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Research Article

Innovative Approaches to Soil Rejuvenation and Post-Harvest Management in Sugarcane Production in the Philippines

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ABSTRACT

Innovations employed in farming are usually done by integrating the existing sugarcane production technologies. The main purpose of innovation is to increase production and to sustain the sugarcane industry. The study aims to validate some of the soil rejuvenation and post-harvest innovations practiced by the farmers that could affect their sugar production. The descriptive method of research is employed in the study. The 320 sugarcane farmers were randomly identify at the seven locations in the Visayas area of the Philippines using the Slovin's formula. An instrument used was the validated survey questionnaire used by the group of Oñal in their study since 2021. Frequency count, mean, one-way ANOVA, and Pearson Product Moment Correlation were utilized in the data analyses. Key findings showed that the average production of sugarcane farms in the Visayas was between 50-64 tons per hectare (TC/ha) when grouped by location (alpha = 0.05). Correlation analysis show that application of correct quantity of lime and mill waste have a strong relationship with production (αlpha = 0.01), while the correct lime placement (αlpha = 0.05) and practice of green manuring (αlpha = 0.01) have a moderate relationship, respectively. For post-harvest innovations, correlation analysis implied that the delivery of freshly cut cane to the mill is strongly correlated with the production. Considering that majority of the soil rejuvenation and post-harvest innovations practiced by the farmers have a moderate to strong relationship with the production, the academe and the government should go hand in hand in the conducting more research, strengthen the extension services and provide more assistance that can increase further the productivity per unit area.

Keywords: *Soil rejuvenation, Post-harvest practices, Sugarcane tonnage, Sugarcane farmers' innovation, Sustainable sugarcane production, Production volume*

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Introduction

Farmers' innovations does not influence the level of productivity. This was the major finding of the group of Oñal (2021), which was conduct last 2017 at the 10 locations in the Visayas, Philippines. After 8 years this study is once again conducted at the seven locations in the Visayas, Philippines to calibrate if soil rejuvenations and post-harvest innovations practiced by sugarcane farmers' increased their production.

Innovations employed in farming are usually done by integrating the existing sugarcane production technologies. The main purpose is to increase their yield and sustain the sugarcane industry (Priyanka, et al, 2019). In India, Misra and Bhatt (2020), had projected an increase of production from 100 to 110 bags per hectare (LKg/ha) if the average sugar recovery be at 10.75% which can be translated to 520 million tonnes.

Innovations is an indirect output of effective agricultural extension, which aim to make more productive and cost efficient. On the concept, agricultural extension is one of the most important factor that can capacitate sugarcane farmers accelerate the adoption of technology and could positively correlated with farm productivity.

Farmers' innovation are new ideas, methods, or practices developed by the farmers themselves often in response to local agricultural challenges. It is the extension services often aims to disseminate such innovations to a wider audiences.

Agricultural extension services are instrumental in bridging the gap between agricultural research and practical farming. It is the catalyst for disseminating knowledge, technology and best practices. Traditionally the indicators of success of agricultural extension services are measures through yield increase or adoption of technology.

The group of Abhijeet in 2023, concluded that the effectiveness of agricultural extension services can be assessed through environmental, social and economic indicators. Integrating those three factors, agriculture will be more sustainable and equitable that could benefit the soil and the people in the community most especially the farmers in striving more to be innovative.

Economically sugarcane industry is one of the major dollar income industries in the Philippines. Despite the continuous extent of services to the farmers' momentum on production could not be realize until this time.

On the production side, the Philippine raw sugar production for 2025 is projected to reach a volume of 1.85 million metric tons because of the improvement of weather conditions that could directly cater the expansion in harvest area (Pelonia, 2024). Relatively, as of February 2, 2025, the total raw sugar production in the country is 1.92 million metric tons with a total tonnage of 21.49 million or an average of 55.33 tons per hectare (SRA, 2025) way below the targeted 75 tons per hectare.

Outside the country it is noteworthy that sugarcane productivity in Eastern Brazilian Amazon showed a significant increase from 2012-13 to 2021-22 (Cardoso et al, 2024).

Back in the Philippines, the vast plantation are located in Regions 6, 7, and 8 specified as follows: 207,909 hectares for Region 6; 57,663 hectares for Region 7; and, 10,200 hectares for Region 8, respectively. The total area of the three regions is 275,772 hectares or 71.01% of the total area of sugarcane plantation in the Philippines (Balita, 2024).

On the number of farmers and laborers, statistics show that there are more than 80,000 farmers who are tilling the 388,378 hectares (out of the total land area of 30 million hectares devoted to agriculture), of sugarcane fields all over the country. Of the total number of sugarcane farmers mentioned-above the majority of them are considered small (farms are 5 hectares or below). In Crop Year 2015-16: 79% are small farmers, in which 17% are cultivating an area of 5.01 to 50.00 hectares and only 4% have an area of 50.01 hectares and above (Overview of the Sugarcane Industry, 2017).

The total number of agricultural and industrial workers directly employed in the industry is about 700,000. Over and above, the total workers mentioned there is an additional 70,000 more or less seasonal planta-

tion workers who are augmenting the laborers in sugarcane plantation and estates nationwide. Relatively, the latest survey mentioned by Crisostomo (2018), indicates that sugarcane farms have 32,000 laborers, which is second to the banana plantation with 49,866 workers. Moreover, the agriculture sector has a share of 24.3% in the country's total employment (PSA, 2019).

The group of Reza (2016) had found out on their study that almost 50 percent of the cost in sugarcane farming is spend in the hiring of labourers. It indicates that sugarcane is a labor-intensive crop in Bangladesh and on average 90-110 man-days labor is needed per acre of sugarcane production. Hence, effective innovations especially in sugarcane production must be employed to increase the volume of production.

This study aims to determine the impact of soil rejuvenation and post-harvest innovations practiced by sugarcane farmers in increasing the production at different locations in the Visayas. Furthermore, this study will focus also on the two innovations practiced by sugarcane farmers in relation to sugarcane production.

Objectives

The general objective of the study is to measure the effect of soil rejuvenation and post-harvest innovations practiced by farmers on the production of sugarcane crops in the Philippines.

Specifically, it aims to;

a. Gather data on the production of sugarcane farmers in seven location;

b. Re-calibrate the effect on the production of sugarcane with the soil rejuvenation and post-harvest innovations practiced by farmers, and;

c. Correlate sugarcane production with soil rejuvenation and post-harvest innovations as practiced by farmers.

Theoretical Background

The diffusion innovation theory refers to the process by which an innovation is adopted and gains acceptance (Rogers, 1995)

The innovation decision theory states that "diffusion" is a process that occurs over time and can be seen as having five distinct stages, namely:

a. ***Knowledge*** – This could be referred also the awareness stage where a person knows of the existence of an idea, the practice or technology. However, he lacks the adequate information. In technology promotion, the first stage is to inform people and make them aware (awakening stage)
b. ***Persuasion*** – This could be the stage where a person is attracted to the technology. Such interest will entice him to know more about the technology – What it is? How Much it Costs? Where to acquire the needed inputs? How much will the yield be? (realization stage)
c. ***Decision*** – An individual shows marked interest in the technology as it applies to him, his family, or his work. His tendency is to obtain or ask more information regarding the technology by obtaining detailed information from researchers, technicians or extension workers buying the product and assessing its merit and even inquiring from others who have tried the technology. (inquisitive stage)
d. ***Implementation*** – This could be referred to as the trial stage where individual tried and experiments in small scale the new technology after weighing the advantages and risks involved. (experimentation stage)
e. ***Confirmation*** – There is an adoption or use of the technology if the person is convinced of the technology's relative advantage. There is satisfaction on the part of the user. (self-satisfaction stage)

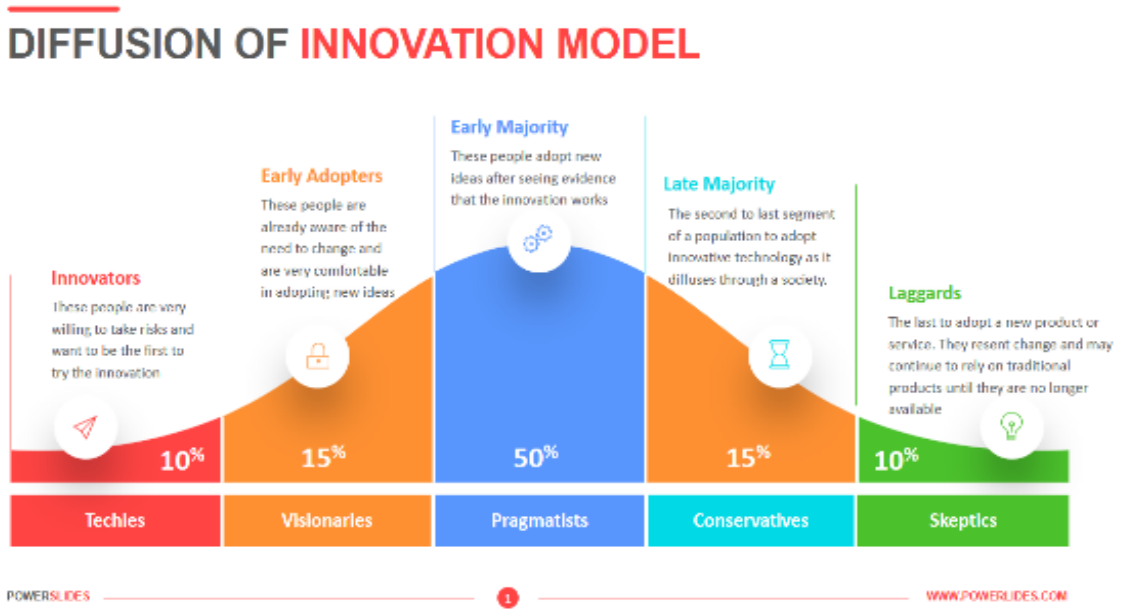

Fig 1. The diffusion innovation theory (Rogers, 1995)

Methodology

The descriptive correlation method was used in this study. It focuses on the sugarcane farmers' areas, farm profile, sugarcane production in tonnage in correlation with the soil rejuvenation and post-harvest innovations as practiced by farmers at the seven locations of the Visayas, Philippines.

Research Environment

Areas planted with sugarcane were chosen as sampling area. There are seven provinces in the Visayas where majority of the sugarcane crops are planted to sugarcane. For this study only six provinces is included namely: Negros Occidental, Negros Oriental, Capiz, Iloilo, Cebu, and Leyte. As of Crop Year 2021-2022, the total area cultivated with sugarcane for the above-mentioned provinces was 271,622.89 hectares and produces 15.58 million tons of cane with an average of 57.63 tons per hectare.

Specifically, the study covered the following location, namely: CEB for Cebu province; LEY for Leyte; ILO for Iloilo; CAP for Capiz; Bayawan for Negros Oriental; San Carlos and Victorias for Negros Occidental. For the seven location, the total area is 93,354.03 hectares and had produced a total of 5,073,484.90 tons with an average tonnage of 54.35 per hectare.

Distribution of the Respondents

The respondents of the study were the sugarcane farmers in the Visayan area, Philippines. Employing the *Slovins* formula, out of 18,539 (Crop Year 2021-2022) sugarcane farmers from the seven locations covered by this study, the sample size of 320 farmers were randomly selected as the actual respondents. The number of respondent was determined by computing the percentages viz-a-viz to the total number of sugarcane farmers per location. The percent distribution of the respondents per location is shown in Figure 2.

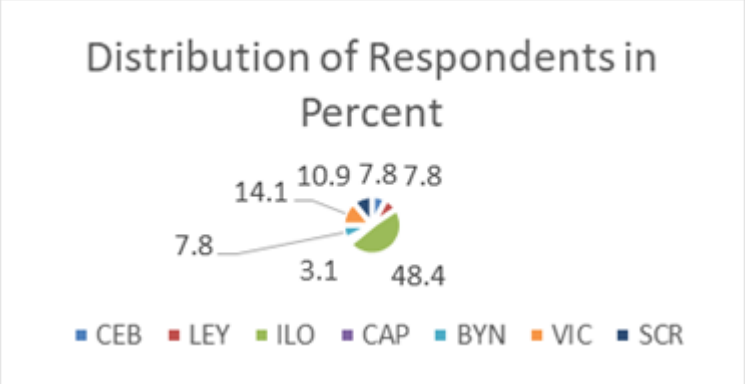

Fig 2. Distribution of respondents at seven location in the Philippines

Research Instrument

The instrument used to gather data was the validated document used by the group of Oñal (2021) from their previous studies with eight parts. It includes the farmers' profile, farm profile, soil rejuvenation and post-harvest innovations as practiced by farmers, and level of production of sugarcane among others.

Data Gathering Procedure

Instrument preparation

The researchers had personally prepared the questionnaire/instrument. The instrument had undergone the reliability and validation tests last 2021 already and is being used in all his previous studies including this one.

Distribution of Instrument and Gathering and Data

The researchers had done the actual orientation on how to fill-out the questionnaire with the field enumerators. It personally distributed the instrument per location to the enumerators.

Thereafter, data gathering started with the assistance of agricultural enumerators at the different location.

Retrieval of Instruments

The researchers had personally retrieved the instruments from the enumerators others were send thru public courier.

Encoding and Statistical Analysis

Upon retrieval of the questionnaire, the researcher had tallied and analyzed the data using the Statistical Package for Social Sciences (SPSS) software under the closed supervision and guidance of the statistician. The procedure is presented on Figure 3.

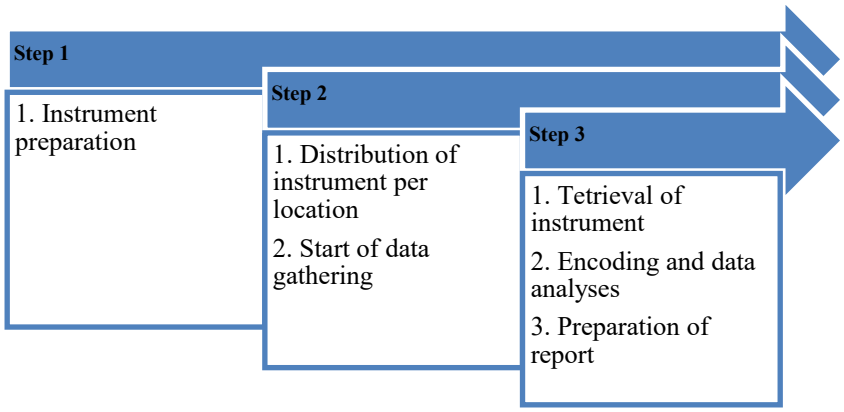

Fig 3. Data gathering procedure

In the analysis of data, the following statistical tools were used in accordance with the nature of the specific objectives.

Frequency and percentage was use to describe the profile of the sugarcane farmers' and farm profile.

Likert's Scale was used in segregating and describing the result.

The mean was used to determine the level of production of sugarcane, as well as the soil rejuvenation, and post-harvest innovations as practiced by farmers.

One way Analysis of Variance (ANOVA) was used to determine the difference in the production of sugarcane, when respondents are grouped according to location, soil rejuvenation, and post-harvest innovations.

Pearson r Moment Correlation was utilized to determine the significant relationship between the level of production versus the soil rejuvenation and post-harvest innovations.

Results and Discussions

Farmers Profile

Figure 4 revealed the farmers profile at the seven location in the Visayas in terms of gender, age, and level of education,

The findings revealed that out of 320 farmers involved in the study, 69.7% are male and 30.3% are female.

Furthermore, the findings revealed that 51.2% of the farmers were 51 years old and above, 36.9% are between 36-50, while around 11.9% were 35 years old and below, respectively.

As to the educational attainment, 47.2% of the farmers were secondary level and 3.8% had undergone vocational courses.

Figure 4 findings implies further, that farmers at the seven location in the Visayas area were majority male, aged 51 years old and above, and obtained a secondary level of education.

For the number of years in sugarcane farming 38.4% have been in sugarcane farming for more than 20 years, while only 26.5% have been doing it for 10 years or less.

The study of Mavaliya et al (2025) on influenced of sugarcane farmers knowledge on some variables, indicates that the age and level of education has no significant impact on the knowledge of farmers.

Relatively, the findings of Gallen (2015) which uses the Danish matched employer-employee data, the paper estimates the relative productivity of men and women and finds that gender "productivity gap" is 8 percent implying that just under two thirds of the residual wage gap can be accounted for by productivity differences between men and women. In the Philippines, employment in agricultural sector by gender in the year 2019 was 28.70% male and 13.60% female.

The productivity gap was measured by estimating the efficiency units lost in a firm-level production function if a worker is female, holding other explanatory covariates such as age, education, experience, occupation, and hours worked constant. Furthermore, both mothers and non-mothers were paid less than the male but the (low) relative pay of mothers is completely explained by productivity for women without children.

Furthermore, in India women perform a crucial role in agricultural either directly or indirectly starting from producing, processing and ultimately marketing of agricultural produce (Mallick & Anshuman, 2023).

Relatively, Hyland, et al (2020) found out the global picture of gender discriminations especially on law that affects women's economic opportunity. They had find a positive correlations between a more equal laws pertaining to women workforce and more equal labor markets outcomes such as higher female labor participation and a smaller wage gap between men and women.

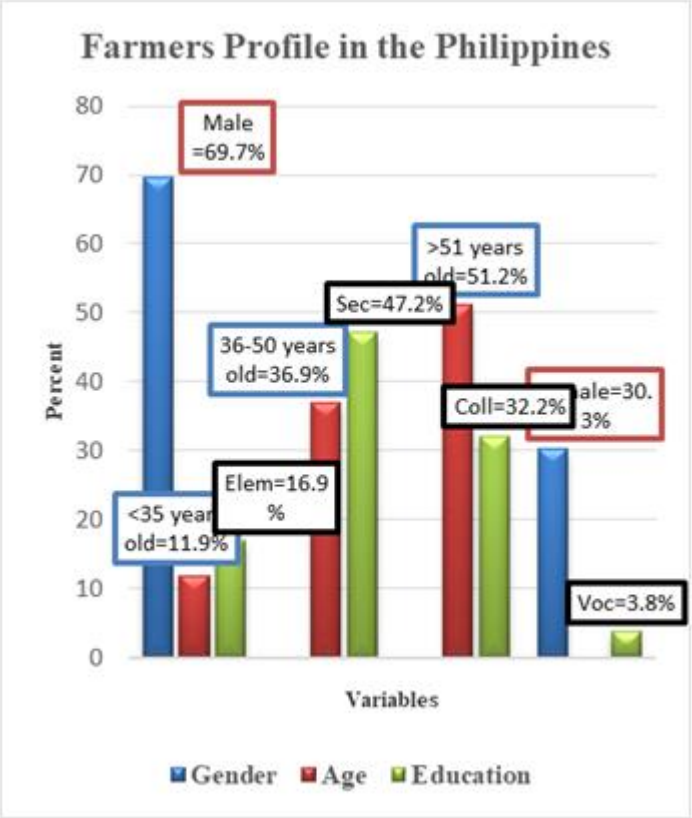

Fig 4. Farmers profile in the Philippines

Farm Profile

For size of farm holding, 69.7% of the respondents have an area below 25 hectares while 6.6% have an area of 51 hectares or more as indicated in Table 1.

As to the land topography, 65.3% of the area has a soil gradient of 6.24 degrees while 15.9% have a slope gradient of less than 5 degrees.

Around 53.9% of the area had an average production of less than 49 TC/ha and 18.8% have an average production of 56 to 64 TC/ha.

Table 1. Farm Profiles at the different location in the Visayas, Philippines.

Variables	Number of Farmers	Percentage
Average Size of Land Holdings		
51 ha & above	21	6.6
26-50 hectares	76	23.8
25 ha & below	223	69.7
Land Topography		
>25 degrees	60	18.8
6-24 degrees	209	65.3
<5 degrees	51	15.9
Average Production		
>65 TC/ha	88	27.5
50-64 TC/ha	60	18.8
<49 TC/ha	172	53.8
TOTAL	**320**	**100.0**

The soil rejuvenation and post-harvest innovations practiced by sugarcane farmers in the Visayas, Philippines

The data in Table 2 shows that the mean analysis on the soil rejuvenation and post-harvest practices of farmers categories by innovation employed in the seven locations in the Visayas was "moderately" done (M=1.80). This means that the practice of rejuvenating the soil and post-harvest innovations of sugarcane farmers in the seven locations in the Visayas was average. Likewise, it can be deduced from the result that majority of the farmers did not practice fallowing (M=1.28) meaning that farmers' had continue planting sugarcane crop for the last 10 years with no gap.

It can be deduced from the result that there are five soil rejuvenations that are moderately practice by farmers. First, is the application of lime in the soil (M=1.73) farmers had applied lime for the last three years even without soil analysis. Second, it's on the correct placement of lime (M=1.73) farmers usually placed the lime on the furrow and covered it before planting and/or applying the lime between furrows. Third, on the quantity of lime applied (M=1.73), for the last three years, farmers had applied an average of 3-5 tons per hectare. Forth, it's the practice of green manuring for the last three years (M=1.90), green manuring is the planting of leguminous crops between furrows. Fifth is the application of mill waste from the sugar mill/central (M=1.66) this is the application of mud press or mill ash on sugarcane field for the last three years.

On post-harvest practices, the results implied that farmers' were moderately innovative (M=1.85). The cane were freshly delivered (M=1.80), trash disposal or spreading of trash on the field after harvest is done (M=1.90), the harvested cane are delivered 4-6 days after harvest (M=1.84), and the average trash deduction per delivery was between 4-5% only (M=1.87), respectively.

The results of the study construe that the respondents in the seven locations in the Visayas, were moderately innovative, both for soil rejuvenation and post-harvest innovations. Among others, the practice of fallowing is not common to sugarcane farmers (M=1.67).

It can be figured out that this study (adoption of innovations of sugarcane farmers) has the same result with our previous study in 2022.

It can be relate that the adoption of innovations is the decision by an individual or community to implement and use a new agricultural practice, technology, or innovation as an output of extension efforts

The innovation of applying of mill waste like mud press and baggase to sugarcane, Dotaniya et al in India (2016) have conducted a study for the utilization of the same. They studied the effect of sugarcane by-products to crop productivity and soil properties. Results shows that application of sugar mill by products improves soil fertility, physical composition, and biological properties. Specifically the by-products improve the organic matter of the soil and it enhanced the yield of sugarcane.

On delivery of cane to the sugarcane Misra et al (2024) found out that unreasonable delay in cane transportation from field to the sugar mills are frequently link to a number of challenges related to either primary or secondary sucrose losses all of which contribute to a significant reduction in sugarcane tonnage and sugar recovery.

Relatively, Muhtadi et al (2024) revealed that delayed time in of delivery of harvested cane up to 4 days had a direct effect on stalk weight loss, juice quality, cane tonnage and sugar yield

On trash deduction, lower trash deduction per delivery of harvested canes will result in the great volume of leftover of sugarcane waste e.g. trash in the field. This will undergo decomposition process that can be convert in a huge biomass of 10-15 tons per hectare (Oñal et al, 2022). Sugarcane trash and other extraneous matter can also influence the color precursors and purity of sugarcane juice during processing.

Furthermore, it can relate to a review work of Adenya (2025) on the production of biomass that undergo carbon neutrality which assures rural development while

protecting the environment, like the sugarcane plantation.

The findings correlate to one of the items as mention by a book authored by the group of Patro (2024). Innovations is a crucial work for redefining the role and scope of agricultural extension for knowledge dissemination and skills development of a farmer especially on their technology innovation and adoption.

The study of Kosim et al (2021) on the other hand shows that farmers who joined the program in agricultural extension increased by 9.05 tons higher than those who have not availed the services of extension, hence no innovation was done on their farm.

By category, the study of Dlamini and Worth (2016) reveal that extension is in good position to address sugarcane production challenges through improved teaching and learning, updated information management, and effective technology adoption including innovations, among others.

Table 2. Main result of soil rejuvenation and post-harvest practice by sugarcane farmers in the Visayas, Philippines as categories by innovation

Soil Rejuvenation and Post-harvest Practice by Sugarcane Farmers	Mean of farmers practice by innovation category			Total Mean	Description
	Innovative	Semi-innovative	Traditional		
Soil Rejuvenation					
1. Soil liming application	2.61	1.94	1.44	1.90	Moderately innovative
2. Lime placement	2.17	1.95	1.08	1.73	Moderately innovative
3. Lime quantity applied	2.24	1.90	1.05	1.73	Moderately innovative
4. Green manuring	2.23	1.91	1.06	1.73	Moderately innovative
5. Mill waste application	2.23	1.75	1.01	1.66	Moderately innovative
6. Soil fallowing	2.46	1.86	1.28	1.28	Less innovative
Mean	**2.32**	**1.88**	**1.10**	**1.67**	**Moderately innovative**
Post-harvest					
1. Freshness of cane	2.54	1.94	1.21	1.90	Moderately innovative
2. Trash disposal	2.29	1.88	1.23	1.80	Moderately innovative
3. Cane delivery	2.28	1.86	1.37	1.84	Moderately innovative
4. Trash deduction	2.51	1.69	1.40	1.87	Moderately innovative
Mean	**2.40**	**1.84**	**1.30**	**1.85**	**Moderately innovative**
Total Mean	**2.35**	**1.87**	**1.18**	**1.80**	**Moderately innovative**

Volume of production of sugarcane in the Visayas, Philippines in tons per hectare when group according to category of innovation

Table 3 shows the volume of sugarcane production in tons per hectare (TC/ha) in the Visayas, Philippines using the mean when group according to innovations. The results revealed that the sugarcane production in the Visayas, Philippines when grouped to category of innovations is between 50 – 64 TC/ha (M= 1.85).

The innovations practice by farmers were categories into three, namely: innovative, semi-innovative, and traditional one. Innovative is classified when farmers use 100% of the technologies recommended. Semi-innovative on the other hand is when the farmers is still trying to adopt the recommended technologies from his usual way of farming. Traditional is that when farmers does not employed any recommended technology. The classification was done by Oñal (2021).

The integration of innovations like the system of diversification, reducing cost including the increased of processing plant system had ensured increase of production (Singh, et al, 2019)

Table 3. Summarized result on the volume of sugarcane production in the Visayas, Philippines when group according to category of innovation

Innovation Category	Production Mean	Description
Innovative	2.35	High production
Semi-innovative	1.86	Medium production
Traditional	2.12	Medium production
Total Mean	**2.11**	**Medium production**

Difference on sugarcane production in the Visayas, Philippines when group by farmers practice on soil rejuvenation

The data in Table 4 presents the difference on sugarcane production in the Visayas, Philippines when grouped by farmers practice on soil rejuvenation innovations using One-way ANOVA. It further revealed that there is a significant difference on sugarcane production in the Visayas, Philippines when grouped by farmers practice on soil rejuvenation. Specifically, the practice of applying the correct quantity of lime (M=2.46), application of mill waste (M=2.38), and the practice of green manuring (M=2.01) had an average production of more than 65 TC/ha (αlpha = 0.01), respectively. On the other hand, correct placement of lime (M=1.88) had and average production of 50-64 TC/ha only. This means that sugarcane production in the Visayas, Philippines when grouped by soil rejuvenation and post-harvest innovations practice by farmers are not comparable.

Agriculture must not only embrace technological advancement but also promote regenerative practices that improve soil health and biodiversity (Oñal, 2024).

Table 4. Analysis of Variance of sugarcane production in the Visayas, Philippines when grouped by farmers practice on soil rejuvenation.

Soil Rejuvenation Practices	Innovation Category	Mean	F	Sig	Description
Soil lime application	Innovative	2.46	5.567	0.004**	High production
Lime placement	Semi-innovative	1.88	3.823	0.023*	Medium Production
Mill waste application	Innovative	2.38	38.893	<0.001**	High Production
Green manuring	Semi-innovative	2.01	33.066	<0.001**	Medium Production

***significant at 1% level, *significant at 5% level*

Difference on sugarcane production in the Visayas, Philippines when group by farmers practice on post-harvest innovations

The data in Table 5 presents the difference on sugarcane production in the Visayas, Philippines when grouped by farmers practice on post-harvest innovations using One-way ANOVA. It further revealed that there is a significant difference on sugarcane production in the Visayas, Philippines when grouped by farmers practice on post-harvest specifically in delivering freshly cut cane to the mill (M=2.36, αlpha = 0.01). This means that sugarcane production in the Visayas, Philippines when grouped by post-harvest innovations practice by farmers are not comparable.

Table 5. Analysis of Variance of sugarcane production in the Visayas, Philippines when grouped by farmers' practice on post-harvest.

Post-harvest Practice	Innovation Category	Mean	F	Sig	Description
Freshness of cane	Innovative	2.36	5.567	0.004**	High production

***significant at 1% level*

Difference on sugarcane production in the Visayas, Philippines when group by location

The data in Figure 5 presents the difference on sugarcane production in the Visayas, Philippines when grouped by location using One-way ANOVA. It further revealed that there is a significant difference on sugarcane production in the Visayas, Philippines when grouped by location (M=2.28) with an average production of 50-64 TC/ha (αlpha = 0.05). This means that sugarcane production in the Visayas, Philippines when grouped by location are not comparable.

The results relates to the finding of the study by Oñal et al (2022) which construed that there's a significant difference in the level of productivity of sugarcane farms when grouped as to the location (αlpha = 0.05)

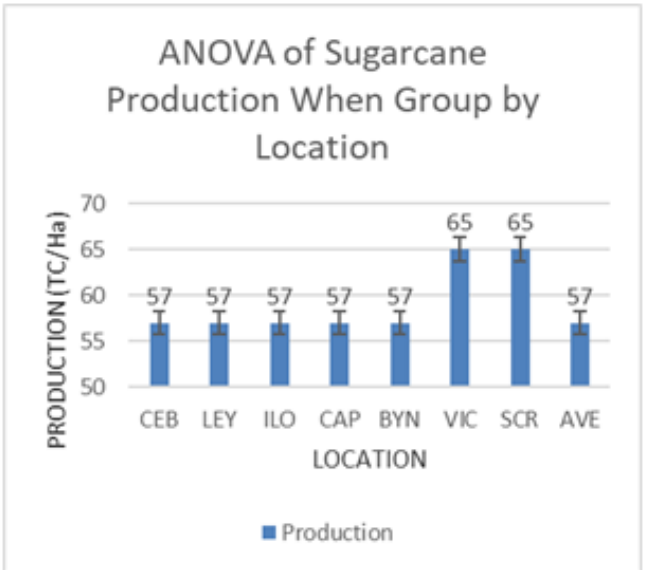

Fig 5. Analysis of Variance of sugarcane production in the Visayas, Philippines when grouped by location.

Relationship between the soil rejuvenation innovations practice by sugarcane farmers and volume production

The data in Table 6, showed the relationship on soil rejuvenation innovations practiced by farmers and volume of sugarcane production in the Visayas using Pearson's r. It could be deduced from the data that there was a strong significant relationship between the two soil rejuvenation innovations practiced by the

farmers and the volume of production of sugarcane specifically on the volume of the lime applied and mill waste application (alpha = 0.01). Moderate relationship is also implied by correct placement of lime (αlpha = 0.05) and the practiced of green manuring (αlpha = 0.01). Therefore, the soil rejuvenation innovations practiced by the sugarcane farmers in the Visayas really affect the volume of production

The findings relates to the study of Jaiswal (2014) which commented that there are enough viable and modern technologies for innovations that have been developed already but many of these have not reached to farmer level because of poor delivery of extension services. Moreover, farmers are not aware of the technology available hence, they could not properly adapt and innovate farming undertaking.

The inefficient delivery of agricultural extension services limits the use of modern technology as well as farm innovations. The lack of technical know-how plus the limited financial resources were the challenge experienced by the farmers in adopting sustainable-modern agricultural practices.

Table 6. Correlation analysis between the soil rejuvenation practices and volume of sugarcane production

Soil Rejuvenation Practice	Pearson r	Sig	Strength of Relationship
Lime application	0.442	<0.001**	Strong relationship
Lime placement	0.136	0.015*	Moderate relationship
Mill waste application	0.398	<0.001**	Strong relationship
Green manuring	0.163	0.004**	Moderate relationship

***significant at 1% level *significant at 5% level*

Relationship between the post-harvest innovations practice and volume of sugarcane production

The data in Table 7, showed the relationship on post-harvest innovations practice by farmers and volume of sugarcane production in the Visayas using Pearson's r. It could be deduced from the data that there was a strong significant relationship between the post-harvest innovations practiced by the farmers and the volume of production of sugarcane specifically on delivering of fresh harvested cane (αlpha = 0.01) . Therefore, the post-harvest innovations practiced by the farmers in the Visayas strongly affects the sugarcane production.

Table 7. Correlation analysis between the post-harvest innovations practiced and volume of sugarcane production.

Post-harvest Practice	Pearson r	Sig	Strength of Relationship
Freshness of cane	0.465	0.003**	Strong relationship

***significant at 1% level*

Conclusion

This study aims to determine the contributions of soil rejuvenation and post-harvest innovations practiced by farmers in increasing the production at the seven locations in the Visayas, Philippines and the relationship to sugarcane production in terms of tons per hectare.

There were 320 respondents involved in the study which covers six provinces within the four regions of the Philippines. Majority of the respondents were male, 51 years old and above, with secondary education, has been in sugarcane farming for more than 20 years and are tilling an average area of 25 hectares and below.

In general, the results revealed that four soil rejuvenation and one post-harvest innovations practiced by the sugarcane farmers have moderate to strong relationship with sugarcane production. The study indicates that on per location the average production was between 50 to 64 TC/ha.

Considering that majority of the soil rejuvenation and post-harvest innovations practiced

by the farmers have a moderate to strong relationship with the production of sugarcane it is best to assist them on this aspect. The academe and the government should go hand in hand in the conducting more research, strengthen the extension services, and provide more assistance that can increase the productivity per unit area.

Conflict of Interest

No other group is involved in this study. No monetary contribution is given to this study.

Ethical Consideration and Data Privacy

The researcher takes responsibility for securing the sanctity and confidentiality of all information/data generated through this instrument used. Data will be used for academic/research and in designing programs/projects for the industry.

The respondents agreed for publishing all generated data.

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References:

Abhijeet, Sahu, K. K, Bardhan, R. & Chouhan, N. S., (2023). A Comprehensive Review on Role of Agricultural Extension Services in the Sustainable Development of Global Agriculture. *International Journal of Environment and Climate Change.* 13(10): 3514-3525. *htpps://doi.org/10.9734/ijecc/2023/v13i.103021* https://www.researchgate.net/publication/3740122723

Adenya, T. (2025). A Review in Biomass Energy for Carbon Neutrality in Nigeria: Opportunities and Challenges. *Academia Green Energy*. 2(1). *https://doi.org/10.20935/AcadEnergy7550*

Balita, C. (2024). Area planted/Harvested of Sugarcane for Raw Sugar Philippines 2023: by Region. https://www.statista.com

Cardoso, L. A. S., Farias, P. R. S., Soares, J. A. C., & De Oliveira, J. (2024). Planted Area, Productivity, and Sugarcane Production in the Eastern Brazilian Amazon. *Bulgarian Journal of Agricultural Science.* 30(4): 686-701. https://www.agrojournal.org/30/04-18pdf

Dlamini M. M. and Worth, S. T. (2016). Agricultural Extension in the Facilitation of Improved Sugarcane Productivity Among Small-scale Growers in Swaziland: A SWOT analysis. *Asian Journal of Agricultural Extension, Economics, and Sociology*. 12(3): 1-13. https://doi.org/10.9734/AJAEE/2016/27094 https://www.researchgate.net/publications/307529674

Dotaniya, M. L., Datta, S. C, Biswas, D. R., Dotaniya, C. K., Meena, B. L., Rajendiran, S., Regar, K. L., & Lata, M. (2016). Use of Sugarcane Industrial By-products for Improving Sugarcane Productivity and Soil Health. *International Journal of Recycling of Organic Waste in Agriculture.* 5:185-194. https://doi.org/10.1007/s40093-016-0132-8 *https://wwww.academia.net/publication/29358366*

Gallen, Y. (2015). The Gender Productivity Gap. *UTC.* 10(36): 1-3. https://www.researchgate.net/publication/283287946

Hyland, M., Djankov, S., & Goldberg, P K., (2020). Gendered Laws and Women in the Workforce. *American Economic Review: Insights.* 2(4): 475-490. https://doi.org/10.1257/AERI.*20190542*

Jaiswal, P. and Tiwari, R. (2014). Technological knowledge and adoption behavior of sugarcane growers of Surguja District, Chattisgarh, Southeast Central India. *Indian Journal of Applied Research*. 4(4): 1-3. https://wordwidejournals.com/indian-journal-of-*applied-research-(ijar)*

Kaur, K. & Kaur, P. (2018). Agricultural Extension Approached to Enhance the Knowledge of Farmers. *International Journal Curr. Microbiology Science.* 7(02): 2367-2376. *https//doi.org/10.20546/ijemas. 2018.702.289*

Kosim, M., Aji, J. M. M., & Hapsari, T. D. (2021). The Impact of Agricultural Extension on Productivity of Smallholder Sugarcane

Farmers in East Java. *IOP Conference Series: Earth and Environmental Science.* 892 012009. https://iopscience.iop.org/article/10.1088/1755/1315/892/1/012009

Mavaliya, M., Jahanara, Khakhal, A., & Chopra, B., (2025). Independent Variables of Sugarcane Growers and their Level of Knowledge about Recommended Package of Practices. *International Journal of Agriculture Extension and Social Development.* 8(5); 205-207. *https://www.doi.org/10.33545/26180723.2025v8,i5c.1889.*

Mallik, B. & Anshuman, J., (2023). Gender Dynamics in Indian Agriculture: Roles, Challenges and Opportunities. Fundamentals of Agricultural Extension. BS Global Publication House. *https://researchgate.net/publications/374328570*

Misra, V., Mall, A. K., Solomon, S., & Ansari, M. I. (2024). Post-harvest Biology and Recent Advances of Storage Technologies in Sugarcane. *Biotechnol Rep (Amst).* Jul 20;43:e00850. *https://doi-org/10.1016/j.tbre*. *https://pubmed.ncbi.nlm.nih.gov/35145888*

Misra, V., & Bhatt, R. (2020). Advance Production Technologies of Sugarcane: A Steps Toward Higher Production. p185-214. *New India Publishing Agency, India*. *https://www.researchgate.net/publication/345662120*

Muhtadi, M. M., Sitawati, S., & Suryanto, A. (2024). Effect of Sugarcane Varieties and Milling Delay Time on Cane Sugar Yield. *Jurnal Teknik Pertanian Lampung (Journal of Agricultural Engineering).* 13(2): 506-511. *https://doi.org/1023960/jtep-l.v13i2.506-511*. *https://researchgate.net/publication/380800896*

Oñal, P. A. Jr., Baldonebro, J. J. G., & Andrade F. E. (2025). Performance of Sugarcane Planted at Different Soil Types and Rainfall Duration in the Philippines. *International Journal of Multidisciplinary: Applied Business and Education Research*. 6(5): 2317 - 2330. *https://doi.org/10.11594/ijmaber.06.05.18*

Oñal, P.A. Jr., Samillano, N.P, Andrade, F.E. & Oñal, P.M.M. (2025). Impact of Age and Farming Experience on Sugarcane Productivity in the Visayas, Philippines. *International Journal of Multidiciplinary: Applied Business and Education Research*, 6(8), 4028-4037. *http://dx.doi.org/10.11594/ijmaber.06.08.23*

Oñal, P. A. Jr., Buenafe, O. B., & Eraldo, V. M., (2022). Farm Profile of Sugarcane Farmers in the Visayas, Philippines and Their Productivity Level. *Revista Review Index Journal of Multidisciplinary.* 2(1): 01-09. *https://doi.org/10.31305/rrijm2022.v02.n01.001*

Oñal, P. A. Jr., Jinon, R. J., & Martinez, L. B., (2022). The Extension Services and the Level of Productivity of Sugarcane Farmers in the Visayas, Philippines. *International Journal of Multidisciplinary: Applied Business and Education Research.* 3(1); 90-101. *https://doi.org/10.11594/ijmaber.03.01.10*

Oñal, P. A. Jr., Juntilla, C. J., & Ortega, J. O. (2021). Degree of Farming Innovations and the Level of Productivity of Sugarcane Farmers in the Visayas, Philippines. *European Journal of Agricultural and Rural Education* (EJARE). 2(12): 57-67. *https://scholarzest.com/index.ph/ejare/article/view/1555*

Oñal, P. A. Jr., Panes, N. P., & Neri, V. A. (2021). Level of Productivity of Sugarcane Farmers and Farm Profile in the Visayas, Philippines. *European Journal of Agricultural and Rural Education* (EJARE). 2(12): 16-24. *https://scholarzest.com/index.ph/ejare/article/view/1527*

Patro, A., Das, S., & Mallik S. (2024). Innovations in Agricultural Extension. *Daya Publishing House, India*. ISBN: 978-93-5919-940-5. *https://www.researchgate.net/publication/386012347*

Pelonia, A. (2024). PHL Sugar Production will Improved. *Business Mirror*. *https://businessmirror.com.ph/2024/09/05/phl-raw-sugar-output-to-fall-by-7-29-sra/*

Philippine Statistics Authority (2019) Major Non-food and Industrial Crops. *Quarterly Bulletin.* Quezon City, Philippines. *https://psa.gov.ph*

Reza, Md. S., Riazi, M. H., & Khan, M. M. H., (2016). Productivity and Profitability of Sugarcane Production in Northern Bangladesh. *Indian Journal of Commerce and Management Studies.* 7(1): 1-9. https://www.researchgate.net/publications/323078354

Singh, P., Sing, S. N., Tiwari, A. K, Pathak, S. K., Singh, A. K., Srivastava, S., & Mohan, N. (2019). Integration of Sugarcane Production Technologies for Enhanced Cane and Sugar Productivity Targeting to Increase Farmers' Income, Strategies, and Prospects. *3 Biotech*. 9(2): 48. https://doi.org/10.1007/s13205-019-15680 https://pubmed.ncbi.nlm.nih.gov/30729072

Sugar Regulatory Administration (2025). Philippine Sugar Statistics for Crop Year 2024-2025 (as of February 2, 2015). Quezon City, Philippine. http://sra.gov.ph/view_file/sugar_statistics/OvXbQG2fPOceZOu

Verna, A. K., Kumar, B. Sahu, R. K. & Kumar, S. (2025). Examine the Constraints of Farmers in the Production and Marketing of Sugarcane in the Lakhim Pur Kheri District of Uttar Pradesh. International *Journal of Agriculture Extension and Social Development.* 8(6): 187-190. *https://www.doi.org/10.3354/26180723.2025.v8.i6c.2012.*

Wakgari, T., Kibret, K., Bedad, B., Temesge, M. & Erkossa, T. (2020). Effects of Long Term Sugarcane Production on Soils Physico-chemical Properties at Finchaa Sugar Estate. *Journal of Soil Science and Environmental Management.* 11(1): 30-40. https://doi.org/10.5897/JSSEM.2018:0710 https://sciencedirect.com/science/article/pii/S24005844023027275

World Bank (2019). Employment in Agriculture (% of total employment). Modeled ILO Estimate. https://www.data.worldbank.org/indicator