
Genetically Modified Crops: Experiences, Challenges and Monitoring in the Municipalities of Villasis, Pangasinan and Cuyapo, Nueva Ecija, Philippines

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Abstract

This study was conducted to narrate the experiences of farmers and local government unit (LGU) employees in the Municipalities of Villasis, Pangasinan and Cuyapo, Nueva Ecija on genetically modified organisms (GMOs) particularly GM crops. This study also sought to identify the challenges encountered by the farmers and the LGUs in using GM crops and it also determined how the LGUs monitor and help the farmers in GM crop production. The findings of this study served as the basis for creating possible courses of action that the LGUs could do to help the farmers, especially the low-production farmers, maximize their production by using GM crops. The researchers employed qualitative research design, particularly the narrative approach through the conduct of one-on-one interviews with farmers and focus group discussion with LGU employees then specific themes were formulated to describe the experiences and challenges encountered by the farmers and the LGUs and how the LGUs monitor and help the farmers.

Keywords: genetically modified organisms, experiences, challenges, monitoring, crop production, farmers

1. Introduction

Genetically modified organisms (GMOs) are usually defined as living organisms whose genetic composition has been altered by the insertion of a new gene encoding a desired protein that is expressed (Modern Techniques for Food Authentication, Second Edition, 2018). GMOs range from micro-organisms like bacteria and yeast to insects, crops or plants, animals, fish and mammals.

Genetically modified crops (GM crops) are those engineered to introduce a new trait into the species. Purposes of GM crops generally include resistance to certain pests, diseases, or environmental conditions, or resistance to chemical treatments (e.g. resistance to herbicides). Other purpose of genetic modification of crops is to enhance its nutritional value, as seen in the case of golden rice.

Another definition presented by Richmond (2006), GM crops are also known as transgenic crops. Biotech crops or GMOs contain a gene from different species that gives the crop the

new traits such as resistance to certain insects or herbicides or increased drought tolerance or enhanced nutritional value.

Genetically modified organisms or GMOs are products of agricultural biotechnology. Agricultural Biotechnology according to USDA (U.S. Department of Agriculture) is a range of tools, including traditional breeding techniques that alter living organisms or parts of organisms, to make or modified products: improve plants or animals, or develop microorganisms for specific agricultural uses. It also includes the use of genetic engineering. Biotechnology's use to agricultural crops has been advocated as a creative step forward in the global effort to increase food security.

GM crops were first introduced in the U.S. in the mid-1990s. Most current GM crops grown in the U.S. are engineered for insect resistance or herbicide tolerance. Corn, soybeans, and cotton are the three largest acreage GM crops (Byrne, 2022).

According to Richmond (2006), Asia, being the world's agricultural heartland, plays a critical role in the development and advancement of food biotechnology on a global scale. The Philippines is at the forefront of the agrobiotechnology movement in Asia.

The Philippines was the first in Asia to approve commercial cultivation of a GM crop for animal feed and food in December 2002 when it allowed GM corn planting proposed by Monsanto. For over a decade, it has also accepted GM agricultural imports. Around 70% of its maize is genetically modified. The Philippines has approved the sale of genetically modified crops for food and feed. The Philippines, being an agricultural country, accepted the notion of agricultural biotechnology to help reduce poverty, hunger, and malnutrition (Richmond, 2006).

Before the advent of the Bt technology, farmers in the Philippines used to be concerned that all of their efforts in growing corn would be wasted due to the bug known as corn borer. Asiatic corn borer (ACB), *Ostrinia furnacalis* (Guenee) is one of the nation's most destructive corn pests (Isaac, 2019). Corn borers were a nuisance all year, and the farmers and other individuals who relied on their corn fields for profit were terrified of them. BT corn or the genetically modified version of the said crop was commercialized in 2003 in the country and it was engineered to be resistant to the said pest. In the article written by Isaac (2019), a farmer named Edwin Paraluman pioneered in using the Bt corn variety in 2003 and he said that the first time he planted this variety, he did not see any corn borer in the seven-hectare lot where he planted the Bt corn.

Following the success of Bt corn, our country began developing genetically modified versions of eggplant, cotton, and even rice and so we now have the Golden Rice, Bt eggplant and Bt cotton. Because of the high prevalence of malnutrition in our nation, golden rice, which includes B-carotene, a precursor to Vitamin A, has been approved for production in our country to treat malnutrition and Vitamin A insufficiency. Bt corn and Bt eggplant, on the other hand, are also combined with *Bacillus thuringiensis*, a kind of bacterium that aids in plant development. Furthermore, because it is a better form of the original crop, it has a higher yield and market viability.

At this time, agricultural fields are beginning to decrease due to industrialization, making biotechnology even more vital to fulfill the country's food supply and demand.

2. Literature Review

What are GMOs?

According to the World Health Organization (2014), genetically modified organisms (or GMOs) are defined as, “organisms (i.e. plants, animals or microorganisms) in which the genetic material (DNA) has been altered in a way that does not occur naturally by mating and/or natural recombination.” The technology, which is also referred to as “gene technology,” “modern biotechnology,” and “genetic engineering” among others, allows selected individual genes to be transferred from one organism into another, and also between nonrelated species (WHO, 2014). Farmers may utilize this technique to improve desired features in their crops, such as nutritional content and herbicide resistance. Traditionally, this enhancement has been accomplished through breeding; however, whereas traditional plant breeding procedures are time-consuming and frequently inaccurate, genetic engineering is fast and can accurately develop plants with the precise required characteristic (Whitman, 2000).

A Brief History

While discussions around GMOs have grown ubiquitous in our culture, it's easy to forget that the technology is still very young or it is still relatively new. While food genetic manipulation dates back thousands of years, the modern phenomenon of GMOs and transgenic plants dates back only about 40 years to the very beginnings of recombinant (man-made) DNA research (rDNA), which was discovered in 1973 by Dr. Herbert Boyer at Stanford University; however, momentum really began in the 1980s, when scientists discovered that DNA could be transferred from one organism to another. (Cohen & Boyer, 2022). In 1982, the FDA approved the first GMO, an artificial form of insulin called Humulin, made from gene-splicing techniques. The following year in 1983, scientists created the first transgenic plant, a tobacco plant that was resistant to antibiotics. The following decade in 1994 marked the first GMO product to hit grocery store shelves: the Flavr Savr, a GMO tomato that possessed a longer shelf life than conventional tomatoes (Bruening & Lyons, 2000). The following year in 1995, Biotech Company Monsanto introduced herbicide-resistant crop seeds known as “Roundup Ready.” Fast-forward only four (4) years to 1999, and over 100 million acres worldwide are planted with genetically engineered seeds (Woosley, 2013).

Why are GMOs being used?

Biotechnology in agriculture is still a very polarized and divisive topic among the general people. While we tend to hear many things about the possible negative effects, there are a lot of proponents who promote the possible advantages, and there is a substantial amount of study on the subject. Scholars such as Bakshi (2003) provide evidences that biotechnology is critical "to resolving the problems of food availability, poverty reduction, malnutrition, and environmental conservation in the developing world, because it benefits not only the farmers who grow crops, but also the consumers who eat genetically modified food". Foods created via the application of biotechnology are more nutritious, stable in storage, and promote improved

health in people in both developed and developing countries, according to Young (1999). Additionally, Nap, et al. (2003) farmers profit immediately from increased yields and cheaper production costs, therefore genetically modified crops have the quickest adoption rate of any new technology in global agriculture.

Another considerable impact of GMOs is that to consumers. The potential for GMO crop cultivation to contribute to a more sufficient and higher-quality food supply is undoubtedly the greatest advantage for consumers. Nutrient shortages can be alleviated by genetically engineered foods to include more vitamins and minerals, hence reducing health inequities. For example, vitamin A deficiency is a primary cause of blindness in many third-world nations. In reality, nearly 350,000 individuals go blind each year owing to a lack of food. (Nash, 2000). To help combat this, Beyer, et al (2002) were able to create a strain of “golden” rice which contained large amounts of beta-carotene (vitamin A), and through the use of non-profit and charity organizations were able to offer the modified rice to any developing country that requested it. Pro- GMO advocates argue that a similar paradigm on a larger scale could benefit millions of others in terms of solving the issue of food insecurity and malnutrition.

Others who support biotechnology in agriculture point to its capacity to increase agricultural efficiency and yield by transferring genes that confer resistance to pests, diseases, herbicides, and environmental stress (Nap et al, 2003). Agriculture has always been plagued by disease and insect infestation, resulting in significant losses in food production. These losses may be catastrophic, as Whitman (2000) points out, leading in terrible financial losses for farmers and famine in impoverished nations. While the majority of people oppose pesticide spraying due to the inherent health concerns and possibility for run-off, farmers can remove the usage of chemical pesticides by designing transgenic, pest-protected crops, lowering overhead expenses.

Brief Introduction of the Two (2) Subject Municipalities

The Municipality of Villasis is a first-class municipality in the province of Pangasinan, Philippines. According to the 2020 census, it has a population of 65,047 people. It is a farming town situated along Agno River. It is subdivided into 21 barangays. Villasis is one of the fastest developing towns in the province. It also thrives on its rice, corn and tobacco plantations and most known for its eggplants (talong) because of its annual celebration of Talong Festival. Its hilly barangays situated along the Malasiqui boundary is an ideal place for resort developers and agri-businessmen. (villasis.gov.ph)

On the other hand, the Municipality of Cuyapo, is also first-class municipality in the province of Nueva Ecija, Philippines. According to the 2020 census, it has a population of 68,066 people. Cuyapo is politically subdivided into 51 barangays. Cuyapo comes from the Pangasinan word “kuyapo”, “kiapo” or “quiapo” in Tagalog; “lul-luan”, in Ilocano; (*Pistia stratiotes*), a water plant that looks like a flower. It thrives on agricultural products, one of which is corn and also on its agro-eco-tourism spots. Cuyapo was also awarded with the National Quality Corn Achievers Award last November 2016 at South Cotabato because of their outstanding performance in corn production. They also make a corn husk product that is already in the

market for many years now and the municipality is also known for its annual celebration Corn Husk Festival.

Objectives

This study was conducted to narrate the experiences of farmers and local government units (LGUs) of Villasis, Pangasinan and Cuyapo, Nueva Ecija on genetically modified organisms (GMOs) particularly GM crops. This study also sought to identify the challenges encountered by the farmers and the LGUs in using GM crops and it also determined how the LGUs monitor and help the farmers in GM crop production. The findings of this study served as the basis for creating possible courses of action that the LGUs could do to help the farmers, especially the low-production farmers, maximize their production by using GM crops.

3. Methods

This research study used qualitative research design, particularly the narrative approach through the conduct of one-on-one interviews with farmers and focus group discussion with LGU employees then specific themes were formulated to describe the experiences and challenges encountered by the farmers and the LGUs and how the LGUs monitor and help the farmers in GM crop production. Based from the interviews, specific themes were formulated. Furthermore, secondary data were obtained from different materials and sources to explain the themes in the study.

Respondents and Sampling Technique of the Study

The respondents of this study are the farmers in the two (2) Municipalities and the LGU Agriculture Office employees. The two (2) LGUs provided the researchers a list of farmers from which the researchers picked their respondents. The farmers were identified through convenience sampling. Convenience sampling is a non-probability strategy that is employed by both qualitative and quantitative researches. To draw a convenience sample, a researcher simply collects data from those people or other relevant elements to which he or she has most convenient access. In this study, the researchers interviewed the farmers in the list whom they know, or those who are their neighbors or near their workplaces

4. Results and Discussion

This part of the paper presents the results of the study through the results generated from the interviews and focus group discussions with the LGU and farmers in the two (2) municipalities. Certain themes that emerged after the data were analyzed are also in this part.

The major research question for this study was “What are the experiences of the farmers and LGUs in using GMOs specifically GM crops?”. The experiences were noted and were discussed in this paper.

All relevant and significant aspects of the survey and interview were brought together, analyzed, and came up with a narration that detailed the experiences and challenges encountered by the farmers and the LGUs and also the monitoring of the LGUs in terms of GMO crop production. The topics are outlined below for a better understanding and clearer picture of the study.

Experiences of farmers and LGUs in using GMOs

With regards to yield, there was a higher yield when Bt corn variety was used, provided that all other factors that help in crop production were satisfied. According to the LGU employees and some of the farmers interviewed by the researchers, if there were enough fertilizers, and other needed materials for crop production, the Bt corn will give a higher yield than the conventional corn variety. Conventional corn is any corn seed that has no foreign DNA or input traits added to the seed (FBN, 2018). Both varieties are grown in about 110-120 days but the only difference would be the amount of yield.

In a study conducted by Sanglestsawai, et. al., (2014), it was found out that in both crop years during the period of their study, yields of Bt farmers tend to be uniformly higher than non-Bt farmers. Additionally, from the same study, using farm-level survey data from the Philippines and quantile regression techniques that control for selection problems, they found that the effect Bt corn on yields is generally more strongly felt by producers at the lower end of the yield distribution. This means that it can strongly be felt by small-scale farmers and so it would benefit them a great deal.

One respondent also shared that the Bt technology is also easy to use, same with conventional seeds. That there is no need for skills training since you grow them the same way as how you grow the conventional crops. As long as the crops are provided with proper care, including water, fertilizers, sunlight among others, you will be able to grow them accordingly.

Challenges and problems encountered by farmers in using GMOs

According to the farmers and LGU employees, the GM crops are more expensive than the conventional seeds or variety. You really have to spend more money for the GM seeds than the conventional seeds. According to MacDonald (2016), GM seed is expensive, so farmers planting these varieties may earn less profit. In marginal land, however, reduced pest damage can mean the difference between profit and loss, so GM crops can enable profitable farming in areas where it might not otherwise be possible. However, according to the farmers and to the MAO employees, the profit could also be bigger when using GM crops provided that all conditions are favorable. But as of today, since most of those being used in crop production are having price increase, like fertilizers, gasolines and others, the profit of farmers also become lower despite that they have higher yields.

There were also times when there were shortages on the Bt corn variety because there was a high demand among farmers. Since the yield has been observed to be higher than the conventional seeds, more farmers are using the Bt corn variety already.

Pest resistance is another issue pointed out by the employees. Some pests may become tolerant of the Bt variety and so it will also cause harm to the plants which will later affect corn production. According to Tabashnik et al., (2008) and Visser and Van den Berg (2020), since Bt crops are already widely used, and because of the target insects' remarkable adaptability can lead to pest growth and resistance to Bt toxins. The resistance to Bt toxins may jeopardize some of the advantages of GM crops mentioned earlier.

Monitoring scheme done by LGUs with regards to GM crops and its distribution and production among farmers

As per the researchers' interview, both LGUs through their Agriculture Offices, conduct monitoring visits to farms and farmers or farm producers. They go and check the status of the farmers and the farmlands to have a close monitoring of the crop production in the Municipality. They also conduct technical briefings and trainings to farmers and farm workers to update them with the updates and latest technologies used in farming to keep them abreast with global situations and advancements. Both LGUs also conduct information dissemination by distributing leaflets or flyers about agricultural concerns to keep our farmers and farm workers posted and updated. Lastly, they also provide subsidies and other help that the farmers need.

In the Municipality of Villasis, they provide subsidies for fertilizers and for the equipment that will be used in land preparation, tilling and others. Also, through the National Agency, the Department of Agriculture (DA) and Region I DA, there are subsidies in seeds being provided but this is not given all the time.

The Municipality of Cuyapo, on the other hand funded a project, which started last 2020, to release corn seedlings to the farmers of Cuyapo. The purposes of this is primarily to help the corn farmers on the identified barangays that have a large area of corn production and improve local corn production which will contribute to greater food security. Also, support comes from the DA in Region III. Market matching is also being done by the Department of Agriculture so that they can assure that the pricing of the corn products of the local farmers is justifiable and within the prevailing market standards.

Proposed courses of action that the Municipalities could do to help farmers, especially the lower-yielding farmers.

Given the immense positive impact and contribution of GM crops to higher food production and food security since its introduction to the Philippines and down to the two (2) subject municipalities, the researchers encourage farmers to use GM crops, specifically the Bt corn. But since despite the fact that this corn variety helps our farmers, there were, there are and there will still problems with regards to Bt technology.

The first problem encountered by farmers is the higher price of GM crops. According to MacDonald (2016), GM seed is expensive, so farmers planting these varieties may earn less profit. The researchers propose that the DA through the LGUs provide not only one (1) type of subsidies to farmers but also work on the different agricultural subsidies. In the case of the Municipality of Villasis, fertilizer and agricultural equipment subsidies are only available while Municipality of Cuyapo distributed seeds also in their locality. While it is true that there are already existing subsidies in the country, it may also not enough for our farmers. If for instance the municipality has already the machineries, it could already provide for agricultural equipment subsidy, the counterpart of the DA Regional Office or the National Agency could be the seed, irrigation or export subsidies, among others. It is also important to note that when subsidies are being given to the LGU from the national or regional level, and when the LGU gives these subsidies, there should be a proper selection of recipients since the subsidies does

not also guarantee that all farmers will be given or will benefit from it. The researchers propose that the selection process should be done accordingly and rigorously to select those who really deserve subsidies.

Another proposed course of action is to strengthen agricultural cooperatives in the locality. According to International Cooperative Alliance (ICA) in 2020, cooperatives cover a large part of the agricultural sectors, and could therefore play a role in the improvement of farm sustainability. Through their close relationships with farmers, agricultural cooperatives may be key actors in supply chains to help farmers change their agricultural practices and to favor the adoption of more sustainable practices. Cooperative values such as democratic decision-making, equality and solidarity give cooperatives a unique identity, which differentiates them from other types of enterprise and implies that they have a distinct organizational characteristic. Therefore, the LGU could make good use of these cooperatives and help the farmers to get access from these cooperatives to enable farmers to cope with market risks and favors investment by sharing fixed costs.

The second concern is the shortage of supplies of GM crops because of high demand among farmers. In a study entitled Economic Assessment of GM Corn Use in the Philippines by Alvarez, et.al., (2021), it was said that in just a period of 17 years, the area planted increased to about 835 thousand hectares, increasing by an average of 31.24% per year. A third of all corn farmers in the Philippines or about 460 thousand families are planting GM corn. If in case a certain area encounters shortage in the Bt seeds, the researchers propose that there should be proper forecasting of needs and demands and the LGU could make necessary linkages to companies that supply these seeds. According to Berkes and Adhikari (2006) and Berkes (2007), partners or linkages work with the local community to provide a variety of services and support functions, such as raising startup funds, institution building, business networking and marketing, innovation and knowledge transfer, technical training, research, legal support, infrastructure, and community health and social services. In the case of the LGUs, partnerships could mean providing constant supply of seeds and other services that may be of help to Bt technology.

The last concern mentioned by the farmers interviewed by the researchers and those at the LGUs was about pest resistance. It was mentioned that the resistance to Bt toxins may jeopardize some of the advantages of GM crops like higher yield, food security, among others. The researchers propose that the farmers should be taught or be equipped with skills training and updates with regards to growing Bt corns. This information dissemination and education (IEC) campaign should also be done by the Local Government. According to Alvarez, et.al., (2021) the Department of Agriculture ensured a good regulatory regime for the safe use of GMOs in the country but the private sector seed owners marketed GM corn and conducted extension works to let the farmers know of the advantages of GM corn and facilitated the correct application of GM corn seeds. This time around, the researchers propose that the Local Government should take active part and initiative in teaching the farmers so that pest resistance could be avoided. It was mentioned by the LGUs that the farmers could actually do mixed seed farming wherein they will make use of both conventional and Bt corns to attract the pest to the conventional variety thereby avoiding resistance to Bt. A sustainable pest management system,

like crop rotations, tillage, and others could be taught to farmers so that they could still enjoy the benefits of Bt corns.

Another proposed strategy once the produce is ready for market distribution is to have a clear policy or regulations with regards to market prices of the produce. Direct selling or marketing is proposed by the researchers and there should be a clear policy drafted and followed by the LGUs for this. According to Coley, et. al., (2022), direct marketing is the sale of agricultural goods and products from the farm straight to the consumer, without intervening distributors or retailers. Direct marketing can benefit farmers by allowing them to earn a greater portion of the consumer food dollar by eliminating intermediary brokers, buyers, and distributors. Examples of direct marketing include community supported agriculture (CSA) ventures, farmers' markets and farm stands, and direct sale to businesses and institutions, such as restaurants, schools or hospitals. Direct marketing can contribute toward sustainable agriculture and food systems by increasing farmer profitability, promoting the local economy, and providing consumers with higher quality and healthier products. If in case it could not be avoided, that there are middle men in the distribution of produce, then the LGUs could also implement a policy wherein the price paid by these middle men to farmers could really cover their incurred expenses and also provide them with decent profit.

5. Conclusions

Based on the findings of this study and based from the respondents' answers, the following may be claimed:

- 1) The farmers and LGUs have positive experiences in using GM crops in crop production, specifically higher yields and ease of use of GM crops or technology.
- 2) There are challenges and problems encountered by the farmers and both LGUs, one of which is it is more expensive.
- 3) Both Local Government Units do monitor GM crop production in the area and they also have programs that help farmers in their crop production.

Recommendations

The proposed courses of action presented by the researchers could be adopted by the LGUs to help their local farmers in their crop production, may it be Bt varieties or the conventional ones, to address the encountered problems and challenges.

Conflict of Interest

The researchers declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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