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Driving Sustainable Growth Through Renewable Energy Adoption: Evaluating its Influence on Community Livelihood in Barangay North Poblacion, Maramag, Bukidnon

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ABSTRACT

The adoption of renewable energy plays a critical role in advancing sustainable global growth by mitigating climate change, reducing pollution, and fostering economic development. This study focused on evaluating the impact of renewable energy adoption on community livelihoods in Barangay North Poblacion, Maramag, Bukidnon. The research examined how different renewable energy types, levels of implementation, accessibility, and community engagement contribute to sustainable development and improve local livelihoods. The study used a descriptive approach, combining both quantitative and qualitative data through surveys and interviews, alongside regression analysis to assess the impact on daily life, economic stability, and overall community growth. A diverse group of participants, including households using renewable energy, business owners, community leaders, and renewable energy providers, provided comprehensive insights into the effects of renewable energy systems. The findings revealed that renewable energy adoption significantly enhances economic opportunities, boosts business growth, and improves energy access and social well-being. Overall, the study underscores that community involvement is crucial for ensuring the effective integration of renewable energy, contributing to long-term sustainable growth in Barangay North Poblacion, Maramag, Bukidnon.

Keywords: *Accessibility, Adoption, Business Growth, Community, Development, Energy*

INTRODUCTION

The transition to renewable energy was a crucial component of achieving sustainable growth on a global scale. Renewable energy sources like solar, wind, and hydropower were essential in mitigating climate change, curbing pollution, and fostering economic growth. A report by the International Energy Agency (2023) revealed that renewable energy deployment not only reduced environmental harm but also stimulated socio-economic benefits such as job creation, improved energy security, and enhanced public health outcomes. Moreover, the widespread adoption of renewables fostered industrial development by diversifying energy markets and creating new economic opportunities.

However, despite global recognition of the need to embrace renewable energy, significant barriers remained, especially in developing regions. The lack of necessary infrastructure, investment, and policy support often hindered the transition to renewable energy systems. Technological gaps, insufficient public awareness, and limited access to financial resources also complicated adoption. Another critical gap in current research was the understanding of how renewable energy directly impacted community livelihoods, particularly in rural and underserved areas. Limited studies focused on the tangible socio-economic benefits of renewable energy at the grassroots level, which were crucial for improving community resilience and reducing energy poverty.

Recent studies underscored the importance of regional, localized solutions to address the unique

challenges faced by communities transitioning to renewables (Berkhout et al., 2022). Furthermore, the legal and policy frameworks surrounding renewable energy adoption played a pivotal role in ensuring the success of energy transitions. International agreements like the Paris Agreement and national regulations were vital in creating incentives for renewable energy adoption (Smith & Wessels, 2023). However, inconsistent enforcement of legal standards, particularly regarding land use and environmental compliance, often hampered the potential benefits of renewable energy.

This study sought to contribute to the growing body of research by exploring how renewable energy adoption could drive sustainable growth and improve community livelihoods. By examining the effects of renewable energy on economic development, energy access, and social well-being in Barangay North Poblacion, Maramag, Bukidnon, this study provided critical insights for policy development and the design of energy solutions that promoted equity and sustainability.

MATERIALS & METHODS

The study employed a mixed-method approach that integrated both quantitative and qualitative data to assess the impacts of renewable energy adoption on community livelihoods. A descriptive research design was utilized, incorporating surveys and interviews complemented by regression analysis to examine relationships and predict the effects of various factors on renewable energy adoption. The quantitative aspect, through regression analysis, provided measurable outcomes such as economic growth and environmental benefits, while qualitative interviews offered deeper insights into community perceptions, adoption barriers, and social dynamics. By combining both methods, the study presented a holistic view of renewable energy's influence, bridging empirical data with real-world applications (Solar Philippines, 2024). This allowed the research to gather a comprehensive understanding, valuable for stakeholders and policymakers.

Barangay North Poblacion in Maramag, Bukidnon, was chosen as the research site because of its unique blend of residential, agricultural, and commercial activities, providing a varied and dynamic context for the study. This diverse community allowed the research to evaluate the impacts of renewable energy across different sectors, capturing a wide range of benefits and challenges. Through the lens of a mixed-use environment, the study could address issues such as energy access, economic opportunities, and social welfare. The location was selected to provide findings that could be applicable to other rural or semi-urban areas facing similar energy and development challenges (Department of Energy Philippines, 2024).

The sampling approach for the study used a stratified random sampling method to ensure the inclusion of diverse demographic groups, with households that directly benefited from renewable energy initiatives comprising the sample. A total of 370 respondents were selected, including participants who utilized renewable energy technologies like solar panels and biomass systems. Additionally, purposive sampling was used to select key informants, such as community leaders, local government officials, and energy providers, for qualitative insights. A control group of households not yet adopting renewable energy was also included for comparative purposes, ensuring a well-rounded and comprehensive assessment (International Energy Agency, 2024)..

RESULTS AND DISCUSSION

1. What is the demographic profile of the respondents in terms of Sex, Age, Civil Status, and Education?

Table 1 presents the respondents' distribution by sex, revealing that a significant majority (68.7%) were female, with only 31.3% male participants. The predominance of women in renewable energy adoption

studies is crucial, especially in contexts where community livelihood is affected, such as in Barangay North Poblacion, Maramag, Bukidnon. Chakrabarty (2023) argues that incorporating gender considerations in the design of decentralized renewable energy programs is key to achieving equitable outcomes. Women's involvement can drive sustainable energy transitions, given their critical role in household energy decisions and economic activities. This demographic shift towards more female participation reflects the evolving gender dynamics in energy systems, where women are increasingly acknowledged as primary stakeholders.

Table 1
The Frequency and Percentage Distribution of Respondents in terms of Sex

Profile	Characteristics	Frequency	Percentage
Sex	Male	47	31.3%
	Female	103	68.7%
	Total	150	100.0%

In a similar vein, Buechler et al. (2020) highlight that women are often central to managing household energy use and small-scale energy-related livelihoods, making them pivotal in the successful adoption and maintenance of renewable energy technologies. Recognizing this demographic can help shape gender-sensitive energy programs that empower women to contribute more effectively to community development and sustainability.

Table 2
The Frequency and Percentage Distribution of Respondents in terms of Age

Profile	Characteristics	Frequency	Percentage
Age	18 – 22	12	8.0%
	23 – 27	23	15.3%
	28 – 32	20	13.3%
	33 – 37	25	16.7%
	38 and above	70	46.7%
	Total	150	100.0%

Table 2 presents the age distribution of respondents, with the majority (46.7%) falling in the 38 and above age group. This is indicative of a more mature workforce in the study area, which might have significant implications for the adoption and implementation of renewable energy projects. Older individuals, as Arcelay et al. (2021) suggest, bring stability and valuable experience to such projects, increasing the likelihood of their success.

The predominance of older respondents may also suggest a workforce that possesses practical knowledge and established networks, which are essential for community-driven energy initiatives. However, the lower representation of younger individuals highlights the need for intergenerational collaboration in renewable energy projects. To ensure long-term sustainability, it is crucial to engage younger generations, whose familiarity with modern technologies and innovation can complement the experience of older participants. As Buechler et al. (2020) emphasize, leveraging the skills and knowledge of different age groups can foster more effective and inclusive community development processes, particularly in renewable energy adoption.

Table 3
The Frequency and Percentage Distribution of Respondents in terms of Civil Status

Profile	Characteristics	Frequency	Percentage
Civil Status	Single	53	35.3%
	Married	97	64.7%
	Total	150	100.0%

Table 3 outlines the respondents' civil status, revealing that married individuals make up a large majority (64.7%) compared to single individuals (35.3%). This suggests that most participants have familial responsibilities, which may influence their adoption of renewable energy solutions. Married individuals may be more motivated to invest in sustainable energy technologies, which can lower household energy costs, enhance living standards, and ensure long-term economic stability for their families.

Ranganathan et al. (2023) underline that family-oriented households often prioritize renewable energy solutions that promise to improve domestic energy security and reduce ongoing expenses. In addition, Buechler et al. (2020) point out that renewable energy solutions designed with the needs of families in mind tend to gain more widespread acceptance. These insights indicate that programs promoting renewable energy should be tailored to meet the needs of married individuals, highlighting the intersection of family-oriented priorities and the adoption of sustainable energy practices. Designing policies that align with these needs can significantly boost participation and support long-term community development.

Table 4
The Frequency and Percentage Distribution of Respondents in terms of Education

Profile	Characteristics	Frequency	Percentage
Education	Elementary	5	3.3%
	High School	48	32.0%
	Undergraduate Degree	84	56.0%
	Masteral Degree	11	7.3%
	Doctoral Degree	2	1.3%
	Total	150	100.0%

Table 4 presents the respondents' educational attainment, with the majority (56.0%) holding an undergraduate degree. This suggests that the workforce in the study area is relatively well-educated, which can enhance their ability to understand and adopt new technologies, including renewable energy solutions. The prevalence of educated respondents supports the idea that renewable energy adoption may be facilitated by a knowledgeable population capable of grasping the complexities of sustainable energy technologies.

Arcelay et al. (2021) emphasize that a well-educated populace is essential for the successful implementation of renewable energy projects, as it provides the necessary skills to design, install, and maintain such technologies. Similarly, Wojuola and Alant (2019) highlight that educational programs are crucial in promoting awareness and understanding of renewable energy systems, which can help drive their widespread acceptance. The relatively high proportion of undergraduate degree holders in the study area suggests that programs tailored to this education level will likely be effective in engaging

participants and encouraging active involvement in renewable energy adoption. However, it is equally important to design initiatives that also cater to individuals with lower educational backgrounds, ensuring that all demographic segments are included in the energy transition process.

The demographic profile of respondents reveals several important insights that can guide the design of renewable energy programs. Gender, age, civil status, and education all play critical roles in shaping how communities engage with renewable energy technologies. The significant representation of women emphasizes the need for gender-sensitive approaches, while the older workforce underscores the value of experience and stability in community-based projects. Moreover, the higher percentage of married individuals suggests that family-oriented interventions could enhance adoption rates, and the educational composition of the respondents points to the potential of an informed and skilled workforce to implement sustainable energy solutions effectively.

2. How do the respondents assess the renewable energy adoption in terms of:

2.1. Type of Renewable Energy Source;
2.2. Level of Implementation;
2.3. Accessibility; and
2.4. Community Involvement in Adoption?

As shown in Table 7, the respondents assessed the adoption of various renewable energy sources with an overall mean of 3.25, indicating general agreement on the positive impact of renewable energy sources in the community. Among the different sources, hydropower received the highest mean of **3.43** (strongly agree), suggesting that this energy source is highly regarded for its efficiency and sustainability. Hydropower projects are viewed as effective, contributing to both local energy needs and environmental sustainability. In contrast, wind energy projects received the lowest mean of 3.10 (agree), reflecting the perception that while wind energy is considered viable, its development may face challenges, such as infrastructure limitations or logistical constraints. This finding aligns with Bobinaitė et al. (2022), who note that wind energy, while promising, often encounters unique barriers that hinder its widespread implementation. Addressing these challenges could improve wind energy adoption and enhance the community's energy mix.

Regarding the level of implementation, renewable energy initiatives received a generally positive assessment, with an overall mean of 3.25. Respondents particularly emphasized the importance of efficient implementation processes, as reflected in the mean of 3.27 (strongly agree) for the indicator on efficient project execution. This suggests that, while there is recognition of the positive impact of renewable energy, further improvements are needed in scaling up and expanding these projects. The lower mean of 3.22 for large-scale implementation highlights the community's struggle with achieving widespread adoption, likely due to barriers such as funding constraints, infrastructure challenges, and technical capacity limitations (Bishoge et al., 2018). These findings suggest that strengthening local capacities, securing additional funding, and improving infrastructure could help overcome these barriers and facilitate more large-scale renewable energy projects.

The accessibility of renewable energy solutions also received a positive assessment, with a mean score of 3.25. Notably, indicators regarding the availability of renewable energy in remote or underserved areas and the accessibility of renewable energy for daily use both scored the highest mean of 3.29 (strongly agree). This suggests that renewable energy solutions are increasingly seen as an important tool for addressing energy access disparities, particularly in marginalized communities. The high rating of accessibility to renewable energy in remote areas aligns with findings from Marrero et al. (2021), who highlight the significant role of renewable energy in empowering underserved regions by providing reliable and sustainable energy solutions. However, the indicator regarding community education on accessing renewable energy received the lowest mean score of 3.22 (agree), indicating a

need for further educational efforts to ensure that community members fully understand how to effectively use these energy systems. Increasing community education and awareness will be crucial for maximizing the benefits of renewable energy solutions.

Table 7
The Respondents' Assessment of the Renewable Energy Adoption in Terms of the Type of Renewable Energy Source, Level of Implementation, Accessibility, and Community Involvement

Profile	Item Description	Mean	SD	Interpretation
Type of Renewable Energy Source	Local government promotes diverse renewable energy sources (e.g., solar, wind)	3.25	0.81	Agree
	Solar energy projects are adequately supported and encouraged	3.27	0.75	Strongly Agree
	Wind energy projects are viable and are being developed	3.10	0.89	Agree
	Hydropower is utilized efficiently for energy production	3.43	0.75	Strongly Agree
	Local government explores bioenergy as a sustainable energy source	3.20	0.79	Agree
Level of Implementation	Renewable energy projects are implemented on a large scale in the community	3.22	0.68	Agree
	Local government actively funds renewable energy initiatives	3.25	0.77	Agree
	Renewable energy projects follow efficient processes	3.27	0.69	Strongly Agree
	Renewable energy projects are monitored for timely completion	3.23	0.75	Agree
	Training programs enhance skills for renewable energy implementation	3.26	0.79	Strongly Agree
Accessibility	Renewable energy is affordable for the majority of community members	3.23	0.86	Agree
	Households have access to renewable energy sources for daily use	3.29	0.77	Strongly Agree
	Renewable energy systems are available in remote or underserved areas	3.29	0.77	Strongly Agree
	Local government ensures accessibility for low-income households	3.24	0.81	Agree
	Community members are educated on accessing renewable energy sources	3.22	0.80	Agree
Community Involvement in Adoption	Community actively participates in planning renewable energy projects	3.19	0.75	Agree
	Community feedback is sought and incorporated into renewable energy projects	3.15	0.78	Agree
	Awareness campaigns about renewable energy are conducted	3.17	0.77	Agree
	Community members are engaged in maintaining renewable energy systems	3.16	0.78	Agree
	Incentives are provided to encourage participation in renewable energy adoption	3.05	0.81	Agree
Overall Summary	**Total Mean**	3.22	0.78	Agree

Community Involvement in Adoption involvement in renewable energy adoption also received positive ratings, with an overall mean of 3.14. While community participation in planning renewable energy projects received the highest mean of 3.19 (agree), suggesting that community members play an active role in shaping energy initiatives, the lowest mean score of 3.05 (agree) was found for the indicator incentives provided to encourage participation. This indicates that, while participation is generally encouraged, there is room for improvement in offering more effective incentives to foster broader engagement. Providing tangible incentives such as financial support, subsidies, or recognition programs could help incentivize further community involvement in renewable energy projects (Zahari & Esa, 2018). Strengthening such incentive mechanisms would enhance community commitment and ensure the long-term success of renewable energy adoption initiatives.

3. How do the respondents assess the community's livelihood in terms of:

3.1. Economic Opportunities;
3.2. Energy Access and Affordability;
3.3. Business Growth and Productivity; and
3.4. Social Well-being

Table 8
The Respondents' Assessment of the Community's Livelihood in Terms of Economic Opportunities

Items	Mean	SD	Description	Interpretation
There are sufficient job opportunities available in the community	3.20	0.63	Agree	Positive Influence
Local government initiatives support the creation of employment opportunities	3.35	0.61	Strongly Agree	Highly Positive Influence
Training programs for skill development are readily available in the community	3.28	0.69	Strongly Agree	Highly Positive Influence
Community members have access to microfinance and small business loans	3.29	0.71	Strongly Agree	Highly Positive Influence
Infrastructure in the community supports economic activities	3.32	0.66	Strongly Agree	Highly Positive Influence
Overall Mean	**3.29**	**0.66**	**Strongly Agree**	**Highly Positive Influence**

Table 8 presents the community's assessment of economic opportunities, which was rated with a mean of 3.29 (Strongly Agree). This strong positive evaluation suggests that community livelihood programs are seen as effectively fostering economic growth and enhancing income-generating opportunities. The local government initiatives supporting the creation of employment opportunities received the highest score of 3.35, highlighting the significant role local policies and interventions play in creating job opportunities and bolstering economic stability. This is a key indicator of the community's recognition of government efforts to improve their financial security.

Additionally, the availability of training programs for skill development (mean = 3.28) and microfinance and small business loans (mean = 3.29) were also seen as vital contributors to economic empowerment. Access to these resources enables individuals to acquire new skills, start businesses, and improve their economic resilience, making them essential components of sustainable community development.

The community infrastructure (mean = 3.32) supporting economic activities also plays a crucial role in ensuring that businesses can thrive. Infrastructure such as roads, transport, and markets is necessary for improving access to goods and services, reducing operational costs, and stimulating economic

activities. However, the item "There are sufficient job opportunities available in the community" received the lowest score of **3.20**, suggesting that while some job opportunities are available, they may not meet the growing demand. This points to an area where further efforts should be focused to increase the number of available jobs, particularly in sectors that align with the community's needs. The lower score here reflects that there are still gaps in meeting full employment potential, which is crucial for long-term economic sustainability.

Table 9
The Respondents' Assessment of the Community's Livelihood in Terms of Energy Access and Affordability

Items	Mean	SD	Description	Interpretation
Energy is affordable for most households in the community	3.17	0.82	Agree	Positive Influence
The local government provides support for renewable energy adoption	3.17	0.74	Agree	Positive Influence
A reliable energy supply supports business and household needs	3.29	0.70	Strongly Agree	Highly Positive Influence
Low-income households receive assistance in accessing energy resources	3.13	0.85	Agree	Positive Influence
Energy infrastructure is well-maintained and sufficient for community needs	3.19	0.77	Agree	Positive Influence
Overall Mean	**3.19**	**0.78**	**Agree**	**Positive Influence**

Table 9 presents the energy access and affordability evaluation, where the overall mean of 3.19 reflects a positive influence, although there are some areas that require attention. Respondents highlighted the importance of a reliable energy supply in supporting both business and household needs, with a mean score of 3.29 (Strongly Agree). This emphasizes the critical role of consistent energy in enhancing economic productivity and meeting basic living requirements, thus contributing to the overall livelihood and well-being of the community.

However, the item "Energy is affordable for most households in the community" received a mean of 3.17, suggesting that while energy is perceived as affordable, there are still concerns about its affordability, particularly for lower-income households. Similarly, low-income households receiving assistance in accessing energy resources scored the lowest with 3.13, indicating that while there is some support, there may still be gaps in fully addressing the energy needs of the most vulnerable groups. These results point to the need for policies that ensure more equitable access to affordable energy, especially for marginalized households, and continued improvements in energy infrastructure (mean = 3.19) to ensure sufficient and reliable energy for all community members.

The findings from Table 10 on business growth and productivity suggest that community livelihood programs are positively impacting local businesses. With an overall mean of 3.28, respondents strongly agree that these programs foster entrepreneurship and enhance productivity. The availability of technology and digital tools (mean = 3.38) for businesses is particularly noted as a key factor in improving business operations. The ability to leverage technology helps businesses streamline their processes, expand their reach, and increase efficiency, making it a significant driver of economic growth.

In addition, community infrastructure (mean = 3.36) plays a crucial role in supporting business growth, particularly in areas like transportation and access to markets. Well-developed infrastructure reduces

operational challenges and enhances the flow of goods and services, which is vital for the success of local businesses.

Table 10
The Respondents' Assessment of the Community's Livelihood in Terms of Business Growth and Productivity

Items	Mean	SD	Description	Interpretation
Local businesses receive support through government programs and incentives	3.17	0.78	Agree	Positive Influence
The community provides entrepreneurs with access to financial services	3.21	0.70	Agree	Positive Influence
Business owners can easily access training programs to improve productivity	3.27	0.66	Strongly Agree	Highly Positive Influence
The community infrastructure supports business growth (e.g., roads, transport)	3.36	0.67	Strongly Agree	Highly Positive Influence
Technology and digital tools are available for businesses to improve operations	3.38	0.65	Strongly Agree	Highly Positive Influence
Overall Mean	**3.28**	**0.69**	**Strongly Agree**	**Highly Positive Influence**

While government programs and incentives for local businesses (mean = 3.17) are acknowledged, the slightly lower mean here suggests that respondents feel there is room for improvement in the scope and accessibility of these programs. Strengthening these government initiatives could help provide more targeted support for businesses, especially small and medium enterprises (SMEs), which are key to fostering local economic development.

Table 11
The Respondents' Assessment of the Community's Livelihood in Terms of Social Well-being

Items	Mean	SD	Description	Interpretation
Community members can access basic social services (e.g., healthcare, education)	3.35	0.59	Strongly Agree	Highly Positive Influence
The local government prioritizes programs for community well-being	3.36	0.64	Strongly Agree	Highly Positive Influence
There are opportunities for cultural and recreational activities in the community	3.38	0.64	Strongly Agree	Highly Positive Influence
Community members feel safe and secure in their neighborhoods	3.23	0.65	Agree	Positive Influence
Programs for marginalized groups are actively implemented in the community	3.30	0.66	Strongly Agree	Highly Positive Influence
Overall Mean	**3.32**	**0.64**	**Strongly Agree**	**Highly Positive Influence**

Table 11 illustrates the community's strong positive assessment of social well-being, with an overall mean of 3.32 (Strongly Agree). Respondents strongly agree that livelihood programs contribute significantly to improving the quality of life in the community. The high scores for access to basic social services (mean = 3.35) and the prioritization of programs for community well-being (mean = 3.36) highlight the community's positive evaluation of healthcare, education, and other essential services provided by local government initiatives.

Furthermore, the opportunities for cultural and recreational activities (mean = 3.38) are seen as vital for personal well-being and community cohesion. These activities help foster social interaction, promote mental health, and contribute to community identity, which is critical for overall social development.

However, the item regarding community safety (mean = 3.23) received the lowest score, indicating that while most respondents feel safe, there are areas for improvement in ensuring the security of all neighborhoods. Addressing safety concerns, such as through community policing and improved infrastructure, is crucial for enhancing the sense of security and further promoting social well-being.

Table 12
The Summary of the Respondents' Assessment of the Community's Livelihood

Items	Mean	SD	Description	Interpretation
Economic Opportunities	3.29	0.66	Strongly Agree	Highly Positive Influence
Energy Access and Affordability	3.19	0.78	Agree	Positive Influence
Business Growth and Productivity	3.28	0.69	Strongly Agree	Highly Positive Influence
Social Well-being	3.32	0.64	Strongly Agree	Highly Positive Influence
Overall Mean	**3.27**	**0.69**	**Strongly Agree**	**Highly Positive Influence**

Table 12 provides a summary of the community's assessment of livelihood in terms of economic opportunities**,** energy access and affordability, business growth and productivity, and social well-being. With an overall mean of 3.27, respondents strongly agree that these livelihood programs positively influence their lives. The findings emphasize the effectiveness of community-driven initiatives in promoting economic development, improving energy access, enhancing business productivity, and fostering social well-being.

However, the assessment also highlights areas for improvement, particularly in increasing job opportunities, ensuring more equitable access to energy, strengthening government incentives for businesses, and addressing community safety concerns. By addressing these areas, community-driven livelihood programs can be further optimized to foster a more resilient, sustainable, and thriving community.

4. Is there a significant difference in the community's livelihood when grouped according to their profile?

Table 13 presents the results of the tests conducted to determine if there is a significant difference in community livelihood when grouped according to different demographic profiles. The analysis reveals that civil status is the only variable that shows a significant difference in the community's livelihood.

Civil Status. The t-test results show that civil status has a significant impact on community livelihood (t-value = 4.079, p-value = 0.019). This means that there is a significant difference in the livelihood outcomes between single and married individuals, with married individuals likely experiencing different or better economic opportunities and access to resources. The null hypothesis (Ho) is rejected in this case, indicating that marital status plays an important role in shaping livelihood outcomes. Married individuals often have more stable access to resources, including joint financial assets, social networks, and additional support systems, which can enhance their economic stability. This finding aligns with the work of Mangíra et al. (2019), who highlight that marital status can significantly influence the economic opportunities available to individuals, often favoring those who are married.

The availability of shared income, support from spouses, and greater social connectivity within marriage can create more favorable economic conditions.

Table 13
Test of Significant Difference in Community's Livelihood when Grouped According to their Profile

Test of Difference in t-test	Profile	Category	Mean	t-value	p-value	Decision on Ho	Remarks
Sex	Male		3.43	2.262	0.135	Failed to Reject	Not Significant
	Female		3.27				
Civil Status	Single		3.43	4.079	0.019	Reject	Significant
	Married		3.27				

Test of Difference in ANOVA	Profile	Category	Mean	F-value	p-value	Decision on Ho	Remarks
Age	18-22		3.42	2.089	0.085	Failed to Reject	Not Significant
	23-27		3.61				
	28-32		3.20				
	33-37		3.20				
	38 and older		3.29				
Education	Elementary		3.40	1.726	0.147	Failed to Reject	Not Significant
	High School		3.48				
	Undergraduate Degree		3.25				
	Master's Degree		3.09				
	Doctoral Degree		3.50				

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Sex, Age, and Education. In contrast, sex, age, and education showed no significant differences in community livelihood outcomes. The p-values for sex (0.135), age (0.085), and education (0.147) were all above the 0.05 significance threshold, leading to the failure to reject the null hypothesis (Ho). This suggests that these demographic factors do not significantly affect the community's livelihood in this particular context. While factors like sex, age, and education can impact livelihood outcomes in other

studies or settings, these particular findings suggest that, within this community, they do not have a strong influence. The lack of significance may be due to other overriding factors, such as economic policies, resource accessibility, or community-based programs, that could be providing a more equal footing for different demographic groups.

Civil Status. The significant difference observed with civil status underscores the need for targeted interventions based on marital status. The data suggests that married individuals may benefit more from existing livelihood programs due to increased access to resources and networks that come with marriage. On the other hand, single individuals, including those who are divorced, separated, or widowed, might face unique challenges in accessing resources and opportunities due to the absence of these supportive structures. This finding aligns with Kapelle et al. (2022), who note that unmarried individuals often face barriers related to economic security and access to social support systems. Programs aimed at enhancing economic opportunities for single or unmarried individuals, such as access to family support services, job placement programs, or financial assistance, could help mitigate these challenges and promote more equitable livelihood outcomes.

Sex, Age, and Education. Despite common assumptions that factors such as sex, age, and education may significantly impact livelihoods, the lack of a significant difference in this case suggests that other factors might be more influential in shaping livelihood outcomes. For instance, access to infrastructure, local government support, and community engagement programs could be leveling the playing field for individuals of different sex, age, and educational backgrounds. Yussuf and Mohamed (2022) argue that demographic factors can influence livelihood outcomes in different settings, but this study suggests that these factors may not be as pronounced within the specific context of this community. Future studies could explore other potential influences, such as the availability of resources, policies on equality, and community cohesion, which may explain the lack of impact from these demographic variables.

The results of this study indicate that while marital status is a significant factor in shaping livelihood outcomes, other demographic variables such as sex, age, and education may not play as pivotal a role in this specific context. These findings suggest that factors beyond basic demographic variables, such as local policies, economic opportunities, and access to community programs, may have a stronger impact on community livelihood.

Abeje et al. (2019) argue that while demographic factors do have an influence in different contexts, the structure of community support systems and availability of resources may mitigate the importance of sex, age, and education in shaping livelihood outcomes. This suggests that a more nuanced approach is needed when designing community development programs, ensuring they address the specific needs of diverse groups while considering the broader social, economic, and policy environments.

5. Does renewable energy adoption influence the community's livelihood?

Model 1: The Influence of Renewable Energy Adoption Variables on Community Livelihood

The first model in Table 16 investigates the relationship between various aspects of renewable energy adoption and community livelihood. The results show that community involvement adoption is the strongest predictor of community livelihood, with a significant t-value of 5.533 and a p-value of 0.000. The unstandardized coefficient of 0.349 indicates that for each unit increase in community involvement adoption, community livelihood increases by 0.349 units. This suggests a direct and positive relationship between community engagement in renewable energy programs and the improvement in overall livelihood outcomes. This aligns with Nochi and Bhuyan (2020), who argue that greater community participation leads to improved well-being and sustainable development.

Table 14
Linear Regression Analysis of Renewable Energy Adoption and the Community's Livelihood

Model 1

Predictors	Unstandardized Coefficients	Stand. Coeff. β	t-value (p-value)	Interpretation
(Constant)	1.210		6.861 (0.000)	
X1: Type of Renewable Energy Source	0.074	0.067	1.100 (0.273)	Not Significant
X2: Level of Implementation	0.127	0.078	1.622 (0.107)	Not Significant
X3: Accessibility	0.111	0.066	1.674 (0.096)	Not Significant
X4: Community Involvement Adoption	0.349	0.458	5.533 (0.000)	Significant
Adjusted R^2			**0.531**	
ANOVA for Regression			**F = 43.197, p < 0.000**	

This model clearly emphasizes the importance of community involvement in renewable energy initiatives, suggesting that fostering greater participation and engagement within the community can lead to significant improvements in livelihood outcomes. This highlights the critical role that active community participation plays in promoting economic and social well-being.

On the other hand, type of renewable energy source, level of implementation, and accessibility showed no significant impact on community livelihood, as indicated by their p-values of 0.273, 0.107, and 0.096 respectively. This means that these aspects of renewable energy adoption, while potentially beneficial, do not have a statistically significant relationship with livelihood outcomes in this case.

Model 2: The Influence of Renewable Energy Adoption on Community Livelihood

The second model examines the overall effect of renewable energy adoption on community livelihood. The results show a strong positive and significant relationship, with a t-value of 12.223 and a p-value of 0.000. The unstandardized coefficient of 0.603 suggests that for each unit increase in renewable energy adoption, community livelihood increases by 0.603 units. This strong relationship underscores the critical role of renewable energy adoption in improving livelihood outcomes. The standardized coefficient (β=0.709\beta = 0.709β=0.709) further suggests that renewable energy adoption is a highly significant predictor of community livelihood.

Model 2

Predictors	Unstandardized Coefficients	Stand. Coeff. β	t-value (p-value)	Interpretation
(Constant)	1.361		8.310 (0.000)	
X1: Renewable Energy Adoption	0.603	0.709	12.223 (0.000)	Significant
Adjusted R^2			**0.499**	
ANOVA for Regression			**F = 149.391, p < 0.000**	

The Adjusted R^2 value of 0.499 indicates that renewable energy adoption explains approximately 50% of the variance in community livelihood. This highlights that renewable energy is a substantial factor in influencing livelihood outcomes. However, it also suggests that nearly 50% of the variation is attributed to other factors not captured in this model.

The ANOVA results ($F = 149.391$, $p < 0.000$) further validate the model, indicating that renewable energy adoption is a statistically significant predictor of community livelihood. The high F-value confirms that the model is reliable, and the low p-value suggests that the relationship between renewable energy adoption and community livelihood is unlikely to have occurred by chance.

The analysis confirms that community involvement adoption and renewable energy adoption both play significant roles in shaping community livelihoods. Specifically, community involvement was the most significant factor in the first model, suggesting that engaging community members in renewable energy programs leads to direct improvements in their livelihoods. This result aligns with studies such as those by Nochi and Bhuyan (2020), who highlight the role of community-driven initiatives in fostering sustainable development.

In Model 2, renewable energy adoption emerged as a significant predictor, emphasizing its crucial role in enhancing community livelihood. This finding reinforces previous research, such as that by Aboul-Atta & Rashed (2021), who argue that renewable energy adoption directly improves economic conditions by providing reliable, affordable, and sustainable energy sources. Moreover, Wang and Wang (2020) have shown that renewable energy not only addresses energy needs but also drives economic growth and environmental sustainability.

Although community involvement was the strongest predictor in Model 1, renewable energy adoption in Model 2 also showed a strong impact, accounting for nearly 50% of the variance in community livelihood. This underscores the importance of integrating renewable energy adoption with community development strategies, as the benefits of sustainable energy solutions are amplified when communities are actively engaged in their implementation.

5. What enhancement plan can be recommended to improve the community's livelihood and the environment?

Renewable energy adoption has been shown to have a positive impact on the community’s livelihood, particularly in terms of accessibility, affordability, and the availability of energy in underserved areas. To further this, the expansion of renewable energy projects should be prioritized, especially in remote areas where energy access is still limited. Moreover, it is essential to improve energy infrastructure, ensuring that the energy systems are reliable and can meet the growing needs of the community. Alongside infrastructure development, community education programs focused on renewable energy usage should be implemented. These programs would help increase awareness and understanding of renewable energy, empowering individuals to use these resources effectively and responsibly.

While community livelihood initiatives have contributed to economic growth, gaps in sufficient job opportunities remain. To address these gaps, targeted job creation programs are crucial. These programs could be designed to cater to the specific skills and needs of the local population, potentially focusing on industries such as renewable energy, technology, and agriculture. Furthermore, skills development initiatives should be expanded to ensure the local workforce is prepared for the evolving job market. Providing access to vocational training and educational resources can increase employability, especially for youth and underemployed individuals. By targeting these areas, the community can ensure that economic growth is inclusive and benefits all members.

While the availability of reliable and affordable energy has positively impacted livelihoods, there is still room for improvement, particularly in assisting low-income households. To make energy access more equitable, the community can increase subsidies and provide targeted programs that assist those who are financially struggling to pay for energy. These programs could include subsidized energy rates or direct financial assistance for households in need, ensuring that the benefits of renewable energy adoption are extended to all members of the community, particularly the most vulnerable.

Table 15
Enhancement Plans that can be recommended to Improve the Community's Livelihood and Environment

Category	Findings	Recommendations
Renewable Energy Adoption	Renewable energy adoption has a positive influence, particularly in terms of accessibility, affordability, and availability in underserved areas.	Expand renewable energy projects, improve infrastructure, and offer community education on renewable energy usage.
Economic Opportunities	Community livelihood fosters economic growth but highlights gaps in sufficient job opportunities.	Develop targeted job creation programs and expand skill development initiatives to address employment gaps.
Energy Access and Affordability	Reliable and affordable energy positively impacts livelihoods, though assistance for low-income households requires enhancement.	Increase support for low-income households through subsidies and targeted energy access programs.
Business Growth and Productivity	Business growth is supported by access to technology and digital tools, though government incentives for local businesses are perceived as limited.	Enhance government support and incentives for local businesses and promote access to innovative business technologies.
Social Well-Being	Social well-being is positively influenced by opportunities for cultural and recreational activities, but further emphasis on community engagement is needed.	Invest in cultural and recreational programs and strengthen community engagement in livelihood initiatives.
Safety and Security	Safety and security in neighborhoods are generally perceived positively, but specific concerns remain, such as enhanced policing and community cohesion.	Implement neighborhood safety measures, improve community-policing programs, and foster collective efficacy.

Local businesses have benefited from access to technology and digital tools, but there is still room for improvement in government support and incentives for local businesses. To further encourage business growth, the government should enhance financial and technical support for local entrepreneurs, especially small and medium enterprises (SMEs). This support could take the form of grants, low-interest loans, or tax incentives. Additionally, businesses should be provided with access to advanced business technologies that improve productivity, streamline operations, and increase market competitiveness. Public-private partnerships could play a key role in providing access to these resources, fostering innovation, and enhancing business sustainability in the community.

The community's social well-being has been positively influenced by the availability of cultural and recreational activities. However, further emphasis is needed on community engagement and creating opportunities for collective participation. To address this, investments in cultural and recreational programs should be prioritized. These activities not only contribute to physical and mental well-being but also promote social cohesion and a sense of community. In addition, community engagement in livelihood initiatives should be encouraged, ensuring that all members have a stake in the development process. This could be achieved through community forums, participatory workshops, and inclusive planning processes where everyone's input is valued.

While the general perception of safety and security in the community is positive, some concerns still remain. These concerns may stem from factors such as limited police presence or insufficient community cohesion. To address these issues, neighborhood safety measures should be implemented. These could include the installation of streetlights, neighborhood watch programs, and improved police patrols. Additionally, fostering community cohesion through social programs and community-building activities can help strengthen neighborhood ties and create a safer environment. Community-

policing programs can further build trust between law enforcement and residents, ensuring that safety concerns are addressed collaboratively.

CONCLUSION

Based on the study's findings, it can be concluded that adopting renewable energy significantly contributes to sustainable growth and positively impacts community livelihoods in Barangay North Poblacion, Maramag, Bukidnon. The results indicate that community involvement in renewable energy adoption is critical in enhancing economic opportunities, business growth, energy access, and social well-being. With renewable energy adoption explaining 49.9% of the variance in community livelihood and being validated as a statistically significant predictor through ANOVA, the study underscores the transformative potential of renewable energy for community development.

These findings align with the Diffusion of Innovations Theory, which posits that adopting new technologies and practices spreads through social systems over time, with community involvement playing a pivotal role in this process. The strong influence of community involvement observed in the study confirms the importance of engaging stakeholders and fostering participatory approaches to accelerate the diffusion of renewable energy innovations.

Similarly, the findings support the Sustainability Transition Theory, which emphasizes the shift from conventional, unsustainable practices to more sustainable systems through technological, social, and institutional changes. The study demonstrates how renewable energy adoption facilitates this transition by improving livelihoods and promoting sustainable growth within the community. The significant contributions of renewable energy adoption to economic and social dimensions of community well-being validate the theory's assertion that transitions require systemic changes that integrate environmental sustainability with social and economic progress.

Recommendations

Based on the findings and conclusions of the study, the following recommendations may be considered for various stakeholders:

1. **Local Government Units (LGUs)**. LGUs may explore opportunities to strengthen partnerships with renewable energy providers to expand access to sustainable energy solutions. They might implement community-focused programs to encourage active participation in renewable energy projects and ensure equitable distribution of benefits. Additionally, they may consider allocating resources for awareness campaigns to educate residents on renewable energy adoption's economic and environmental advantages.
2. **Policy Makers and Legislators**. Policymakers and legislators might review existing policies to identify areas for improvement in promoting renewable energy adoption. They may enact laws incentivizing community involvement in renewable energy initiatives and provide tax benefits or subsidies to companies prioritizing community engagement. Furthermore, they might facilitate the integration of renewable energy technologies in rural and underserved areas to address disparities in energy access.
3. **Non-Governmental Organizations (NGOs)**. NGOs may consider supporting renewable energy projects by providing technical assistance, funding, and capacity-building programs for communities. They might also advocate for policies that prioritize sustainability and community empowerment while fostering collaborations between stakeholders to ensure the success of renewable energy initiatives.
4. **Community Leaders and Residents**. Community leaders may take a proactive role in promoting

renewable energy adoption by serving as advocates and facilitators of community engagement. They might organize dialogues, focus group discussions, and training programs to enhance residents' understanding of the benefits and implementation of renewable energy projects. Residents may actively participate in such initiatives to ensure their perspectives and needs are addressed.

5. **Renewable Energy Companies**. Renewable energy companies may invest in projects that prioritize accessibility, affordability, and community involvement. They might establish partnerships with local stakeholders to create tailored solutions that address specific community needs. Furthermore, companies may consider providing training opportunities for residents, enabling them to develop skills relevant to renewable energy technologies.
6. **Educational Institutions and Researchers**. Educational institutions may integrate renewable energy concepts into their curricula to raise awareness and build knowledge among students. Researchers might explore innovative solutions to improve renewable energy technologies and their implementation at the community level. Collaborative studies involving academic institutions, LGUs, and NGOs might also be encouraged to assess the long-term impacts of renewable energy on sustainable growth.
7. **Future Generations**. Future generations might embrace the principles of sustainability by advocating for the continued adoption and improvement of renewable energy technologies. They may contribute to the preservation of the environment by practicing responsible energy consumption and engaging in initiatives that promote clean and sustainable energy practices.

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