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INVESTMENT APPRAISAL OF SELECTED CLIMATE SMART AGRICULTURAL (CSA) PRACTICES AMONG SMALL SCALE COCONUT FARMERS IN LEYTE, PHILIPPINES

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Abstract

Small scale coconut farmers are facing unprecedented challenges when attempting to increase productivity because of the occurrence of extreme weather events and changing climatic conditions. This paper investigates the practices adopted by coconut farmers in response to climate variability and assesses the agricultural practice using an investment lens to evaluate its profitability and potential for scaling up. We use farmers' survey data complemented with focus group discussion and key informant interviews. Results show that investing in coconut banana intercropping and the use of improved coconut variety are among the potential options that the farmers can adopt. The comparison of these climate smart agricultural practices to conventional coconut farming shows positive incremental benefit and the financial analysis yields positive net present value and higher internal rate of return. These suggest that the adoption of climate smart agricultural practices generates higher farm productivity compared to the conventional farming system. This implies that there is a high potential for improving coconut productivity through scaling up of these feasible options that small-scale farmers can adopt. Considering the capacities of local farming communities, there is a broad scope for government and non-government organizations in enhancing the role of climate smart agricultural practices in coconut farming.

Key words*: *climate smart agriculture, cost benefit analysis, farming system, productivity

INTRODUCTION

The coconut industry in Eastern Visayas region, Philippines, particularly in Leyte province, hosts an array of challenges whose impacts are felt across the value chain [6]. If not addressed, these challenges will continue to constrain the sector, resulting in yields and incomes below their potential. The region is vulnerable to natural disasters such as typhoons due to its geographical location [28]. On November 8, 2013, the super typhoon Haiyan (locally known as Yolanda) hit Eastern Visayas and caused massive devastation in lives, properties and livelihood [15]. For the coconut industry, an estimated 33 million coconut trees, across 295,191 hectares of land have been damaged, putting the livelihoods of more than one million farming households at risk [23]. Small scale farmers who relied on coconut farming were heavily affected because Filipino coconut farmers are considered among the poorest of the poor in the agricultural communities [1] [7] [17] [22].
Coconut used to be the most extensively cultivated crop in Eastern Visayas. According to the Philippine Statistics Authority (PSA) (2016) [20], coconut production in Leyte reached 526,559 metric tons per year, covering a total farm area of 167,974 hectares before the to super typhoon Haiyan hit in 2013. In the following year, production fell by more than 60% to 194,050 metric tons covering a total farm area of just 94,744 hectares [20]. Coconut farming is an essential source of economic activity among farmers [7]. However, the occurrence of strong typhoons is damaging the limited income stream of small-scale coconut farmers. Farmers will constantly face a lot of income shocks from frequent and stronger typhoons

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[7] [10] [24]. This poses a serious threat to coconut production adversely affecting livelihoods of small scale farmers [3] [6]. The damage inflicted by typhoons on coconut farming will take a longer time to fully recover because it will take an average of 7-9 years for coconut trees to fully mature after replanting. Some farmers are disproportionately impacted than others. Farmers who don’t have access to farming facilities and infrastructures are more vulnerable to calamities than those who have access [6].

Coconut farmers are facing unprecedented challenges when attempting to increase productivity because of the occurrence of extreme weather events and changing climatic conditions. Farmers need information on appropriate climate smart agricultural practices in order to effectively adapt to extreme weather events and unpredictable climate conditions. With this, the adoption of climate smart agriculture (CSA) practices are relevant in the area. The CSA are practices that have significant potential to enhance the productivity and help in mitigation and adaptation to climate change [3] [5]. This study will investigate the adoption of CSA practices among small scale coconut farmers and asses its profitability using cost benefit analysis. The results of this study will help farmers and investors to investigate the viability of adopting climate smart agricultural practices in coconut production. This would benefit not just the small scale coconut farmers but also the coconut industry as a whole. It would help the policymakers in formulating policies that can effectively contribute to the improvement of livelihood of coconut dependent farmers.

MATERIALS AND METHODS

Study site

The study was carried out in the province of Leyte, located in Eastern Visayas region, Philippines (Figure 1). Leyte province is one of the hugely devastated areas when super typhoon in Eastern Visayas [15] [27]. The occurrence of super typhoons is one of the identified adverse effects of climate change [28]. According to copra buyers and some farm owners, around 50 to 60 percent of coconut farms were damaged due to super typhoon [6]. Leyte shared the highest number of farms with 136.2 thousand, covering 258.6 thousand hectares of agricultural land among the provinces in Eastern Visayas [19]. The total farms in the province accounted for 41.2 percent of the total farms in the region. The agricultural land comprised 39.4 percent of the total land area of the province [19].

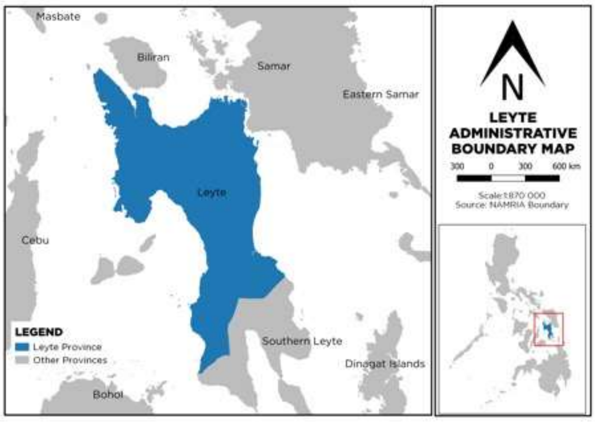

Fig. 1. Map of Leyte province, Philippines
Source: [16].

Data Collection

Primary data was collected through a survey among randomly selected coconut farmers. The survey instrument aims to compare the productivity and profitability of coconut production for farmers who adopted climate smart agricultural practices and those that practiced the conventional farming system. In addition, focus group discussion and key informant interviews were conducted to identify emerging climate smart practices adopted by the coconut farmers.

Cost-benefit Analysis

To estimate the income derived from coconut production, a gross margin was used. The gross margin was computed by subtracting the total variable cost from the total revenue. The total variable cost includes transportation cost, labor cost, and material input cost. Total revenue is obtained from the cash income and non-cash income of the coconut farmer. Cash income simply refers to the cash obtained from the coconut harvests, while non-cash income refers to home consumption, given away products, and others.

A discounted financial cash flow was used to estimate the benefits and cost of adopting climate smart practices in coconut farming as compared with the usual practice. The cash flow was projected for 10 or 20 years. Project revenue reflects the income generated from coconut farming, particularly copra production. Operating cost is the cost of labor, raw materials and farm inputs.

In valuing the net benefits, this was discounted to obtain the net present value. In doing the cost-benefit analysis, a 10% discount rate was used. The methods used in the financial analysis were based from Harrison and Herbohn (2008) [8]. The net present value (NPV) can be computed as follows:

$$NPV = (\sum B_t - \sum C_t) / (1 + r)^t;\ t = 1, 2,..,n \quad (1)$$

where:

B_t are the benefits at time t, and C_t are the costs at time t and r is the discount rate. In determining the profitability of the investment, the net present value should be positive, which implies that the benefits exceeds the costs.

Payback period (PP) reflects the number of years in which investment cost is recovered particularly the year when the net cash flow changed from negative to positive. The CSA practice with the shortest payback period is more attractive because the investment cost is recovered faster.

Another financial criterion considered is the internal rate of return (IRR). IRR represents the discount rate where the present value of benefits and the present value of costs are equal. This is where the NPV is equal to zero. This measured the capacity of the net revenue to pay off the investment cost. Mathematically expressed as:

$$(\sum B_t - \sum C_t) / (1 + IRR)^t = 0 \quad (2)$$

where:

t = 1, 2,…..,n and IRR = internal rate of return. If the computed IRR is greater than the opportunity cost of capital which is the discount rate, then adapting a particular CSA practice is a profitable investment.

RESULTS AND DISCUSSIONS

Socio-demographic profile of the respondents

Table 1 presents the socio-demographic characteristics of farmer respondents. A total of 240 coconut farmers were interviewed. Descriptive analysis shows that the average, the age of coconut farmers is 55 years old. Around half of the respondents are female (49.2%). The majority of them are married (74.6%) and some are widowed (9.2%). The average years in education is around 8.1 years. This implies that on average, coconut farmers have reached 2nd year high school. The average household size is composed of around 4-5 members. The average farm area cultivated is 1.67 hectares. In terms of land ownership, more than half of the respondents (55.4%) are owner cultivators and close to 40% are tenants.

Table 1. Socio-demographic profile of the farmer respondents

Profile of the Respondents	n	%
Age		
Below 35 years	11	6.8%
36 - 45	23	14.2%
46 - 55	43	26.5%
Above 55 years	85	52.5%
Average Age	55	
Sex		
Male	122	50.8%
Female	118	49.2%
Civil Status		
Married	179	74.6%
Widowed	22	9.2%
Single	16	6.7%
Live-in	14	5.8%
Separated	8	3.3%
Refused	1	0.4%
Average Years of Education	8.1	
Average Household Size	4.47	
Average Farm Area (hectare)	1.67	
Land Tenure		
Owner Cultivator	133	55.4%
Share Tenant	89	37.1%
Leaseholder	11	4.6%
Mortgagee	3	1.3%
Free Access/Land Use	2	0.8%
Refused	2	0.8%
n	240	

Source: Authors' own calculation and analysis (2020).

Climate smart agricultural practices for coconut

Climate smart agriculture (CSA) practices in coconut production were identified through focus group discussion, key informant interviews and literature reviews. These identified practices are considered CSA practice because it enhances the productivity and achieves the other two objectives which are climate change mitigation and adaptation option [3] [5]. Table 2 presents the results of the focus group discussions (FGD) among 14 small scale coconut farmers.

Table 2. Description of climate smart agriculture (CSA) practices for coconut

CSA Practice	Description	Climate Related Hazard	Current adaptation rate %
Early Harvesting	Harvest coconut early before the typhoon hits and keep the harvested coconuts in elevated areas	Typhoon	60-100%
Weather forecasting	Be informed with weather updates	Typhoon and drought	60-100%
Intercropping	Utilizing the spaces between coconut with other crops such as banana, vegetables and other crops	Typhoon	less than 30%
Use of improved varieties	Typhoon resistant varieties	Typhoon	less than 30%
Bio-control	Use of bio-control in dealing with pests and diseases	Pest infestation	less than 30%
Sanitation	Cutting of the affected parts due to pest infestation and burning it to avoid the spread of pest	Pest infestation	less than 30%
Watering of seedlings	On normal conditions, farmers do not water the coconut seedlings only during drought	Drought	less than 30%
Three (3) seedlings per hill scheme/ Cropping intensity	Planting scheme wherein three coconut seedlings were planted per hill	Typhoon	less than 30%

Source: Authors' own calculation and analysis (2020).

Table 2 highlights several climate smart agricultural (CSA) practices for coconut production. The occurrence of damaging typhoons was the major climate hazard considered during the FGD but some farmers also mentioned that they experience drought and pest infestation in coconut production. Results show that the most common practice of the farmers in relation to the typhoon as climate hazard is to do early harvesting and check the weather forecast.

Prioritized CSA practices for coconut production

A review of Ranasinghe (2019) [21] in Sri Lanka and Hebbar et al. (2013) [9] in India suggests that the long-term adaption option is on developing resilient and tolerant varieties with high survivability with the effects of climate change. On the other hand, the short-term adaptation option is on doing coconut-based efficient cropping systems with best management practices [9] [13] [21]. Findings of Ranasinghe (2019) [21] is also relevant to the Philippine setting in particular Leyte province. Among the identified climate smart agricultural practices presented in Table 2, we asked the participants to prioritized two CSA in responding to typhoon related climate hazards. After ranking, results show that farmers prioritized intercropping and the use of improved coconut varieties. We discussed in detail and conduct financial analyses of these top two CSA practices selected by coconut farmers.

For intercropping, the farmers indicated that banana can be used as an intercrop. Banana is planted alongside or between the coconut trees. This practice maximizes the unproductive spaces between the coconuts that were left unplanted. Since banana and coconut have similar nutrient and climate requirements, they make a suitable crop for intercropping.

Another prioritized CSA practice for coconut production is the use of improved coconut varieties. Being vulnerable to typhoons, coconut farmers seek to gain knowledge on what varieties of coconut that can withstand during a typhoon. In consultation with the experts or key informants from the National Coconut Research Center, Visayas State

University, Tacunan green dwarf coconut variety is a promising one. Tacunan green dwarf is a dwarf variety of coconut that is early maturing. This variety is often seen bearing nuts touching the ground because it is a dwarf one. The average number of nuts harvested per tree per year is around 48-84 nuts, according to a key informant from the National Coconut Research Center. From the year 1985 to 1993, the average weight of copra per nut is not less than 220 grams. According to the Philippine Coconut Authority (2016) [18], the Tacunan green dwarf was among the identified outstanding dwarf varieties that can withstand strong winds and typhoons. It could be attributed to its physical characteristics with thick and short stem, well-anchored root system and sturdy palm [18].

Financial indicators for prioritized CSA practice for coconut production

To evaluate the profitability of adopting climate smart agricultural practices, a cost benefit analysis was conducted. The CSA practice is compared with the conventional practice in coconut production, which is mono-cropping. The difference between the CSA practice and conventional practice is analysed through its incremental change. Results show that coconut banana intercropping requires an initial investment amounting to PHP 7,890.00 (USD 153.20). The payback period would start four years after adopting the CSA practice, with an annual incremental net benefit of PHP 3,348.9 (USD 65.03) (Table 3).

Table 3. Financial indicator of adopting coconut banana intercropping

Indicator	Value
Initial investment (requirement / hectare)	PHP 7,890 (USD 153.20)
Estimated annual incremental benefits	PHP 3,348.9 (USD 65.03)
Net present value (NPV) at 10%	PHP 148,465.17 (USD 2,882.82)
Payback period	4 years
Internal rate of return (IRR)	80.70%

Source: Authors' own calculation and analysis (2020)
Note: Exchange rate for October 2019 is 1 USD = PHP 51.50. Source: [2].

At 10% discount rate and projected for 10 years, adoption of the coconut banana intercropping is a profitable investment generating a positive net present value of PHP 148,465.17 (USD 2,882.82). The internal rate of return (80.70%) is greater than the opportunity cost of capital suggesting coconut banana intercropping is feasible investment yielding acceptable returns.

In terms of productivity, there is a substantial increase in revenue through the intercropping of banana in areas planted with coconut. Results show that on average, farm revenue of those who adopted the CSA practice is higher by 50% compared to those who used the conventional practice (Table 4).

Table 4. Farm production for conventional practice (mono-cropping) and coconut banana intercropping

Non-CSA Practice		CSA Practice	
Yield/ hectare (kg)	Value (PHP)	Yield/ hectare (kg)	Value (PHP)
Coconut	67,500.00	Coconut	67,500.00
Banana	-	Banana	70,000.00
Revenue (in PHP)	67,500.00	Revenue (in PHP)	137,500.00

Source: Authors' own calculation and analysis (2020).

The minimal-to-none fertilizer and pesticide input requirement of coconut and banana intercropping make this CSA a feasible solution to reduce agricultural emission and food security issues. Although agriculture is least carbon intensive as compared to the industrial sectors [26], Magat (2011) [12] reported that coconut lands and forest ecosystems in the Philippines can mitigate climate change by serving as carbon sinks. This not only reduces carbon dioxide emissions but can also double cash benefits from revenues and carbon sequestration. This will help attain the ambitious target of the Philippine government in reducing carbon emissions [11] [25].

Results of this study is similar to what was reported by Mendoza et al. (2018) [14] in Southern Mindanao, Philippines indicating that coconut production intercropped with banana or fruit trees such as mango, durian, mangosteen, coffee and cacao can generate highest revenues than mono-cropping especially when these products move along the value chain. Similarly, De Guzman et al. (2015) [4] recommended the practice of diversified and integrated farming systems highlighting one of the most productive and profitable cropping system, a coconut-based multi-story system in Cavite, Philippines. This system is coconut-based with a combination of annuals and perennial crops such as papaya, pineapple, taro, ginger and also banana. Besides, Rodriguez et al. (2007) [22] reported that the promotion of intercropping coupled with improved access to credit and technical assistance contributed to better outcomes in coconut farming.

In addition to coconut banana intercropping, we also conducted financial analysis on another CSA practice, which is the use of Tacunan green dwarf coconut variety. Results show that the use of improved coconut variety such as Tacunan green dwarf requires an initial investment of PHP 6,802 (USD 132.08) per hectare (Table 5).

Table 5. Financial indicator of adopting Tacunan green dwarf coconut variety.

Indicator	Value
Initial investment (requirement / hectare)	PHP 6,802 (USD 132.08)
Estimated annual incremental benefits	PHP 62,160 (USD 1,206.99)
Net present value (NPV) at 10%	PHP 171,067.04 (USD 3,321.69)
Payback period (for a period of 20 years)	9 years
Internal rate of return (IRR)	37.01%

Source: Authors' own calculation and analysis (2020)
Note: Exchange rate for October 2019 is 1 USD = PHP 51.50. Source: [2].

This initial cost pertains to the procurement of seedlings for this coconut variety. In a 1-hectare land area, approximately 179 Tacunan dwarf coconut seedlings could be planted with an 8m x 8m planting distance [18]. The period of analysis for this CSA practice is 20 years since the adoption of this CSA would require replanting of coconuts. The investment will be recovered in the 9th year. Over a period of 20 years, farmers can expect a yearly incremental net benefit of around PHP 62,160 (USD 1,206.99).

With a 10% discount rate, replacing the existing coconut variety with Tacunan green dwarf generates a positive net present value of PHP 171,067.04 (USD 3,321.69). The computed internal rate of return (IRR) is 37.01% suggesting that adoption of improved coconut variety is a profitable potential investment that the farmers can pursue (Table 5).

Table 6 shows the comparison between the farm production of using the Tacunan green dwarf variety and the traditional coconut variety. Assuming that a typhoon would hit the coconut farm area on the 9th year, most of the devastated coconuts will be the traditional variety. This is due to its taller and thinner stem characteristics compared to the Tacunan green dwarf which is shorter and thicker [18]. The expected outcome would be that Tacunan green dwarf will still be productive as compared to the existing traditional variety when a damaging typhoon will hit. In a 20-year period analysis, the adoption of Tacunan dwarf variety generates higher income on average compared to the traditional variety by PHP 83,230 (USD 1,616.12) per hectare annually (Table 6). Dwarf coconut varieties are not new to coconut farmers in Leyte province. The factor that limits the adoption of this CSA practice is that farmers are not fully aware of the advantages of growing dwarf coconut varieties. Public and private institutions' support are needed in the adoption of the practice.

Table 6. Coconut production of the use of Tacunan green dwarf variety and use of traditional coconut variety

Non-CSA Practice		CSA Practice	
Coconut (kg/ha)	1,962	Coconut (kg/ha)	2,870
Revenue (in PHP)	54,936	Revenue (in PHP)	83,230

Source: Authors' own calculation and analysis (2020).

CONCLUSIONS

Coconut farming is a very important source of economic activity among small scale farmers in Leyte, Philippines. Climate change can affect coconut production significantly. Among the hazards brought by climate variability and change, the typhoon is the most damaging to coconut production. When super typhoon Haiyan hit Leyte in November 2013, the coconut farms were severely damaged causing reduction in income among small scale farmers. Farmers are facing unprecedented challenges in improving coconut productivity. One of the feasible ways to respond to changing climate and extreme weather events is to adopt climate smart agricultural practices (CSA). CSA is a sustainable development strategy anchored on three pillars such as productivity, mitigation and adaptation to climate change. Investigation of CSA practices and its potential for scaling up was the focus of our study, particularly in Leyte province. Results showed that adapting and mitigating climate variability and change in coconut production requires adoption of typhoon resilient coconut variety coupled with diversified cropping practices. For Leyte, Philippines, the adoption of either coconut banana intercropping or improve coconut variety are feasible options that the farmers can explore. They can maintain or increase productivity and also mitigate the adverse effect of extreme weather events and changing climatic conditions.

Intercropping coconut with banana is an efficient solution to increase farm productivity. With the continuous conversion of agricultural land into commercial and housing purposes, areas of cultivated lands for food production are on the decline which endangers the food security of Filipinos. Thus, coconut farmers must adopt diversified and efficient cropping technologies. Through intercropping banana in areas planted with coconut, farm productivity will increase significantly. On average, farm income of farmers adopting the CSA is higher by 50%. Similarly, the adoption of Tacunan green dwarf coconut variety provides a continued stream of benefits in comparison to the traditional variety when a damaging typhoon will hit the area. Leyte province is likely to experience more frequent and damaging typhoons; thus, the use of improved variety can mitigate this climate hazard.

Small scale coconut farmers face different barriers in adapting these CSA practices. These challenges include financial and technical resources. Hence, support from various institutions, either government or private sector, should prioritize technical and financial support for potential scaling up of these practices. This will enhance the adoption of these prioritized CSA practices and help coconut farmers become more resilient. Various agencies and stakeholders should conduct capacity building activities and trainings related to the adoption of these climate smart agricultural practices but should also consider providing access to technology and markets.

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