introduction of biological technology, especially, GMOs to increase the efficiency of agricul tural production has recently received much attention. However, there is no clear conclusion on whether genetic modification has produced good or bad effects. According to the report of the International Assess–ment of Agricultural Knowledge, Science and Tech–nology for Development (IAASTD) (2009), more than 400 scientists had conducted a study on this issue for more than 4 years under the support of international organizations, such as FAO, UNEP and World Bank, including governments of many countries. They have concluded that until now there has been little under–standing of the impacts of GMOs and that there have been insufficient and conflicting data on the issue.

The term GMOs is shortened from genetically modified organisms. They are living things plants or animals or bacteria or microorganisms which are genetically modified. In the genetic engineering process, some genes of a living thing are put into another living thing, resulting in a new species that has desirable traits. The living thing into which the genes are put is a GMO. For example, genes of a polar fish are put into tomatoes so that the latter can be grown in the cold climate or genes of a certain virus are put into papayas so that the latter can be immunized against papaya ring spot virus (PRSV). The plant which is genetically modified in the genetic engineering process can be called a "transgenic plant", while the term GMOs is used to call general organisms that are genetically modified. GM plants now on the market are, for instance, soybean, corn, potato, tomato, papaya, cotton, canola (oil-plants) and squash (Greenpeace, 2011; Thai Biotech.info, 2016).

Due to great concern over biological safety worldwide, there has been much controversy on the benefits and harmful effects of GMOs, since there is no clear scientific proof on this matter. There are both organizations that agree to the concept and those that are against it.

Organizations that support the biological safety concept are, for instance, the Office of the Cane and Susan Board in Thailand, the United Nations Environment programme (UNEP), AATF, ABSF, ABSR, AnBio, Cleaning House BCH, BSBA, CIB, CGIAR, Danforth Research Institute, EFB, FARA, GMO-safety. en, IDS, IPBO, IFPRI, ISAAA, ISBR, PeruBiotec, SAIHP. These organizations have argued that GMOs have various advantages, since they are products of the advance of biotechnology and molecular biology, especially genetic engineering, which has rapidly progressed to a great extent. What drives scientists and research institutes across the world to devote their time and energy to genetic engineering and many organizations to offer huge research funds to this field of study is the determination to upgrade the quality of life of people around the world in terms of nutrition, medical care, and public health. Therefore, genetic engineering is regarded as a great genomic revolution.

Genetic engineering is beneficial for the agriculturalist. It can help develop new plant species that are endurable to the environment, or that can protect themselves from plant enemies like viruses,

molds, bacteria, insects, or even insecticide, pesticide and herbicide. Some new plant species can tolerate drought, salty soil, acid soil. In addition, genetic engineering can help develop new plant species that are fresh for several days (e.g. slowly ripe tomatoes) and thus can be transported to faraway places without being decayed. These desirable traits are called "agronomic traits". Such agronomic traits are good for not only agriculturalists but also distributors.

Besides, genetic engineering benefits the consumer. It helps to produce vegetables and fruits that are bigger or more nutritious such as oranges or lemons with more vitamin C, or fruit trees that yield more fruit. Moreover, genetic engineering helps to create new plant species that are commercially beneficial such as new species of flower plants or decorating plants that are more exotic, larger in size, varied in color, and more durable. These quality traits result from genetic modification.

Many industries also gain benefits from genetic engineering. Since the good traits of the plants help to decrease chemical use and to have more yields, the production cost can be reduced. Consequently, raw materials from the agricultural sector, such as soybean meal and animal feed, are cheaper, thus increasing price competitiveness.

Besides GM plants, there are several kinds of GMOs currently used in food industry, such as an enzyme for producing vegetable and fruit juices and Chymosin enzyme, which has for a long time been used to produce almost all kinds of cheese.

Vaccines or other medicines in the medicine industry are all now produced from GMOs. In the near future, we may have cow milk with some hormone produced from GMOs, which is necessary for human beings.

One benefit of GMOs for the environment is reducing or even getting rid of chemical use because plants can protect themselves from their enemies. Therefore, environmental pollution resulting from chemical use can be reduced, including harm to the agriculturalist as a result of spraying a high volume of chemical substances (except for some cases such as plants tolerating to herbicide, which might lead to more use of herbicide produced by some companies; however , this is still controversy.)

To conclude, the organizations that support GMOs believe that GMO development can give rise to biological varieties because outstanding genes can be selected to be shown in organisms of different species.

On the other hand, organizations that disagree with GMOs because of concern over biological safety are, for example, Greenpeace Bio-path Foundation, Foundation for Consumers, United Organization for Consumers and the Alternator Agricultural Network. These organizations point out the following problems.

Consumer risks. There might be some contaminated nutrients in food. Some GM plants might produce some undesirable substances or some kinds of undesirable protein, which are different from those derived from naturally bred plants, because some genes not naturally found in the plants are put into them. Those substances or proteins might negatively affect consumer health. In some cases, some substances in GM plants are not of the same quantity as in natural plants. The biological system of plants is much more complex than that of bacteria or virus, so all the outcomes cannot be predicted.

Apart from plants, animals, such as cows, pigs, chickens and others that receive recombinant growth hormone, might not have the same quality as naturally bred animals. Or there might be some residues in GM animals. However, there is no confirmation in this issue. Since the biological system of animals is far more complex than plants and micro-organisms, there might be other unexpected impacts from genetically modified animals, which can have other toxic residues. For this reason, to genetically modify animals for food, it is necessary to evaluate all the procedures for safety more seriously than genetic modification of plants and micro-organisms in order to know the degree of consumer risks.

Next, drug resistance might occur because in GMO production, a selectable marker is used, which is usually a kind of genes that builds an antibiotic resistance substance. There might be an antibiotic resistance substance. If a consumer of GMOs takes an anti-biotic drug, the treatment will not work. However, scientists say that the chance is very rare and can be avoided or corrected. If a micro-organism in the human body gets a marker gene in its DNA, this may give rise to a new breed of micro organism, which can be anti-biotic. If some genes, such as 35s promoters and NOS terminators, are in GMO cells and are not digested in the stomach or intestine but are absorbed to normal cells of a human being who eats GMOs, it is likely that human genes might be changed.

Environmental risks. Some poisonous sub–stances in herbicide Bt toxin often put in to GMOs, for instance might affect insects and other living things useful for plants. The problem of contamination results. Although growing GM plants is said to help reduce chemical use, in practice GM plants are grown for commercial purpose by making the plants tolerate glyphosate (or the trademark "Round-up" manufac–tured by Monsanto), a herbicide which is popular in many countries. Thus, more agriculturalists use glyphosate, causing more contamination of the environment and human health. This affects not only chemical users but also people in the vicinity, including perhaps the consumer.

Although glyphosate does not immediately produce a deadly effect, it might accumulate in human bodies and cause bad health in a long run. If often used, glyphosate can produce super weeds which can endure glyphosate itself. The introduction of GMOs to the wide environment might affect bio-diversity, leading to the occurrence of new species whose traits are superior to original species, which might cause the latter to become extinct. Or some outstanding traits might appear in undesirable species. Or plant enemies might resist herbicide, giving rise to super bugs or super weeds.

Socio–Economic problems. There might be other problems than scientific problems, such as monopoly of GMO products by private companies with GMO patents, leading to food insecurity and people no longer being self-reliant, including the problem in the international trade arena due to imposition of GMO trade barriers by some countries.

Complex management of GMOs and risks is necessary to have safety and more benefits than harm. So far there have been no report of harmful effects from GMO consumption; however, concern about risks of GMO use is difficult to avoid.

Attempts have been continually made to publicize the concept of GMOs in Thailand since 1995, starting with the Department of Agriculture permitting

the import of BT cotton seeds for cultivation tests. Also, the committee for testing biological safety of GMOs was set up with three representatives from Monsanto Company invited as committee members. The committee attempted to push several Thai governments to pass the law for legitimacy of genetic modification. Meanwhile, there were continually movements against GMOs by scholars and NGOs, which ended after the submission of the (drafted) Biological safety Act, B.E. ... for the Cabinet's consideration on December 15, 2015 because the draft was repealed and prohibited from being submitted for consideration again by the order of General Prayuth Chan-Ocha, the present Prime Minister (Sueb Nakasatien Foundation, 2015).

The GMO issue is related to many sectors. Related government organizations, like the Office of National, Economic and Social Development, the Ministry of Industry, the Office of the Public sector Development Commission, have suggested that studies on GMOs should be conducted before the government sets any policy on this matter, that the roles and responsibilities, missions and authority of the responsible agencies should be clearly defined, and that the operational procedures should be set and the public opinion surveyed before the passage of the law (Isranews Agency, 2015).

Therefore, this survey was conducted from May to December, 2016 with the purpose of revealing the attitude of Thais in Chanthaburi province toward GMOs and biological technology so that some recommendations could be made on the direction of Thailand's agricultural development policy and the drafting of the Biological Act.

Research Methodology

Population and Sampling. The Population of this study was Thais living in Chanthaburi province during the study. There were 522, 716 people in total (Office of National Statistics, 2016). In the application of probability sampling, cluster sampling was employed and the samples in each of the ten districts (10 clusters) were selected by simple random sampling. Taro Yamane's formula was calculated to obtain the number of samples with the confidence level of 95% and standard error of not higher than 5%. There were 400 samples in total. Table 1 shows the numbers of population, samples, and copies of the questionnaire in each cluster.

Table 1: Numbers of Population, Samples and Copies of Questionnaire

	District	#of population	#of samples	#of copies of the questionnaire
1	Muang	444,58	58.40	58
2	Kaeng Hang Maew	252,99	33.23	33
3	Klung	478,48	62.85	63
4	Tha Mai	205,13	26.94	27
5	Na Yai-arm	29,733	39.06	39
6	Pong nam Ron	14,428	18.95	19
7	Ma-Kham	37,791	49.64	50
8	Soy Dao	41,701	54.78	55
9	Leam Sing	30,326	39.83	40
10	Kitchakuot	12,385	16.27	16
	Total	304,482	399.95	400

The variables in the study are shown below.

Independent variables	Dependent variable
Personal information: sex, age, education, monthly income, occupation	
Knowledge and understanding: of agriculture and GMOs	Attitude of Chanthaburi people toward GMOs and biological technology
Safety: health, eco-system safety	
Food security Impacts on the country: Social impacts economic impacts	

Research Instrument.

The data for qualitative research were taken from Cabinet for consideration and other documents related to biological safety in Thailand and other countries from the past until present, including related research in and outside Thailand.

Also, a survey questionnaire was used as the research tool for quantitative research. It was composed of 3 parts:general information, the Measure ment of the attitude of Thais in Chanthaburi toward GMOs and biological technology, and suggestions on agricultural development policy and the biological Act.

The tool for quantitative research, was tested for its reliability with forty samples. The value of each aspect indicated the high reliability of the questionnaire as are shown in table 2.

Table 2: The value of each aspect indicated the high reliability of the questionnaire

Variable	Alpha Coefficient
Knowledge and nderstanding of agricultural methods and GMOs	.830
Safety	.852
Food security	.947
Socio – economic impacts on the country	.881
Overall	.940

Results of the study

Results of the qualitative research. First, the Biological Safety Protocol, which records an agreement on international trade control to deal with the use of GMOs, is described to see what has happened in the international arena, and then the current state of GMOs in Thailand is briefly stated, including what has happened to the draft of the Biological Safety Act, as these might have some impacts on conservation and sustainability of bio-diversity and on human health risks as well.

The Biological Safety Protocol, which forces different countries to acknowledge and approve GMOs before importing GM crops, is called "Advance Informed Agreement (AIA)". That is, before any member country exports GMOs, which may unintentionally release toxins into the environment, it must seek approval from the import countries. All the countries agree to define responsibility and revise the regulations every 4 years.

However, there are still some problems that cannot be solved. For example, what is the appropriate amount of information to be given for

transporting GM crops across the borders? What should be done if a loss occurs as a result of letting GMOs enter the wide environment? Large GMO producers like the USA, Canada, Argentina, including other GMO supporting countries known as the Miami Group, have not yet signed this protocol.

In some countries, GM foods are labeled so that consumers will know that such foods on the market have GMO components or have been made from raw material produced by the genetical engineering method. Connecticut and Maine are the first two states in the USA that passed the law on putting a label on GM food. This indicates the approval of food made from GM crops. Meanwhile, the USA drafted a law to cover up the food sources entitled Deny Americans the Right to Know Act (Dark Act) pushed by Monsanto and a giant food and agricultural corporation. This Act was approved by the Congress with 150 out of 275 votes on July 23, 2015. The Dark Act caused the Act on putting a label on GMOs of at least 3 states to be automatically abolished and another 26 states to stop enacting such a law automatically. Consequently, American consumers denounced that the Dark Act violated the right of consumers and democracy.

According to Biothai Foundation (2015), which made a conclusion on rejecting GM crops, EU governments made a resolution with the majority votes of 480 to 159 and 58 abstentions that the member countries could set their own direction and policy on GMOs.

The countries that do not want to grow GM crops and have got approval from the EU government have given both socio-Economic and environmental reasons for not doing so. That is, they do not want to have GMO contamination in other products. They also state that GM crop cultivation should depend on the agricultural policy of individual countries. This reaction has happened in spite of the fact that some GMOs have passed the evaluation of the health and environmental impacts by the European Food Safety Authority (EFSA).

December 31, 2015 was the last day for member countries that did not want to grow GM crops to seek approval from the EU Council. Sixteen countries which sought the approval were Germany, France, Italy, The Netherland, Denmark, Poland, Austria, Greece, Lithuania, Latvia Slovenia, Cyprus, Bulgaria, Luxemburg, Hungary and Cro-Asia. Other four key areas were Scotland, the North Ireland (in the United Kingdom) and Wallonia (in Belgium). Most farmers (70%) have still grown non-genetically modified strains.

According to USDA (2015), only 5 out of 28 countries in European Union grow GM crops. They are Spain (750,000 rai), Portugal (37,500 rai), the Czech Republic (10,625 rai), Slovakia (2,500 rai) and Romania (13,125 rai). About 93 percent of all the areas where GM crops are grown are in Spain and only GM corn, MON 801, is grown there.

Noticeably, the area for growing GM crops in Europe has been gradually decreasing. Countries that used to grow GM crops, such as Germany, France and Poland, stopped to do as, resulting in a small proportion of GMO cultivation area, only 0.07 percent of the total agricultural land of 1,100 million rai.

In addition to the afore-mentioned counties that reject GMOs, the other EU members for example, England, Sweden Ireland, Hungary, Slovenia, Estonia,

Malta, and others do not grow GM crops. Countries outside Europe Union, such as Russia or countries where leading biotechnology companies are located, like Switzerland and Norway, grow no GM crops. Not only does Russia oppose GMO cultivation, it also rejects the import of GMOs as raw material for production of all kinds of food.

Independent researchers cannot compare the GMO cultivation and the normal strain cultivation because of some restrictions, such as patents and agreements of the GMO use with GMO companies. Therefore, impacts of GMOs on health and the environment cannot be proved.

At present Thailand does not permit GM crop cultivation or GM animal-raising for commercial purpose. It only allows importing GMOs for experiments to make sure that GMOs do not affect health of its people, animals and plants. Permission will be given case by case for biological safety.

Thailand does not allow GM crops to be grown liberally in any agricultural area. It also does not permit import of forty kinds of GM crops, which are, for example, rice, corn, soybean, muskmelon, green bean, tomato, papaya. But ready to eat food is an exception. After the government's announcement in 1995, there are eight GM plants that were officially imported for experiments. They are, for instance, tomato, corn and papaya.

To set a policy on agricultural development and to pass the Biological Safety Act, it is necessary to consider Thailand's status in the international arena and the controversial issues of GMOs and biological technology at present. Currently, Thailand has a policy to promote and support sufficiency economy and several governments have implemented an organic agriculture strategy. Such a policy and strategy are totally in the opposite direction of GMO cultivation in the production area.

Results of quantitative research. Most respondents were female (53.8%) and were more than 40 years old (34.3%). Most of them had a Bachelor's degree (29.8%) and earned a monthly income of 10,000-15,000 baht (38.0%). The majority were engaged in general employment (35.8%). See table 3.

Variable	Percentage (Frequency)
Sex	
Male	46.0 (184)
Female	53.8 (215)
No answer	0.3 (1)
Total	**100.0 (400)**
Age	
Below 20	6.5 (26)
21 – 30	29.0 (116)
31 – 40	29.8 (119)
Over 40	34.3 (137)
No answer	0.5 (2)
Total	**100.0 (400)**
Education	
Below primary school	0.3 (1)
Primary school	19.3 (77)
Secondary school	17.8 (71)
High school	15.8 (63)
Vocational school	13.8 (55)
Bachelor's degree	29.8 (119)
Beyond Bachelor's degree	3.3 (13)
No answer	0.3 (1)
Total	**100.0 (400)**
Income	
Below THB10,000	31.8 (127)
THB10,000 – 15,000	38.0 (152)
THB15,0001 – 20,000	15.5 (62)
Over THB20,000	13.3 (53)
No answer	1.5 (6)
Total	**100.0 (400)**
Occupation	
Unskilled labor / general employment	35.8 (143)
Agriculturalists	22.8 (91)
Public officers	18.0 (72)
Entrepreneurs	14.5 (58)
Students	5.5 (22)
Others	3.3 (13)
No answer	0.3 (1)
Total	**100.0 (400)**

Knowledge and understanding of agriculture and GMOs

Traditional agriculture. Most respondents had a very good knowledge that traditional agriculture relied on suitable factors and suitable time for cultivation.

Chemical use. When the respondents were classified by age, education, income and occupation, those aged between 21 – 30 (37.1%), those with a Bachelor's degree (39.5%), those with a monthly income of over THB20,000 (43.4%) and those who were entrepreneurs (41.1%) were found to support the use of chemical whereas 35.3%, 24.4%, 28.3% and 29.3% respectively were found to disagree that chemical use in agriculture could get rid of crop enemies to maintain and increase the yields.

Scientific advance. Most respondents (49.2%) had a moderate knowledge and some (36.2%) a good knowledge of the fact that scientific advance helped to improve or develop plant species to achieve higher quality.

Application of technology.Most respondents (50.3%) had a good knowledge and understanding of the fact that application of technology to agriculture could lead to higher efficiency and higher yields.

GMOs. Most respondents had a good knowledge that GMOs could (44.5% agreed and 21.9% strongly agreed) give rise to new strains that could endure the environment and plant enemies. Likewise, most respondents (43.7 %) had a good knowledge and understanding that GM crops could help reduce chemical use to get rid of plant enemies. Still, some respondents were not sure whether GM crop could increase the yields (14.4%) or whether produces from GMO cultivation could be kept for a long time (16.8%).

On the other hand, the respondents disagreed (46.3%) and strongly disagreed (32.8%) that agriculturalists could get lower return from growing GMOs. But most (47.6%) agreed and some (25%) very strongly agreed that monopoly of GM crop seeds could reduce the native species. With regard to safety of GMO consumption, about 33.9% agreed that GMOs provided were more nutrition than natural food, while 27% disagreed with the statement. However, 22.9% of the respondents were not sure about nutrition.

Food safety. The numbers of those who strongly agreed, agreed, disagreed, strongly disagreed that GMO consumption would not affect present health were very close. Most respondents (35%) agreed that consumption of GMOs would not affect future health, while some (2407%) were not sure were about it.

Impact on biodiversity. Most respondents agreed (49.2%) and strongly agreed (24.1 %) that the spread of GM crops adversely affected biodiversity, causing the original species to become extinct and that GM crops effected change in the eco-system in the future while 24.5% were not sure about the impact on biodiversity..

Food security. Most respondents agreed (36.6%) and not agreed (25%) that GMOs enabled people to access sufficient, safe and nutritious food and that GMOs could help produce a larger quantity of food. They agreed (41.8%) that GMOs would contribute to cheap food, new food products, and easy

access to a variety of food sources. However, 20.9% of the respondents disagreed on these matters and 17.9% were not sure about them.

Socio –Economics impacts on the country. Most respondents agreed (43.9%) and strongly agreed (30%) that people should be given information about GMOs. About 47.1 % agreed that the govern– ment should pass the law to have GM products labeled so that people would know which products were genetically modified. About 46.7% agreed that development of GMO production could reduce the production cost, give more yields, and increase income. The majority of respondents (51.7%) agreed and 25.2% strongly agreed that commercial GMO production would make the country face trade barriers set by the countries that did not support GMOs.

Attitude toward GMOs and biological technology. Overall, Thais in Chanthaburi had a positively moderate attitude toward GMOs and biological technology ($\bar{X}$=3.39). When the individual dimensions were considered, knowledge and under–standing related to GMOs ($\bar{X}$=3.67), socio–Economics impacts on the country ($\bar{X}$=3.50) and food security ($\bar{X}$=3.11) had an effect on the attitude at a high level, while food safety (2.91) had a moderate effect on it. See Table 4 below

Table 4: Attitude toward GMOs and biological technology

Attitude	$\bar{X}$	S.D	R2	Sig.
1.Knowledge and understanding of agriculture and GMOs	3.67	0.506	0.292	0.01
2. Food safety	2.91	0.556	0.253	0.01
3. Food security	3.11	0.516	0.301	0.01
4. Socio – economic impact on the country	3.50	0.574	0.189	0.01
Total	3.39	0.372		

Table 5: Regression result toward GMOs and biological technology

	SS	df	MS	F	p
Regression	22.404	3	7.468	25.827**	.000
Residual	101.784	352	.289		
Total	124.188	352			

Discussion and Recommendations

Chanthaburi Province has been selected as the geographical area of the study because it mainly consists of agricultural land plenty of orchards, plan–tations, rice fields and traditional and industrial fishery.

Copies of the questionnaire were dis–tributed to people from different walks of life, espe–cially agriculturalists, government officials, and those engaged in general employment.

The samples have a good knowledge and understanding of the type of agriculture they are engaged in, as it has been inherited from generation to generation the knowledge of soil, water, weather, and season suitable for production. Apart from traditional agriculture, they have got additional knowledge of chemical use for agriculture from companies that sell chemical sub stances.

However, the samples still have a moderate knowledge about food safety and food security as it can be seen that both organic farming and non-organic farming have been practiced in Chanthaburi Province. Some unclear results of this study came from the characteristics of the samples and types of farming they have practiced.

Lastly, the impacts of GMOs on the country are not obviously seen because most samples are not well educated and do not have enough knowledge and understanding of related laws and

regulations, so they do not realize the harmful effects of GMOs.

The study of the concept of biological safety and the tendency to support and oppose GMOs and the draft of the Biological Safety Act, revealed that people in Chanthaburi did not have a basic knowledge and understanding about GMOs and their impacts. They have little knowledge about the Draft of the Biological Safety Act. The number of those who had a good knowledge and understanding was small. Therefore, the researchers made the following recommendations.

1 People at all levels should be given the body of knowledge about GMOs and should be encouraged to express their opinions on the agricultural development policy and the drafting of the Biological Safety Act..

2 The Biological Safety Act should be drafted without interference of private companies or foreign organizations.

3 A special organization equipped with experts on GMOs, agriculture and organic forming should be set up. The role, authority, responsibility and mission of this organization should be clearly defined. It should report directly to the Prime Minister. The organization should deeply study the impacts that might occur after the passage of the Biological Act, the commercial direction and the trade position of Thailand in the global arena, and whether Thailand should focus on GMOs or organic forming. The organization should be able to give advice on the issue.

This research found that information about GMOs was not clear and was still in conflict. Therefore, the following studies should be conducted.

1 A comparative study should be made to analyze the data from different angles, such as international trade, science, biology, agriculture, economics, social sciences, etc.

2 A feasibility study should be conducted to build a body of knowledge about GMOs so that Thailand can use it as an academic guideline to accept or reject GMOs.

3 Case studies of different countries should be analyzed and synthesized to determine on how to open the door for GMOs to be grown in Thailand for consumption and for commercial purpose and how it affects Thailand in a short-, mid- and long-run.

4 Impacts on different aspects should be studied carefully, covering the stakeholders in all sections, especially agriculturalists.

5 The direction for setting an agricultural development policy and for drafting the Biological Safety Act should be studied in details with caution to obtain a clear policy that can be implemented and the Act that can be effectively and efficiently enforced.

6 Evaluation should be made on the outcome of enforcing the Biological Safety Act to see how it affects the country socially, politically, legally, economically, and also how it has an impact on international relations.

Those who conduct studies on GMOs must have suitable qualifications. They must understand all aspects of both support and opposition.

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