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Market potential study of Nutrio™ biofertilizer for sugarcane and eggplant

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ABSTRACT

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Nutrio™ is a new foliar spray biofertilizer inoculant containing endophytic bacteria that has been tested for improved yield of sugarcane. The product has also been proven effective for eggplant production. Although Nutrio™ has already been in the market, it was still operating on a small-scale during the time this research was conducted. This PCAARRD-funded study looked into the market potential of Nutrio ™ as biofertilizer for sugarcane and eggplant. Specifically, this research aimed to a) define the potential market for Nutrio™, which was anchored on the sugarcane and eggplant commodity systems analyses, b) determine the level of awareness, perceptions/evaluations and willingness of the potential market to use/buy Nutrio™, c) estimate the market requirements for Nutrio™, d) identify market-related challenges toward the commercialization of Nutrio™ and e) recommend pathways for the commercialization of Nutrio.™ Three provinces were randomly selected for each commodity, namely, Batangas, Iloilo and Negros Occidental (for sugarcane), and Pangasinan, Iloilo and Cagayan (for eggplant). A total of 148 farmer-respondents were interviewed. Key informant interviews and literature review were also conducted. Both qualitative and quantitative data analyses were employed. Nutrio™ biofertilizer can be considered as a promising technology based on the responses of the sugarcane and eggplant farmers interviewed. Among 148 respondents, 134 (91%) were willing to buy the product. Establishing a new enterprise for manufacturing and selling of the technology of 435,870.56kg of the product for both sugarcane and eggplant market would be profitable. Furthermore, distribution of the product through existing enterprises would also be profitable, with an additional potential income of PHP64,523,630.00 if product distributorship would be adopted. Some strategies to expand the business scale of Nutrio™, such as the improvement of product

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packaging, product demonstration and field testing and product label expansion as well as adoption of distributorship for the technology to realize its full potential were recommended.

Keywords: foliar spray inoculant, market potential, technology commercialization

INTRODUCTION

Biofertilizers are products that are used for enhancing crops' uptake of nutrients through "rhizosphere interaction or colonization". These contain living and latent cells of different strains of microorganisms that help in the acceleration of certain microbial processes in the soil, increasing the supply and availability of the nutrients for the plants (Tnau Agritect Portal, Organic Farming 2014). Moreover, these beneficial microorganisms, which also contain humus enhance the soil's physical, chemical and biological properties that are very crucial for crop production (Agriculture Monthly 2016).

Biofertilizers can be considered as supplementary to chemical fertilizers. The use of biofertilizers reduces the use of expensive inorganic fertilizers. Hence, farmers incur lower input costs and they can earn more profit because biofertilizers improve crop productivity, as they multiply and participate in the nutrient cycling when applied as seed or soil inoculants. Biofertilizers have great potential to improve crop yields through environmentally better nutrient supplies. Biofertilizers have been reported to increase crop yields by 20–30% and stimulate plant growth because of the nitrogen and phosphorus added to the soil, and biofertilizers restore the fertility of the soil, making it healthier and sustainable. PhilRice Senior Science Research Specialist Wilfredo B. Collado stated in an interview with Business World that the financial capability of the farmers to buy fertilizers with relatively high price is another issue in the Philippines (Mogato 2018). The recommended volume of the application of inorganic fertilizers is high but the farmers cannot afford these products due to financial constraints.

Nutrio™ is one of the innovations of the National Institute of Molecular Biology and Biotechnology (BIOTECH) specifically formulated by Dr. Virginia M. Padilla, a University Researcher III in BIOTECH for over 38 years. BIOTECH is a national research and development (R&D) organization specializing in agricultural, environmental, food, feeds and health biotechnology. It capitalizes on the use of the Philippine's diverse collection of microorganisms, rich natural resources and agro-industrial waste and by-products to develop and advance alternative technologies and products towards improved agro-industrial productivity. Nutrio™was funded by the Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (PCAARRD), one of the sectoral councils under the Department of Science and Technology (DOST).

"Nutrio ™ is a new foliar spray biofertilizer inoculant containing endophytic bacteria *(Enterobacter sacchari S18),* which is a type of nitrogen-fixing bacteria that has been isolated, screened and tested for improved growth and yield of sugarcane (Domingo and Maranan 2017). The technology is in the form of a powder that is available in 100g packs. The recommended application of Nutrio™ for sugarcane is 4kg per hectare (40 packs of the product), which is good for two applications. Twenty packs or 2kg of the product is mixed with 1,000 liters of water

and sprayed on the leaves of the plants after the second and third or fourth month of planting. The product is also proven effective for eggplant production. Four kilograms of the product is recommended for a hectare of land. The product is applied once every month from the first month until the fifth month of fruit bearing. Eight hundred grams or eight packs of the product is mixed in a 400 liter-drum of water for every application.

Based on the results of Dr. Padilla's unpublished research funded by PCAARRD entitled, "Development and Field Testing of Endophytic Bacterial Inoculant as New Biofertilizer for Improved Production of Eggplant (*Solanum melongena*) and Sugarcane *(Saccharum officinarum L.)",* Nutrio™ is best used in combination with half the recommended application of inorganic or chemical fertilizers. Nutrio™ is a supplementary fertilizer for inorganic fertilizers. Upon, using Nutrio™, farmers will be able to save around 50% of their total inorganic fertilizer usage. Two kilograms of Nutrio™ is applied twice per cropping season of sugarcane, two months and three to four months after planting. The use of the product resulted in greener and healthier plants, reduced chemical fertilizer usage, an increase of 15-25% cane yield and a reduction of 50% inorganic fertilizer requirement was observed. This is a positive result given the fact that use of too much inorganic fertilizer degrades the soil quality. Furthermore, it was observed that applying Nutrio™ in combination with inorganic fertilizers or farmers' practice increased the yield by 19% and 37% in terms of monetary value in comparison with the full inorganic application. Based on the results, the application using the full recommendation of the product in comparison with full recommendation of inorganic fertilizers is almost comparable. In terms of addition of labor, there will be an additional cost to spray the product onto the crops. However, despite the increase in the labor cost, the overall cost is still lower compared to the use of inorganic fertilizers alone.

Nutrio™ is already registered under the Fertilizer and Pesticide Authority (FPA) as fertilizer for sugarcane alone last December 2017, which means the product can already be sold in the market. However, it was only a provisional registration, which is good or effective for one year only and would have expired in December 2018. In order to convert the product into full registration, which is a three-year product license, Experimental Use Permit (EUP) and bio-efficacy trial should be conducted. According to Dr. Padilla, there is a plan to expand the label of the product to different crops like rice, corn and other vegetables once a full registration has been granted.

There was no formal introduction or launching of the technology yet, except for field trials, word of mouth and self-promotion of the product, according to the developer. The product was made known to the public through experiments in various locations. According to Dr. Padilla, when interviewed by the researchers, trials have been conducted in Floridablanca, Pampanga, Rosario, Batangas, San Antonio, Quezon and Luisiana, Laguna, Philippines. The co-operators of the developer's previous research had personally witnessed and shared the positive outcomes to other farmers. The good results have spread through word of mouth. There was a pilot test of the product for sugarcane in Regions III and IV in 2018.

BIOTECH owns the registration as well as the patent for Nutrio™. Having said that, they are the only company that has the capacity and legality to produce the product. The product is available in 100g packs for PHP100 based on the initial costing. The company is still working on the final price that will probably range from PHP150-200 per 100g pack. During the period that this research was conducted, the product could only be bought at BIOTECH's office. In the future, there is a plan to get distributors and dealers for Nutrio™. The current users of the products are the

farmers, especially those planting sugarcane according to the developer. There is still a plan to expand the use of the technology to accommodate other crops such as rice, corn and other vegetables. Private entrepreneurs and companies can also be tapped.

A study of Datta, Reed, and Jessup (2013) stated that out of every 3,000 new innovation ideas, only one was commercialized into a successful product. The generation of ideas is not sufficient to commercialize innovations. In the Philippines, a number of mature technologies have not yet reached the commercialization stage. According to Narayan (2012), there were possible reasons why many promising technologies were not commercialized, namely: 1) failure to meet the financial or market volume of large corporations which typically license university research; 2) the lack of applied research, engineering and economic demonstration data that are essential for the company to make an investment decision; and 3) presence of substantial market risk and absence of a committed technical business champion.

Technology developers often neglect the economic aspect of innovation. The market for the product is often not identified and the cost-competitiveness is normally given less importance. The lack of a sound business plan will result to the innovation being unattractive to the investors. Hence, it is apparent that there is a need to demonstrate the economic viability of new technologies and products developed by research institutions in the country. Determining the market potential of a technology is essential to identify the technology's viability through market opportunities and subsequently make sound investment decisions on opportunities that will generate the highest returns. It provides an estimate of the maximum total sales potential for a particular market. In addition, market potential analysis enables companies to categorize and segment their markets, quantify market potential for a specific product by country, by region or globally in the future, determine the drivers and barriers to market growth, to tailor strategies in marketing, product development and production to meet customer demands (Kraemer and Dedrick 1998). In estimating the market potential for a business, there is a need to estimate the number of people or potential buyers, average selling price of the product, and the consumption/usage of the product for a specific time period (Wolfe 2006).

This research aimed to a) define the potential market for Nutrio™ which was anchored on the sugarcane and eggplant commodity systems analyses, b) determine the level of awareness, perceptions/evaluations and willingness of the potential market to use/buy Nutrio™, c) estimate the market requirements for Nutrio™, d) identify market-related challenges toward the commercialization of Nutrio™ and e) recommend pathways for the commercialization of Nutrio™.

RESEARCH METHODOLOGY

This research was guided by the conceptual framework shown in Figure 1. The socio-demographic, farm or organizational and behavioral profiles of the potential market influence their awareness, perceptions/evaluations, and willingness towards the technology. Moreover, their awareness about the technology shapes their perceptions/evaluations towards the technology and in turn, these determine their willingness to use or buy the technology. These four and their interactions are determinants of the requirement (demand) of the potential market for the

technology. This requirement and a number of market-related challenges will serve as the bases for the commercialization of the technology.

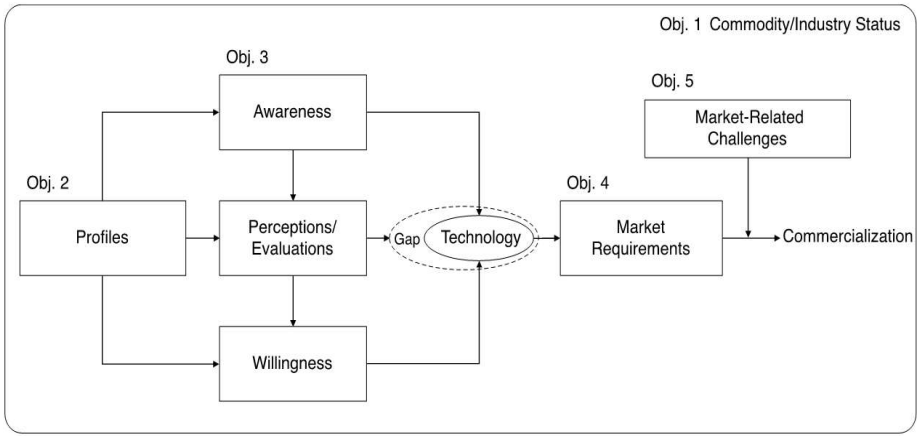

Figure 1. Conceptual Framework of the Market Study

Table 1. shows the objectives of the study and summarizes the data needs, collection and processing methods, and analyses corresponding to each objective.

Table 1. Summary of Methodology

Objective	Data Needs	Data Collection	Data Processing and Analysis
1. Provide an overview of the biofertilizer industry and sugarcane and eggplant commodity systems	Information about the input, production, processing, marketing and support subsystems of the biofertilizer, sugarcane and eggplant	Literature review	Qualitative Analysis
2. Define the potential market of the technology	Description of the technology, potential market, socio-demographic, farm/organizational profile of the potential market	Literature review, survey, KII	Quantitative Analysis (Descriptive Statistics) and Qualitative Analysis
3. Determine the level of awareness, perceptions/evaluations and willingness of the potential market to use/buy the technology	Description of the technology and its competitors; level and sources of awareness, perceptions, willingness of the potential market to use/buy the technology	Literature review, survey, KII	Quantitative Analysis (Descriptive Statistics, Analytic Hierarchy Process (AHP), Linear Programming, Eigenvector, tests of hypothesis) and Qualitative Analysis
4. Estimate the market requirement of each technology	Willingness rates to use/buy the technology, farm/organizational profile, industry players	Literature review, survey, KII	Quantitative Analysis
5. Identify market-related challenges toward the commercialization of the technology	Perceptions/evaluations about the technology; barriers or challenges to commercialization	Survey, KII	Qualitative Analysis

Figure 2. Study Areas (*Provinces marked with stars)*
Image Source: Google

Cluster and Simple Random Sampling were employed for determining the sample size for the study. The list of top producing and low producing provinces was obtained from the website of the Philippine Statistics Authority (PSA). There were 82 provinces recorded for each commodity (eggplant and sugarcane). Out of these, 34 (eggplant) and 19 (sugarcane) provinces have major contribution based on their share to the production in terms of their cumulative percentage. Only three provinces (3) were randomly selected for each commodity due to the time and cost constraints as well as other factors. These provinces were Negros Occidental, Batangas and Iloilo (for Sugarcane) and Pangasinan, Iloilo and Cagayan (for eggplant), as shown in Figure 2. From these, a total of 148 farmer respondents were

randomly selected. The number of respondents interviewed for each province for each commodity is presented in Table 2. The estimation of the market potential of Nutrio™ was also anchored on the literature review of the relevant commodity systems, farmer respondents' surveys and Key Informant Interviews (KII). The important technology attributes were elicited from farmer-respondents through Analytic Hierarchy Process (AHP) to ensure a more systematic approach in assigning weights to the technology attributes based on importance. In addition, their awareness, perceptions/evaluations and willingness to use/buy the technology were also evaluated. Market-related challenges towards the commercialization of the technology were also identified. Key strategies to optimize the market potential of Nutrio™ were recommended.

Table 2. Geographic Distribution of Survey Participants

Type of Commodity	Province	No. of respondents interviewed
Sugarcane	Iloilo	16
	Batangas	20
	Negros Occidental	30
Sub Total		66
Eggplant	Pangasinan	34
	Iloilo	26
	Cagayan	22
Sub Total		82
Overall Total		148

RESULTS AND DISCUSSION

Table 3 presents the socio-demographic profile of the sugarcane farmer-respondents. Most of the sugarcane growers (38%) interviewed were above 55 years old, and had an average age of 51 years. Sixty four percent (64%) of the respondents were males while 36 % of them were females. Majority of the respondents (83%) were married. Almost half of the respondents were high school graduates. Seventeen of the respondents reached college but only 10 (15%) earned a degree. On the average, the farmer-respondents have been engaged in farming for almost 21 years. Forty two percent (42%) of them had been farming for around 6 to 15 years. The majority of them were engaged in agricultural farming for 16 to more than 35 years and gained knowledge about this particular sector through several years of farming experience. On the average, they had been cultivating sugarcane for almost 18 years. Of the 66 respondents interviewed, 63 of them (95%) considered farming as their primary source of income. Most of them greatly relied on the income they derived from farming to support their families, as well as their daily needs. The average monthly income of farmer-respondents per month was around PHP19,285.71. Eighty three percent (83%) of the respondents did not have a secondary source of income. Forty- seven percent (47%) of the respondents

belonged to a group or organization while 48% of them did not. These organizations were mostly farmers groups (84%) and cooperatives (16%). These organizations or groups provided them updates on the sector as well as some benefits. For instance, information dissemination was better if a farmer was part of a group or organization. Trainings and seminars were also some of the perks of being member of an organization. Private companies as well as government agencies tapped various farmer groups and associations for training and other skill enhancement-related activities.

Table 3. Socio Demographic Profile of Sugarcane Farmers

Age		Years Engaged in Sugarcane farming		
35 and less	4(6%)	5 and below	10 (15%)	
36 -45	13 (20%)	6 to 15	28 (42%)	
46 to 55	24 (36%)	16 to 25	17 (26%)	
Above 55	25 (38%)	26 to 35	6 (9%)	
Mean	51.38	Above 35	5 (8%)	
Mode	50 (9%)	Mean	17.52	
Min	23 (2%)	Mode	15 (20%)	
Max	83 (2%)	Min	3 (5%)	
		Max	50 (2%)	
Sex		Primary Source of Income		Ave. monthly income (PHP)
Female	24 (36%)	Farmer	63 (95%)	19,285.71
Male	42 (64%)	Politician	2 (3%)	47,500.00
		Photography services	2 (3%)	40,000.00
Civil Status		Secondary Source of Income		Ave. monthly income (PHP)
Married	55 (83%)	Farmer	3 (5%)	175,000.00
Single	8 (12%)	Politician	4 (6%)	25,600.00
Widow	3 (5%)	Carpenter	1 (2%)	10,000.00
		Teacher	1 (2%)	15,000.00
		Renting business	1 (2%)	12,000.00
		Truck maintenance	1 (2%)	20,000.00
		None	55 (83%)	-
Highest Educational Attainment		Membership in Organizations/Group		
Elementary Graduate	8 (12%)	1	31 (47%)	
High School Undergraduate	6 (9%)	2 or more	3 (5%)	
High School Graduate	32 (48%)	None	32 (48%)	
College Undergraduate	7 (11%)			
College Graduate	10 (15%)			
Vocational	3 (5%)			
Years Engaged in Farming		Type of Organizations		
5 and below	5 (8%)	Farmers group	37 (84%)	
6 to 15	28 (42%)	Cooperative	5 (16%)	
16 to 25	17 (26%)			
26 to 35	5 (8%)			
Above 35	11 (17%)			
Mean	20.98			
Mode	15 (18%)			
Min	3 (2%)			
Max	72 (2%)			

Socio Demographic Profile of Eggplant Farmers

Table 4. Socio Demographic Profile of Eggplant Farmers

Age		Years Engaged in Eggplant farming		
35 and less	2 (2%)	5 and below	13 (16%)	
36 -45	19 (23%)	6 to 15	37 (45%)	
46 to 55	27 (33%)	16 to 25	13 (16%)	
Above 55	34 (41 %)	26 to 35	8 (10%)	
Mean	52.45	Above 35	11 (13%)	
Mode	56 (9%)	Mean	17.3	
Min	33 (1%)	Mode	10 (26%)	
Max	78 (1%)	Min	1 (1%)	
		Max	53 (1%)	
Sex		Primary Source of Income		Ave. monthly income (PHP)
Female	32 (39%)	Farmer	78 (95%)	7,165.75
Male	50 (61%)	Driver	1 (1%)	5,000.00
		Reflexologist	1 (1%)	27,000.00
		Teacher	1 (1%)	17,000.00
		Vendor	1 (1%)	20,000.00
Civil Status		Secondary Source of Income		Ave. monthly income
Married	72 (88%)	Farmer	4 (5%)	9,000.00
Single	2 (2%)	Brgy Official	2 (2%)	4,375.00
Widow	7 (9%)	Carpenter	3 (4%)	2,000.00
Live In	1 (1%)	Laborer	1 (1%)	3,000.00
		Mechanic	1 (1%)	12,000.00
		Government Employee	1 (1%)	15,000.00
		Tricycle driver	1 (1%)	3,000.00
		Piggery Owner	1 (1%)	4,000.00
		Vendor	1 (1%)	4,000.00
Highest Educational Attainment		Membership in Organizations/Group		
Elementary Graduate	6 (7%)	1	49 (60%)	
High School Undergraduate	2 (2%)	2 or more	2 (2%)	
High School Graduate	44 (54%)	None	31 (38%)	
College Undergraduate	3 (4%)			
College Graduate	19 (23%)			
Vocational	3 (4%)			
Years Engaged in Farming		Type of Organizations		
5 and below	5 (6%)	Farmers group	48 (94%)	
6 to 15	21 (26%)	Cooperative	2 (4%)	
16 to 25	18 (22%)	Religious	1 (2%)	
26 to 35	18 (22%)			
Above 35	17 (21%0			
Mean	23.85			
Mode	20 (12%)			
Min	1.5 (1%)			
Max	58 (1%0			

Table 4 shows the profile of eggplant farmer-respondents. The average age of the respondents was 52 while the mode or the highest frequency of farmers was at 58 years old. Sixty one percent (61%) of the respondents were male while 39 % of

them were female. Farming requires laborious as well as heavy work, thus most of the time, males were the ones responsible for or in charge of the farm. The majority of the respondents (88%) were married. More than half of the respondents (54%) were high school graduates while 23% of them earned a college degree. The farmer respondents had been engaged in farming for 24 years on the average. Twenty eight percent (28%) of them were engaged in farming for around six (6) to 15 years. Furthermore, 45% started cultivating eggplant around six (6) to 15 years ago. They had been growing these crops for an average of 17.3 years. Of the 82 respondents interviewed, 78 of them (93%) considered farming as their primary source of income. Most of them greatly relied on the income they derived from farming to support their families, as well as their daily needs. The average income of an eggplant farmer per month was around PHP7,165.75 based on the survey. Moreover, eighty three percent (83%) of the respondents did not have a secondary source of income. Among the respondents, who had a second occupation, 5% still worked as farmers. The majority of the respondents (62%) belonged to a group or organizations. These organizations were mostly farmers groups (94%), cooperatives (4%) and religious groups (2%). These organizations or groups provided them updates about the farming sector as well as benefits. Information dissemination was better if a farmer was part of a group or organization. Trainings and seminars were also some of the perks of being member of the organization. Private companies as well as government agencies tapped various farmer groups and associations for training and other skill enhancement-related activities.

Farm Profile

The profile of the eggplant and sugarcane farms of the respondents for this study is shown in Table 5. This research covered three eggplant producing provinces, namely Pangasinan (34), Cagayan (22) and Iloilo (26). In addition, this study also covered the sugarcane producing provinces Iloilo (16), Batangas (20) and Negros Occidental (30). A total of 82 eggplant growers and 66 sugarcane growers participated in the study. More than half of the eggplant farmer respondents (55%) owned the land they cultivated and 44% of them were tenants. As for sugarcane farmers, 80% of the respondents were the owners of the land or farms. For eggplant farmers, the majority (76%) of them adapted a multi-cropping type of production system, which helped in maximizing the potential yield and profit. The other crops cultivated aside from eggplant included rice, corn, other solanaceous crops (tomato, pepper), okra, and ampalaya among others. As for sugarcane, around eighty percent (80%) of the respondents adopted mono-cropping while the the rest practiced intercropping with rice and/or corn. Based on the survey, the average area of the farm for eggplant and sugarcane farms were 1.7ha and 7.62ha, respectively. The maximum size of the farm of an eggplant farmer was 10.9ha (1%) while the minimum size of the farm was 0.125ha. For sugarcane farms, the maximum farm size was 150ha while the minimum was 0.32 ha. Majority of the eggplant farmers (15%) had farms with an area of one (1) ha while two (2) ha (23%) for sugarcane farmers. In most instances, farmers rented a portion of the land to increase their production. The average area owned by eggplant farmer respondents was 1.32ha and 6.34ha for sugarcane farmers. Most of the farmers allocated or divided their land for cultivation with other crops. Thus, these provided them with additional profit, aside from those coming from eggplant

or sugarcane alone. The average land area allocated for eggplant production based on the survey was 0.5ha while 17.125ha was allocated for sugarcane production. Most of the farmers grew eggplant on 0.5ha of land while they cultivated sugarcane on 5ha of land. The maximum land area of cultivation for sugarcane was 150ha while it was 2ha for eggplant.

Table 5. General profile of eggplant and sugarcane farms in the study

	Frequency % value	
Variable/Parameter	Eggplant (n=82)	Sugarcane (n=66)
Location of the Farm		-
Pangasinan	34	-
Cagayan	22	-
Iloilo	26	16
Batangas	-	20
Negros Occidental	-	30
Type of Ownership		
Owner	45 (55%)	53 (80%)
Tenant	36 (44%)	2 (3%)
Leasehold	1 (1%)	10 (15%)
Caretaker	-	1(2%)
Type of Production System		
Intercropping	13 (16%)	9 (14%)
Mono cropping	7 (9%)	54 (82%)
Multi cropping	62 (76%)	3(5%)
Total Area of the Farm (hectare)		
Mean	1.7	7.62
Mode	1 (15%)	2 (23%)
Max	10.9 (1%)	150 (2%)
Min	0.125 (1%)	0.32 (2%)
Total Area Owned(hectare)		
Mean	1.32	6.34
Mode	0.5 (17%)	2 (32%)
Max	6.3 (2%)	150 (2%)
Min	0.14 (2%)	0.32 (2%)
Total Area Allocated for the Commodity (hectare)		
Mean	0.42	7.12
Mode	0.25 (26%)	2 (23%)
Max	2 (2%)	150 (2%)
Min	0.002 (2%)	0.32 (2%)

Respondents' Awareness of Organic Fertilizers and Biofertilizers

Awareness of organic fertilizers, biofertilizers and Nutrio™ validates the identified technology readiness level and the stage of the technology in the commercialization process. The perceptions of those respondents who had not yet used the technology, and the evaluation of those who had, was elicited. The respondents' willingness to use and buy Nutrio™ was also elicited. The willingness rates obtained served as input in the estimation process of the market requirement for the technology.

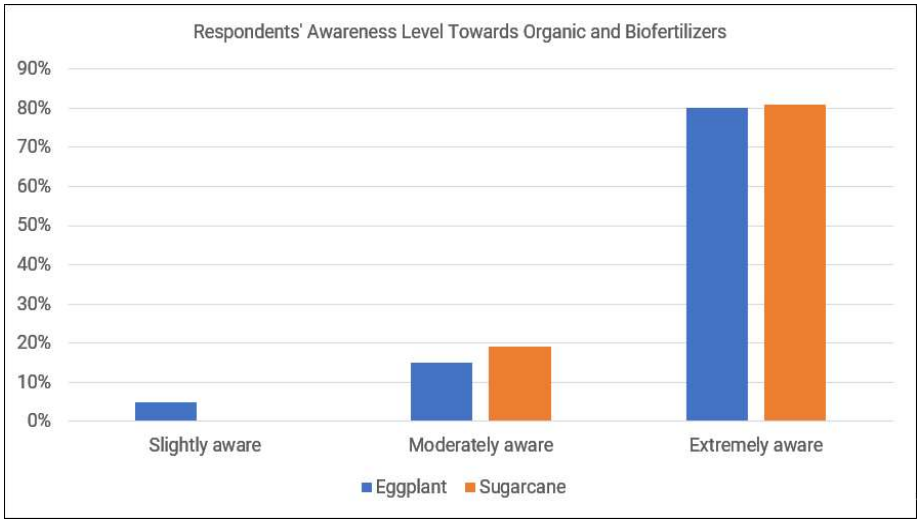

Figure 3. Awareness of respondents towards organic and biofertilizers

As seen in Figure 3, most (80%) of the eggplant and sugarcane growers who participated in the study were extremely aware or very familiar with the existence of organic and biofertilizers in the market, while others were moderately aware (16%) and slightly aware (4%). This awareness was due to extensive promotion by technicians from various agricultural private companies. The local agriculture offices (provincial and municipal) also had put in a lot of effort to promote organic products by conducting seminars, conventions, free trainings and giveaways of samples in partnership with the private sector. Membership of farmer associations or organizations was also the best means for the farmers to be updated in terms of new technologies available since these organizations and associations were commonly tapped by the government. Some also learned about organic fertilizers from different social media platforms, such as Facebook and from television programs.

On the other hand, none of the respondents were aware of Nutrio™ biofertilizer. They only heard about this brand of organic fertilizer during the interview. This was because neither promotions nor demonstrations had been conducted in these provinces. Moreover, Nutrio™ was only being sold at BIOTECH, UPLB at the time of this study. Nevertheless, one of the respondents said he was somewhat or slightly aware since it was similar to Bio-N which is also a product of BIOTECH. However, he was using Bio-N for rice crops but not for eggplants.

Respondents' Perceptions on the Attributes of Nutrio™

In this study, four (4) attributes of Nutrio™ have been identified namely, 1) Effectiveness, 2) Efficiency, 3) Shelf Life and 4) Ease of application. Effectiveness refers to the degree in achieving the desired result. It is characterized by increase in yield. It also includes environmental friendliness of the product or how safe it is to use in the environment. Efficiency refers to the characteristic of the technology in achieving the desired result with least use and waste of input. It is characterized by the decrease in use of inorganic fertilizer which results in the decrease in

production cost. Shelf life is the period during which the product can perform effectively and is safe to use. Ease of application is how convenient and easy it is to use the technology. This takes into consideration the frequency and method of application as well as the labor requirement.

Based on the qualitative responses of the farmers interviewed, effectiveness ranked first among the four attributes. Since the majority of them relied greatly on farming as their primary source of income, the effectiveness of the technology is very important to them. The more effective the product is, the more profit they will generate. Likewise, efficiency was also found to be a very important attribute according to the respondents. Reduced usage of inorganic fertilizers would reduce their cost of production and increase their profit. Moreover, this would not only benefit them but also the environment as too much use of inorganic fertilizers is not sustainable and has negative effects on the environment. The manner by which the product was used and applied was also considered. Most of the farmers reported that they preferred fertilizers that do not require too much labor and are easy to apply. However, regardless of whether it was easy, convenient or not, as long as it could give them better yield, it was okay with them. Most of the respondents did not store large volumes or quantities of fertilizers. They only bought enough quantity of fertilizer when they needed to apply it. However, some did store fertilizer in anticipation of sudden increases in the price and to avoid the hassle of going back and forth to the nearest agricultural store. Nevertheless, they preferred fertilizers with a longer shelf life. The remarks of respondents regarding the technology attributes are presented in Table 6.

Table 6. Sample remarks of respondents about the technology attributes

	Remarks
Effectiveness	*-"1st priority din. Kung di naman safe sa paligid at makakasama sa hayop at tao mahirap yun." (This is the first priority. However, if the fertilizer is harmful for the environment, animals and human, it would not be good).*
	-"1st. Yun naman talaga ang dahilan kung bakit ka bumibili ng fertilizer para magkabunga yung tanim." (This is the first priority because this is the primary reason why farmers buy fertilizer- that is, to have a harvest).
	-"1st: nandon ang pera. Bakit ka gagastos kung di naman pala effective. Parang nagtapon ka lang ng pera." (This is the first priority because it entails cost. Spending on something which is not effective is a waste of money).
	-"2nd ito. Para sustainable." (This is the second priority. For it to be sustainable).
	-"Mas importante yung safe. Epektibo nga pero delikado din naman, wala din naman." (Safety is more important than effectiveness. Having an effective product which is not safe is no good).

Table 6. continued

	Remarks
Efficiency	*-"1st. 50% decrease than 10% is good." (This is the first priority. 50% decrease in fertilizer usage compared to 10% is good).* *- "Reduced fertilizer tsaka effective ang gusto ko." (I prefer reduced fertilizer usage and effective biofertilizer).* *- "Pag sa negosyo mahalaga bawat sentemo so dapat mabisa na, matipid pa." (In business, every centavo counts, thus, the technology should be both effective and efficient).* *-"Yung medyo matipid para di ka palaging bibili." (Efficiency so that one would not buy often).* *-"Tinitipid tapos wala namang bunga. Wala din naman." (lower fertilizer application rate but no yield will be useless).* *-"Pag mas matipid at mabisa, mas marami ang pera." (If it is efficient and, effective earnings will be higher).*
Ease of Application	*-"Kahit mahirap e apply pagtityagaan basta may bunga na i-ha-harvest." (Even if it is laborious to apply, it will be fine as long as there will be harvest).* *-"Mas mabilis e-apply, mas okay." (The easier to apply, the better).* *-"Oo, kung ihahalo lang sa tubig, madali lang naman." (Yes, if it will just be mixed with water, it is easy).*
Shelf Life	*- "Bibili lang naman kami pag mag a-apply na kami." (We will only purchase as needed).* *- "Kung mag expire eh wala nang silbi. Dapat gamitin agad, saka lang bilhin 'pag gagamitin na." (If it will expire soon, it will be useless. It should be used immediately and purchased at the time it is needed).* *- "Mas matagal mas okay kasi pwede pa ulit gamitin sa next cropping season." (The longer the shelf-life, the better, so it can still be used in the next cropping season).* *-"Okay lang din naman kasi ako nag iimbak ng napakadaming fertilizer at kulang din sa budget." (It is okay, as I am not storing a lot of fertilizer as the budget is limited).*

Shown in Figure 4 are the quantitative assessment results (averaged) of Nutrio™ for each attribute by sugarcane and eggplant growers. Effectiveness consistently ranked 1st among four attributes for both sugarcane and eggplant growers. Efficiency ranked 2nd for eggplant famers but ranked 3rd for sugarcane growers. Overall, Efficiency ranked 2nd. Shelf-life ranked 3rd overall. The Ease of Application ranked 3rd and 4th for eggplant and sugarcane growers. respectively. Overall, it ranked 4th or last among the set of attributes for the technology. On the other hand, the qualitative assessment of Nutrio ™ based on the respondents' perceptions is presented in Table 7.

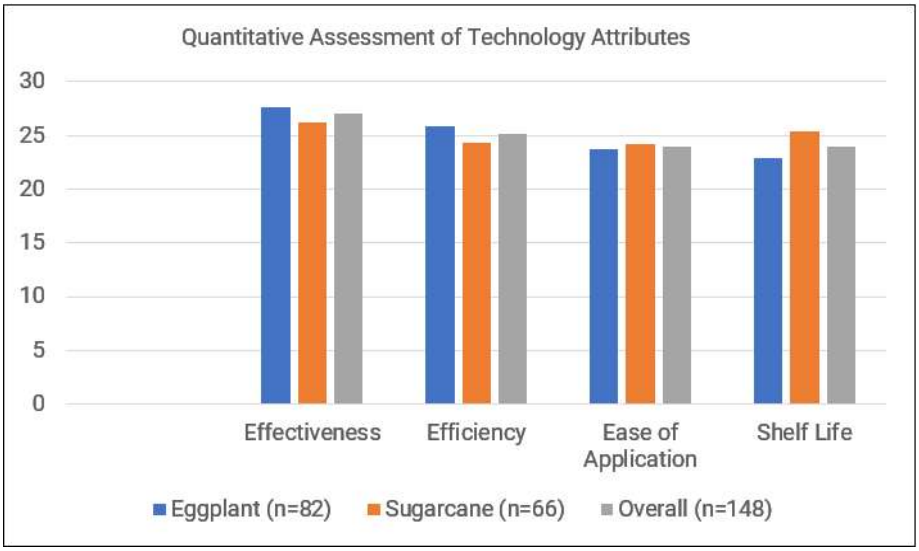

Figure 4. Quantitative assessment of technology attributes

Table 7. Qualitative assessment of Nutrio™ based on respondents' perception

	Towards Negative Remarks	Towards Positive Remarks
Effectiveness	*-"I can't decide unless I really see."* *-"Not willing to use."*	*-"Mukhang maganda yun kung talagang may increase sa harvest." (It seems good to have actual increase in harvest).* *-"Okay yan kasi may increase in yield." (It is okay because there is an increase in yield).* *-"Gagamit ako para ma try ang epekto." (I will try to use it to see its effects).*
Efficiency	*-"I can't decide unless I really see."* *-"Matipid oo, pero kung sa mabisa hindi ko pa sure. Gusto ko muna subukan." (Yes, it is efficient but if it is effective, I am not sure yet. I would like to try it first).*	*-"Affordable na yan para sa amin." (It is affordable for us).* *-"Efficient naman siguro pagka sinubukan." (Perhaps it will be efficient once we try it).* *-"Maganda yung 3 teaspoon sa isang knapsack-sa eggplant." (Three teaspoon per knapsack for eggplant is good).* *-"Makakatipid kung mababawasan ang consumption ng inorganic fertilizer." (We can save if inorganic fertilizer usage will be decreased).* *-"Matipid lang. Lumalabas na halos PHP30 per knapsack." (It is cost-efficient, amounting to almost PHP30 per knapsack).*

Table 7. continued

	Towards Negative Remarks	Towards Positive Remarks
Ease of Application	*-"Tedious because water should have no chlorine and applicator should not be previously used with chemicals to not kill inoculant."*	*-"Okay lang kung spray di kelangan ng mas maraming laborers." (It is okay if it will be sprayed. There is no need to hire more laborers).* *-"Di naman ganon ka kumplekado. Madali lang naman." (It is not that complicated. It is just easy).*
Shelf Life	*-"Dapat higit pa 6 months and shelf life." (The shelf-life should be longer than six months).* *-"Medyo mabilis pala ang expiration." (The shelf-life is quite short).* *-"No idea since I have never tried using foliar."*	*-"Maganda na. matagal na yun sa tingin ko." (It is good to have longer shelf-life, in my opinion).* *-"Mas mahaba nag expiration,mas mabuti. Mga taon dapat siguro." (Longer shelf-life is better. In years, perhaps).* *-"Matagal na yang 6-8 months para sa organic." (Six to eight months shelf-life for organic is already long).* *-"Dapat nasa proper storage ito." (This should be in a proper storage area).*

Based on the preliminary results of the field survey, almost all of the respondents were not aware about Nutrio™. More than 50% of the respondents perceived Nutrio™ to be effective based on the information provided to them. A promise of a 10% to 15% increase in their yield was considered desirable. The majority of them stated they would like to try using the product to really test if it was really effective. Farmers also care for the environment. As much as possible, they wanted to minimize heavy usage of inorganic fertilizers if there was an alternative which was more affordable and without sacrificing their profit. Farmers would prefer to use products that would allow them to maximize their potential income. In terms of efficiency, most of the farmers perceived Nutrio™ to be efficient based on the facts provided to them that it can increase the yield by 10 to 15% and reduce fertilizer usage by around 25 to 50%. However, there were some of them who were doubtful if it was really as efficient as promised since they have never tried using it. The idea that only spending PHP4,000 for a hectare of eggplant and sugarcane thus, saving them a large sum of money when buying fertilizer was appealing to them. Most of them did not have a problem with how the product was to be applied. One respondent pointed out that the water should have no chlorine and the applicator should not be previously exposed to chemicals so as not to kill the microbial inoculants or bacteria present in the fertilizer. Overall, based on the responses, foliar application of Nutrio™ was still perceived to be manageable. According to the sugarcane and eggplant farmers interviewed, a shelf life of six (6) to (8) months was acceptable for organic products since they understand that these were made up of live microorganisms. However, it would be better if the shelf life could still be prolonged since most of them wanted to stock it to avoid incurring higher expenses if the price of fertilizer increased.

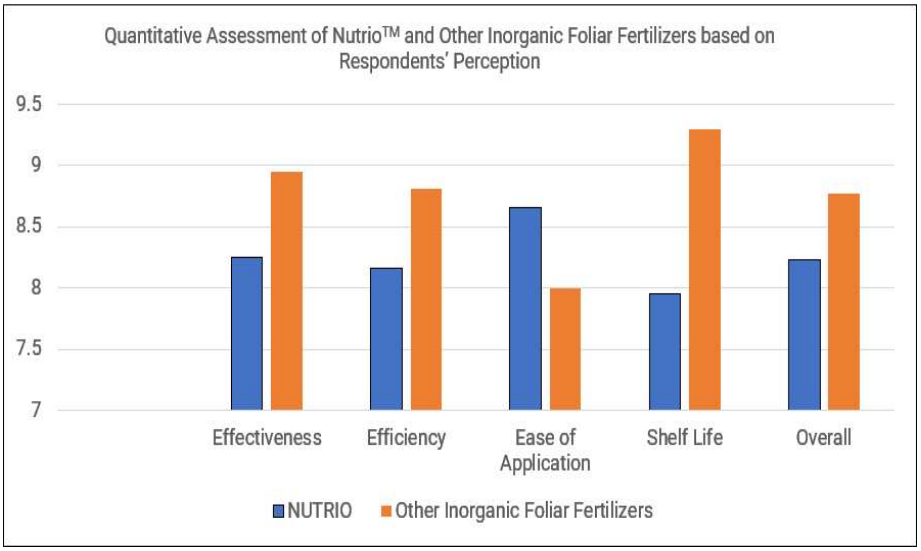

Figure 5. Quantitative Assessment of Nutrio™ and Other Inorganic Foliar Fertilizers based on Respondents' Perception

Figure 5 presents the quantitative assessment results of Nutrio™ and other inorganic foliar fertilizers based on respondents' perception. Among the four (4) attributes, Nutrio™ scored the highest on ease of application for both eggplant (9.11) and sugarcane (8.08) growers, with an overall rate of 8.65. In terms of effectiveness, it ranked second with an overall score of 8.25 given by the respondents. In terms of efficiency, it ranked 3rd with an overall rating of 8.16. Longevity ranked last among the attributes, with an overall rating of 7.95. Eggplant growers scored the overall performance of Nutrio™ including all the attributes with 8.60, while sugarcane growers gave a score of 7.76 with an overall weighted score of 8.23. On the other hand, the respondents gave a higher rating for the inorganic foliar fertilizers that they have been using in terms of the four attributes, as compared to Nutrio™.

The researchers asked the respondents regarding their preferred price or the price at which they are willing to buy the technology if they were to decide. This was done to provide insights for the developer regarding the price affordability of the technology and if the price of the technology can still be adjusted based on the willingness of the potential market. The average price per 100g sachet that was affordable for the respondents was PHP74.23. Thirty two percent (32%) of the respondents for both sugarcane and eggplant growers were willing to buy the technology for PHP100.00 per sachet. About 1% of them gave a minimum price of PHP10 while the maximum price was PHP150 (1%). These preferred prices can still change once farmers already have an actual experience of using the product. Furthermore, the average price that the respondents were willing to pay, if Nutrio™ effectiveness was proved, was PHP122.95 based on the survey. Half of them (50%) were willing to pay PHP100 for each sachet. One eggplant grower said that he was willing to pay a maximum of PHP500 for each sachet, as long as it was really effective and would increase his production, while another respondent set a minimum price of PHP200 for each unit.

It was noted that the willingness of the respondents to pay for a certain product increased if the product provided them additional benefit (eg, increase in yield) through improvement of one of the products attributes. Farmers interviewed were willing to pay an additional PHP22.95 on the averageover the product's current market price, as long as it delivered what it promised. Still, the majority of them would want to buy the product at its original price despite improvement because most of them were just smallhold farmers. These price estimates were based on the perception of the farmers alone and could still change once the farmers have actual experience of using the product. Since they have not experienced using the product yet, these estimates are still conservative and reflect the risks acceptable for them in case the product does not prove its claim.

Based on the survey, the average quantity the respondents were willing to purchase at PHP100 price was 26.35~26 packs. The maximum quantity recorded was 500pcs while the minimum was one piece. Twenty two percent (22%) of them were willing to buy 20 packs. The average quantity to be purchased by sugarcane growers was 26.18 packs while the average quantity willing to be purchased by eggplant growers was 6.89 packs. The respondents were also asked if the product was proved (eg, increased yield). The average quantity to be purchased increased by 3.45 packs, from 26.35 to 29.80. Farmers were more willing to buy more of the product if there were improvements and if these improvements would provide them better yield and profit in return. However, this estimation can still be adjusted upon actual use of the product.

Market Related Challenges/Problems

Government institutions like DOST-PCAARRD invest in key enabling technologies to solve challenges in the society and develop the economy. The developed technologies are subject to assessment whether they are ready for commercialization or not. However, during technology development, there are risks which may lead to market-related problems in the future.

Intensity of Competition and Substitution

The competition for both inorganic and organic fertilizers is very high, as the market is very saturated with different kinds of these products. There are plenty of fertilizers already available in the market and more are still being developed. Since the Philippines is an agricultural country, agricultural inputs such as fertilizers that help increase the productivity of the agricultural sector of the country are given focus and importance such that both private companies government continue to innovate. Nutrio™ biofertilizer does not compete with domestically manufactured fertilizers but with internationally made fertilizer products that are being imported by the country. Farmers have various options to choose from, as there are various substitutes available in the market. Moreover, large and international companies invest heavily in the marketing and promotion of their products to the farmers. Nutrio™, in order to penetrate and gain share of this market, needs to have a competitive edge over other commercially available biofertilizers in terms of its performance, price, accessibility and visibility.

Labor Requirement

The use of foliar fertilizers requires additional labor. Farmers can either spray the plants with these foliar fertilizers themselves or through hired labor especially those who cultivate large tracks of land. Hiring individuals to do the spraying entails cost, which is also one of the reasons why some farmers are hesitant to use foliar fertilizers in general. According to some of the farmers interviewed, lack of manpower is one of the problems that they are experiencing. Some workers no longer want to accept work on the farm (ie, spraying, weeding, etc.) because of the relatively small wages. Moreover, they found other jobs like construction work to be more appealing. The government's Cash Conditional Transfer Program, also known as 4P's (Pantawid Pamilyang Pilipino Program) can also be a factor because beneficiaries are given financial assistance even if they do not work, according to one respondent.

Volume Requirement

The recommended application rate of the technology for both eggplant and sugarcane is 4kg or 20pcs of 100g packs for every one hectare of land per cropping season of each crop. Respondents were willing to buy a total of 2,010pcs of 100g pack or 201kg of Nutrio™ based on their perception of the product alone. However, this can still change upon the actual use of the product. Assuming a positive result, the volume requirement will increase. The volume required by each farmer depends upon the land they cultivate for the commodity and the recommended application rate for the product for that specific crop. Based on the survey, eggplant growers required a total volume of 128.13kg for their production while sugarcane growers required 1921.08kg of the product per cropping season.

The researchers also computed the total requirement of the population for Nutrio™ using the willingness rate and total area cultivated for the two commodities based on the recommended rate. A total of 1,534,035.31kg of Nutrio™ is required based on the computation.

Table 8. Market Volume Requirement Computation for Nutrio™

Target Crops	Eggplant	Sugarcane
Average Area cultivated per commodity (ha)	0.42	7.12
Willingness of the respondents	94%	86%
Recommended application rate of Nutrio™ per ha (kg)	4	4
No. of farmers	3,379	17,578
1. Potential Market (area) for Nutrio™		
(Total area cultivated for the commodity X willingness rate of respondents X No. of farmers)	1,334.03	107,633.61
2. Recommended application rate X Potential Market for Nutrio™	5,336.12	430,534.44
Total Requirement (kg)	435,870.56kg	

Comparison of Sugarcane and Eggplant Production with and without Nutrio™

Comparison between the use of Nutrio™ biofertilizers and farmers' practice of fertilization in sugarcane production was made to determine whether there is increase in production as well as profit for the farmers per hectare. Partial Budget Analyses showed net benefits for sugarcane (PHP232,767.35ha^{-1} as presented in Table 9) and eggplant production (PHP68,172.15ha^{-1} as shown in Table 10) with the use of Nutrio™. The net reduction in cost per hectare associated with fertilizer application was PHP6,507.35 for sugarcane and PHP6,855.14 for eggplant and the yield increased by 15 % ha^{-1} for each commodity. The use of Nutrio™ fertilizer will reduce inorganic fertilizer usage by 50%. This implies that using Nutrio™ is more profitable to the sugarcane and eggplant farmers.

Table 9. Partial budget analysis for sugarcane production using Nutrio™

	Volume	Price Per Unit (PHP)	Amount (PHP)
Added Returns:			
Additional Yield/ha	9,000kg	25.14	226,260.00
Reduced Costs:			
18-46-0	2 bags	1,546.23	3,092.46
Urea	2.5 bags	1,133.20	2,833.00
Ammosul	2.5 bags	607.50	1,518.75
MOP	3 bags	1,197.94	3,593.82
			11,038.03
Total Positive Impacts			237,298.03
Added Cost			
Nutrio, 4kg	4kg	1,000.00	4,000.00
Fertilizer Application (2 man days)		265.34	530.68
Total Negative Impacts			4,530.68
Net Benefit			232,767.35

Table 10. Partial budget analysis for eggplant production using Nutrio™

	Volume	Price Per Unit (PHP)	Amount (PHP)
Added Returns:			
Additional Yield/ha	2,700kg	22.71	61,317.00
Reduced Costs:			
Complete Fertilizer	3 bags	1,117.83	3,353.49
Ammophos,	5.25 bags	984.86	5,170.52
Urea, 1 bag	1 bag	1,133.20	1,133.20
MOP, 1 bag	1 bag	1,197.94	1,197.94
Total Positive Impacts			72,172.15
Added Cost			
Nutrio, 4kg	4kg	1,000.00	4,000.00
Total Negative Impacts			4,000.00
Net Benefit			68,172.15

Market Requirement for Potential Distributor

The potential distributor interviewed provided an estimate of the demand for Nutrio™. Their operation is focused on the rice market so they plan to introduce the product to the rice growers. As for the first year, they only plan to target 1% of the rice market. Table 11 presents the computation of the market requirement for rice.

Table 11. Market requirement for Nutrio™ by distributor

Target Crop	Rice
Total Area Cultivated in Philippines as of 2017 (ha)	4,811,800.00 *
Target Market Share	1%
Recommended rate per hectare (kg)	1
Total Requirement (kg)	48,118.00

Investment and Enterprise Budget Analyses

Given the current estimated market potential for Nutrio™, a profitability of investing in manufacturing Nutrio™ was analyzed using Net Present Value and Internal Rate of Return. The following assumptions were used:

a. Sales Target for each commodity (ha): eggplant (1,334.03) and sugarcane (107, 633.61).
   These were computed by multiplying the willingness rate of the respondents by the average area allocated for the commodity and number of farmers.
b. Nutrio™ requirement per hectare is 40 packets.
c. Royalty based on gross sales is 3%.
d. Sales return and allowance based on gross sales is 1%

The total fixed asset investments include tools, equipment and infrastructure requirements of the business. Summarized in Table 12 is the breakdown of these requirements as well as the estimated costs. The total estimated cost for the investment is PHP8,986,458.33.

Table 12. Investment requirements for Nutrio™.

Asset Requirements	Amount (PHP)
Land	600,000.00
Building	500,000.00
Equipment	1,350,000.00
Working Capital	6,536,458.33
Total	8,986,458.33

An existing company or enterprise will be involved in the distribution of Nutrio™ in addition to its current product lines. Hence, an enterprise budget analysis was made. According to the technology developer, there is a plan to expand the label of Nutrio ™ to other crops such as rice upon being granted full registration of the product. As indicated in Table 11, the estimated market requirement for Nutrio ™ by the distributor is 48,118kg. Based on the information given by the potential distributor, the researchers came up with the following estimates of additional

costs as indicated in Table 13 and showed a positive net return of PHP64,523,630.00. This implies that distributing Nutrio™ is profitable for the business.

Table 13. Enterprise Budget Analysis of an Existing Enterprise or Company in the Distribution of Nutrio™

Item	Quantity	Unit	Price (PHP)	Total (PHP)
Receipts				
Sale of Nutrio	481,180.00	packs	250 per 100g pack	120,295,000.00
Total Receipts				*120,295,000.00*
Variable Costs				
Cost of Product	481,180.00	packs	100 per 100g pack	48,118,000.00
Cost of Packaging	481,180.00	piece	8/piece	3,849,440.00
Electricity				5,000.00
Labor	2	pax	330/day	190,080.00
Marketing expense				3,608,850.00
Total costs				55,771,370.00
Returns				
Receipts				120,295,000.00
Total Costs				55,771,370.00
Net Returns				PHP64,523,630.00

Assumptions:
Labor:additional 2 workers will be hired; PHP330 minimum wage per day; 6 days per week
Cost of packaging: PHP8.00 per pack
Suggested price at distributor: PHP250/100g pack
Marketing expense: 3% of gross sales

CONCLUSION AND RECOMMENDATIONS

Nutrio™ biofertilizer is a promising technology based on the responses of the sugarcane and eggplant farmers interviewed. Among 148 respondents, 134 (91%) were willing to buy the product at its current market price. Establishing a new enterprise for manufacturing and selling of the estimated demand for the product of 435,870.56kg for both the sugarcane and eggplant market is profitable based on the financial analysis made. Production of 4,358,705.55 pieces of 100g packets of the product based on the computed market volume requirement will result in a positive NPV of PHP871,770,893.23 (at 18% discount rate). Two scenarios were considered for the business such as pessimistic scenario, where there was a 10%

decrease in the revenue, and optimistic scenario, where there was an increase of 10% in the revenue. Both scenarios obtained positive values of NPV, which implies that investing in the product can be profitable.

Also, there is an option to look for an existing enterprise that will distribute the product to the market instead of establishing a new one. Using enterprise budget analysis, it was discovered to be profitable and an additional income of PHP64,523,630.00 can be generated based on the computation. A well-established enterprise, such as the one interviewed for this study, is needed to realize the big market potential for the technology. This type of enterprise has vast networks that are very crucial in the promotion and selling of the product. The technology developer is currently manufacturing the Nutrio™ biofertilizer and is operating on a small-scale basis. It is recommended that the technology developer look for an enterprise that is willing to manufacture the technology to be able to produce it on a larger scale to cater to the computed market requirements for the product.

A comparison between production with and without the use of Nutrio™ was made to determine whether this can be profitable for the farmers. An additional income of PHP231,177.35 per hectare planted with sugarcane can be generated in comparison to the usual or farmers' practice, while an additional income of PHP68,172.15 can be generated from one hectare of land cultivated for eggplant. Thus, farmers will be financially better off using Nutrio™ in their crop production.

Although Nutrio™ is already in the commercialization stageas it is already being sold in the market, however, it is still operating on a small scale at the time of this study and can still be improved. The proponents of this research would like to recommend some strategies to expand the business scale of Nutrio™.

1. Improvement of the Product Packaging

Packaging is an important aspect in the marketing of the technology. Since the product is organic and perishable in nature, it is essential that the product is packaged properly to prevent any spoilage and damage during transport. Moreover, based on the interview with the representative of a distribution company, product packaging greatly influences farmers' perception of the product, particularly for fertilizers. Good product packaging is perceived by farmers to be of high quality while poor product packaging is perceived to be a low quality product. In addition, the size of the product packaging also depends on the target crop. For plantation crops like sugarcane, a minimum of 25kg packaging is preferred. For vegetables like eggplant, 100g packaging is already acceptable.

2. Product Demonstration and Field Testing

Marketing a new technology is very challenging. This requires time and additional resources. According to the potential distributor, it takes around two to three cropping seasons after product launching before the product finally takes off in the market. The most common practices of fertilizer and chemical companies in promoting new products are through product demonstrations and field testing. These companies collaborate with government agencies such as the Department of Agriculture (DA) and conduct seminars, conferences and harvest festivals, which serve as venues for farmers to become aware of new

technologies. These companies also give free samples of the products to farmers for them to test. As the mindset of farmers is more of "to see is to believe," if one farmer sees that a product really works, then other farmers will follow. Promotion through "word of mouth" is also a good strategy for the farmers.

3. Product Label Expansion

Currently, the registration for the product is for sugarcane only, despite proven tested for eggplant. It is better if the product's registration can be expanded to other agricultural crops such as rice, since the distributor's market identified in this study is for rice and corn. Expanding the product registration will further increase the potential market size of Nutrio™. The technology developer already has plans to do this.

4. Eventually tap distributors and producers for the technology

Although Nutrio™ has long been available in the market, the awareness of the product based on the survey was very low. This was probably because of the limited market reach of the product due to the low volume of production. Currently, Nutrio™ is produced and distributed under licence from BIOTECH by Fullmight Agricultural Corporation (FAC), a family business owned by the technology developer herself. The results of the enterprise budget analysis of this study which is presented in Table 11 proves to show the higher potential earnings that will be generated from the manufacture and sales of Nutrio™ on a much larger scale. This way, the full potential of the technology will be realized. Hence it is recommended that the commercialization pathway of distributorship be eventually adopted for this technology. This will pave the way for economies of scale as well as increase in market size of the technology not only locally but also internationally, provided that the distributors that will be selected are already established, are capable of large scale production and have wider networks.

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