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ECONOMIC IMPACT OF SUPER TYPHOON YOLANDA ON THE LIVELIHOOD OF COCONUT (*Cocos nucifera)* FARMERS IN SELECTED AREAS OF LEYTE

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This paper examines the impact of the super typhoon Yolanda on the livelihood of coconut farmers in Leyte using quantitative approach. Impact evaluation answers to the cause-and-effect questions thus providing information about the impact of and intervention or an event. The impact quantification will be done by analyzing the survey data using descriptive analysis, gross-margin analysis, means comparison, and propensity score matching method. The propensity score matching is a method of impact assessment where the multidimensionality of the data is reduced to a single dimension. A total of one hundred seventy-six (176) coconut farmers were interviewed face to face using structured questionnaire of which eighty-three (83) were from the not-affected area and ninety-three (93) were from the typhoon affected area. We find that the impact of the super typhoon has significantly reduced the annual income of coconut farmers. Majority of the farmers replanted the damaged coconut trees. It is recommended that the replanting of coconut trees must be assisted by government agencies to select better and resilient varieties of coconut. Farmers may also consider using an improved variety such as hybrid coconut varieties to maximize productivity of coconuts in Leyte, Philippines.

Keywords: impact assessment, propensity score matching, coconut farmers, super typhoon Yolanda

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1. INTRODUCTION

Coconut industry in the Philippines comprises a significant area of 3.5 million hectares which includes 1.4 million farms both small and large scale farms. The average farm area is around 2.4 hectares (Dy, 2006). The industry provides significant income and employment to the Philippine economy. A year prior to typhoon Yolanda, 2.51 million metric tons of copra were produced and 1.53 million metric tons were exported (United Coconut Association of the Philippines [UCAP], 2018).

Due to the location of the Philippines which is along the typhoon belt in the Pacific Ocean, an average of 20 typhoons hit the country annually. On November 2013, super typhoon Yolanda, one of the strongest typhoons hit the country and affected 13 million people, 1.5 million of which resides on Eastern Visayas. Roughly 33 million coconut trees across 295,191 hectares of land which are farmed by more than 1 million households were damaged during the calamity (NDRRMC, 2015).

This paper determines the effect of super typhoon Yolanda using impact evaluation methods popularized by World Bank in quantifying the impact of the super typhoon. Impact evaluation answers to the cause-and-effect questions. Quantifying impact would give everyone a clearer and better understanding on how the super typhoon Yolanda affected the coconut farmers in Leyte. To be able to estimate the causal effect or the impact, the so called counter factual will be estimated using the data from the non-affected group of coconut farmers. This is what the outcome would be if there will be no incident of super typhoons.

The result of this paper would provide information, knowledge and input to policy making to government bodies such as the Philippine Coconut Authority, Disaster Risk Reduction Management Council, Department of Agriculture and different local government units in providing better service to the stakeholders. This paper will also help individuals and other researchers in obtaining information regarding impact analysis, climate change and other highlighted topics presented in this paper.

The main objective of this study is to assess the economic impact of super typhoon Yolanda to the production and income of coconut farmers in Leyte. Specifically, this study aims to (i) describe the socio-demographic characteristics of the coconut farmer-respondents; (ii) estimate the economic impact of the super typhoon on the livelihood of coconut dependent farmers; (iii) identify the adaptation strategies undertaken by the farmers after the super typhoon; and (iv) provide recommendations that will benefit coconut farmers who were greatly affected by the super typhoon.

The study focused mainly on the assessment of the coconut production in Hindang and Mayorga, Leyte after the destruction of Typhoon Yolanda. It included only the farmers engaged in small scale coconut farming. Results of the study may or may not be applicable to the farmers in other localities considering the differences in the physical and agronomic conditions, and the magnitude of destruction by the Typhoon Yolanda.

2. REVIEW OF RELATED LITERATURE

Philippine coconut industry is very important to the country especially in the agricultural sector. Dy (2006) stated that coconut-based farms are reported to be present in 69 out of 79 provinces in the country. It also covers 3.3 million hectares, nearly 30% of farmlands. According to Magat (2014) coconut's annual productivity per ha with moderate fertilizer application of coconut trees in a mono cropping system usually achieved a fairly good yield of 8,000 nuts/ha which is equal to 2,000 kg of copra. This provides an annual net return also termed as economic income of PhP21,050 given a price of PhP15 per kilo of copra; but considerably improves under coconut intercropping system. Earlier publications of UPLB and PCA, as cited by Magat (2014), revealed a production system capable of producing coconut for copra. The total economic benefit amounts to an average of P198,000/ha, annually, and with hybrid coconut up to PhP 223,800, mainly attributed to its higher nut and copra yields over tall and dwarf varieties. Another study of Mondoñedo (2004) stated that the average copra production is 251.50 kilograms per hectare per harvest and up to 1,202.89 kg annually. The quantity of copra sold by farmers is 3,398.06 kilograms per farm with an average price of PhP11.62. This gives the farmers an average gross sale of PhP40,491.40 annually. Another study of Herrera et al. (2019) showed a farmer's average annual income of PHP 38,719.64 at the average price of PHP 8.41 per nut.

Tropical typhoons cause a significant damage worldwide for about $26 billion (Mendelson et al., 2012). The Philippines is the most storm-exposed country on earth and nn average around 8 to 10 destructive typhoons make a landfall each year (Brown, 2013). (Food and Agriculture Organization (FAO, 2015) reported that the Philippines was affected by 75 disasters between 2006 to 2013, which primarily consists of floods and typhoons. For this reason, the agriculture sector incurs $3.8 billion worth of damage in a span of 8 years. This roughly translates to $477 million annually.

On 8th November 2013, Super typhoon Yolanda with an international name of Haiyan made its land fall in the Eastern Visayas. This was considered as one of the most powerful typhoons ever to make landfall in the recorded history. It has maximum sustained winds reaching 315 kph (170 knots) with gusts up to 379 kph (205 knots) prior to landfall (Lagmay et al., 2014; Seriño et al., 2017).

The Philippine Coconut Authority (PCA) stated that the Eastern Visayas region is the second highest coconut producer in the country, with some 46 million trees producing 1, 771 thousand metric tons of coconuts in 2012 (PCA, 2015). In Leyte province, an estimated 168,000 hectares are planted with coconut. After the typhoon, there was an estimated 33 million trees damaged or destroyed affecting around 1 million coconut farmers (OXFAM,2013)

Impact evaluation is defined by Gertler et. Al. (2016) as a type of evaluation which answers to cause-and-effect questions. It is structured to answer only one type of question "*What is the impact of a program on an outcome of interest?*" this institute that it only looks for the changes in the outcome that are directly related to the program under evaluation. To be able to estimate the causal effect or the impact, any chosen method must estimate the so called "*counter factual*". The counter factual is what the outcome should be without the program. Rojers (2012), also defined impact evaluation as impact evaluation investigates the changes brought about by an intervention and can be undertaken on interventions at any scale.

Matching is a method of impact evaluation which relies on observed characteristics to construct a group for comparison. A good match requires a close approximation of the variables or determinants that explains the individual's decision to enroll in the program. Although matching can be hindered by dimensionality when the number of characteristics or dimension increase, propensity score matching can ease the dimensionality (Rosenbaum and Ruben, 1983). This approach provides the probability of a unit to undergo the same program with the presented values of its characteristics.

A study conducted by Ali and Erenstein (2016) implied a high bias of around 69-76% regression analysis on the impacts of the number of adaptation methods used on household food security and poverty levels before matching. Another study conducted by Ureta et al. (2020), revealed that the t-test for means between treated and control groups in the unmatched sample, the design was effective but matching can further improve balance by using difference in key variables. Mendola (2007) used a cross-sectional household survey from rural Bangladesh, to isolate the causal effect of adopting high yielding varieties (HYVs) of rice on poverty alleviation by using the propensity-score matching (PSM).

Taganas (2019) used difference in difference method in estimating the impact super typhoon Yolanda in other municipalities in Leyte island. Their results showed that the gross margin income of coconut farmers from the affected area decreased by PHP 10,882.18 per hectare per cropping (Taganas, 2019). There is limited application of propensity score matching technique in analyzing the impact of disaster related incidents. This paper is similar to what Seriño et al. (2020) did in quantifying the impact of super typhoon Yolanda.

3. METHODOLOGY

Area of the Study

The two municipalities in Leyte province were chosen as the study site namely Hindang and Mayorga, Leyte. Consultation with technicians from PCA were conducted in selecting the study sites representing typhoon affected area and less affected area. The municipality of Mayorga was heavily affected by the super typhoon while the municipality of Hindang received minimal damage in coconut production. The location of the study sites is shown in Figure 1. The damages of the super typhoon were compared between the two municipalities where Hindang area served as the counterfactual considering it was far the super typhoon path than Mayorga, Leyte (Figure 2).

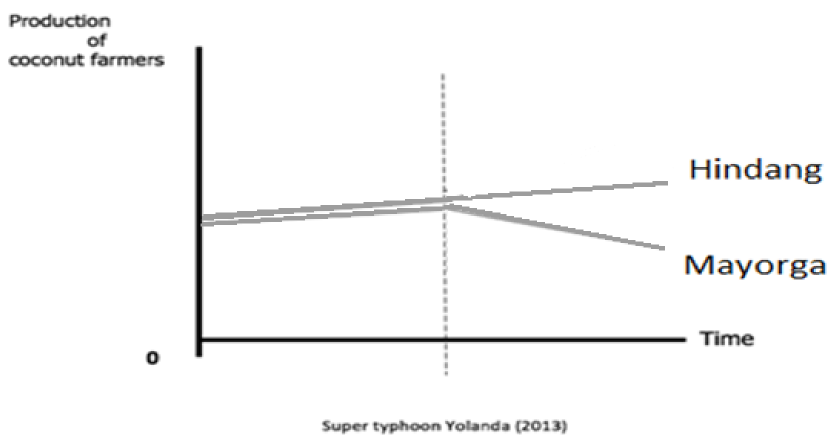

Figure 1. Figure showing the effects of Super Typhoon Yolanda in the production of coconut farmers in Hindang and Mayorga, Leyte

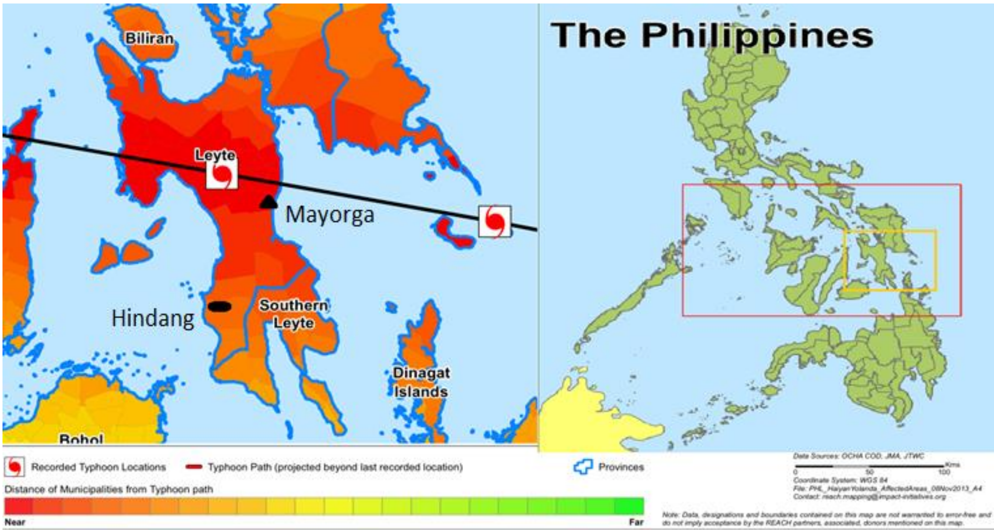

Figure 2. Path of Super Typhoon Yolanda in the Leyte island.

Sample Size and Data Collection

Simple random sampling was used to collect the necessary data. The population of the study included all coconut farmers in the municipalities of Hindang and Mayorga, Leyte who are growing full bearing coconut trees before the super typhoon hit the area. One of the considerations in the selection and pairing of these municipalities was based on the income class where both of them fall into the 5^{th} class municipalities. Using the Slovin's formula with a 90% confidence level, a total of one hundred seventy-six (176) sample respondents were selected from the 5 top coconut producing barangays of the two municipalities. Eighty-three (83) of which were chosen from Hindang Leyte and ninety-three (93) from Mayorga, Leyte.

Primary data were gathered through a survey using a prepared interview schedule. The questionnaire used was divided into 4 parts, namely: (i) general information, (ii) income and employment; (iii) general characteristics of the farm, and (iv) coping mechanisms. Furthermore, the part 3 which is the general characteristics of the farm was further divided into six (6) parts, land use and ownership, farming activity information, farm inputs and expenditures, marketing practices, farm assets and lastly, livestock ownership. Data collected include the farm size, yield, physical quantities of variable inputs (both cash and non-cash), prices of outputs, prices of inputs, current production practices, and socio-demographic characteristics of the farmers. The data sets were based from the last two cropping/harvesting done by the farmers in 2018.

Data Analysis

Data were analyzed using descriptive analysis, gross-margin analysis, means comparison using t-test and propensity score matching. Gross margin is the difference between the total revenue and the total variable cost. In equation form:

Gross Margin = Total Revenue – Total Variable cost *(Equation 1)*

Total revenue is obtained from the cash and non-cash income of the coconut farmer. This is computed by multiplying the price of the goods to the number of units of goods sold. On the other hand, the total variable cost includes the transportation cost, labor cost, and material input cost in production and processing of copra.

Independent samples t-test is used since the means of two groups, the treatment and the control group were compared. The two groups were compared to identify if there is significant effect of the super typhoon to the population. If there is no difference between the two treatments, the difference in the result would be close to zero (Kim, 2015).

Propensity score matching was conducted to quantify the impact of super typhoon Yolanda on the coconut farmers. The method used in this study follows what Seriño et al. (2020) did in quantifying the impact of super typhoon on small scale coconut farmers. Propensity score matching is an important method to scale down the selection bias by pairing similar households from the treatment and control groups using propensity score. Propensity score is the estimated probability of receiving treatment. When estimating the propensity score, some factors or covariates are needed to be considered. The covariates should capture the similarity between the not-affected and the affected group. The idea of matching is to pair each household in the affected area, with a household in the non-affected area which has very similar characteristics with the affected one with regard to a certain set of socio-economic indicators. These indicators can include various characteristics such as sex, level of education, age, income level and many more. Propensity score matching reduces the problem of multidimensionality with a large set of indicators to one dimension namely the propensity score (Rosenbaum and Rubin, 1983). The propensity score (PS_i) can be measured using limited dependent model such as logit or probit model. For this evaluation, probit model was use in the form:

$$PSi = \varnothing(x_i'ß \qquad \text{(Equation 2)}$$

where x_i denotes as vector of covariates viewed as to identify the probability of experiencing treatment, PS stands for propensity score, and Ø is the cumulated density function of the normal distribution. In a second part, untreated individuals were matched to the treated ones on the basis of the estimate propensity score. Propensity score matching (PSM) is a tool that tries to give an estimate of the effect of a treatment, policy, or other intervention by calculating for the covariates that predict experiencing the treatment. This cancels out the bias when comparing two groups. The nearest neighbor matching methods is used in setting the average treatment effect of the treated.

4. RESULTS AND DISCUSSION

Socio-Demographic Characteristics

Table 1 shows the profile of the farmer respondents including their age, civil status, sex, education level, occupation and land tenure. The average age of the farmer respondents in the affected group was 54.99 years while 55.42 years old for the not-affected group. There was little difference between the average age of the farmers in both areas. The average age of all farmers was 55 years old with the age bracket of 46-55 years old having the highest percentage with 31.82% of all respondents. More than three-fourth of the respondents in both groups were married, which comprised 75.27% and 86.75% of the affected and not affected respectively. Also, in both groups there were more female than male respondents. The female respondents constitute about 54% of the total respondents. Both groups appeared to be relatively similar in terms of the average number of years spent in school with the affected respondents having a little over 9 years (9.27) and the unaffected respondents with a little less than 9 years (8.8). In terms of household size, the bigger proportion (45.45%) of the total respondents had a household size ranging from 6-8 members with the average household size of 5. Furthermore, having a household size of 3 and below was more common in the not affected area while 6-8 household size was more common in the affected area.

Table 1. Socio-demographic profile of coconut farmers in the not affected (Hindang) and the affected (Mayorga) group, 2019

Profile of the Respondents	**Not Affected**		**Affected**		**Total**	
	n	**%**	**n**	**%**	**n**	**%**
Age						
18-25	-	-	1	1.08%	1	0.57%
26-35	6	7.23%	3	3.23%	9	5.11%
36-45	9	10.84%	19	20.43%	28	15.91%
46-55	30	36.14%	26	27.96%	56	31.82%
56-65	21	25.30%	26	27.96%	47	26.70%
66-75	13	15.66%	13	13.98%	26	14.77%
76-85	3	3.61%	5	5.38%	8	4.55%
86 above	1	1.20%	-	-	1	0.57%
Total	83	100.00%	93	100%	176	100%
Average age (years)	54.99		55.42		55.21	
Sex						
Male	40	48.19%	41	44.09%	81	46.02%
Female	43	51.81%	52	55.91%	95	53.98%
Total	83	100.00%	93	100%	176	100%
Civil Status						
Married	72	86.75%	70	75.27%	142	80.68%
Single	6	7.23%	9	9.68%	15	8.52%
Widowed/Widower	4	4.82%	6	6.45%	10	5.68%
Separated	1	1.20%	5	5.38%	6	3.41%
Live-in	-	-	3	3.23%	3	1.70%
Total	83	100.00%	93	100%	176	100%
Education Level						
Elementary	44	53.01%	37	39.78%	81	46.02%
High school	31	37.35%	46	49.46%	77	43.75%
College	7	8.43%	10	10.75%	17	9.60%
Vocational	1	1.20%	-	-	1	0.57%
Total	83	100%	93	100.00%	176	100%
Average education ((years))	8.8		9.27		9.05	
Household size						
3 and below	37	44.58%	22	30.11%	65	36.93%
06-Aug	36	43.37%	44	47.31%	80	45.45%
Sep-13	9	10.84%	19	20.43%	28	15.91%
14 and above	1	1.20%	2	2.15%	3	1.70%
Total	83	100%	93	100%	176	100%
Average household size	5		4		5	

Table 2 shows that more than half of the respondents (61.93%) were dependent on farming as their main occupation, with a bigger proportion (68.67%) in the not affected group compared to the affected group (55.91). In terms of land tenure, most of the respondents (59.09%) were owner-cultivators and only about one-fourth (25.57%) of them were share-tenants and some (11.36%) were landlords.

Table 2. Occupation and tenure of coconut farmers in the not affected (Hindang) and the affected (Mayorga) group, 2019

Variables	Not Affected		Affected		Total	
	n	%	n	%	n	%
Main Occupation						
Farmer	57	68.67%	52	55.91%	109	61.93%
Other Occupation	26	31.33%	41	44.09%	67	38.07%
Total	83	100.00%	93	100%	176	100.00%
Tenure						
Owner-Cultivator	58	69.88%	46	49.46%	104	59.09%
Share tenant	15	18.07%	30	32.26%	45	25.57%
Landlord	8	9.64%	12	12.90%	20	11.36%
Mortgagee	-	-	3	3.23%	3	1.70%
Free access/Land Use	1	1.20%	1	1.08%	2	1.14%
Leaseholder	-	-	1	1.08%	1	0.57%
Claimant Cultivator	1	1.20%	-	-	1	0.57%
Total	83	100.00%	93	100%	176	100%

Other Sources of Income

Most of the respondents in both not affected (68.67%) and affected group (60.22%) have obtained remittances from family members and made it as one of their other sources of income. Farming other crops was more common in the affected group (53.76%) than that of the not affected group (38.55%). Nearly half of the respondents in both not affected (40.96%) and the affected (44.09%) acquired income from non-farm sources (Table 3.)

Farm and Farmer Characteristics

The farmer respondents in the not affected group had a slightly longer farming experience (32 years) than those in the affected group (30 years). Overall, the average farming experience of all the farmers was about 31 years (Table 4). The affected farmers had a bigger land area devoted to coconut production (1.66 hectares) than the not affected farmers (0.95 hectares). However, the not affected farmers had a higher number of coconut trees per hectare (128 trees) than the affected (64 trees). This huge difference in the number of coconut trees may have been due to the devastation brought about by typhoon Yolanda.

Table 3. Other sources of income of coconut farmers in the not affected (Hindang) and the affected (Mayorga) group, 2019

Other sources of income*	Not affected		Affected		Total	
	n	%	n	%	n	%
Remittances	57	68.67	56	60.22	113	64.20%
Farming income (other crops)	32	38.55	50	53.76	82	46.59%
Non-farming income	34	40.96	41	44.09	78	44.32%

*multiple response

Table 4. Farmer and farm characteristics of coconut farmers in the not affected (Hindang) and the affected (Mayorga) group, 2019

Variable	Not Affected		Affected		Total	
	n	Mean	n	Mean	n	Mean
Years in Coconut Farming (average years)	83	32	93	30	176	31
Land Area (ha.)	83	0.95	93	1.66	176	1.32
No. of coconut Trees / ha	83	127.95	93	64.06	176	94.19

Annual Income

Table 5 shows that between the 2 groups, the affected group had a lower gross income from coconut farming (Php 11,382.55) than that of the not affected group (Php 32, 764.05). However, the total household income of the respondents in the affected area was much higher (Php 193,380.00) than those in the not affected (Php 129, 267). This may be attributed to the bigger average farm size of the affected farmers, and to their other source of income such as remittances and non-farm occupations.

Table 5. Annual income of coconut farmers the not affected (Hindang) and the affected (Mayorga) group, 2019

Variable	Not affected		Affected		Total
	n	Mean	n	Mean	Mean
Gross Income from coconut farming	83	32,764.05	93	11,382.52	21,465.86
Total Household Income	83	129,267.9	93	193,380.00	163,145.3

Estimation of Difference in Income Using T-Test

Table 6 shows the difference in gross income of the respondents from coconut farming between the affected and not affected groups. The average income of the affected group was lower by Php 21,381.53 per hectare per year. The difference was significant at 1% with p value of 0.00.

Table 6. Independent t-test of annual gross income per hectare from coconut farming in the not affected (Hindang) and the affected (Mayorga) group, 2019

Group	n	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
Not Affected	83	32,764.05	4,468.90	40,713.74	23,873.96	41,654.15
Affected	93	11,382.52	1,651.02	15,921.88	8,103.45	14,661.59
Combined	176	21,465.86	2,412.74	32,008.66	16,704.04	26,227.68
Difference		21,381.53	4,568.11		12,365.50	30,397.56

diff = mean (0) - mean (1)		t = 4.68
Ho: diff = 0		degrees of freedom = 174
Ha: diff < 0	Ha: diff! = 0	Ha: diff > 0
Pr(T < t) = 1.0000	Pr(|T| > |t|) = 0.0000	Pr(T > t) = 0.0000

Estimation of Difference in Gross Margin Using T-Test

Table 7 shows the differences of mean gross margins per hectare in coconut farming between farmers in the not affected group and the affected group. The average gross margin of the respondents from the not affected group is significantly (p val. = .0003) higher by Php 15,000.48 than that of the affected.

Table 7. Independent T-test of annual gross margin per hectare from coconut farming in the not affected (Hindang) and the affected (Mayorga) group, 2019

Group	n	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
Not Affected	83	22,156.32	4,090.31	37,264.56	14,019.37	30,293.26
Affected	93	7,155.84	1,821.67	17,567.57	3,537.84	10,773.83
Combined	176	14,229.93	2,222.46	29,484.21	9,843.66	18,616.19
Difference		15,000.48	4,317.63		6,478.81	23,522.16

diff = mean (0) - mean (1)		t = 3.4742
Ho: diff = 0		degrees of freedom = 174
Ha: diff < 0	Ha: diff! = 0	Ha: diff > 0
Pr(T < t) = 0.9997	Pr(|T| > |t|) = 0.0000 6	Pr(T > t) = 0.0003

Propensity Score Matching

Propensity scores were computed to each observation using age, education, sex, civil status, number of children, years in coconut farming, market distance, and farm size as covariates.

To match the treated and control group, nearest neighbor matching technique using the propensity scores was used. This technique was used to match observations with the same characteristics as measured by propensity score to determine the average treatment effect of the treated group (ATT). With this technique, 81 observations from the treated (affected) and 34 from the control (not-affected) have matched through PSM (Table 8). The average treatment effects or ATT depicts the impact of the super typhoon Yolanda. Results showed that there was a significant (t = -2.4) decrease of income from coconut by Php 13,400.00 in the affected area (Table 9). There was also significant (t = -2.99) decrease in the number of coconut trees by 36 trees per hectare (Table 10).

Table 8. Number of respondents before and after matching

	Before PSM			After PSM		
	Not affected	**Affected**	**Total**	**Not affected**	**Affected**	**Total**
Number of Respondents	83	93	176	34	81	115

Table 9. Average treatment of the treated using nearest neighbor matching techniques on the income from coconut farming

	Affected	Not Affected	ATT	Std.Err.	t
n	81	34	-13,400.00**	5607.077	-2.40

** significant at 5% level

Table 10. Average treatment of the treated using nearest neighbor matching techniques on the number of coconut trees

	Affected	Not Affected	ATT	Std.Err.	t
n	81	34	-36.277***	12.143	-2.99

*** significant at 1% level

Adaptation Strategies

Adaptation strategies are the actions done by the farmers in order for them to cope up with the devastation caused by typhoon Yolanda. Table 11 shows the different activities undertaken by the respondents for them to cope with the event.

All of the affected respondents stated that one way to cope with the devastation of super typhoon Yolanda was praying to God. About 92.47% of them replanted the destroyed or fallen coconut trees through the help of the Philippine Coconut Authority (PCA). Almost half or 47.31% of the respondents pointed intercropping as one of their adaptation strategies. It is followed by multiple cropping having identified by 31.18% of the total respondents in the affected area.

Table 11. Adaptation strategies by the affected (Mayorga) group

Adaptation Strategies*	**Count**	**%**
Praying	93	100.00%
Replant	86	92.47%
Intercropping	44	47.31%
Multiple cropping	29	31.18%
Non-farm work	16	17.20%
Switching to livelihood such as livestock or plants	15	16.13%

*multiple response

5. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This study was conducted to assess the economic impact of super typhoon Yolanda on the production and income of coconut farmers in Leyte. Specifically, this study aims to: (i) describe the socio-demographic characteristics of the coconut farmer-respondents; (ii) estimate the economic impact of the super typhoon on the livelihood of coconut dependent farmers; (iii) Identify the adaptation strategies undertaken by the farmers after the super typhoon; and (iv) provide recommendations that will benefit coconut farmers who were greatly affected by the super typhoon.

The municipality of Mayorga and Hindang were chosen as the place of study being among the coconut producers in the province of Leyte, and having shown similar production output prior to the devastation of typhoon Yolanda. Hindang which was less affected by the typhoon was designated as the counterfactual case to Mayorga which was heavily affected by the typhoon.

A total of 176 farmer-respondents were selected from the top 5 barangays in terms of number of farmers and accessibility. Using Slovin's Formula with a 90% confidence level, 83 respondents were selected in the municipality of Hindang, and another 93 respondents in the municipality of Mayorga.

The average age of the farmers-respondents in both affected and not affected area was 55 years old. Most of the respondents fall in the age bracket of 46 to 55 years old (31.82%). More than three- fourth of the total respondents were married (80.68%). In both affected and not affected group, more than half of the respondents were female. On average, the respondents spent 9 years in formal education. More than half of the respondents were mainly dependent on farming. About 59.09% of them were owner cultivators and only 25.57% were share-tenants, while some (11.36%) were landlords. Their average household size of was 5. Having a household size of 3 and below was more common in the not affected group while a household size of 6-8 members was more common in the affected group.

Both groups had remittances from family members as one of their other sources of income. Farming other crops was more common in the affected group than the not affected group. Less than half of the respondents in the not affected (40.96%) and the affected (44.09%) acquired income from non-farming occupations. Farmers in the not affected group had a slightly longer farming experience than those in the affected group. The land area devoted to coconut production was also higher in the affected than in the not affected group. However, the number of coconut trees per hectare was much higher in the not affected area than the affected.

The gross income from coconut production was lower in the affected group (Php 11,382.55) than that of the not affected group (Php 32, 764.05). However, the total household income of the respondents in the affected area (Php 193,380.00) was much higher than those in the not affected (Php 129, 267).

Using the T-test, the significance of the difference in gross income generated from coconut farming between the affected and the not affected group was determined. The analysis determined the not-affected group to be higher by Php 21, 381.53, which was significant at 1%.

The propensity score matching matched all observations using age, education level, sex, civil status, number of children, years in coconut farming, market distance and farm size as covariates. This method cancels out the bias of the data giving a much more accurate impact estimate than the T-Test before matching. A total of 83 respondents from the affected group and 34 respondents from not affected group have been matched using the method. Using the matched respondents that were derived from the selected covariates, the analysis gave and impact estimate of Php 13,400.00.

The final analysis of the study depicts the adaptation strategies done by the farmers in the affected area for them to cope up with the effects of the super typhoon. All of the affected farmers identified that praying to God was one way to cope up with the tragedy. Most (92%) of them responded to the devastation by replanting the destroyed or fallen trees with the help of the rehabilitation program of the Philippine Coconut Authority (PCA).

The gross margin analysis showed Php 22,156.32 average gross margin per hectare per year in the not affected area. It was significantly higher by Php 15,000.48 compared to the gross margin acquired by the farmer-respondents in affected area.

The t-test showed that there was a significant difference in gross income from coconut farming between the affected and not affected group at a difference of around Php 21,381.53 per hectare per year. Subsequently, using the propensity score matching the estimated impact of the super typhoon Yolanda was Php 13,400.00 which was much lower and more accurate than the impact estimate given by the t-test before matching.

All of the respondents in the affected group relied on the divine assistance for them to cope with the after effects of the super typhoon. Although almost all of them replanted their fallen coconut trees with the help of the Philippine Coconut Authority.

Based on the results of the study, it is recommended that the affected area must still undergo huge coconut rehabilitation program assisted by the government agencies with direct supervision of the coconut industry. Since there was a significant difference between the number of productive trees per hectare between the affected and the not affected area, vast replantation of coconut trees must be exercised in the affected area to get the farmers to be on the same level with the not affected area. It is also recommended that the variety of the coconut trees to be planted is an improved variety such as hybrid varieties. Ruales et al. (2020) also emphasized that in the long run one of the adaptation options is to develop climate resilient and tolerant coconut varieties with high survivability in the occurrence of strong typhoons. Using of fertilizers and pesticides while replanting is also recommended to boost the growth of the newly planted seedling and to keep them from diseases and insect infestations that could lead to mortality. Farmers are also recommended to plant other crops in their farms to generate additional income while waiting for the replanted coconut trees to bear fruits to be harvested.

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