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Farming Techniques and Pest Management Strategies of Queen Pineapple Farmers in Camarines Norte: Basis for a Mobile-Based Pest Detection

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A B S T R A C T

The importance of agriculture is obvious, from food security and for the farmers who are simply living for it. At the context of developing an AI-based system for pest detection, the researchers conducted an in-depth study on the farmers' farming techniques and their pest management strategy that would provide a baseline data for the development. This study aims to provide insights on the different farming techniques and pest management utilized by farmers on the queen pineapple propagation in the province of Camarines Norte. Using a quantitative descriptive method from four large queen pineapple sites in Camarines Norte with N=200 local farmers as participants of the study, a survey across the different respondents were conducted. Similarly, intensive literature review was provided along with some first-hand interview with the officials from the Department of Agriculture and other partner agency. Findings of the study revealed that there are various farming techniques and pest management followed by farmers while issues and concerns were lack of access to information, lack of infrastructures and machines for pre- and post-harvest, and lack of innovative farming and pest management control. Efforts were made to continually fund researchers and materials needed to boost QP production but the fast dissemination of new knowledge hinders the practice and implementation of new knowledge. It is highly recommended that a mobile-based application with validated pest and diseases library is needed by the farmers and utilizing new technology enablers such as AI to detect pest and provide proper recommendations could be useful to them.

1. Introduction

This research is part of the partnership between Camarines Norte State College (CNSC) and the Department of Science and Technology (DOST) that initiated the Queen Pineapple (QP) Niche Center in the Regions (NICER) project to address the challenge on food security brought about by the COVID-19 pandemic. The queen pineapple was deemed to be a stable investment because it is a typhoon-resilient crop, considering it a suitable crop for the said typhoon-prone province.

A closer look at Queen Pineapple revealed how its fruit had reddish traces at the edges of the eyes, the crown and the base and how leaves had a red hue at its center. The Queen Pineapple also known as "Formosa " is the sweetest variety of pineapple in the whole world, this variety leads over the pineapple industry, particularly in Camarines Norte in the Bicol Region. The Queen pineapple is one of the top agricultural commodities, and provided several opportunities for the people of Camarines Norte that the Pinyasan Festival, a festival named in honor of the sweet fruit, is celebrated yearly in the capital town of Daet (Czarina, 2017).

Aside from being the sweetest pineapple variety, Queen Pineapple can also be processed into jam, vinegar, fresh juices, purees and pies. Labo Progressive Multi-Purpose Cooperative has promoted livelihood projects that integrate pineapple leaf processing and use leftover pineapple leaves to create hand-woven and machine-decorticated fibers (for piña cloth and as a substitute for cellulose fibers). The cooperative has targeted to export hand woven products to high end consumers in Japan, USA, Canada and Europe. There is a study showing that queen pineapple waste can be used to make chicken feed and charcoal, which can help farmers and other individuals earn additional income aside from the fresh queen pineapple fruit.

With CNSC as the spearhead, in cooperation with the Visayas State University and Department of Agriculture (DA) in Region V, the QP-NICER program further aims to determine the problems and gaps in queen pineapple production and marketing and focus primarily on the development of the needed technologies to address these gaps.

2. Methodology

The research is based on a quantitative descriptive study which focused on several methodology techniques. Hence, some of which are discussed in this section.

2.1 Farming System Analysis Definition

Farming systems analysis, also known as FSA, is the study of the structures and functions of farming systems, the analysis of the limitations to farm-level agricultural production, and the application of this knowledge to adaptive research projects. These approaches to farming systems have a number of characteristics. They are primarily focused on creating agricultural technology for small farmers, who frequently work on fields of a limited size, use family labor, and buy just a small amount of their inputs from outside sources. Small farmers are farmers who engage in a variety of crop and/or livestock activities (Fresco, 1988).

The concept of a farming system is defined as an organized combination of production factors and activities focused on agricultural production (including livestock and crop production) for both self-sufficiency and for sale. An analysis of a farming system includes a study of the relationships that exist between the various components of the system, particularly the division and organization of family labor among the various production activities as well as relationships between the various cropping and livestock systems (Cochet et al. 2002).

Farming systems analysis is definitively part of the pro-family farmers' action-research agenda because it is an approach that helps in understanding the choices and practices of family farmers. Farming systems analysis aims to gain knowledge about the agrarian system of a particular region and the diversity of farms it encompasses, both in terms of resources endowment and technical choices in production. The farming systems analysis seeks to comprehend the farms' structure and means of production (what they already have), the practices of the farmers (what and how they do it), the thinking behind their decisions (why they do it), the technical and financial barriers, and the outcomes they achieve. It is important to avoid making the assumption that farmers' practices are outdated, that they lack knowledge and ideas, or that they are incapable of using proper reasoning in order to conduct a proper farming systems analysis. Farmers typically make decisions in accordance with their interests, within the material, human, and cognitive means to which they have access (Diepart, 2018).

2.2 Farming System Analysis Method

Farming systems analysis is conducted through the use of a series of systemic concepts developed to study agrarian landscapes. Broadly speaking, a system is a collection of interconnected or interacting parts that come together to form a complex whole and are organized to achieve one or more goals. (Crozier and Friedberg 1977).

It is essential to consider the farming systems analysis in the context of a larger social utility and to take rural people into account. This is significant when the analysis is done in collaboration with a project or NGO that is trying to address a particular development issue. It is advised that the farming systems analysis be conducted with a specific agricultural development issue in mind, one that poses a particular concern for the local population and those who support them such as development professionals, NGOs, and others. In this approach, the farming systems analysis can be viewed as a research contribution to an actual, realistic development problem (Barral et al. 2012).

The systemic approach consists of delineating the boundaries of this object, its components, the interaction between them and the relationships that integrate each and every component into a more or less organized whole (Figure 1). In comparative agriculture, the concepts of the agrarian system, farming system, cropping and livestock system all deal with the exploitation of an ecosystem by humans (Figure 1). These concepts help make sense of different agrarian units at different scales: the agrarian system addresses the interactions between an ecosystem and a group of people at the landscape level while the farming system deals with these interactions at farm/family level. The cropping or livestock earing system refers to interactions at the plot or herd level. These concepts form a nested hierarchy, and a key characteristic of the farming systems analysis is to integrate these different levels of analysis. As Figure 1 shows, the type of analysis and tools used to examine these different "systems" also vary according to the scale, ranging from detailed agro-ecological analysis at plot or herd level to wider socio-geographic and socio-economic analysis at landscape level.

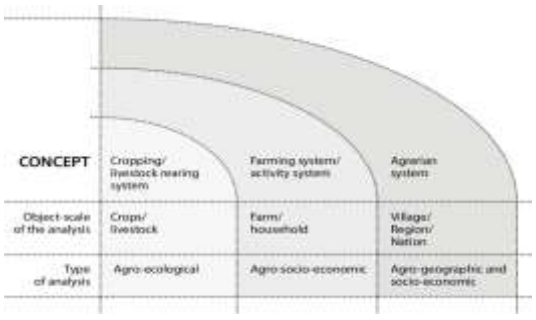

Fig. 1 - Hierarchy of systemic concepts used in farming systems analysis, adapted from Cochet (2015).

2.3 Sources of information

This study will gather information from various sources about the queen pineapple farming practices in Camarines Norte province: I) official and historical data from the Municipal Agriculture Office (MAO) and other sources; II) Publications in books and journals; III) Official documents or working documents adopted by agencies, both national and local, i.e., in the form of agricultural area maps, industry plans, queen pineapple studies, and similar literature; IV) Other papers, presentations, and conference proceedings.

3. Results and Discussions

The different farming practices and pest management were particularly discussed here in detail that helped in the development of the project under study.

3.1 The Agrarian Environment

One of the largest producers of pineapple fruit in the country is the Bicol Region, with Camarines Norte contributing 96% of its abundant fruit to production. The majority of the province's land area, with about 70.6 percent or 163,826.77 hectares, is dedicated to rice fields, coconut plantations, and brushwood coco planted with vegetables, root crops, and fruits like the Queen Pineapple. This contributes to the province's predominantly agricultural economy (Status Report on the Millennium Development Goals (MDGs) Using CBMS Data, 2010). The landscape of Camarines Norte is often rugged and made up of rolling hills, mountainous terrain, and a productive coastal plain. It belongs to a Category II climate, which means that there is no dry season and that the rainy time of the year is from November to January. The province's pineapple production zones are only believed to be located between 4 and 100 meters above sea level, and its particular soil composition and climate are thought to be the primary contributors to the QP's sweetness. The method of planting pineapples between coconut trees may have also improved the flavor. Year-round pineapple planting provides farmers with a reliable source of income between harvesting coconuts.

In Camarines Norte, the size of QP farms is typically small, approximately 1 to 2 hectares, which serves the local market. The significant potassium concentration of the soil in the province is said to be the cause of the pineapple's prolific development there. Although low soil fertility is tolerated by pineapples, high potassium levels in the soil lead to the best production. According to Obrero's (2010) research, soil applications of nitrogen and potassium increase the height, length, and width of the leaves on pineapple plants. Attaining high-quality fruits will satisfy the export market. When plants receive enough nitrogen fertilizer, they develop quickly and bear enormous fruits. Additionally, potassium makes fruit bigger and sweeter (Capuno, 2010). In the 2015 study, more than 40% (41.1%) of the QP farmers stated that their soil was fertile at a rate of 50–74%. The majority of responders (81.8%) stated that the soil has a humus-like appearance and is blackish in appearance.

The QP, otherwise known as Formosa, is abundant in Daet and the neighboring towns of Labo, San Lorenzo Ruiz, San Vicente, Vinzons, Talisay, and Basud because of its rich soil and vegetation. It is also distributed throughout the country due to its sweet flavor. San Lorenzo Ruiz, San Vicente, and Labo in Camarines Norte are the main towns in the Bicol Region producing the QP variety for Metro Manila and other local markets. Most farmers were associated with cooperatives. Some of their technology and knowledge in farming were acquired through seminars held by their respective cooperatives/associations, Department of Agriculture (DA), Office of the Provincial Agriculturists (OPAG) and/or from the office of the Municipal Agricultural Officer.

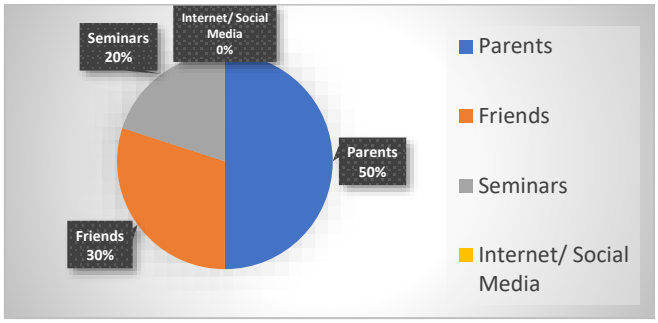

Fig. 2 - Survey conducted in 200 QP farmers in Camarines Norte on where they acquired their knowledge and techniques in farming.

A survey conducted by the current researchers on the 200 QP farmers within the province in 2021 revealed that 50% of the QP farmers believe most of their farming knowledge and techniques came from their parents transferred from generation to generation. Thirty percent (30%) learned from their friends while 20% gained farming knowledge from the seminars they attended. Not one of them claimed that they acquired information through the internet or social media or any other online platform.

The data from MAO, on the other hand, revealed that the average cost of planting pineapple per hectare is around P20,000, with 20,000 to 25,000 pineapple plants or suckers per hectare at less than 10% pilferage. With an average of 1.33 hectares and a standard deviation of 1.99 hectares, the farm sizes used for the QP farming system range from 0.25 to 14.0 hectares. It is mostly grown as a coconut intercrop, with 30,000 plants per hectare being the average plant density. The plants are placed 12 inches apart, with 24 inches between each row. The months of April to June are the busiest for harvesting, though it is done all year long.

3.2 Farming and Pest Management Techniques

50 percent of the 98,000 hectares of coconut areas in the province are available for pineapple production, particularly the varieties of Queen Pineapple and Red Spanish. The QP is best eaten fresh, but aside from that, local farmers process this fruit into jam, fresh juices, and pies. And its leaves are converted into fiber to produce high-quality cloth. Based on a survey among farmers in 2012, multiple cropping with banana, coffee, other fruit trees, coconut, vegetables, and agronomical crops (rice and corn) was practiced by the majority when it came to pineapple farming, while monocropping was practiced by 35% of farmer respondents. QP is mostly grown as a coconut intercrop, with 30,000 plants per hectare being the average plant density. The plants are placed 12 inches apart, with 24 inches between each row.

Suckers and slips are the usual planting materials used on small farms. The best practices included in QP are medium-density, low-fertilizer planting techniques of farmers; high density; and medium fertilizer. To prevent pest infestation, it is advised to plant QPs on mountain slopes where water flows freely and the sun directly strikes the ground. QP is best suited for planting under coconut trees in sloping terrain with consistent rainfall and sunny seasons. Avoid weeds by spraying herbicide three times per planting season. For early flowering, fertilizer and other chemicals are advised. The use of organic material as fertilizer is also gaining popularity because of two factors. First is agronomic, such as improving the physical qualities of the soil, providing a balanced amount of nutrients for crops, and creating a sustainable cropping system. The second is economic, such as increased customer demand for items made from organically cultivated ingredients and effective use of wastes and byproducts. According to the analysis, the organically fertilized pineapple produced encouraging results.

An average loss in QP harvesting amounting to 8.28% was recorded in 2012. Common causes of loss were damage by rodents (40%) and birds (24%), undersized fruits called “butterball” in the case of Queen pineapple (9%), mechanical damage (7%), theft (4 %), sunburn and decay (3% each) (A Compilation of Baseline Studies for The Development of Technical Assistance Projects on The Reduction of Postharvest Losses in Exporting and Importing Countries, 2012). Table 1 & 2 shows the results of survey conducted by the current researchers, it was found out that the main QP pests include birds (97%), rodents (93%), Mealy Bug (50%), Tungro virus (42%), grubs (.2%), and monkeys (.03%), as ranked by QP farmers, respectively.

Table 1 - Identified Queen Pineapple Pests.

Queen Pineapple Pests	Percent (%)
Birds	97
Rodents	93
Mealybugs	50
Tungro Virus	42
Grubs	2
Monkey	.03

With regards to the QP farming technique the QP farmers employ, 100% of them spray grass weed killer first like Diuron (85%), Demolition (17%), and Zagro (.03%) about one month before planting; then, spray fertilizer to boost sprouting like 14-14-14 NPK ratio (100%), urea (100%), and Ammonium Phosphate 16-20-0 (37%); and spray fertilizer to encourage fruit-bearing and ripening like Ethrel (50%).

Table 2 - Farming Technique used of QP Farmers based on survey.

Application of QP Farming Technique	Farmer’s Technique
Weed Killer	Diuron
	Demolition
	Zagro
Fertilizer	14-14-14
	Urea
	Ammonium Phosphate (16-20-0)
	Ethrel

To mitigate the impact of loss, Panganiban and his team from the Bureau of Agriculture and Fisheries Standards came up with a brochure to have a uniform interpretation of the standards on pineapple among DA, LGU, farmers, traders, processors, academe, quarantine and phytosanitary officers in 2018. According to Dimalauan, focal person on Food Safety of the Agricultural Training Institute, standards are very important in export of agricultural

products. He presented the 36 pages draft of an explanatory brochure on pineapple which focused on two major varieties of the country. The Cayenne pineapple which is generally planted in Laguna, Cavite and Davao as well as the areas managed by multinationals (Del Monte and DOLE) in Bukidnon and South Cotabato respectively and the QP, which is generally planted in Camarines Norte and Southern Leyte. The brochure contains the scope, minimum requirements, classification, provision concerning quality and size tolerance. It was prepared by the BAFS in collaboration with a technical working group composed of representatives from the UP Los Baños, Agribusiness and Marketing Assistance Service (AMAS), Agricultural Training Institute, Bureau of Plant Industry, and private sector. The enactment and approval of this ordinance will ensure the implementation of grading standards for pineapple set by BAFS through the PNS and will also safeguard the welfare of the farmers as well as the future of the entire pineapple industry (Guarin, 2018).

In addition to the many programs protecting, managing, and encouraging QP farming, experts and researchers from Visayas State University (VSU), Camarines Norte State College (CNSC), and Department of Agriculture Regional Field Office 5 (DA RFO 5) composed the team that spearheaded the 3-year program aiming to increase and stabilize the income of at least 3,500 marginalized and subsistent QP farmers in Bicol and Eastern Visayas in 2018. The P31 million research project, titled "Enhancing Productivity and Marketability of the Queen Pineapple Program," is funded by the DOST-PCAARRD (Philippine Council for Agriculture, Aquatic, and Natural Resources Research and Development). The initiative is a part of the Queen Pineapple National R&D Program of the Council. It entails selecting high-quality plants, producing sufficient high-quality planting materials, controlling planting density, managing pests, by-product utilization, and developing fruit grading and trading policies. The first component project of the program aims to optimize the micropropagation technique of Queen Pineapple in order to increase its quality and productivity. It explores the use of two methods of Queen Pineapple micropropagation: direct organogenesis and somatic embryogenesis. Direct organogenesis involves regeneration of the plant tissues (explants) into plantlets. Explants may consist of pieces of organs of plants, such as roots and leaves (Lubang & Panaligan, 2018).

The DA-BAR invested a total of Php3,473,755.20 for the project titled "Support to Mass Production of Pineapple Quality Planting Materials through Mass Propagation Technique and/or Protocol in Camarines Norte". Which has a two-year duration from July 2020 to June 2022. With the use of tissue culture and macro-propagation technology, this project will ensure the availability of quality planting materials for pineapple and solve the problem of a limited supply of quality planting materials as local farmers mainly rely on conventional planting materials like suckers and slip, which can be very limited. The other components of the project include the establishment of a nursery for pineapple and a demonstration farm at the CNLRRS to showcase the package of technology of the MD-2 pineapple variety using macro-propagation and tissue culture technology, pineapple production practices, nursery management, and marketing; the production of IEC materials; and the establishment of an informal seed system profile (Guarin, 2020).

Social Aspects

In Camarines Norte, QP was traditionally harvested manually once a week, and the indicator of fruit maturity was based on the color of the fruit's shell. All respondents harvested the QP when 10% of the cover turned yellow. The harvesting duration usually relies on the availability of labor and the quantity of fruits available. Most pineapple products produced in the Camarines Norte are delivered to nearby provinces in the Bicol Region and Metro Manila market through local traders. And some sold their produce to their cooperatives directly. The price of QP depends on the size and quality. The buying price of sizes 1 to 7, usually ranges from USD0.05 (P2.62) to 0.14 (P7.34) per fruit, while the undersize called butterball was bought at USD0.02 (P1.05) per fruit. They are also offered the pineapple to wholesalers and traders per kilo. However, one of the difficulties faced by the farmers is that a small percentage of the fruits were rejected during sorting due to mechanical damage sustained during the hauling of fruits from the field to the collection center (A Compilation of Baseline Studies for The Development of Technical Assistance Projects on The Reduction of Postharvest Losses in Exporting and Importing Countries, 2012).

The pineapple industry in Camarines Norte has been included in the National Technology Commercialization Program (NTCP) of the Department of Agriculture's Bureau of Agricultural Research (BAR) to increase productivity. The NTCP was established by the BAR as one of its main programs to guarantee that technologies were strategically put and distributed to areas and communities that most needed them. NTCP also ensures that agriculture is transformed from a resource-based to a technology-based industry.

The Cooperatives and agencies in Camarines Norte focusing on QP products emerged and became prominent like the Basud Coconut and Pineapple Cooperative (BACOPICO) and the Labo Multipurpose Cooperative (LMPC). Both organizations were provided of grant and technical assistance from the Spanish government through its international development cooperation agency or Agencia Española de Cooperacion Internacional para el Desarollo (AECID).

Foreign buyers began to show interest in the QP variety. Trial shipments of this variety were made recently to South Korea. A Korean company has signed a marketing agreement with the Municipal Government of Basud and the Provincial Government of Camarines Norte to export ‘Queen Pineapple’ in Korea. As a result of the increase in demand for pineapple fiber in the textile industry, the Labo Progressive Multi-Purpose Cooperative has promoted livelihood projects that integrate pineapple leaf processing and use leftover pineapple leaves to create hand-woven and machine-decorticated fibers (for piña cloth and as a substitute for cellulose fibers). The cooperative has targeted to export hand woven products in Japan, USA, Canada, and Europe. However, undersized or rejected pineapple fruits can be processed and sold as dried pineapples perfect for desserts and snacks. According to the study conducted by the Department of Agriculture’s Agribusiness Marketing Service, the Philippines’ pineapple industry has promising future potential(Balito, 2011).

In 2006, LPMPC engaged in Decortication of Pineapple Leaves in coordination with the Philippine Fiber Industry Development Authority (PhilFIDA) to maximize the use of pineapple leaves. It provided two (2) Deco Machines, one (1) Deco Machine from DOLE and four (4) Deco Machines and Brusher from the Philippine Equity Fund (PEF). Through DA-RFO 5, the cooperative was given an opportunity to tie-up with RP-Spain Program, Agencia

Española de Cooperation International focused on Decorticated Pineapple Fiber. The coop received one (1) unit Mitsubishi Close Van, one (1) unit Hauler, one (1) unit CSF with complete set of tools and equipment. In 2013 three (3) units of brand-new Deco Machine were provided by DTI-5. Ananas Annam from London placed an order of 36,000 kilos of decorticated fiber. This project received nine (9) mechanical decorticating machines and one (1) double tandem deco machine from DTI-and PhilFIDA. Members of the LMPCP and their employees use fiber from pineapple leaves to create high-quality textiles. Piña fibers, manually scraped and mechanically decorated, are interlaced with other fibers, like silk or polyester, to create expensive silky textiles for Barong Tagalog. A high-end piña cloth made from pineapple fiber has a delicate texture that is silky, shiny, and typically white or ivory. It readily absorbs and holds colors. In addition, the decorticated pineapple fiber is also used by LPMPC to make handmade piña paper from the remaining leaves after the fiber extraction. Greeting cards and other novelty items, like home decor, are made with this material. The cooperative began pursuing multiple businesses with goods that are all pineapple-based. The pineapple juice drink "Queench," pineapple jam, and the dried pineapple product "Queen's Choice" have become massive hits at pasalubong shops across the region. Aside from this, other products produced in modest quantities are wine, vinegar, and pastries. A testament to the quality of the cooperative's products, the FDA-DOST awarded the cooperative with a Certificate in Good Manufacturing Services. The town of Daet, which has become the center for trading QP, is now supplying fresh fruits in Southern Luzon and Metro Manila markets.

3.3 Economic performance of farming systems

Various agricultural and rural development programs and projects are being pursued to address poverty in the province like oil conservation focused on sustainable agriculture development, pineapple development program, and many more(Status Report on the Millennium Development Goals (MDGs) Using CBMS Data, 2010). According to Sarical, the seller of Pineapple in Pinyasan Village, their lives have improved since they started growing pineapples." before being provided a residence by the local government of Daet and Gawad Kalinga in 2007, the majority of them were reportedly squatters. Pinyasan Village stands on a 5.3-hectare land and majority of dwellers there are engaged in pineapple and vegetable farming. The three hectares of Pinyasan Village were allotted as farmland and communal plots in which the village dwellers took turns in tilling. The price at which the residents sell their produce depends on the quality of the pineapple; for the small size called butterball, the range is P2 each, while the big one can be had for P4, except in the Christmas season when they sell for up to P10. Large and good-quality pineapples can sell for P8 each in the local market and increase to P20–P25 each in December (Barrameda, 2014).

According to (Amo & Felipe, 2002) the average cost of planting pineapple per hectare is about P20,000 with 20,000 to 25,000 pineapple plantlet or suckers per hectare at less than 10 percent pilferage. The pineapple farmer can receive at least P90,000 per hectare per harvest if they harvest 18,000 pineapples per hectare and sells them for P5 each. To whole-sellers, first class pineapple is sold at P4 each piece. Queen pineapple in Camarines Norte is planted in all of its 12 municipalities, but many farms are located in Basud, Labo, San Lorenzo Ruiz, and San Vicente. Around 106.555.0 MT were produced in 2008 from 2,528.0 hectares of area planted (Status Report on the Millennium Development Goals (MDGs) Using CBMS Data, 2010).

The overall land area used for pineapple production in Bicol in 2018 was 4,773 hectares, and which province of Camarines Norte is the leading producer in the region with a 4,231-ha land area. Pineapple production provides sustainable livelihood and employment opportunities to many local farmers and allows several farmers' cooperatives and associations to engage in different value-added enterprises. In 2019, the Bicol Region increased its production from 151,217 MT last 2018 to 163,274 MT (Agriculture, 2020). Northern Mindanao remained the leading pineapple producer which contributed 462.32 thousand metric tons or 64.9 percent to the total production in the fourth quarter of 2020. This was followed by SOCCSKSARGEN with respective shares of 29.8 percent and 2.1 percent for the Bicol Region (Philippine Statistics Authority, 2020).

Camarines Norte is the leading producer of Queen pineapples in the province. This crop is highly adapted to the soil and weather conditions of the province. It is usually grown as an intercrop of coconut with an average density of 30,000 plants per hectare. Only 50% of the 98,000 hectares of coconut areas in Camarines Norte are available for pineapple production (Ezaki et al., 2022).

Before COVID-19 happened the Camarines Norte Queen Pineapple Trading and Processing Project in Brgy. Malasugui Labo, Camarines Norte produce a 4,500 boxes of pineapple juice and expanding its market to 40 schools outside the province. However, when the Luzon-wide enhanced community quarantine (ECQ) and general community quarantine (GCQ) protocols were implemented, the operation of this Philippine Rural Development Project (PRDP)-funded firm suffered a significant setback (Department of Agriculture RFO5, 2020). The DA Bicol has continued to invest in various interventions, in addition to research and technical support for pineapple producers, to free the farmers from the exploitative traders. The P15 million fund from the DA Philippine Rural Development Project (PRDP) for the Camarines Norte Pineapple Trading and Processing Project of Labo Progressive Multipurpose Coop (LPMPC) will aid the province in regaining its position in the international export market (Guarin, 2018).

Gap Analysis on Agro-Geographic and Socio-Economic Analysis of QP Farming in Camarines Norte

Using the Agro-Geographic and Socio-Economic Analysis technique on the reviewed secondary materials and data gathered from QP farmers and MAO personnel, the following are the main issues in the QP farming in Camarines Norte.

Fig. 3 - Agro-Geographic and Socio-Economic Analysis of QP Farming in Camarines Norte.

3.4 Environmental

One of the causes for low QP productivity that was determined by DILG Region 5 is the conversion of highly restricted prime agricultural land to other land uses and declining soil fertility. Inadequate infrastructure. Storage facilities and poor transport of produce products by local pineapple growers. Challenge on marketing of fresh pineapple is also encountered because of its highly perishable nature. Locally grown pineapples that are fully mature cannot be kept in storage for longer than 4-5 days after being harvested. Concerns also included the short shelf-life of perishable derivatives, the small size of pineapple fruit, and improper fruit handling that caused the fruit to decay quickly. In terms of climate, rainfall causes rot and pest infestation in QPs. QP farmers also experienced worm damage, rodent damage, weeds, death of plants and fruit cracking. Extra-technical constraints that affected their production system included high input costs, particularly for pesticides and fertilizers, and lack of financing (Balito, 2011).

3.5 Economic

One of the top countries exporting pineapples worldwide is the Philippines. The industry is favorably affected by the General Agreement on Tariffs and Trade (GATT). The reduction in trade barriers will have a large effect in the country's pineapple industry. Although exporting to other countries and cities offers income-generating activity for both the QP farmers and the town it hailed, there are instances when some fruits were rejected during sorting due to mechanical damage and poor roads incurred during hauling of fruits from farm to collection center. Other postharvest related included the instability of market demand for pineapple and the low buying price. During wholesaling, loss was generally low. Trader/wholesalers indicated a range of 0.5 to 1 percent loss since the fruits were sold immediately upon arrival in the market. For those instances where fruits that were not sold stayed in the stalls for up to three days, losses were reported by wholesaler respondents to reach up to eight percent. The common causes of losses were the same as that encountered during transport, when mechanical damage in the form of bruising and compression occurred. Losses were due to decay, overripening and mechanical damage in the form of bruising and compression. Overripening became a problem especially during the months when there were other fruits available in the market, like mango and melons. QP farmers wish for the establishment of ordinance or resolution to protect the industry; creation of infrastructures to lengthen the shelf-life or QPs, and the easy access to information so they could learn more about techniques in farming and preserving QPs.

3.6 Social

Low productivity due to inadequate research and extension services in agriculture, a lack of infrastructure support facilities, and a slow uptake of new technologies by farmers were seen as issues blocking the rapid development of QP farming in Camarines Norte. According to experts, QP farmers usually use the traditional farming method because of their difficulty in accessing much more advanced techniques and knowledge using technology. This led to substandard production - QP's irregular sizes, insufficient number of fertilizers, fruit-bearing and sprouting not maximized, and rejects because of pest damages. Additional issue is the oversupply of QPs because the farmers do not follow cropping patterns. Although a lot of programs supporting the QP farming in Camarines Norte were implemented and the farmers' income increased some, the demand for innovations and technological advances for QP farmers easy access to knowledge and techniques and programs and funds to further enhance their craft and continuous progress of QP production in the province is still strong.

4. Conclusion and Future Work

The agencies Department of Agriculture (DA), Department of Science and Technology (DOST), Bureau of Agricultural Research (BAR), and others must focus their resources to the advancement of technology in the field of QP farming. All of the issues and concerns presented in farming and gap analysis all boil down to lack of access to more information, lack of infrastructures and machines for processing produce and products, and lack of innovative farming and pest management control. Efforts were made to continually fund researchers and materials needed to boost QP production but the fast dissemination of new knowledge hinders the practice and implementation of new knowledge. The infusion of new, advanced technologies has allowed the global agriculture sector to surge ahead and transform the way producers cultivate, harvest, and distribute agricultural commodities. The use of ICT in agriculture has accelerated agricultural and rural development by adopting innovative ways to improve the existing information and communication

processes. It is high time that technology be incorporated in QP farming and address challenges associated with the traditional form of agriculture. The Convolutional Neural Network (CNN) which is a deep learning algorithm is particularly recommended for its capacity to analyze images and recognize the subject to give the appropriate label or class of the image. Using this methodology, the Queen Pineapple Intelligent Pest Detection and Crop Protection Management System (QPIPED-CPM) which is a smartphone application that will be able to identify the QP Pest by capturing using the cellphone camera. This will help the QP Farmers to increase their yield and income through better farming pest identification and mitigation. Farmers will lessen the material cost of pesticides as they will be able to determine the right pesticide to use with the right information they have of the pest in their farm. Likewise, the result will serve as an early warning system for pest infestation as an increase in pests and their detection will give better farming approaches and prevent spread of crop damages.

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