

Identification of Economic Benefits of Taro Cultivation for Small Scale Farmer Communities in Papua New Guinea, a Study based on Markham District in Morobe Province

SWSB Dasanayaka¹, N. Naida², Theo Michael² and Junior Rex^{2*}

¹Dept of Management of Technology, Faculty of Business, University of Moratuwa, Moratuwa, Sri Lanka,

^{1,2}Section of Economics, School of Business, PNGUoT, LAE, PNG

Email: sarathd@uom.lk

*Corresponding author email: junior.rex@pnguot.ac.pg

Abstract: The taro plays a vital role in contributing to rural economic growth and development in Papua New Guinea (PNG); however, the subsistence nature of its farming practices has hindered improvements in productivity and non-usage of modern agricultural practices, and emerging new technologies, which led to the unsustainable low-volume of supply which restricts access to export markets. In this context, this research aims to evaluate the challenges in taro cultivation and marketing practices. This study employs quantitative and qualitative methodological approaches, collecting data through 50 local taro farmers in Markam village in Morobe Province and interviews with key stakeholders in the taro value chain. The primary methods for analyzing this data are multiple regression, ANOVA analysis and focus group discussions. The findings indicate that taro farming has raised the income levels of rural households, thereby enhancing food security within the community and leading to improved nutritional, economic, and social stability in these areas. The main themes identified are the impact of climate change, the non-availability of agricultural inputs, and the non-existence of economic success factors. Furthermore, taro production is limited by several other challenges, including restricted market access, high transportation costs, and fluctuating prices in urban markets. Moreover, insufficient government extension service support throughout the supply chain is the main barrier to advancing this critical crop to the next higher level. The policy recommendations include further promoting the cooperative model for both cultivation and marketing, employing new marketing strategies through cooperative societies to improve market access, developing rural road infrastructure, addressing issues related to the climate changes on production, government intervention through the provision of reliable extension and training services, awareness programs on modern technology and updated cultivation methods for farmers, as well as offering additional financial and marketing assistance to strengthen this nationally important symbolic food crop in PNG.

Keywords: Agriculture, Taro production, Market Access, Rural Development, and Papua New Guinea; PNG.

1. INTRODUCTION

Taro (*Colocasia esculenta*) is a very ancient food crop and a staple food crop of immense cultural and nutritional significance in PNG. Historical records shows that this may be one of the oldest foods grown with irrigated system and was utilized in the highlands as early as 9000 years ago. It was the most important food crop in PNG until about 300 years ago when it was displaced in the highlands (above 1200m altitude) by the recently introduced sweet potato. In the lowlands, it remained an important food crop until the early 1940s (Bourke, 2012). Since then, taro production has been greatly reduced by a combination of taro blight, taro beetle and declining soil fertility. However, it is still the most important staple food crop in a limited number of remote inland locations including Markham. This plant is a perennial aquatic and cultivated as annually in swamps, lowland or up land fields. Taro has long been used as a staple food in the subsistence diet of PNG. However, expansion of urban centers and a growing market for new types of foods – like the diversity provided by taro – have transformed it from sustenance to more than just commercial potential. Taro is an

important crop for the country, providing 6% of total calories for rural people (PNGNSO, 2010; Schmidt, 2024). Other studies based on FAO consumption data claiming an even higher percentage than this 6% (Mark, 2024).

It is also the ninth leading crop in terms of cultivated land area and the third in cultivated area among non-perennials (FAO,2004). This study carried-out a village in the Markham district of Morobe Province to ascertain the impact of taro production and marketing for rural development in that area. All farmers in this village are the members of a cooperative society of taro farming called the Markham Food Cooperative Society. The village's proximity to Lae provides a strategic advantage for transporting taro to the urban market. By examining the economic activities of Mamaringan villagers, it is possible to gain insights into the broader economic impact of taro production and marketing in the region. In overall, promoting food crop like taro in rural localities, country's standard cost of basic needs poverty line of 43% and 64% of healthy diet poverty line can be reduced (Mahrt, 2025).

2. RESEARCH QUESTIONS AND OBJECTIVES

Research Questions

- I. What are the current production and productivity problems encountered by the taro farmers in Mamaringan village?
- II. What are the main economic benefits of taro production to Mamaringan village in terms of rural development?
- III. What are the challenges faced by taro farmers of Mamaringan in accessing to the Lae market?
- IV. What are the main policies and strategies can recommend to improve the economic viability of taro production in Mamaringan village?

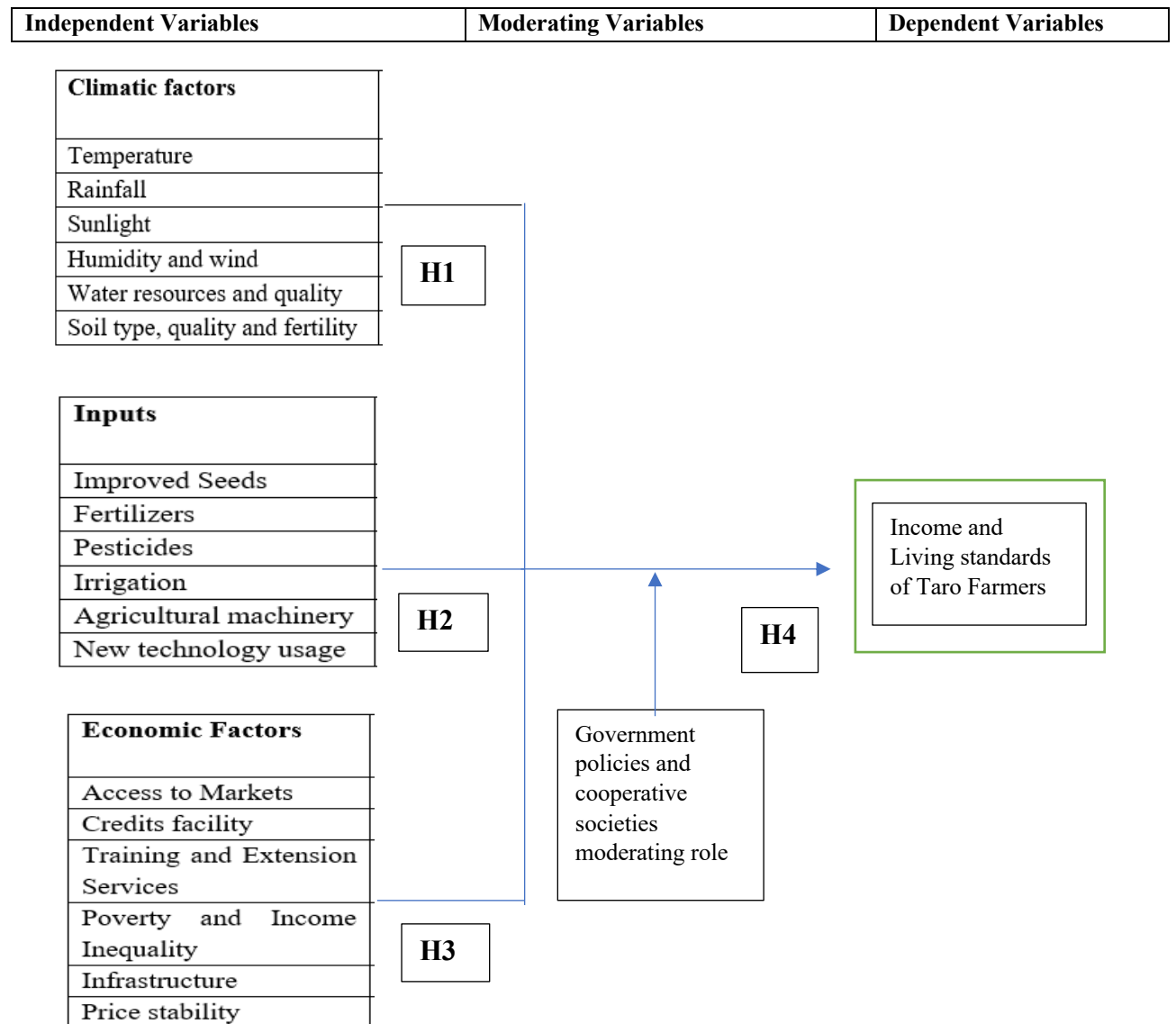
Research Objectives

- I. Identify the main economic benefits of taro production to Mamaringan village in terms of rural development.
- II. Investigate the challenges faced by taro producers in Mamaringan village in their overall supply chain including to access the surround markets.
- III. Recommend policies and strategies to improve the economic viability of taro production in Mamaringan village.

3. METHODOLOGY AND CONCEPTUAL FRAMEWORK

This research designed to use mix methods with first quantitative and later qualitative approaches in view of developing a comprehensive case study. This case study aims to see social, economic or cultural aspects of taro production and marketing in the village through rural development perspective. The use of this mixed methods approach enhances the validity and reliability of findings through triangulation. The quantitative data will largely be used to measure key variables (such as taro sales, income, production levels and market prices), while the qualitative data will investigate community perceptions, experiences and social dynamics to generate some themes. In addition to the 50 interviews by using a structure questionnaire, several other faces to face interviews and group discussions carried-out with other stake holders and apex bodies in overall taro value chain. The conceptual framework outlines the key independent, dependent and moderating variables.

Conceptual Framework of the Study



Based on the above conceptual framework, the following four hypotheses have derived.

- ❖ H1: Non-addressing the climate changing factors have created negative impact for the taro production, quality and productivity in Mamaringan Village.
- ❖ H2: Non-availability of agricultural inputs has created negative impact for the taro production, quality and productivity in Mamaringan Village.
- ❖ H3: Non-availability of critical economic success factors has created negative impact for the taro production, quality and productivity in Mamaringan Village.
- ❖ H4: The government and cooperative societies have moderating role in improving income and living standards of taro farming communities in Mamaringan Village.

4. DATA COLLECTION AND ANALYSIS

Semi-structured interviews were conducted with key stakeholders, including taro farmers, local market vendors, cooperative members, and community leaders in Mamaringan Village. The interviews explore topics such as farming practices, challenges in production, market access, income levels, and the social and cultural significance of taro. This method allows for flexibility in probing deeper into certain issues while maintaining a consistent structure across interviews. These discussions were accompanied by groups of taro farmers to capture collective experiences and common challenges. Focus Group Discussions (FGD) are especially suitable for understanding community dynamics and opened discussions on topics that may not have come up in individual interviews.

Primary data collected from 50 farmer families in Mamaringan Village and 37 farmers are subsistence farmers and 10 are semi-subsistence and other 03 are small scale commercial taro growers. Gender wise 30% farmers are female and 20 farmers are males. Prices wise, they said they get good prices from supermarket chain in LAE city but difficulty to approach them because they need quality posh products possibly packeted ones. Second level prices they get from Lae main market and Mutzing market close to village give very low prices. A portion of households supplement their income by working wage jobs or non-farm businesses, in addition to selling cash crops and their own output. Nonetheless, 37 households in the 50 sample only participate in own-farm agriculture, making subsistence farming one of the distinguishing features of rural household livelihoods in this village. Please see the appendix for the field photos in interviews and focus groups methods in Mamaringan Village. Table 1 shows farmers perceptions on climatic factors affecting for the production of Taro.

Table. 1 – Farmers perceptions on climatic factors affecting for the production of Taro

Climatic Changing Factors	No of responded families	Rank	%
Temperature	40	2	80%
Rainfall	45	1	90%
Sunlight	10	4	20%
Humidity and wind	25	3	50%
Water resources and quality	45	1	90%
Soil type, quality and fertility	25	3	50%

Source: Structured questionnaire interviews

As shown in Table 1, farmers explain that climatic factors such as rainfall, water resources and quality, temperature, humidity and wind, soil type, soil quality and fertility, availability of water supply and its quality and sun light are badly affected for the volume and quality of the taro production. The percentages are shown their actual knowledge about these factors. The multiple regression model and the related ANOVA test carried out to check the validity of H1 hypothesis. Estimated regression results such as R Square (0.767), R Bar Square (0.698) and t and F statistics are significant and low value of SSE shows that non-address of climate change factors have negative impact for taro production. Therefore, the H1 hypothesis can be accepted with somewhat shaky scale data set. Now government and agricultural Apex and R&D bodies duty is the address these climate change factors successfully and help various level taro producers to stay in market competitively to push this industry to next higher level. However, the real impact of climate change on taro productivity and production must be carried-out via climatic econometric models such as DSSAT, IPSL-CM-1-6. The effects of climate change on agricultural output in PNG have not been extensively modeled previously, making the analysis of its impact on a crucial crop like taro vital for national food security. However final outcome of these on-going models-based studies is recommendation of government heavy investment in boosting productivity by creating improved taro varieties that thrive better in wetter and dry conditions, as well as enhancing the availability of fertilizers and other extension services via cooperative societies to farming communities. Table 2 shows farmers perceptions on impact of agricultural input availability for the production of Taro.

Table. 2 – Farmers perceptions on impact of agricultural input availability and knowledge about them for the production of Taro

Inputs	No of responded families	Rank	%
Improved Seeds	15	2	30%
Fertilizers	10	1	20%
Pesticides	10	3	20%
Irrigation	05	4	10%
Agricultural machinery	02	5	0.04%
New technology usage	01	6	0.02%

Source: Structured questionnaire interviews

As shown in Table 2, farmers explain the impact of agricultural input availability for the production of Taro. As shown in the Table 2, farmers knowledge on the new technology usage and agricultural machinery are very low may be due such information and awareness mechanism may not exist. Even other inputs such as irrigation, pesticides, improved seeds and fertilizers may also have such low values may be due to non-availability and unaffordability of them. The multiple regression model and the related ANOVA test carried out to check the validity of H2 hypothesis. Estimated regression results such as R Square (0.653), R Bar Square (0.618) and t and F statistics are significant and low value of SSE shows that non-address of agricultural input availability have negative impact for taro production. Therefore, the H2 hypothesis can be accepted with somewhat shaky data set. Now government and agricultural Apex and R&D bodies duty is the address of these agricultural input non-availability issues successfully and help various level of taro producers to stay in market competitively to push this industry to next higher level.

Table. 3 – Farmers perceptions on impact of economic factors for the production of Taro

Economic Factors	No of responded families	Rank	%
Access to Markets	45	2	90%
Credits facility	48	1	96%
Training and Extension Services	40	3	80%
Poverty and Income Inequality	40	3	80%
Infrastructure	45	2	90%
Price stability	35	4	70%
Availability of government supports in time	45	2	90%
Availability of cooperative society's supports in time	40	3	80%

Source: Structured questionnaire interviews

As shown in Table 3, farmers explain the severe impact of non-availability of credits facilities, non-accessibility to markets, poor infrastructure for the production of Taro. Lack of training and proper extension services from government, non-availability of marketing and business development supports from any sides, volatility of prices and poverty as other reasons for poor performance in this crop. The multiple regression model and the related ANOVA test carried out to check the validity of H3 hypothesis. Estimated regression results such as R Square (0.569), R Bar Square (0.545) and t and F statistics are significant and low value of SSE shows that non-address of critical economic factors have negative impact for taro production. Therefore, the H3 hypothesis can be accepted with somewhat shaky data set. Now government and agricultural Apex and R&D bodies duty is the address of these agricultural input non-availability issues successfully and help various level of taro producers to stay in market competitively to push this industry to next higher level. The impact of moderating factors such as availability of government supports in time and availability of cooperative society's supports in time did not check separately as a separate hypothesis (H4) because it covers in H3. However, these Likert scale data are

somewhat shaky. Therefore, it is better to carry out a Structural Equation Model (CB-SEM or PLS-SEM) to get understand real relationships between all these multiple variables by checking H4 in next stage of this research.

Focus group discussion with farming communities revealed that major constraints to taro production include diseases like Taro Leaf Blight (TLB), pests as taro beetle, poor soil management practices and declining fertility, lack of value addition to production and lack of efficient marketing systems. Some farmers said TLB and taro beetle are of prime importance since the former can reduce yield by up to 50 percent and can also lead to poor quality of the corms while the later can cause up to 95% crop loss due to damaged corms. Many groups appreciated the taro varieties developed by National Agricultural Research Institute (NARI) now widely adopted in this village as a result of mass scale distribution of material and awareness/promotion campaign, and already there are indications of the positive impact achieved towards food security and income generation for rural farmers. Further, the most farmers said they were satisfied and impressed with the performance of the three improved varieties (NT 01, NT 02 and NT 03) with their tolerance to TLB disease and higher corm yield per plant in comparison to the local varieties. However, for the locals in Mamaringan, they farm their own local varieties which are unique in taste including Lae yellow, Lae green and namkowi which is their original local unique variety. Numerous participants stated that their earning potential is shaped by the kind of crops they grow and the sales they make. Particularly, taro growers who grow cocoa and coffee make a lot of money because of a quick spike in market prices, which raises their level of living.

The taro farmers from Mamaringan used “slash-and-burn agriculture” to clear areas for subsistence agriculture. This method, which has been used by the indigenous population for a good number of years, involves burning small areas of forest to clear land for gardens, using the nutrients in the ash to help nurture plant growth. After the garden soil has lost much of its nutrients due to cultivation, farmers move to a new area, leaving the previous garden to revert to a secondary forest. While this tradition has been historically sustainable, there are concerns that PNG’s growing population, which has doubled in the last thirty years, may increase the effects of slash-and-burn agriculture on the most biodiverse forests. Those were what frequently mentioned by the local people of Mamaringan village about how they cultivate the land for taro farming as it is their staple food especially the area under study. Taro is one of the well-known food crops in Morobe and at this time now it is of high value than other food crops sold at the open markets within the province. Focus group discussion further revealed that in addition to its economic importance, taro has a long history of social and cultural attachment in PNG societies. In PNG, taro is a prized commodity for traditional social activities such as compensation payments, bride price ceremonies and feasts. Its importance stems from the crop’s unique taste. Possibly customary land tenure system also may be one of the impediments for growth of large-scale taro cultivation in this area as few tribal leaders explained in interviews.

Further, most of participants appreciated the efforts are underway to address challenges like declining soil fertility and water management to ensure sustainable taro production, introduction of new taro varieties resistant to blight and adaptable to different agro-ecological zones, and necessity of popularizing consumption of taro over the sweet potatoes in highland areas and among the new generation in PNG. Many group participants emphasized importance of small-scale short-term projects to improve the productivity and sustainability of taro production while popularizing local consumption and commercial exports. Participants in this group discussion explained that over the years rain fall as increased but temperature has not increased that much in these localities. This group discussion further revealed that some farmers cultivate new varieties of taro to tackle this temperature and rain fall issues but they said they tried alternative crops and farming techniques to minimize losses due to climate changes and reduce income losses with their timing actions. But overall effect of climate change in decreasing productivity they alone can not tackle. Therefore, government and related agricultural apex bodies badly need to addressed this issue in holistic manner. Access to and cost of a healthy food may be the biggest obstacle to achieving household welfare goals for a sizable portion of rural people in this village. Many participants said that funding rural feeder roads that reduce rural remoteness may have major welfare benefits to these taro cultivating communities in this province.

5. FINDINGS AND POLICY RECOMMENDATIONS

This study was mainly based on interviews through structured questionnaires, focus group discussions and selected stakeholder interviews to raise a few important themes for further research. Farmers' perceptions of climatic factors affecting the production of taro explain that climatic factors such as rainfall, water resources and quality, temperature, humidity and wind, soil type, soil quality and fertility, availability of water supply and its quality and sunlight are badly affected by the volume and quality of the taro production. The multiple regression model and the related ANOVA test were carried out to check the validity of the H1 hypothesis, and it proved that non-addressing the climate-changing factors have created a negative impact on the taro production, quality and productivity in Mamaringan Village. Therefore, in policy and strategy setting to minimize climate change's effect on agriculture is a timing requirement government and related Apex bodies pay attention to assisting poor taro farming communities (Thomas, 2025).

Taro farmers' knowledge of new technology usage and agricultural machinery is very low. It may be due to such information and awareness mechanisms may not exist in this village and surrounding localities. Even other inputs such as irrigation, pesticides, improved seeds and fertilizers may also have such low awareness values in Table. 2 may be due to the non-availability and unaffordability of them. The multiple regression model and the related ANOVA test were carried out to check the validity of the H2 hypothesis, and it proved that the non-availability of agricultural inputs has created a negative impact on the taro production, quality and productivity in Mamaringan Village. The application of fertilizers, pesticides, and herbicides and the use of improved seeds are not yet common across the households in this village for any crops they cultivated. This fact is further confirmed by the IFPRD researchers in 2023 with 14 provinces covered Household Survey in PNG (Schmidt, 2024). Therefore, policies and strategies should set to make available agricultural inputs and dissemination of knowledge and awareness about importance of it, is another timing requirement for government and related Apex bodies act on.

Taro farmers in Mamaringan Village explained the severe impact of the non-existence of critical economic factors such as non-availability of credit facilities, non-accessibility to markets, poor infrastructure for the production of Taro. Furthermore, lack of training and proper extension services from the government, non-availability of marketing and business development supports from all sides, volatility of prices and poverty as other reasons for the poor performance of this crop. The multiple regression model and the related ANOVA test were carried out to check the validity of the H3 hypothesis, and it proved that non-address or non-provision of critical economic factors have a negative impact on taro production, productivity and marketing and export activities.

In Brisbane, Australia alone, there is a demand for three to four container loads per month, yet PNG can only supply one container due to many bottle necks in supply side. There are significant opportunities to export taro to regional markets like New Zealand, Australia and other Pacific countries, where many expatriates from PNG live. For instance, the National Agriculture Research Institute (NARI) in Lae celebrated the launch of its first shipment of 13 tons of premium Morobe taro to New Zealand on March 3, 2024 (Luma, 2024). Consequently, it is crucial for the government and relevant Apex organizations to create policies and strategies that address key economic factors impacting taro production and marketing, helping impoverished taro farming communities elevate their industry and quality of life. Additionally, in light of the upcoming food security challenges associated with rising population growth, advancing the taro sector is essential. Innovative initiatives like the TaroGen project are necessary to propel the taro industry to a higher level (Abner, 2009).

This project produced high yielding TLB resistant taro varieties in short period is no doubt an exceptional achievement for any conventional breeding program in PNG which gives farmers access to new TLB resistant taro cultivars (Yalu, 2009). However, the impact of climate change on taro productivity via econometric models (Hoogenboom, 2019; Jones, 2003; Jones, 2024) in PNG has not been carried-out by the researchers therefore, it is the national duty to promote this type of high-end econometric models-based research in understanding the climate change impact on important crop like taro to keep the national food security in-line. Available some studies (Smith, 2025; Thomas, 2025) revealed that projected reduction in agricultural yields between 2005 and 2050 from climate change is likely to be around 6.4% based on the IPSL model. The findings from these articles highlight the necessity for policy measures to be specifically designed to address the unique circumstances in all PNG rather one specific province.

In areas deemed more vulnerable, such as remote and economically disadvantaged parts of this Province, there is an immediate need for a targeted safety net initiative that addresses risks to agricultural productivity while also providing agricultural extension services, along with health and nutrition assistance. The well-being of rural communities would significantly benefit from the development and maintenance of rural feeder roads and bridges that connect more isolated areas to secondary and tertiary market hubs within this province. Constructing community infrastructure, such as roads and bridges, as part of a program that supports subsistence agriculture could help families dealing with production shocks by stabilizing sustainable incomes. Additionally, it may improve overall welfare by enhancing connections between rural and semi-urban areas in this province. Notably, there is extensive evidence globally that social protection measures (whether cash or in-kind transfers) assist low-income households in escaping precarious and food-insecure situations; however, PNG has yet to invest in a formal social safety net program despite having passed 50 years of political independence. While PNG is recognized as one of the most diverse tribal societies, no research has been conducted to examine significant connections between violence and household consumption expenditure. Given the sensitive nature of household and community conflicts in PNG, more comprehensive research into the impacts of violence on various outcome indicators is critically needed. Furthermore, there is a lack of empirical data assessing whether rural households in Morobe Province that cultivate taro can sufficiently meet other essential needs while adhering to nutritional dietary guidelines. This concern was prominently voiced by numerous participants during our focus group discussions.

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APPENDIX

Fieldwork Photos



Photo. 1: Semi-structured interviews in Mamaringan carried out by Research Assistants led by Ms. Noel Naida



Photo. 2: Focused Group Discussions



Photo. 3: Field works - Participants' Observations



Photo.4: Drone View of the Markham Food Cooperative Taro Farm in Mamaringan Village