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Exploring the Effectiveness of Modern Agricultural Technology for Farmers for the Green Revolution

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ABSTRACT

Purpose of the study: This study aims to determine the extent of effectiveness of modern agricultural technology among farmers.

Methodology: This research employs a quantitative descriptive method to assess farmers' perceptions and experiences in utilizing modern agricultural technology. Data were collected through surveys distributed to selected farmers in Barangay Butong. The gathered data were analyzed using statistical tools to determine the level of effectiveness and the correlation between demographic factors and technology adoption.

Main Findings: The results indicate that while modern agricultural technology has contributed to improved farming practices, its effectiveness is still influenced by farmers' knowledge, financial capacity, and access to support services. The study found a low positive correlation between age and family income with the effectiveness of modern agricultural technology, whereas gender showed a very low negative correlation. These findings suggest that while technology provides potential benefits, its impact is not uniform among farmers.

Novelty/Originality of this study: The novelty of this study lies in its localized assessment of modern agricultural technology's effectiveness, focusing on Barangay Butong. Unlike previous studies that examine broader agricultural trends, this research provides insights into specific barriers and opportunities faced by small-scale farmers in adopting technological advancements.

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1. INTRODUCTION

Agriculture has always played a crucial role in sustaining human civilization, providing food, raw materials, and economic stability to various communities. Over the years, the rapid advancement of agricultural technology has transformed traditional farming practices into highly efficient and productive systems [1]-[3]. With the introduction of herbicides, insecticides, fertilizers, and genetically modified seeds, farmers can now cultivate crops in regions previously deemed unsuitable for [4]-[6]. Genetic engineering, for instance, has enhanced crop resilience against pests and extreme weather conditions, leading to improved agricultural yields and quality. These innovations enable farmers to maximize their resources while ensuring food security for the growing population.

Despite the promising benefits of modern agricultural technology, its adoption among farmers remains limited due to various constraints. The implementation of advanced farming techniques is influenced by economic, institutional, and social factors [7]-[9]. Land size, cost of technology, and expected benefits play a significant role in determining the willingness of farmers to adopt new methods [10]-[12]. Additionally, factors such as

educational background, age, social affiliations, and gender further impact the decision-making process of farmers [13]-[15]. Therefore, understanding the extent of modern technology utilization among farmers requires an in-depth examination of these influencing elements.

Agriculture has evolved beyond mere subsistence farming into a profession requiring technological proficiency [16]-[18]. New methods such as hydroponics, aquaponics, and aeroponics have emerged as sustainable solutions to agricultural challenges [19]-[21]. These innovations emphasize efficient resource utilization, minimal environmental impact, and enhanced productivity. However, the integration of such methods into traditional farming systems in rural areas remains a challenge. Farmers in Barangay Butong, City of Cabuyao, Laguna, represent a vital demographic whose engagement with modern agricultural technology needs to be analyzed for sustainable development.One of the pressing concerns arising from technological advancements in agriculture is the migration of rural populations to urban areas [22], [23]. Many individuals have shifted from agricultural livelihoods to industrial and service-based employment, leaving only a fraction of the population engaged in farming [24]-[26]. This transition affects the sustainability of agricultural communities and poses challenges in maintaining food production levels [27]-[29]. Understanding how farmers in Barangay Butong adapt to modern agricultural technologies can provide insights into how rural agricultural communities can be sustained while keeping up with technological advancements.

Several studies have explored the impact of modern agricultural technology on farming efficiency. Research has indicated that access to mechanized tools, precision farming techniques, and data-driven agriculture significantly improves productivity and profitability [30]. Studies conducted in various agricultural regions highlight how different socio-economic factors influence the adoption rate of technology among farmers [31]. However, there is limited research specifically focusing on the farmers of Barangay Butong, which necessitates a localized investigation into the effectiveness and adaptability of modern farming technologies in this area.

The urgency of this study lies in its potential to bridge the gap between technological advancements and their practical applications among farmers in Barangay Butong. While numerous innovations are available to enhance agricultural productivity, their effectiveness depends on the farmers' ability to integrate these technologies into their traditional farming practices. This research introduces a novel perspective by examining both the challenges and opportunities faced by local farmers in adapting to modern agricultural advancements. The findings will contribute valuable insights to policymakers, agricultural experts, and farming communities seeking to optimize agricultural practices.

This study aims to assess the extent of effectiveness of modern agricultural technology among farmers in Barangay Butong, City of Cabuyao, Laguna. By examining the factors influencing the adoption of modern farming techniques, this research will provide a comprehensive understanding of the technological landscape in local agricultural settings. Furthermore, the study will serve as a foundation for future initiatives aimed at promoting sustainable agricultural practices through the integration of innovative technologies.

2. RESEARCH METHOD

2.1 Research Design

The method used is a quantitative descriptive research type because the goal is to determine the extent of the effectiveness of the use of modern agricultural technology among farmers in farming [32], [33]. Quantitative design emphasizes objective measurement and statistical, mathematical, or numerical analysis of data collected through questionnaires and Google surveys [34]. Descriptive research explains categories of information such as gender and interaction patterns by simply recording what is observed or asked about the group being studied.

2.2 Respondents

The subjects of this study were farmers domiciled in Barangay Butong, Cabuyao City, Laguna Province. A total of 12 farmers became respondents in this study, who were selected based on direct recommendations from the Chairperson of the Farmers Association in Barangay Butong. These respondents represent a group of active farmers who are directly involved in agricultural activities in the area and have sufficient experience in managing farming businesses, both in traditional contexts and those that are starting to adopt modern agricultural technology. This purposive selection of subjects was carried out to ensure that the respondents have relevance and direct connection to the research objectives, namely to evaluate the extent to which the use of modern agricultural technology is applied in their daily agricultural practices.

2.3 Instrument

The instrument of the research was a survey questionnaire. It is a self-made questionnaire in which the researchers will use google forms to gather data from the respondents. The type of questionnaire utilized was a rating scale survey where the research used the Likert scale to get data from the respondents [35], [36]. Likert scale is a psychometric reaction scale essentially used in surveys to get the respondents' preference or level of agreement

with a set of statements. This questionnaire consisted of ten items that will answer the SOP 2 and 3 of the research. It required the subject to check on a five-point scale which consists of the responses: strongly agree, agree, neutral, disagree, and strongly disagree. Data Gathering Procedure:

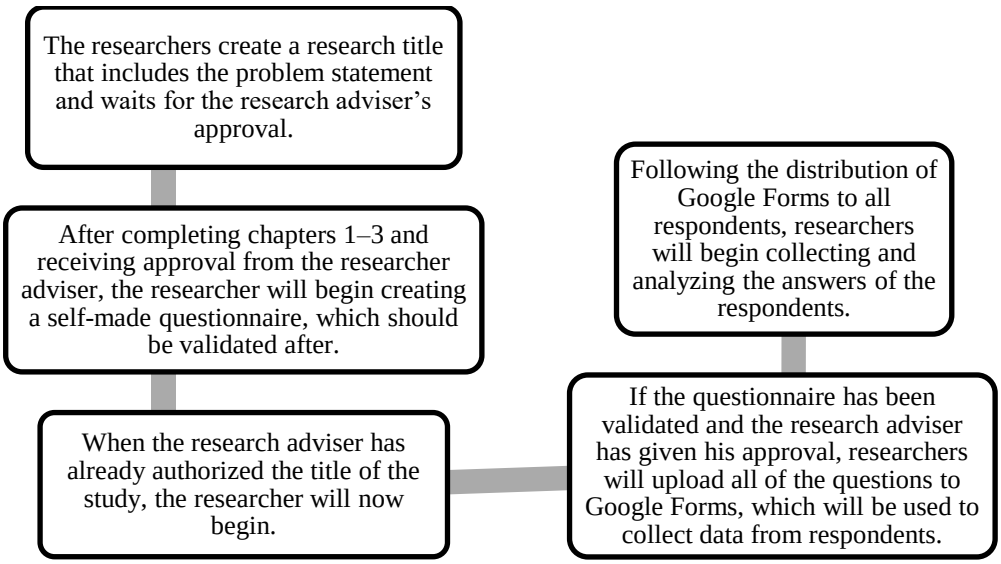

Figure 1. Data Collection Procedure

To ensure that the instruments used are in accordance with the research objectives, the researcher compiled a grid instrument as a guideline in compiling the questions. This grid aims to map the relationship between research indicators, research objectives (SOP), and the measurement scale used in the questionnaire. The research instrument grid is shown in the following table:

Table 1. Research Instrument Grid Table

No	Research Indicators	No item	Objective (SOP)	Description
1	Farmers' knowledge of modern agricultural technology	1, 2	SOP 2	Assess the level of farmers' understanding of the latest agricultural technology
2	Frequency of technology use in farming activities	3, 4	SOP 2	Measure how often farmers apply modern agricultural technology
3	Ease of access to agricultural technology	5	SOP 2	Assess the extent to which technology is easily accessible to local farmers
4	Perception of benefits of using agricultural technology	6, 7	SOP 3	Describe farmers' perceptions of the positive impacts of the technology
5	Barriers to using agricultural technology	8	SOP 3	Identify the obstacles faced by farmers in implementing technology
6	Farmers' satisfaction level with agricultural results after using technology	9, 10	SOP 3	Assess the effectiveness of technology from a production yield perspective

Based on the grid table above, it can be seen that each question item in the questionnaire is designed to measure certain aspects that are relevant to the formulation of the research problem. The following are the criteria for the questionnaire in which the researchers will use Google Forms to gather data from the respondents, which can be seen in Table 1.

Table 1. Likert Scale

Interval Of Scales	Perceived Rating	Verbal Interpretation
4.21-5.0	5	Strongly Agree
3.41-4.20	4	Agree
2.61-3.40	3	Neutral
1.81-2.60	2	Disagree
1.00- 1.80	1	Strongly Disagree

Table 1 shows the Likert scale with its interval. The means are interpreted as follows: Strongly Agree in the point interval of 4.21 – 5.00, Agree has the interval of 3.41 – 4.20, Neutral indicates 2.61 – 3.40, Disagree indicates 1.81 – 2.60, and Strongly Disagree interval is 1.00 – 1.80.

2.4 Data analysis

Data obtained through a questionnaire using a five-point Likert scale were analyzed quantitatively with a descriptive approach. The analysis techniques used included calculating the mean, frequency, and percentage [37] to determine the level of effectiveness of the use of modern agricultural technology by farmers in Brgy. Butong, Cabuyao City, Laguna. Each statement item in the questionnaire was given a score from 1 to 5, where 1 indicates "strongly disagree" and 5 indicates "strongly agree". The mean value was used to interpret the level of respondent agreement with each statement, with reference to the interpretation interval: 4.21–5.00 (strongly agree), 3.41–4.20 (agree), 2.61–3.40 (neutral), 1.81–2.60 (disagree), and 1.00–1.80 (strongly disagree). In addition, the number of frequencies of each answer choice was calculated and converted into a percentage to describe the distribution of respondent responses to each item. The results of this analysis provide an overview of farmers' perceptions of the effectiveness of the modern agricultural technology used, as well as the extent to which this technology has been accepted and implemented in daily agricultural practices.

3. RESULTS AND DISCUSSION

This chapter presents the results, the analysis and interpretation of data gathered from the answers to the questionnaires distributed to the field. The said data were presented in tabular form in accordance with the specific questions posited on the statement of the problem. Demographic Profile of the Respondents. The distribution of respondent's demographic profile in terms of Age, Gender, and Family income.

Table 2. Age of the Respondents

Age	Frequency	Percentage
51-60 years old	4	33
61-70 years old	6	50
71-80 years old	2	17
Total	12	100

According to Table 1, 33% of the respondents between the ages of 51-60 answered the questionnaire, 50% from the age of 61-70, a2nd 17% from the age of 71-80. Therefore, most of our respondents came from 61-70 of age and answered our questionnaire.

Table 2. Gender of the Respondents

Gender	Frequency	Percentage
Male	11	92
Female	1	8
Total	12	100

According to Table 2, 92% of the respondents are Male that answered the questionnaire, and the 8% is female. Therefore, most of our respondents came from the Male's and answered our questionnaires

Table 3. Family income of the Respondents

Family Income	Frequency	Percentage
2000-3000	2	17
4000-5000	1	8
6000-7000	0	0
8000-9000	2	17
10.000-11.000	2	17
12.000-13.000	4	33
14.000-15.000	1	8
Total	12	100

According to Table 1.3, 17% of the respondent has 2000-3000 family income answered the questionnaire, 8% from the 4000-5000 family income, 0% from the 6000-7000, 17% from 8000-9000 family income, also 17% from the 10,000-11,000-family income, and 33% from the 12,000-13,000 incomes, lastly is 8% from the 14,000-

15,000-family income. Therefore, most of our respondents have 12,000-13,000 family income and answered our questionnaire.

Table 4. Perceptions of Farmers in Modern Agricultural Technology

No	Statement	Weighted mean	Interpretation
1	Technology provided increase on crop yield as work can be done faster and more efficient	4.50	Strongly Agree
2	It thus promotes lesser physical work for farmers	4.08	Agree
3	It is evident that fewer plants are affected by pests, so it increased number of crops to sell	3.25	Neutral
4	It thus increased profit for the farmers.	3.83	Agree
5	Farming made easy, so costs/ number of farm workers are minimized.	3.75	Agree
6	It thus increased crop yield as fertilizer makes crops grow better.	4.58	Strongly Agree
Total average		4	Agree

Table 2 shows that the technology provided increase on crop yield as work can be done faster and more efficient with the mean of 4.50 and a verbal interpretation of Strongly Agree. Second statement is about the technology thus promotes lesser physical work for farmers with the mean of 4.08 and a verbal interpretation of Agree. Number 3 states that there is evident that fewer plants are affected by pest, so it increased number of crops to sell with the mean of 3.25 and a verbal interpretation of Neutral. It is also stated that there is an increased in the profit of the farmers with the mean of 3.83 and a verbal interpretation of Agree. Number 5 states that farming made easy, so cost/ number of farm workers are minimized with the mean of 3.75 and a verbal interpretation of Agree.

Lastly Number 6 states that there is increased crop yield as fertilizer makes crops grow with the mean of 4.58 and a verbal interpretation of Strongly Agree. In a total average mean of 4 and a verbal interpretation of Agree. As a whole, perception of the farmers in modern agricultural technology generate an overall weight mean of 4 with the variable interpretation of agree, As regards in perception of the farmers in modern agricultural technology, fertilizers makes crops grow better (it increased crop yield as fertilizers makes crop grow better) gathered the highest weight mean of 4.58 while the (evident the few plants are affected by pest, so it increased the number of crops to sell) were the least with a weighted mean of 3

Table 5. The Significant relationship between the demographic profile of the respondents and the effectiveness of the modern agricultural technology among farmers

Demographic Profile	Effectiveness	R-value	P-value	Remarks	Decision
Age	Effectiveness	0.39	0.21	Low positive correlation	Accept null hypothesis
Gender	Effectiveness	-0.06	0.85	Very low negative correlation	Accept null hypothesis
Family Income	Effectiveness	0.38	0.22	Low positive correlation	Accept null hypothesis

Table 5, which displays the relationship between traditional agriculture and the usage of modern agricultural technology and the significant relationship between the demographic profile of the respondents and the extent of the effectiveness of modern agricultural technology among farmers using Pearson r correlation, shows that age with a P-value of 0.21, which is less than the level of significance (0.5). Next is the gender with a P-value of (0.85), which is not significant. Lastly, the family income, with a P-value of 0.22, is not significant. Therefore, the null hypothesis is accepted. There is no significant difference between traditional agriculture and the use of modern agricultural equipment in terms of the perceptions of the farmers, and there is no significant relationship between the demographic profile of the respondents and the effectiveness of modern agricultural technology among farmers.

Old farming is accustomed and often traditional at this point since technology keeps on helping farmers step by step. Old forms of farming are optional, especially if the farmers are not used to the modern technologies the modern agriculture has to offer [38]-[40]. Old ways of farming only apply a farm sickle and an extremely durable body, rumors say that the old version of farmers have a durable body enough to be naturally resistant against natural temperatures, and be able to defy normal way of walking without disrupting their posture after work [41], [42]. Modern technology has helped farmers a lot as they do not need to spend hours on working, and will only focus on how to produce more, by using efficient methods.

Old farming traditions will be soon abolished once a lot of farmers became aware of what modern technology can do to their daily lives as farmers; With a cost of having the next farmer generations to have less durable body against natural temperature conditions, since as many people know, modern technology has its own sets of flaws [39], [43], [44]. Working and farming using modern technologies has its own set of flaws that harms the plantation more often than what the inventors of such technologies think about. Technical difficulties often happen to the current farming technology we have, and heavy technological maintenance were needed instead of thinking of the possible natural threats a normal plantation can face; Modern technology often forces farmers to learn more about machinery, something that not enough of them can fully understand how it actually works [45].

Modernity in farming using technologies is often a sight to see for some of the normal people who has a moderate knowledge about technology, but most farmers in this country do not know that the word technology even exist, nor knowing its own definitive meaning [46]-[48]. The effects of modern techniques for farming are often helpful, especially if more than half of the total farmers know how to do it and has the knowledge to tweak it based on their own lifestyles [49]-[51]. The farmers ability to know a lot about modern technologies and techniques while retaining the knowledge of what traditional farming has is something that can ultimately change how consumers enjoy each harvest

The novelty of this study lies in its approach that combines Pearson correlation analysis of farmers' demographic profiles with the level of effectiveness of modern agricultural technology, as well as considering farmers' perceptions of traditional farming practices. This study not only evaluates the technical effectiveness of technology, but also highlights the interaction of local farmers' culture and habits with technological advances [52], [53]. This approach provides a new perspective in understanding that resistance to innovation is not only due to economic or technical factors, but is also closely related to identity, experience, and limited technological knowledge.

This study has several limitations. First, the geographical coverage is limited to Barangay Butong, so the results cannot be generalized to other areas with different social and economic characteristics. Second, despite using statistical tests, this approach does not delve deeper into psychological or cultural factors that may influence farmers' perceptions of modern technology. Third, this study is also limited to quantitative data, without interviews or field observations that could provide a richer contextual understanding. The results of this study can be implemented in the formulation of community-based agricultural policies. Local governments and related institutions can develop technology training programs that are tailored to the demographic characteristics and technological literacy levels of farmers in the region. In addition, a hybrid approach that combines traditional agricultural practices with modern technology can be developed, so that farmers do not lose their cultural identity, but can still feel the efficiency benefits of innovation. Participatory and community-based education will be key to accelerating technology adoption in the agricultural sector.

4. CONCLUSION

Based on the results of the study, it can be concluded that modern agriculture shows a positive perception, with an average value of 4.00 which is included in the "Agree" category, where the use of fertilizers to increase crop yields gets the highest score (4.58), while pest control is still perceived neutrally (3.25). However, the results of the Pearson test showed no significant relationship between the demographic profile of farmers and the effectiveness of modern agricultural technology ($p > 0.05$). This indicates that positive perceptions of technology are not influenced by age, gender, or income. This finding confirms that although agricultural technology is considered efficient, its adoption is still constrained by limited understanding of technology and attachment to traditional methods. Therefore, it is recommended that local governments and agricultural institutions develop community-based training that is adaptive to the characteristics of local farmers, and encourage a hybrid approach that combines local wisdom with modern technology to accelerate the adoption of innovation without eroding the cultural identity of farmers.

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