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SUSTAINABLE MANGO PRODUCTION IN BATAAN THROUGH SCIENCE AND TECHNOLOGY INNOVATIONS AND SUPPORT MECHANISMS FOR CAPACITY DEVELOPMENT

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ABSTRACT

This institutionalized research cum extension project through community-based model farms (CBMF) was conducted from January 2021- May 2022 at the eight GAP mango farms in Bataan. Farmer cooperators received soft loans in the form of pesticides amounting to PhP 28,000.00 intended for 50 carabao mango trees. Fruit bagging using large-size waxed papers and newsprint fruit bags were used to determine the efficiency of each material for mango. Trained 296 mango farmers and technicians on GAP and ICM from nine trainings conducted by the project team. Additional seven mango farms were awarded GAP accreditation. A net income of PhP 63,476.00 was recorded from the five (5) CBMFs. An income of PhP 97,200, PhP 225,000 and PhP 240,000 were recorded from the control, conventional bagging, and fruit cluster bagging, respectively. The application of cluster and conventional bagging of fruits remarkably produced more and quality fruits of 128 kg and 120 kg per tree, as compared with the control of 77.76 kg per tree. The results proved that the bagged fruits would assure or even guarantee a high rate of quality fruits and income. The project is institutionalized for being one of the commodity research agenda of the University. The creation of Bataan Mango Development Council was also initiated to lead the programs and road map for the mango of the province.

KEYWORDS

Bagging, Bataan, carabao mango, community-based model farms.

INTRODUCTION

In the Philippines, mango is the third most important fruit crop next to pineapple and banana. Aside from its fine taste and nutritional value, it has a significant contribution to the export earnings of the Philippines. FAO (2012) cited that the Philippines is one of the top mango producers in the world and is the world's seventh leading mango producer. Accordingly, It has established its credibility in supplying high quality mangoes to important markets such as Hong Kong, Japan and Singapore. Significantly, according to Roadmap to Mango Industry and BAS (2004), the Philippine mango industry supports some 2.5 million farmers and farm family members. The Philippines' lands and climate are suitable for the cultivation and growing of mango. And of the 880,759 ha of the Philippine soil planted to fruit crops, the area planted to mango was estimated at 158, 000 ha, with seven million trees in 2004. It has produced 967, 000 mt fruits, valued at P16, 135 million. DOST-PCAARRD (2011) stressed that the mango industry has played an important role in the economy of the Philippines as it provides a source of livelihood to about 2.5 million farmers. Thus, mango is considered as the Philippine national fruit which can be eaten fresh and processed. However, certain factors like climate change, insect pests, diseases, and inadequate orchard management affect the growth, yield, production, and quality of mango in the Philippines. In response, the Department of Agriculture (DA) and the Department of Trade and Industry (DTI) have extended assistance to the production and product development of mango. Despite the efforts of DA and DTI, mango production still proved to be an expensive activity. And these high maintenance costs led to poorly managed mangofarms.

PSA (2016) disclosed that mango is also one of the priority commodities in Bataan in terms of production. However, mango production in Bataan and Zambales is characterized as a non-productive mango orchard due to a lack of cultural management practices, such as sanitation, fertilization, irrigation, sanitary pruning, and flower induction. According to BAS (2008), the drop in production was traced to typhoons, wind damage, anthracnose, bacterial wilt, fruit flies, and leaf hoppers. Climate and pests remain major drivers of production. Pearl (2004) stated that there is no adequacy of supply when it comes to export grade mango. Further, according to Quitaneg (2020), the primary cause was the changing weather patterns brought about by global warming. He added that the research data showed a significant drop in mango production not only in Zambales but the entire CentralLuzon.

However, despite the efforts to address the gaps in mango production, the attempt to address the problems of mango farmers has not yet been sustained. Mango farmers are still pressed with the issues of fluctuating rate of production, climate and weather change, excessive use of chemicals, poor post harvest practice, declining yield and quality, and destructive pest and diseases. In addition, other gaps in the mango industry are direct buyers for mango growers, limited technology on mango production and other innovations, lack of working capital, lack of opportunity for the export industry, and product development. Also, although a number of modern technologies have been introduced to control the quality of mango fruit, and yet, most of these are only utilized by big industries, so what about the small scale mango industry? In this light, the researchers have decided to conduct further study on how to improve and sustain the production of mango as it is essential to improve the crop protection and postharvest handling to further develop the mango industry in Bataan and to extend the innovations to the neighbouring provinces.

Objectives

General Objective. Enhance the mango sector in Bataan through community- based model farming practices and support mechanism strategies.

Specific Objectives. It aims tosustain the GAP accredited mango orchards through community -based model farming system; to improve yield and income of farmer co-operators by 20%; to increase the number of ICM adopters by 25%; to capacitate 200 mango farmers on ICM and PQM; and to enhance the organizational management of Bataan Mango FarmerCooperative.

METHODOLOGY

A. Scope of theStudy

The project was conducted to improve the production performance and productivity of GAP accredited mango orchards in Bataan. Community –based model farms were established to practice the Improved Crop Management (ICM) on mango production. The comparison between conventional and cluster fruit bagging were performed in the two (2) model farms. It was conducted to determine the viability and applicability of the large waxed paper bags for cluster fruit bagging. The participating mango farms were GAP accredited in which the farm owners as being equipped with the ICM protocol are expected to observe the management practices.

However, continued capacity development activities were extended to the co-operators and mango farmers to further enhance their efficiency on improved mango production. Soft loan in the form of pesticides for 50 trees of the model farm were extended to farmer cooperators. The equivalent value of inputs was paid-back after harvest. The economic benefits of the modality were determined through partial and cost-benefit analysis. The parameters used to evaluate the effects of the interventions were as follows: (A) Before the Intervention-data on pruning, fertilization, irrigation, flush induction and pests management, field sanitation, growth regulation, flower induction, pest management, harvesting and packaging, marketing, and number of productive fruiting cycles for the last five years; (B) At Post-Production-data on harvesting (maturity indices followed) method, system of buying, where grading and sorting are done, proportions of marketable fruits, quality profile of fruits, size classification, packaging materials, other post-harvest operations, and type of buyer; (C) Yield before the interventions which includes the total yield (tons/ha and pertree), selling price (Php/kg) and gross and net income; and (D) Trainings attended on mango production, technical and marketing support and subsidies received, problems met and recommendations.

B. Area of the Study

A Community-based Model Farms (CBMF) for Mango Production were established in the eight (8) mango orchards in Bataan. The model farms were accessible to transportation and water supply, purposely to encourage the greater participation of stakeholders and farmers during the conduct of technology promotions, cross visits and practical trainings. The farmer adopters were bonded with Memorandum of Agreement (MOA) as a legal binding agreement of their support and responsibilities in the project. The farmer co-operators became very active during the cluster meetings, consultations, cross-visits, training, seminars and field days. With the opportunity of being a part of the project, they developed their respective mango orchards into learning site for mango production. The model farms were available all throughout for cross-visits and other forms of technology promotional activities.

C. Description of the ICM Interventions

Generally, the mango production in Bataan is characterized as non-productive mango orchard due to lack of cultural management practices. The recommended S&T interventions which focused on Integrated Crop Management (ICM), consisted with cultural and integrated pest management (IPM), and Post-harvest Quality Management (PQM) were demonstrated and introduced in the said CBMF. Additionally, the farmer clusters were provided with training on ICM and PQM for them to get more acquainted with the correct application of each intervention. Specific schedule of activities and monitoring tool were formulated.

Integrated Crop Management

a) *Flower Induction.*To break the normal fruiting habit, mango trees were induced to promote prof use flowering and fruiting anytime of the year. The 2-3% KNO_3 or Ca $(NO_3)_2$ was applied preferably in the afternoon. Higher concentration was recommended during off-season and lower rates during on-season. Follow-up spray of low dose (1.0 to 1.5%), three (3) days after flower induction was also done for it can improve flowering response, especially during off-season production

b) *Soil Analysis.* Representative soil samples from every techno-demo farm were subjected to complete soil analysis at the Soil Testing Laboratory of Department of Agriculture, Regional Field Unit-lll, City of San Fernando, Pampanga, Philippines.

c) *Nutrient Management. T*he nutrients in soil were analyzed using a soil test kit for NPK. Improvement on soil fertility was done through the application of inorganic fertilizers including urea (46-0-0) and complete fertilizer (14-14-14) at a rate of 5.0 kg and 2.0 kg per tree, respectively, immediately after harvest. Whereas, the same fertilizers (1.0 kg urea, 3.0 kg complete fertilizer and 15.0 kg organic fertilizers were applied during the flowering stage.

d) *Paclobutrazol application.* Paclobutrazol is a chemical substance that retards vegetative growth of mango tree. This chemical inhibits gibberellins (GA) biosynthesis, thus, resulting in lower GA levels, which in turn results to accumulation of carbohydrates, primarily starch, in the leaves and shoots. Thus, this will enhance the flowering intensity of mango. Desired amount of product was diluted (1 g a.i./4mL formulated product per linear meter of canopy diameter) in sufficient amount of water. Paclobutrazol solution was drenched within the active rootzone.

e) *Pruning Open Center Canopy Pruning.* The center of the canopy was open by removing the primary or dominant branch(es). Indeed, this improved light penetration and air circulation within the canopy reduced the pest and disease pressure and improved pesticide efficiency and flowering within thecanopy.
Sanitary Pruning. This was also done in each mango farms which involves removal of dead, diseased and infested branches to reduce sources of inoculum or infestation.

f) *Field Sanitation.* Field sanitation was observed by making the demo-farms free from weeds throughout production period, particularly at the onset of flowers. Grass cutting was done when grasses and weeds reached the 30 cm in height. The cut grasses were collected and put around the tree as natural mulch. Mulch was drenched with effective micro organism activated solution (EMAS) at the rate of 10ml per litre of water twice a week to hasten the decomposition of the materials and to encourage the presence of beneficial microorganisms in the soil.

g) *Fruit bagging.* Bagging was promoted for it contributes on the high recovery of marketable fruits. Likewise, it also increases fruit acceptability by reducing damages from pests, diseases and other causes of rejection such as latex burn, winds car, etc. Co-operators conducted early bagging (45-50 DAFI) to prevent cecid fly in damaging the fruit. Late bagging (60-70 DAFI) using the appropriate bagging materials (thick waxy magazine, yellow page telephone directory, imported and local newspaper) can be practiced when fruiting coincides with rainy month. Need-based pesticide sprays were also suggested after bagging if ants, scale insects and mealy bugs are present in the bag.

Table 1. Need-based spray program for pests management

No. of Spray	DAFI	Stage	Insecticide	Fungicide
1st	10-12	Flower post-emergence	Lambdacyhalothrin+ Thiametoxam	Mancozeb/Propineb
2nd	16-18	Panicle elongation	Dinotefuran + Cartapdrochloride	Mancozeb/Propineb
3rd	21-25	Anthesis	Pymetrozine+Bufrofezin (Profenofos)	Azoxystrobin/ Difenoconazole/ Tebuconazole
Optional spray	27-28	Full bloom	-	Azoxystrobin + Mancozeb
4th	30-35	Fruit set	Cypermethrin and otherpyrethroids(Mesurol)	Mancozeb/Propineb/ Copper-basedfungicides
5th	40-45	Young fruit stage (quail egg)	Cartap hydrochloride	Azoxystrobin/Difenoconazole/ Tebuconazole
6th	50-55	Young fruitstage (chicken egg)	Carbaryl or other carbamates or pyrethroids	Mancozeb/Propineb/ Copper-based fungicides
7th	70-80	Premature fruit stage	Cartap hydrochloride	Azoxystrobin/Difenoconazole/ Tebuconazole

Postharvest Quality Management

a) Harvesting

- The use of maturity indices in harvesting (105 - 135 days after flower inductionwhich include Light creamy - yellow pulp, flat shoulder at stem end, Full cheeks, Sinks in 1% salt solution) was done to ensure proper timing of harvesting.
- Proper timing of harvesting considered was 9 am – 3 pm to avoid extensive latex

b) Delatexing method – Use of delatexing trays and washing of fruits in 1%alum
c) Fruit size classification
d) Use of proper packaging materials

Capacity Building

As part of the promotion of the CBMF, capacity building such as training and seminars were provided to mango farmers in Bataan. Farmer cooperators and adopters of the extension program on mango production of BPSU and PLGU were trained on ICM particularly on bagging and pest management. The management capacities of the farmer adopters were enhanced through practical training on Good Agricultural Practices (GAP) and record keeping.

Monitoring and Evaluation

The cluster team was continuously engaged in the monitoring and evaluation of the project on a weekly basis to assess its progress. The standard monitoring form designed by the project team was used to facilitate accurate monitoring of activities. The implementation strategies and activities performed by the co-operator were taken for validation. Close monitoring and recording were done from the start of flower induction, date of spray, amount and kind of pesticides used, insect pests and diseases present, and the fruit development at every growthstage.

Marketing Aspect

Marketing, being the heart of any agricultural activities, should become a substantive component of the project. To be able to realize the positive cost and return analysis of the project, the farmer co-operators were bridged to the institutional buyers in Manila, specifically to the marketing platform of Mr. Jiggy Manicad. Bataan Tourism and DTI were also tapped on marketing of the fresh and processed mango products

Project Documentation

A quarterly, semi-annually and annually accomplishment reports (composed of narrative, tables, photo documentation) were prepared by the Local CBMF Team. The cluster team documented and recorded the day-to-day farm activities, including the expenditures. On- line news updates in Facebook, Instagram or Twitter were uploaded, and written articles for newspaper were published at least once a month. Also, the database system was developed solely to keep track of all the records and data collected pertaining to theproject.

RESULTS AND DISCUSSION

1. Establishment and Implementation of the ICM-Interventions

Presented in Table 2 is the list of farmer co-operators of the institutionalized CBMF mango production in Bataan. Their respective mango farms served as techno-demo-farms of the ICM interventions. As CBMF, the components of the ICM such as: sanitary and open-center pruning, fertilizer application (basal and foliar), soil analysis, field sanitation, flush induction and protection, application of growth regulator, flower induction, need-based pesticide application, and bagging were implemented.

The list of eight (8) mango co-operators were presented in Table 2. The said farmer cooperators were among the progressive mango beneficiaries of the BPSU community-based farm on mango production in Bataan. Their mango farms were used for the project because of the owners manifested commitment and willingness to participate in various capacity development activities, on-farm research on mango production, finance the production expenses of the farm and interest to acquire the soft loan of the project for the agricultural inputs of 50 mango trees. The soft loan is an intervention to ensure that the advantages of being a GAP accredited mango farms are being demonstrated in-terms of farm efficiency and productivity.It is noteworthy to mention, that these community based farms are productively utilized for cross visits, production research and venue for training on mango production. In fact, two (2) of these mango farms were used to conduct the research on mango fruit bagging, wherein the effect of panicle or cluster bagging of fruits using the large, waxed paper fruit bags were evaluated.

Table 2. Mango farmer cooperators of sustainable mango production through ICM

Name of Farmer Cooperators	Address	Size of Farm	No. of Mango Trees
Mr. Benedicto L. Perey	Upper Dangcol, Balanga City	4.0	200
Mr. Armando S. Bulaong	Sto. Domingo, Orion	2.0	80
Teodoro A. Ayson, Jr.	Alion, Mariveles	3.0	155
Mr. Florante C.Santiago,Jr.	Sto. Domingo, Orion	3.0	112
Mr. Gregorio J. Rodis	Palili, Samal	1.0	73
Atty. Norberto S. Tria	Palili, Samal	1.0	50
Ms. Liza DF.Chua	Salian, Abucay	1.0	50
Mr. Raul Dela S. Rosa	Gugo, Samal	1.0	85

Additionally, the first research study on smart farming on mango in Bataan that determines the water manipulation of mango tree through automated sensor-based instruments is being conducted at the Perey Mango Farm. Likewise, the improved crop management (ICM) of GAP such as pruning, mulching, flush induction, growth regulation, fertilization, sanitation, flower induction, IPM and bagging as the interventions of the modality have been reliably conducted of the farmer cooperators. The project generally improved the management know-how and behavioral perspective of mango farmers that resulted in the profitability of the techno- demo mango farms and adopters.

Capacitating the farmer's technical know–how and characters are vital that will build the holistic and sustainable farming activities.The sound research based management practices as perceived to be a vibrant solution to translate the depressing conditions of many small scale agricultural production especially on mango production could be observed only if the key players are capacitated to embrace fully the technology. List of training activities were presented in Table 3.

Table 3. Capacity development activities for improved management practices of mango growers in Bataan

Topics	No. of Participants		Cooperating Agencies/Offices
	Male	Female	
Improve Crop Management (ICM)	15	7	Regulatory Division-DA-RFO- 3; LGUs, Mango Farmer Cooperative
Good Agricultural Practices on Mango Production	30	20	Regulatory Division-DA-RFO- 3; LGUs, Mango Farmer Cooperative
Good Agricultural Practices on MangoProduction and Record Keeping	30	15	Regulatory Division-DA-RFO- 3; LGUs, Mango Farmer Cooperative
Demonstration on Sanitary Pruning	20	8	LGUs and OPA
Training on IPM and Fruit Bagging	12	8	LGUs and OPA
Flower Induction and Fertilization	15	5	LGUs and DA-RFO-3
Webinar on Fruit Bagging of Mango	15	5	ATI and Mango Farmer Cooperative
Online Training on Cecid Fly Management	30	16	ATI and Mango Farmer Cooperative
Pesticides formulation and application for mango	20	5	LGUs and Farmer Mango Cooperative
Integrated Pest Management on Mango	10	10	LGUs and Farmer Mango Cooperative

Comparative analysis of carabao mango with and without fruit bagging on yield and income of 8 GAP Accredited Mango Farms

With the experienced shortage of bagging service providers in the province, fruit bagging was not conducted under the three (3) mango farms. Thus, field sanitation, mulching and selective use of in secticides and timely spray were observed among farmer co-operators to at least minimize damage characteristics and loss of fruits caused by insect pests and diseases. The production performance of the techno-demo farms were evaluated through the set indicators and parameters. As presented in Table 4, higher gross income, net income and return on investment (ROI) was observed in the 5 CBMF who bagged their mango fruits.

Table 4. Comparative Analysis of 50 Mango Trees with and without Bagging of Fruits in the 5-Techno-Demo Mango Farms

Particulars	No Bagging	With Bagging
A. Cost of Agricultural Supplies		
Bagging materials	-	12,624.00
Fertilizers	6,000.00	6,000.00
Pesticides	46,680.00	27,458.00
Flower Inducer	3,500.00	3,500.00
Growth Regulators	15,000.00	15,000.00
Litter materials	5,000.00	5,000.00
Kaing	1,854.00	3,388.00
Manila Paper	388.00	6,776.00
Gasoline and Oil	3,500.00	2,200.00
Sub-Total	*81,922.00*	*81,946.00*
B. Labor Cost		
Field sanitation	3,500.00	3,500.00
Pruning	6,300.00	6,300.00
Bagging	0.00	20,200.00
Application of Fertilizers	900.00	900.00
Flower Induction	2,700.00	2,700.00
Spraying	21,600.00	13,500.00
Harvesting	6,300.00	6,300.00
Sub-Total	*41,300.00*	*53,400.00*
Total Expenses	**123,222.00**	**135,346.00**
Yield , 50 trees	**4,860.00**	**6,000.00**
Price/kg	**40.00**	**45.00**
Gross Income	**194,400.00**	**270,000.00**
Net Income	**71,178.00**	**134,654.00**
ROI	**57.76**	**99.49**

Table 5. Partial Budget Analysis of the 5-Techno-Demo Mango Farms

A. Income Reducing		**B. Income Increasing**	
Added Costs		***Added Returns***	
Manila Paper	6,388.00	Additional yield	75,600.00
Bagging	20,200.00		
Reduced Returns		*Reduced Cost*	
paper bags	12,624.00		
Spraying		8,100.00	
Kaing	1,534.00		
Insecticides/fungicides		19,222.00	
Gasoline and Oil		1,300.00	
Sub-total A	40,746.00	**Sub-Total B**	104,222.00
Net Change in Income (B- A)			63, 476.00

As presented in Table 5, the mango farms that practiced fruit bagging were comparatively better from the mango farms without bagging of fruits. The average yield difference of the bagged fruits of 19.0% when translated to earnings was equivalent to PhP 75,600.00 during the production cycle where the community-based techno-demo farming was conducted. Through the said modality, it was observed that the non-wrapped mango fruits are generally less superior in-terms of grades compared to bagged fruits and pricing. The non- bagged fruits were sold PhP 5.00 lower than the bagged fruits. Meanwhile, the interventions showed significant effect on economic gains as observed through the partial budget analysis. A total of PhP 63,476.00 net change in income was obtained.

Yield performance of the CBMF as affected by conventional bagging method and cluster fruit bagging using large, waxed paper fruit bags.

As presented in Table 6, the results reveal the comparison of the mango tree's yield performance as affected by bagging through individual fruit and cluster fruits method with that of no bagging as a traditional farmer's practice as observed in the two (2) techno-demo sites of the project.

Table 6. Profitability Analysis of 50 Carabao Mango Tree in Cluster 2

Particulars	**No Bagging**	**Conventional Bagging**	**Bagging of Fruit Clusters**
Cost of Agricultural Supplies			
Bagging materials		6,312.00	8,000.00
Fertilizers	3,000.00	3,000.00	3,000.00
Pesticides	23,340.00	13,729.00	13,729.00
Flower Inducer	1,750.00	1,750.00	1,750.00
Growth Regulators	7,500.00	7,500.00	7,500.00
Litter materials	2,500.00	2,500.00	2,500.00
Kaing	927.00	1,694.00	1,500.00
Manila Paper	194.00	3,388.00	3,000.00
Gasoline and Oil	1,750.00	1,100.00	1,100.00
Sub-Total	*40,961.00*	*40,973.00*	*42,079*
Labor Cost			
Pruning	3,150.00	3,150.00	3,150.00
Bagging	0.00	10,100.00	5,000.00
Fertilizing	450.00	450.00	450.00
Flower Induction	1,350.00	1,350.00	1,350.00
Spraying	10,800.00	6,750.00	6,750.00
Harvesting	3,150.00	3,150.00	3,150.00
Sub-Total	*18,900.00*	*24,950.00*	*19,850.00*
Total	**59,861.00**	**65,923.00**	**61,929.00**
Yield , 50 trees	**1,944.00**	**3,000.00**	**3,200.00**
Gross Income (PhP)	**97,200.00**	**225,000.00**	**240,000.00**
Net Income (PhP)	**37,339.00**	**159,077.00**	**178,071.00**

It is noticeably observed the comparable production cost among the three treated groups, ranging from PhP 40,961-PhP 42,079. The three (3) treatments were applied with the same interventions, except for bagging. The cost of paper bags used for the fruit clusters were relatively higher compared with the conventional bagging material due to the material's quality, size, texture and useful period. The said bag is made up of glossy and waxy materials that make its usage relatively

longer with the ordinary paper bags for bagging. The said paper bag could be used for five (5) fruiting seasons as compared with ordinary newsprint. That paper bag for cluster or panicle bagging with average cost of PhP 3.00 per piece is calculated at PhP 1.00 depreciation value perapplication. Its durability and efficiency will be observed during the three (3) fruiting period. As to the yield performance, it was observed that the tradition method of mango farming remained to be less viable when compared with the application of bagging technology. The application of cluster and conventional bagging of fruits remarkably produced more and quality fruits of 128 kg and 120 kg per tree, as compared with the control of 77.76 kg per tree.

Table 7. Average production performance parameters of mango trees as affected by fruit bagging methods

	Variables					
Treatments	**Ave Costper tree**	**Ave.Yield per tree**	**Ave. Cost to produce perkg of fruit**	**Ave. Gross Sales/tree**	**Ave. Income per Tree**	**Ave. ROI/Tree**
No Bagging	2,394.44	77.76	30.79	3,888.00	1,493.56	62.38
Individual fruit bagging	2,636.92	120.00	21.97	9,000.00	6,363.08	241.31
Cluster's fruit bagging	2,477.16	128.00	19.35	9,600.00	7,122.84	287.54

The result of the project supported the previous studies of Paguia, et al. (2015) and Paguia et al. (2021) that through the Science & Technology (S & T) interventions like integrated crop management; there is a significant increase in yield and income. The fruits from the no bagged trees did not command a better price due to stains, evidence of fungal diseases like stem end rot, sooty molds and anthracnose and scratches. Anthracnose and stem end rot (SER), caused by *Colletotrichum* and *Dothoriella spp*., respectively, were reduced by bagging (Hoffmanet al., 1997). Nevertheless, fruits from the control group were even sold at the average price of P50.00/kg. The use of large or big glossy paper bags was observed to be more economical as far as cost efficiency and ease of application of usage is concerned and do not require skillful fruit baggers to undertake or perform the operation unlike in individual fruit bagging wherein the selection of what fruits should be wrapped has to be done by baggers while they are being hanged /carried-out by the tiny tree branches. Islam et al.(2019) pre-harvest bagging with brown paper bag improved physical parameters' viz: weight of fruit, length of fruit, diameter of fruit, pulp weight and stone weight over control fruits, and the variation was statisticallysignificant.

2. GAP Accreditation

Aside from the initial 13 GAP accredited mango farms under the project, seven (7) new mango farms were awarded with GAP certification. This new set of GAP accredited mango farms is a break through not only in the project but also for the mango sector in Bataan. GAP has taught farmers on safety measures to be observed when it comes to the storing of pesticides and fertilizers to be used. Further, they have been equipped with knowledge on how to minimize the risks of microbial safety hazards and on the proper handling of mango fruits. They have known the proper ways of pest and nutrient management, pruning, flushing, flush management, bagging and harvesting which expect to improve the quantity and quality of their yield.

3. Product Development

There were already 11 products (mango spread, mango barquiron, mango cookies, mango marmalade, pickled mango, mango bar, mango tart, mango polvoron, mango wine and mangonitas) developed under the project. The products are in the continuous stage of improvement for longer shelf-life. Additionally, dried mango and mango flour have been subjected for testing to ensure that

these can be included in the research output. Apparently, seven (7) of these mango-based products developed already obtained the individual NUTRITION FACTS. Likewise, it is expected that the product development can be a source of livelihood of the end users, and can be transferred to the community as well. Utilization of the technology in processing and in developing mango products would entail that the mango production could be sustained.

4. Sustainability Plan

The proposed creation of the Bataan Mango Development Council (BMDC) was adopted by the Bataan PLGU through Hon. Enrique "Joet" Garcia, Jr. who spearheads the consultation meetings and formation of the Technical Working Group. The council intends to organize the mango industry in the province by means of policy support and framework that cover the whole supply chain of mango. Essentially, the council oversees the operations of mango players in coordination with the various offices and private sectors that safeguard the implementation of guidelines and procedures in-terms of subsidies for farm inputs, access to credits, extensions and marketing. The local task force is headed by OPA with BPSU as one of the members who take responsible for research and extension.

SUMMARY

The sustainability of mango production as the institutionalized research and extension project of the university is initiated through capacity development and support mechanisms including the conduct of community based model farms. The eight (8) GAP accredited mango farms were selected to implement the said community based model farming system. The farmer partners have received soft loan in the form of pesticides amounting to PHP 28,000.00 intended for50 carabao mango trees. The arrangement and terms of reference were stipulated in the contract of agreement and MOA. The large waxed paper fruit bags were used in the two (2) model farms to evaluate its effects for cluster fruit bagging. It was compared with conventional bagging and without bagging in-terms of ease of application, cost, yield and income. The study was an attempt to develop for alternative but practical solutions on scarcity of bagging service providers. The performance of the treated mango farms with ICM were also evaluated by comparing the fruit bagging with no bagging in the three (3) mango farms. Atotalof seven (7) mango farms were awarded with GAP accreditation. Interestingly, the two (2) separate technology validation showed a marked positive results on yield and income. A net change of income of PhP 63,476.00 was recorded from the three (3) CBMFs as affected by conventional bagging and without bagging of fruits. Moreover, the mango trees treated with cluster fruit bagging, conventional fruit bagging and without bagging showed significant results on yield and income. An income of PhP 97,200; PhP 225,500 and PhP 240,000 were recorded from the control, conventional bagging and fruit cluster bagging respectively. The results once proved that the bagged fruits would assure or even guarantee the high rate of quality fruits and income. The project is institutionalized for being one of the commodity research agenda of the University. The creation of Bataan Mango Development Council was also initiated to lead the programs and road map for mango of the province. A total of 296 mango farmers and technicians were trained on GAP andICM.

RECOMMENDATIONS

The institutionalization of the community based model farms modality shall be strengthened through farmer participation, LGUs and academe collaboration. The role of the model farming systems to ignite the adoption of the science based solutions on mango production is necessary leading to profitability and competitiveness of the sector. The university's role to activate the partnerships with various extension service providers in the province and in the region must diligently be initiated to enhance extension delivery services. The creation of the Bataan Mango Development Council should be pushed through to mobilize the activities of the sector and to facilitate rehabilitation and production operations of the unproductive mango farms in the province.

REFERENCES

Bureau of Agricultural Statistics (BAS). (2004). http://www.bas.gov.ph

Bureau of Agricultural Statistics (BAS). (2008). http://www.bas.gov.ph

DOST-PCAARRD. (2011). https://www.pcaarrd.dost.gov.ph/

Food and Agricultural Organization (FAO). (2012). https://www.fao.org/

Islam, M. T., Rahman, M. S., Akter, M. M., Hasan, M. N., & Uddin, M. S. (2019). Influence of pre-harvest bagging on fruit quality of mango (Mangifera indica L.) cv. Langra. *Asian Journal of Agricultural and Horticultural Research*, *4*(4), 1-10.

Hofman, P., Smith, L., Joyce, D., Johnson, G., & Meiburg, G. (1997). Bagging of mango (*Mangifera indica cv. `Keitt'*) fruit influences fruit quality and mineral composition. Postharvest Biology And Technology, 12(1), 83-91. doi: 10.1016/s0925-5214(97)00039-2

Paguia, H. M., Lopez, R., Cabutaje, A., Rosano, M.M., Tuazon, J.P.B., & Corpuz, M.N.C. (2015). "Effects of community-based farming on the productivity and profitability of mango (mangifera indica, linn.) in Bataan, Philippines."*International Journal of Agriculture Innovations and Research* 7.6 (2019): 605-609.

Paguia, R.Q., Paguia, H.M., Ventura, C.E., Javier, M.A., & Roldan, L.R. (2021).Sustainable Mango Production in Central Luzon, Philippines as Affected by Community-Based Model Farms Of Improved Crop Management. *IOP Conf. Ser.: Earth Environ. Sci*. 709 012086

PSA (Philippine Statistics Authority) (2016). Retrieved from http://psa.gov.ph/