

Analyzing the US Genetically-Modified Soybean Consumption: Its Implication in Indonesia

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ABSTRACT

Agricultural production problem causes the rising of GM food development. Indonesia, as a country with the significant amount of soybean consumption, mostly imported from the US to meet the needs of soybean consumption. As the factors that may affect the consumption, GDP, education index, and food security become the variables in this study. This paper examines the association between education, income, food security, and genetically-modified soybean consumption. Using secondary data of US from 2006-2015, the result shows a direct association between food security and GM soybean consumption. However, education and income tend not to have a significant relationship. From the results, this paper discusses the factors that associate with GM soybean consumption and its implication in Indonesia.

Keywords

GM Food, Education, GDP, Food Security, Consumption

1. BACKGROUND

A genetically modified organism (GMO) or genetically modified (GM) food is the result of transforming genes in an organism that are already present from the use of recombinant DNA biotechnological procedures [1]. These changes are not found in the original organism with the natural mechanism. The genetic engineering approach can reduce production costs since it is used to produce superior quality against pests or herbicides, so pesticides are no longer necessarily needed [2]. Besides, since the bioengineering could create plants produce more nutritious food, the nutritional implications are also often mentioned as a tangible benefit for consumers. The growth of genetically modified (GM) food has been a concern of worldwide public controversy and considerable interest to discuss [3].

The United States, which supports GM, has also researched these engineered foods, stating that genetically modified foods have no adverse effects on people who consume it for the short-term. The United States Department of Agriculture (USDA) also organizes all genetically-engineered (GE) plants

before environmental release, including the small and large field trials, interstate movement, import, and, commercial (farm) cultivation. In contrast, even though agricultural land in developing countries is getting smaller because the land is built into industrial and housing areas, this issue has not been an interest in many developing countries. Rector of Paramadina University Firmanzah in National Seminar of Political Economy of Food Security said the transfer of productive agricultural land into industrial and business area is not only happening in Indonesia alone. This also happens in China and other developing countries [4]. Whereas, developing countries have to look for more efficient methods of agricultural production to utilize the remaining land.

The USDA's data show that soybean is the variety of GM food which is the most widely planted in the US. Equally important, US soybean consumption is particularly high, even though most of American is more familiar with the terms of soybean crushings instead of the soybean itself. Similarly, soybeans are widely used for Indonesian food product, such as tempeh and tofu. Furthermore, most of the imported soybeans are from US and

transgenic (GM food). Even though the consumption of GM soybean is also high, the US can manage its self-sufficiency and do export to Indonesia. For these reasons, reviewing data from the US as a reflection to study about Indonesian genetically-modified soybean consumption, is conducted. Therefore, it can withdraw its implication in Indonesia. The discussion in this study uses three independent factors namely education index, Gross Domestic Product (GDP), and food security. The objective of this study is to identify the association between education, income, food security, and genetically-modified soybean consumption. Subsequently, further discussion about the implication of genetically-modified soybean consumption in Indonesia will also be undertaken.

2. LITERATURE REVIEW

Food is the foundation of food consumption schemes, defines as the consumption of certain food items and their combination of dishes and food. These patterns show great temporal and spatial tribes, especially those used by economic elements, cultural aspects, and distillation commodities [5, 6]. In general, the pattern of food consumption and eating habits are influenced by various factors, such as environment, food availability, economic considerations, the existence of abstinence and taboo, and also education and awareness of nutrition [7, 8]. Other elements such as preferences, habits, availability, tradition, and income also influence these schemes [9]. From the several elements, GDP, Education, and Food Security are often selected as the main variables in previous studies about food consumption. So, the variables used in this research are Gross Domestic Product (GDP), Education, and Food Security.

2.1 Gross Domestic Product (GDP)

The gross domestic product per person or GDP per capita is calculated as the gross domestic product of a country divided by its population [10]. Whereas the definition of revenue is a gross inflow of economic benefits during the period arising in the ordinary activities of an entity when those inflows result in increases in equity, other than increases relating to contributions from equity participants [11]. So it can be concluded that income is something that a person obtains in economic form, and if he is in a country with a large population, this will affect the amount of GDP of that country. Besides, a person's condition can be measured using the concept of income that shows the sum of all money received by a person or household for a certain period [12]. However, before 2011, it was difficult to identify how many people were contributing to GDP versus how many were not [10].

The amount of GDP of a state will also affect the consumption pattern of the community. As income increases, people's consumption or household final consumption expenditure patterns will tend to increase and choose to consume goods or use services that match their income levels, but if income tends to decline, they will postpone spending until incomes rise again. Besides, food consumption is also one of the expenses paid by the community and same as household final consumption expenditure when earnings increases, people spend more money on food [9, 13]. But concerning food selection for consumption, people will be more concerned about the safety of the food than by choosing it through other factors such as their income level or the country's GDP level. It is because the higher the price of food cannot guarantee the higher the safety of the food.

2.2 Education

In general, education is a structure of learning such as knowledge, skills, and habits of a group of people through teaching, training or researching from one generation to next generation. Usually, education often held under the guidance of others such as at school or courses, but it can autodidactic too. The United Nations Development Programme releases the Human Development Index (HDI) that contains education index, life expectancy index, and income index annually. The education index in HDI is calculated from the means years of schooling index and the expected years of schooling index. Education is the main constituent of prosperity and is used in measuring the life quality and economic growth [14].

The higher level of a person's education will impact to the greater the knowledge. The high level of education will be proportional to the study period so that the duration of study can also be used as an indicator of the depth of a person's knowledge, especially the Genetically Modified (GM) food problem. The Huffington Post and YouGovresearched about the security of consuming GM food in the US. The results of a YouGov or Huffington Post survey of 1000 US adults interviewed April 8 - 10, 2016 shows 49% of respondents with a college degree said they believe GM foods are generally safe to consume, compared with 36% who had completed some college and just 22% who completed high school or less [15]. However, the impact of education index in the United States to GM food's soybean crushing consumption doesn't contribute significantly.

2.3 Food Security

The Plan of Action of the Rome Declaration stated in the World Food Summit of 1996, and

reconfirmed in 2002 [16], defines food security as: “exists when all people at all time have both physical and economic access to sufficient food to meet their dietary needs for a productive and healthy life”.

The problem of advanced food security is the affordability and accessibility while developing countries are producing or securing food. Chairman of the Commission for Safety of Genetically Engineered Product Biology of Indonesia, Prof. Agus Pakpahan in the National Biotechnology Seminar organized by the Faculty of National Biology University revealed GM food could be one of the strategic instruments for the future of food availability [17]. GMOs can contribute to higher food and integrated growth. As well as anti-members to access farmers. The results of research in India, states that agricultural production using GM cotton has a positive impact on food security and food quality [18].

According to the International Services for Agri-Biotech Applications Acquisition (ISAAA), data from 1996 to 2014 shows that GM food contributes to food security, increase the production of US\$150 billion, serving a better environment by saving 583.5 million kg of pesticides in 1996-2014. In 2014 alone reducing CO₂ emissions by 27 billion kg, preserving biodiversity in the period 1996-2014 by saving 152 million hectares of land [19], decreasing poverty by helping up to 16.5 million small farmers and their families. GM crops can intensify productivity and significance. Also, it can contribute to economic development, resource-poor in the world, and poverty alleviation for small farmers [20].

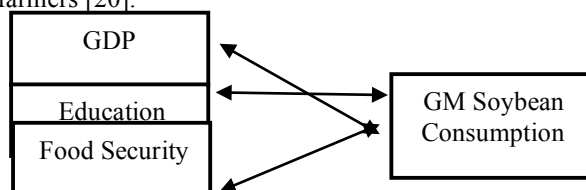


Figure 1. Research Model

Figure 1 is the research model of this study. Research model above is about the association between independent variables and a dependent variable.

3. RESEARCH METHOD

Research design which is suitable for the topic of this study is causal. The causal design is a method for collecting and processing data to help the researcher understand the correlation between variables [21]. In this research, the data used are quantitative data. Also, the data collected are secondary data obtained from reliable sources, namely Human Development Reports United Nations Development Programme, World Bank, and United

States Department of Agriculture (USDA). Data from Human Development Reports United Nations is Education Index, data from World Bank is Gross Domestic Product, data from USDA are Food Security Index and Soybean Consumption (See Table 1).

Table 1. Data in the US from 2006-2015

| Year | GM Soybean Crushing (million bushels) | GDP Percapita | Education Index | Food Security Index |
|------|---------------------------------------|---------------|-----------------|---------------------|
| 2006 | 1,808 | 46,437 | 86.95 | 89.06 |
| 2007 | 1,803 | 47,897 | 87.63 | 88.89 |
| 2008 | 1,662 | 48,330 | 88.04 | 85.41 |
| 2009 | 1,752 | 46,930 | 88.04 | 85.31 |
| 2010 | 1,648 | 48,304 | 88.70 | 85.49 |
| 2011 | 1,703 | 49,721 | 88.98 | 85.06 |
| 2012 | 1,689 | 51,389 | 88.98 | 85.49 |
| 2013 | 1,734 | 52,721 | 88.98 | 85.72 |
| 2014 | 1,873 | 54,640 | 90.00 | 85.95 |
| 2015 | 1,870 | 56,394 | 90.00 | 87.34 |

After collecting the data, the next step is calculating and analyzing the data by using SPSS. The method for this calculation is correlation analysis to know the correlation between independent variables and dependent variable [22].

4. DATA ANALYSIS

In this section, researchers will explain the results of data analysis. The data used is data of ten years, from 2006-2015. To begin with, here is the research model of this study that has been set.

Table 2. Pearson Correlation

| Correlations | | | | |
|---------------|------------|--------|-----------|---------------|
| | GM Soybean | GDP | Education | Food Security |
| GM Soybean | 1 | | | |
| GDP | 0.485 | 1 | | |
| Education | 0.254 | 0.911 | 1 | |
| Food Security | 0.589* | -0.150 | -0.463 | 1 |

Table 3. Significant Value of Correlations

| Correlations | | | | |
|---------------|------------|-------|-----------|---------------|
| | GM Soybean | GDP | Education | Food Security |
| GM Soybean | | | | |
| GDP | 0.77 | | | |
| Education | 0.239 | 0.000 | | |
| Food Security | 0.036* | 0.339 | 0.089 | |

Center for Food Safety, MSNBC, states that 91% of US soybeans are genetically modified. Therefore, we multiply the data of US Soybean Consumption by 91% so that its result a data of US Genetically-Modified (GM) Soybean Consumption. From the data analysis of GDP and GM Soybean Consumption in the US from 2006 to 2015, it results in Pearson correlation value of 0.485 and significant value of 0.77 ($p > 0.05$). The Pearson correlation value analysis between Education and GM Soybean Consumption is 0.254 with the significant value of 0.239 ($p > 0.05$). Lastly, data analysis of Food Security and GM Soybean Consumption shows that it has Pearson correlation value of 0.589 and significant value of 0.036 ($p < 0.05$).

Based on these data, the factor that influences on the dependent variable is Food Security. This happens because the significant value of correlation between these two variables is 0.036, which is less than a significant value at 0.05. This means Food Security has a positive and significant relationship to GM Soybean Consumption.

5. DISCUSSION

This study reveals that food security is directly associated with GM soybean consumption. Food security itself consists of three indicators, namely availability, affordability, quality and safety. Studies have shown that food availability can affect consumers' purchasing decision and result in higher sales of food items [23, 24]. The higher the food availability, the higher the food consumption as well. In reverse, consuming GM food can also be a solution for keeping food availability in a country, because GM food can increase agricultural production with better quality and nutritious result. In economy, the higher the product availability, the cheaper the price will be. Similar to this case, the higher food availability because of GM food, the soybean price will be much more affordable. In fact, lack of affordability is related to low consumption of the latter [25]. It supports this finding that when food is much more affordable, consumers will tend to buy it. Also, food quality and security play a big role in food consumption pattern and consumers attitude [26]. It happens because as well as consumers know that food is qualified and secured, consumers will not hesitate to consume the food. Moreover, certification from trusted organizations or government institutions such as Center of Food Safety and Applied Nutrition (CFSAN), Food and Drug Administration (FDA) or BPOM in Indonesia, will convince consumers to perceive that it is safe to eat the food.

In contrast, this study suggests that the GDP does not have a direct association with GM soybean consumption. The increase in the economy indicates that food consumption and food production levels

will increase as well. However, the food selection process of individual will be different from each other [5]. It means, although consumers have a high economic capacity, they will not be so much affected by that factor once they choose and decide what they are going to eat. Therefore, GDP does not affect the consumption of GM food as a different form of food selection itself.

Along with GDP, education also does not indicate a significant association with GM soybean consumption. Works of literature consider that there is a relationship between education and food consumption [27, 28]. Education is very related to perception. However, Frewer et al. [29] reveal that consumers who favour the GM food are more likely to trust a source which promotes its benefits as their source of information to perceive how GM food is. Lusk et al. [30] support the view by stating that consumers' response to information depends on their prior acceptance of GM food. Moreover, US consumers do not have sufficient information in detail what they are consuming, and they have trust on the safety governmental policies that permit GM food to be on the market, so they are more tolerant with GM products [3]. Thus, in the US, education does not associate with consumers decision to eat GM food.

6. IMPLICATION

Food security problems are one of the most common problems in developing countries. Indonesia, as one of the developing countries, imports 1.96 million tons of soybeans from the US in 2017, whereas Indonesia is an agrarian country that has great potency in agriculture [31]. The US, as the largest GM soybean producer has successfully utilized genetic engineering technology in its agricultural production process. From the US, it can be learned that actually, Indonesia can adopt its technology to increase domestic soybean production. In fact, Indonesia still uses traditional methods for agricultural production, which sometimes fail to overcome weather problems, which result in lack of product quality and crop failure. Therefore, by adopting the technology, Indonesia does not need to import any more.

To introduce this technology, the government should hold socialization to farmers. For instance, Ministry of Agriculture delivers elucidation about the benefits of using the technology and how to use it. So, the farmers will understand how to optimize their soybean production with that biotechnology. Similarly important, consuming GM products must be balanced with knowledge about the product itself. Hence, a campaign about GM food is also necessary to give understanding to Indonesian consumers. This campaign will convey detail

information about GM food and a safe way to consume it.

With the adaptation of this technology, it is expected that farmers can boost their production. Through the increase of soybean production, Indonesia can push the sales of soybean domestically or abroad. The result of the sales will affect country's GDP levels and have a positive effect on economic growth. If Indonesia adopts GMO technology and succeeds in producing large quantities of agriculture product, Indonesia's GDP will also increase and improve the welfare of its people.

On the other hand, to increase public welfare by keeping pace with the safety of consuming GM food products, consumers must remain selective in sorting and selecting products to be consumed. One way can be done, is by checking the product label. Product labelling is performed by the government through a trusted institution. For instance, the United States of America that provides a special statement on the labelling of GM food products by the American Association for the Advancement of Science (AAAS) [32]. In Indonesia, there is a food and drug supervisory agency or BPOM that provides supervision through labelling of food and drug products in the country. Also, government policy to reinforce restrictions on the consumption of GM food can be done. Therefore, the government can control the society's consumption of GM food. Besides, risks that have been the concern of many countries can also be under government supervision. This is conducted to provide safety limits on the GM food consumption.

Not only for soybean production, but GM technology can also be implemented for other agriculture products, such as rice, corn, cotton, etc. The progress of GM food produced by a country increases the availability of agriculture products. So, it is expected that Indonesia will increase its capability to do self-sufficiency in providing food. If a country can meet its domestic needs and has sufficient availability to meet its foreign market share, then the country may trade abroad. These implications can be applied to facilitate the problem solving faced by Indonesia.

7. CONCLUSION & FUTURE RESEARCH

The results of this research on GM soybean consumption is not related to the level of GDP and education index but is directly associated with food security factors. In the discussion about GM food, this study only focuses on soybean product, because soybean is a product that has largest market demand in Indonesia along with the case of a large amount of import from the US. Also, this study is supported by secondary data originating from several official websites owned by the United States government for the last ten years (2006-2015). However, the use of

secondary data has limitations regarding differences in the main objection of data collection that makes obstacles in identifying and interpreting the data [33]. The other weaknesses of secondary data usage are lack of supervision on the quality of the data [34]. It results in many secondary data sources that provide less valid information and provide less accurate research results, particularly in the acquisition of GM food data itself. Limitations of the data obtained as well as the short duration of time have an impact on the lack of supporting information for this research.

For future research, to provide in-depth analysis, it is necessary to collect data directly (primary data) or indirectly (secondary data as supporting data). One of the things that can be done is through a survey to the public to know how far the consumer's knowledge about GM food product. Also, secondary data is required as a complementary data in comparing the results of the research conducted directly. It should also be considered that in using secondary data, more data and longer time periods are needed. Moreover, more varied product data is also necessary to expand the discussion on GM food issue. Thus, the results of the study will be more valid and provide more relevant information to measure GM food consumption. Furthermore, it certainly needs more handling to oversee the consumption of GM food products. Therefore, formulation of GM food products processing strategies and supervision in the form of more assertive and clear regulations is suggested.

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