Advantages and Disadvantages of Traditional Abaca, Genetically Modified Abaca, and Cross Hybrid Abaca

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Abstract: Abaca (Musa Textilis Née), also known as Manila hemp, is a plant native to the Philippines, which expanded through different parts of Asia. It is a biodegradable and sustainable source of fiber known for its high quality. Due to viruses, poor government support, and lack of fundings, the abaca fiber industry is encountering obstacles in keeping up with the global demands. Over time, researchers developed new abaca types such as crossbred abaca and genetically modified abaca to solve these problems, but these have their own deficiencies as well. The purpose of the study was to identify, assess, and elaborate on the advantages and disadvantages of each of the abaca types. This was accomplished through the evaluation of literature and the collection of data in interviews. The study was a systematic review focusing on meta-synthesis, with information derived from previously published research or related literature and information from experts in the field. It was determined that traditional abaca is vastly preferred over genetically modified abaca and cross hybrid abaca, due to a number of reasons, including lack of research and economic viability. Traditional abaca was found to be more sustainable overall. It was recommended that traditional abaca should be promoted more to spread awareness, and that farmers should be educated regarding the proper process of caring for abaca plants. Stigma regarding cross hybrid and genetically modified abaca should be addressed as well.

Key Words: traditional abaca; cross hybrid abaca; genetically modified abaca; Philippine abaca industry; abaca virus

1. INTRODUCTION

1.1 Background of the study

Abaca, also known as Musa textilis Née, is a plant that originated in the Philippines. It is known as Manila hemp internationally. The Philippines was first to cultivate (Lalusin, 2010) and has remained the world's top abaca supplier for several years. It is among thecountry's top exports, boosting the Philippines' economy, and has an average of 4.7 billion pesos in export value (PhilFIDA, n.d.). Traditional varieties are still used due to the lack of new and improved varieties of abaca (Lalusin, 2010). These traditional abaca varieties are more likely to contract diseases such as the abaca bunchy top virus (ABTV) or the abaca bract mosaic virus. These viruses kill or give low-quality abaca yields, potentially affecting the industry as it reduces the income of many 21st century farmers. Furthermore, the Philippines is currently facing competition in the abaca industry with Indonesia and Costa Rica.

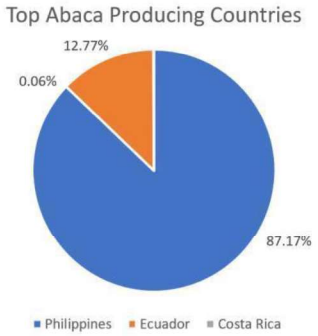

Figure 1. Top abaca producing countries.

Waller et al. (2019) stated that farmers lack knowledge in utilizing modern farming practices affecting farming productivity and efficiency. Moreover, the PhilFIDA roadmap of 2018-2020 discussed issues about lack of funding for the abaca industry requiring 5.633P billion and that more abaca seedling nurseries are lacking per region to hike outputs in production. Furthermore, the industry has

been encountering losses due to the impacts led by the abaca viruses and poor management of the government. The researchers were led to conduct the study because of the lack of consolidating research regarding which among cross hybrid abaca, genetically modified abaca, and traditional abaca is considered the best. The advantages and disadvantages of each abaca type will be determined, assessed, and compared. Furthermore, the study would help 21st-century farmers apply new farming methods and help the industry gain new and efficient farming methods and techniques.

1.2 Research Questions

Due to the lack of consolidating research, there is no concrete and validated document that can be distributed regarding which type of abaca is best to cultivate, given the properties and characteristics of the different abaca types. With that, the researchers aim to answer the following questions:

1. Which among traditional abaca, genetically modified abaca, and cross hybrid abaca is best suited for the Philippines' abaca industry in terms of economic viability, growth, and production?
2. What are their properties, uses, and applications?
3. What are the advantages and disadvantages of each?
4. How will their advantages or benefits, disadvantages or issues, and properties affect the Philippine abaca industry?

1.3 Objectives

The researchers assessed the advantages and disadvantages of traditional abaca, genetically modified abaca, and cross hybrid abaca. The specific objectives are as follows:

a) To identify the properties and uses of traditional abaca, genetically modified abaca, and cross hybrid abaca
b) To determine and assess their benefits and issues and their possible impacts and influences in the abaca industry
c) To compare and evaluate the differences between each type of abaca

1.4 Scope and Limitations

This study reviewed, compared, and assessed the advantages and disadvantages between traditional abaca, genetically modified abaca, and cross hybrid abaca, which was done through a systematic review focusing on meta-synthesis. The data was derived from interviews of experts or people involved with the Philippine abaca industry, as well as previous studies to find which abaca type would be more beneficial economically and agriculturally. Interviews were conducted for clarification and support for the gathered data. The different properties and uses of the abaca types were discussed and distinguished from each other. Each abaca type was examined, identifying its benefits and disadvantages.

1.5 Significance of the Study

The comparisons between traditional, crossbred, and genetically modified variants of abaca can help 21st-century farmers gain information in applying modern methods and techniques in farming. It can guide in identifying the type of abaca, its properties, its productivity, efficiency, and effectiveness in farming. This study can also aid experts and organizations in the abaca industry in identifying needed information for strategies to improve the abaca economy, aid industrial growth, compete internationally, and utilize advanced agricultural methods. The paper may also help future researchers and organizations in conducting similar studies about the abaca industry.

2. METHODOLOGY

The researchers performed a systematic review focusing on meta-synthesis regarding the characteristics and properties of each type of abaca from related studies. A meta-synthesis is used to combine qualitative data by combining information from related literature to find common themes and concepts (Siddaway et al., 2019). A systematic review was utilized for this paper because it summarizes the large quantities of research that have been published about the different types of abaca.

The researchers first identified the research questions, then searched for related literature, composed of articles selected through inclusion criteria. The content from the articles was analyzed and various themes were noted. Following that, respondents for the study were identified and contacted, and online interviews or surveys were conducted to further expound and validate the previously collected data. The data from the interviews was cross-checked with the previous data to find similar ideas and themes. The data were synthesized and evaluated to find the answers to the questions presented. The results were then interpreted and the conclusion for the topic was formed.

The data was presented through a narrative on which abaca cultivar is the most preferable to produce and utilize. The reasons and explanations as to why would be presented as well to elaborate the previously found data and research.

Inclusion Criteria (Respondents)	Inclusion Criteria (Related Literature)
• Experts that are in the abaca field or have connections to the abaca industry	• Local and international studies published after 2010 that is related to abaca
• Experts that have conducted abaca-related research	• Qualitative, quantitative, and mixed methodology
• Relevant government officials	• Academic journals, conference papers, and reports related to abaca
	• News articles regarding discoveries in the abaca industry
	• Non-academic articles from reputable sources
	• Older studies documenting the history of abaca in the Philippines
	• Situations of 21st-century farmers in the Philippines

3. RESULTS AND DISCUSSION

3.1 Characteristics of Abaca

Abaca is among the strongest natural fibers. It can be used as a raw material in textile manufacturing. It has high fiber yield and quality, high tensile strength, and resistance to virus diseases. Abaca is considered to be sustainable, as its waste can be reused as fertilizer. It is also the type of abaca preferred by buyers and farmers due to familiarity and that other abaca types may have unwanted side effects.

Cross hybrid abaca possesses high yield, good fiber quality, and disease resistance. The Bandala hybrid, specifically, is resistant to the bunchy top virus. Another abaca hybrid, a hybrid of Pacol and traditional abaca, is also resistant to ABTV and can be used as a raw material. However, its fiber quality is lacking (Lalusin et al., 2015). It is stated that cross hybrid abaca has similar qualities to traditional abaca, such as folding endurance, burst strength, tensile strength, and environmental adaptability. Furthermore, the application of cross hybrid abaca may help reduce losses caused by the viruses. However, cross hybrid abaca requires more tests, trials, and studies to verify and further identify its potentials in the industry and the market. In addition, it was noted that some abaca hybrids such as the Daratex have low fiber recovery due to their low tensile strength.

Genetically modified abaca is more resistant to ABTV. However, the fiber quality is still inconclusive (PhilFIDA, n.d.). Both hybrid and genetically modified are neither strong enough nor have enough reliable studies. Additional issues for genetically modified abaca would also include sustainability and production cost. More studies are needed to properly identify characteristics and the results of existing studies are inconclusive. With this, genetically modified abaca is currently not a viable option. A lot of the current information and research regarding its characteristics, among others, are theoretical and therefore may be faulty.

3.2 Other Issues Related to Abaca

The abaca virus can cause damage to the plant, reducing its production quality and economic viability. Using resistant varieties would be the best way to control the effects of diseases, yet it should be the same standard as the current abaca types. Currently, traditional varieties are still recommended, as with the results of the survey. However, traditional varieties are more susceptible to ABTV, due to the environment than conventional farming practices create, i.e., a breeding ground for insects. These can still be managed with recommended practices, like regular cleaning and fertilization. Otherwise, depletion of the topsoil and its fertility may occur.

Some reasons as to why abaca diseases occur would be that: an infected cutting knife for all the plants, following "pohada" system, the attitude of farmers, and lack of knowledge and funding. These are all important issues, but temporary solutions are used instead, as abaca is an industrial crop.

Studies regarding genetically modified abaca have inconclusive results (PhilFIDA, n.d.), and nothing has been developed for commercial use. At present, there are still negative connotations with farmers regarding genetically modified and hybrid abaca due to a previous issue with these. Additional issues include fiber quality, resistance traits stability, etc. Cross hybrid abaca types cannot also be mass-produced, for similar reasons. According to a respondent, one hybrid type was introduced in the 1990s called Daratex, which incurred many issues, such as cooking fiber batches. The industry suffered due to losses encountered.

3.3 Economic Benefits and Sustainability

Currently, it is believed that traditional abaca would provide more benefits in the long run. More studies may be needed to answer the question more objectively, as there is more information

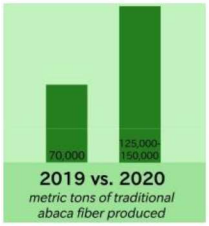

Figure 2. A comparison of the production of abaca fiber in 2019 and 2020.

regarding traditional abaca than either cross hybrid or genetically modified abaca. Foreign buyers, who constitute a significant amount of the market, are against hybrid or genetically modified types. Furthermore, traditional abaca has been used since the 1900s, and it has been helping the country's economy consistently.

In 2019, over 70,000 metric tons of traditional abaca were produced. The demand in 2020 was around 125,000 to 150,000 metric tons. Exports of abaca fiber and manufacture also generated an average of US$97.1 million per year in the last decade (Department of Agriculture, 2019). Additionally, abaca is sought after as a raw material as it is sustainable: it can replace synthetic, plastic, and petroleum-based products; it is more sustainable than wood pulp. Abaca causes relatively fewer environmental problems than typically used materials as it does not disturb weather patterns.

Neither cross hybrid types nor genetically modified types have been properly propagated in the market. A respondent stated that the Bandala hybrid can be used for its virus resistance, have a high production level if propagated, and can be used to produce textile products, similar to traditional abaca. According to another respondent, it is too early to introduce abaca hybrids, not while it is inferior to traditional abaca.

3.4 Production and Growth

Traditional abaca may be best suited to the environment, as new hybrids have not yet gone through multilocational trials. It was also stated that the Bandala hybrid might also thrive in the Philippine environment, though there have been no proper conclusions regarding this. Abaca is location-specific; different varieties are recommended for different areas. In general, it can survive and thrive in the country's environment. Abaca also requires partial shade. However, they thrive on well-drained fertile soil, mountains and interlands, with type II, III, and IV climates, as well as areas rich in volcanic soil (PhilFIDA, n.d.).

Additionally, the mindset of farmers regarding the plants must be changed. Many farmers lack information regarding modern techniques (Waller et al., 2019). They should adapt to modern and proper farming practices such as fertility maintenance as traditional abaca is self-sustainable to reproduce.

Currently, there is insufficient information and data to determine the abaca type with more efficient and cost-effective production. One reason would be that both hybrids and genetically modified types have restricted market access. Traditional abaca can produce more as hybrid abaca is easily broken, with a low chance of recovery. According to another respondent, the abaca with the more efficient and cost-effective production type would be varieties with low-quality fibers, especially wild and hybrid species, as the production cost would be lower.

Fibers are the ultimate product of abaca. Several factors affect fiber quality, such as the method of stripping, blade used, etc. Hybrid abaca has a lower fiber recovery since the tensile strength is lower compared to traditional abaca. Much fiber is broken while stripping, and more effort is required to produce the same amount of hybrid fiber with traditional abaca fiber. Genetically modified abaca elseways**,** shows inconclusive results on its data on fiber quality and abaca yield (PhilFIDA, n.d.). More studies or trials are needed to assess the properties of the genetically modified abaca and its fiber.

4. CONCLUSIONS

It was determined that traditional abaca is a more viable option in the market due to it being of higher quality compared to the other abaca types despite issues in its vulnerability against diseases. This vulnerability can be remedied with proper sanitation, cleaning practices, detection of the abaca viruses, and application of modern agricultural practices. The usage of crossbred abaca and genetically-modified abaca could help prevent significant financial losses led by the viruses and improve the fiber quality and yield; however, further tests and trials are needed to determine the capabilities of the crossbred and genetically modified abaca varieties.

The survey only had a limited number of respondents and it is recommended to conduct similar studies in the future. To solve issues in the abaca industry, political leaders, abaca farmers, researchers, and the general public should be educated on the importance and potential of abaca through seminars, online campaigns, training programs, and conferences. A respondent had also addressed the importance of modern applications in agriculture for abaca farming. Abaca farmers should also be educated regarding the issues of the traditional abaca and the abaca industry. This would include identification of infected plants, implementation of proper farming practices, among other information. Raising awareness on the issues should also be promoted to the general public, the government, and people in positions of power through seminars, online campaigns, training programs, and conferences. The spreading of the virus could be prevented this way.

For the industry to improve, it would be recommended that experts set and evaluate reasonable goals for the industry. If previously used methods do not work, then new methods and strategies should be used. People involved in the

industry should be actively engaged in it as well for the industry to thrive. More studies regarding cross hybrid and genetically modified abaca should be conducted. Additionally, political leaders, researchers, and farmers should be educated about the abaca hybrids' agronomic and economic potential. This could be a way to reduce the stigma and misconceptions that surround hybrid and genetically modified abaca in the market.

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