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FOREST COVER CHANGE AND DEFORESTATION RATES OF ZUMIGUI- ZIWANAN RIVER WATERSHED: BASIS FOR STRENGTHENING MANAGEMENT

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Abstract

The Zumigui–Ziwanan River Watershed is a vital ecological system supporting water resources, soil stability, biodiversity, and climate resilience in the provinces of Apayao and Cagayan, particularly within the municipalities of Luna and Calanasan. A mixed-methods approach was employed using ArcGIS-based analysis of land cover maps and satellite imagery for 2015, 2020, and 2025, complemented by interviews with 48 beneficiaries of the National Greening Program and 10 key stakeholders from DENR, local government units, barangays, and people's organizations. Furthermore, Analysis of land cover maps from the National Mapping and Resource Information Authority revealed a 19.28% increase in closed forest areas and a 7.39% decrease in open forest areas from 2015 to 2025, indicating gradual forest recovery. Annual deforestation rates from 2020 to 2025 were relatively low at 0.210% for closed forests and 0.195% for open forests. Despite the availability of spatial datasets, limited watershed-level studies have integrated forest cover dynamics, drivers of deforestation, stakeholder perceptions, and the effectiveness of reforestation interventions. Overall, results revealed that forest recovery was evident; however, deforestation pressures driven by poverty, agricultural expansion, and natural disasters such as typhoons continue to threaten sustainability. Reforestation initiatives were perceived as moderately effective but constrained by insufficient funding, weak maintenance, and limited community participation. Strengthened law enforcement, sustainable livelihood programs, climate-resilient strategies, and continuous watershed monitoring are recommended to ensure long-term forest conservation and sustainable watershed management.

Keywords: Forest Cover Change, Deforestation Rates, Watershed

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Introduction

Watersheds play a critical role in safeguarding ecosystem services against climate change and extreme weather events. They are composed of interconnected ecosystems extending from upland to lowland areas that support diverse forms of flora and fauna (Rodeo et al., 2019). Thus, watersheds are highly susceptible and vulnerable to human-induced risks, which can significantly affect surrounding communities by impacting soil health, plant health, and animal health. Watershed areas largely depend on forest integrity because forests regulate streamflow, enhance groundwater recharge, prevent soil erosion, reduce sedimentation, and maintain water quality (Ajzen, 1991; Department of Environment and Natural Resources–CENRO Calanasan, 2022). Furthermore, watershed degradation poses serious threats to ecological stability, food security, disaster risk reduction, and sustainable development (Fauzi et al., 2019; Department of Environment and Natural Resources–CENRO Calanasan, 2022).

In the Philippines, forest management is primarily overseen by the Department of Environment and Natural Resources (DENR) through conservation programs, watershed protection activities, and reforestation initiatives such as the implementation of the National Greening Program and other watershed rehabilitation efforts. Despite these initiatives, forest degradation remains a pressing concern in upland and watershed areas, particularly in ecologically sensitive provinces (Myers, 2023; Silva Junior et al., 2021).

The Zumigui–Ziwanan River Watershed, covering approximately 79,600.43 hectares and located mainly in the municipalities of Luna and Calanasan, Apayao, is a vital ecological system that supports water supply, soil stability, and biodiversity. The watershed is currently managed by the DENR–Community Environment and Natural Resources Office Calanasan (DENR–CENRO Calanasan) (Department of Environment and Natural Resources–CENRO Calanasan, 2022).

Forest cover within the watershed showed slight fluctuations over the decade according to the National Mapping and Resource Information Authority (NAMRIA) Land Cover Maps. The combined area of closed and open forest was approximately 61,411.73 hectares (77.15% of the total watershed area) in 2015, which increased to 61,622.26 hectares (77.41%) in 2020 and slightly declined to 61,572.22 hectares (77.36%) in 2025 (National Mapping and Resource Information Authority [NAMRIA], 2015–2025).

Forest cover change refers to measurable alterations in the extent and condition of forested areas over time, including forest loss through deforestation and forest gain through reforestation or natural regeneration (Fuller et al., 2019). Meanwhile, deforestation rate pertains to the proportion of forest area permanently converted into non-forest land uses



within a specified period (Myers, 2023). Despite the availability of national and local datasets, there remains a lack of integrated watershed-level analysis combining spatial information and stakeholder perceptions within the Zumigui–Ziwanan River Watershed. Consequently, the key factors influencing forest cover changes, stakeholder perceptions, and the effectiveness of reforestation and watershed management interventions remain insufficiently understood.

Anchored on these identified gaps, the present study entitled Forest Cover Change and Deforestation Rates of Zumigui–Ziwanan River Watershed: Basis for Strengthening Management adopts a mixed-methods approach to comprehensively examine the condition of the watershed. Specifically, the study aims to analyze forest cover dynamics from 2015 to 2025, compute deforestation rates, identify the local drivers of forest cover change, examine beneficiary perceptions and conservation behaviors, and provide evidence-based recommendations for strengthening watershed management and improving forest governance (Appiah et al., 2021; Belayneh et al., 2020).

Statement of the Problem

The Zumigui–Ziwanan River Watershed, has experienced notable fluctuations in forest cover, raising concerns regarding watershed integrity, biodiversity conservation, climate resilience, and the sustainability of local livelihoods. Despite reforestation and forest protection initiatives, site-specific empirical assessments of forest cover change, deforestation rates, and management effectiveness remain limited.

This study seeks to address the following questions:

1. What is the extent of forest cover change within the Zumigui–Ziwanan River Watershed over the past decade (2015–2025)?
2. What is the computed deforestation rate within the watershed from 2020–2025?
3. What are the drivers of forest cover change and deforestation within the watershed?
4. How do beneficiaries perceive the effectiveness of reforestation projects in mitigating deforestation and promoting sustainable resource management?
5. To what degree have reforestation initiatives influenced the attitudes and behaviors of beneficiaries toward forest conservation in the Zumigui–Ziwanan River Watershed under the management jurisdiction of DENR-CENRO Calanasan?



Methodology

The researcher employed a mixed-method research design, integrating both quantitative and qualitative approaches to provide a comprehensive assessment of forest cover change, deforestation rates, and stakeholders perspectives within Zumigui-Ziwanan River Watershed covering the municipalities of Luna, Calanasan, small portions of Pudtol and Kabugao and part of Cagayan.

The quantitative component of the study adopts a descriptive research design aimed at systematically collecting and analyzing numerical data. Secondary data derived from Geographic Information Systems (GIS), land cover maps, and satellite imagery were utilized to quantify forest cover changes and compute deforestation rates within the defined assessment period (National Mapping and Resource Information Authority [NAMRIA], 2015–2025; Belayneh et al., 2020; De Lombaerde et al., 2022; Heilmayr et al., 2020). Statistical techniques were further applied to determine the trends, magnitude, and rate of forest cover change within the watershed.

Primary quantitative data was gathered through structured Likert-scale surveys administered to forty-eight (48) beneficiaries of reforestation projects (National Greening Program). The survey instrument measured attitudes, subjective norms, perceived behavioral control, and behavioral intentions toward forest conservation. This enables objective measurement of beneficiary perceptions and conservation-related behaviors.

The qualitative component complements the quantitative findings through Key Informant Interviews (KII) with personnel from DENR-CENRO Calanasan, PENRO Apayao staff, and other relevant stakeholders, including the review of related secondary documents (Soe & Yeo-Chang, 2019; Sinthumule & Mashau, 2020; Talukdar & Gupta, 2018). This approach provides contextual explanations regarding the forest cover change, drivers of deforestation, management responses, and stakeholder experiences that may not be fully captured through quantitative analysis alone.

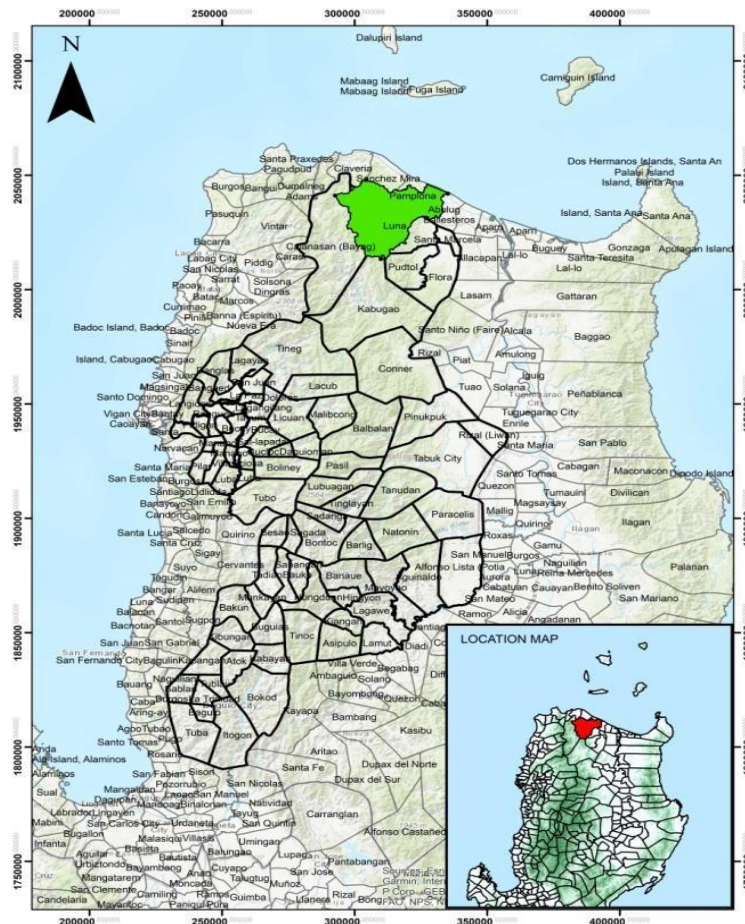


Figure 2: Location map of the Zumigui-Ziwanan River Watershed and Study Area
(Source: NAMRIA)

Results and Discussion

Extent of Forest Cover Change from 2015-2025 within Zumigui-Ziwanan River Watershed

Evaluating the land cover dynamics of Zumigui-Ziwanan River watershed from 2015-2025 shows that closed and open forests are the predominant land cover in the area. However, these forests are under increasing pressure primarily from anthropogenic influences including their main livelihood, which is Agriculture.



As shown in Table 2, the percentage of forest cover changes from 2015-2025. In an open forest land cover classification, there is -4.96% decrease in open forest from 2015-2020 and a decrease of -2.56% from 2020-2025 and with a continuous decrease of open forest cover from 2015-2025 of -7.39% respectively. The open forest refers to the discontinuous canopy of 10-40% coverage allowing more sunlight to penetrate. Thus, the decrease of open forest is a positive indication that the Zumigui-Ziwanan river watershed is naturally healing itself from anthropogenic and calamities factor. Meanwhile, a significant increase of Closed Forest cover from 2015-2025 with a 19.28% implying the decreasing land cover of the open forest. The annual crops increase their land cover from 2015-2025 with 11.05% while land cover for brush/shrubs decrease with a maximum of -16.58% after 10 years. The presence of fishpond from 2015 was already swept from 2020-2025 primarily cause by natural calamities. The grasslands become notable in the area as 80.48 % increase from 2015-2025 while inland water decrease in -22.42%. Fortunately, Mangrove Forest increases from 2015-2025 with a 1.72% on which aquatic lifeforms sustain its life with the presence of the mangrove forest. Mangroves are crucial in supporting biodiversity and mitigating climate change by absorbing carbon dioxide and storing carbon stocks in both below-and above-ground biomass and sediments. (Rahman et al., 2026). However, there is a massive increase of open/barren lands along the watershed accumulating 98.55% from 2025-2025 and a slightly decrease of land covers for perennial crops of -1.20%. Thus, a total decrease of land covers for built-up area with -4.00%, this refers to the land surface occupied by human-made infrastructure, such as residential buildings, commercial sites, parking lots, roads and other impervious surfaces.

Table 2: Forest cover change within Zumigui-Ziwanan river watershed (2015-2025)

Land Cover class	Area (ha)			Forest Cover Change between period (%)		
	2015	2020	2025	2015-2020	2020-2025	2015-2025
Open Forest	43,772.22	41600.575	40537.029	-4.96	-2.56	-7.39
Closed Forest	17,639.51	20021.692	21041.193	13.50	5.09	19.28
Annual Crop	7,593.25	7991.267	8432.291	5.24	5.52	11.05
Brush/shrubs	6,554.11	6099.399	5467.672	-6.94	-10.36	-16.58
Fishpond	16.27	0.000		-100.00		-100.00
Grassland	231.51	318.922	417.827	37.76	31.01	80.48
Inland Water	1,279.80	1062.969	992.822	-16.94	-6.60	-22.42
Mangrove Forest	1,144.02	1161.032	1163.724	1.49	0.23	1.72
Open/Barren	207.79	229.996	412.569	10.69	79.38	98.55
Perrenial Crop	733.72	725.256	724.942	-1.15	-0.04	-1.20
Built Up	428.25	389.32	411.121	-9.09	5.60	-4.00

Source: NAMRIA



Land Cover Map of Zumigui-Ziwanan River Watershed Maps (2015-2025)

Source: DENR, DEM, NAMRIA

Figure 2: 2015 Land cover map

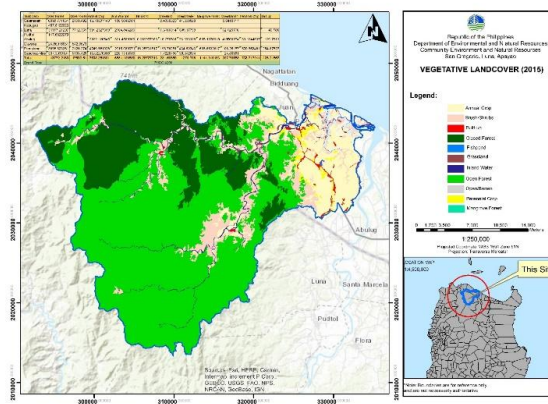


Figure 3: 2020 Land cover map

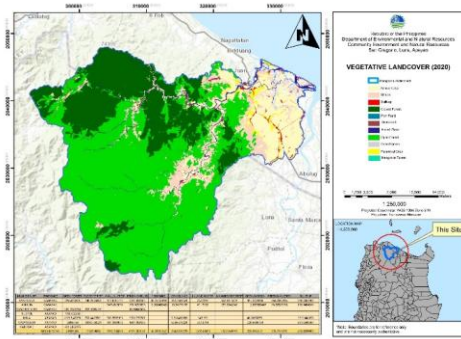
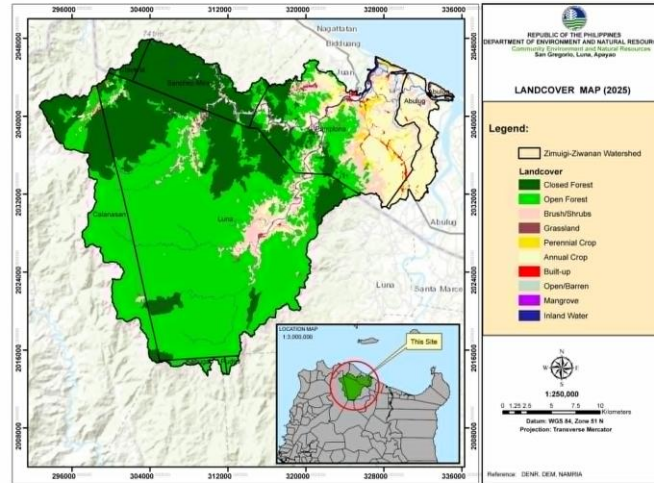




Figure 4: 2025 Land cover map



Awareness of Forest Cover Change (2015-2025)

Survey results from 48 reforestation beneficiaries showed that most respondents perceived stable or slightly increasing forest cover from 2015–2025, indicating that efforts of national agencies, LGUs, and NGOs contributed to watershed protection and sustainability. However, some respondents observed slight forest decline. Overall, the findings suggest generally stable forest cover, further supported by the recognition of Apayao as the 4th Biosphere Reserve in the Philippines.

Table 3: Awareness of forest cover change (2015-2025)

Awareness of Forest Cover Change (2015-2025)	N=48	Percentage
Significant Decrease (1)	1	2.08%
Slight Decrease (2)	14	29.17%
No Noticeable Change (3)	16	33.33%
Slight Increase (4)	16	33.33%
Significant Increase (5)	0	0.00%
If no: Specify the reason	0	0.00%

Deforestation Rate



Analyzing the deforestation rate of the Zumigui-Ziwanan river watershed from year 2015-2025 confront the anthropogenic activities in the area in the past 10 years. However, the data showed that a 0.19% rate of annual deforestation for open forest from 2015-2020, while a 0.195% rate for 2020-2025 and only a 0.185% rate from 2015-2025. Furthermore, the closed forest land cover reveals annual deforestation rate of 0.23% from 2015-2020 and 0.21% from 2020-2025 and with only a 0.24% annual deforestation rate from 2015-2025. The slow annual deforestation rate in the Zumigui-Ziwanan river watershed indicates the effectiveness of the different projects and programs for reforestation implemented by the DENR, CENRO, PENRO, MENRO and LGUs of the eight (8) municipalities that are directly beneficiary of the natural resources of the watershed. Communities along the watershed should be more in depth on their involvement in the conservation and protection of the watershed for future generations.

Table 4: Deforestation rate within Zumigui-Ziwanan river watershed (2015-2025)

Land Cover class	Area (ha)			Deforestation Rate (%)		
	2015	2020	2025	2015-2020	2020-2025	2015-2025
Open Forest	43,772.22	41600.575	40537.029	0.190	0.195	0.185
Closed Forest	17,639.51	20021.692	21041.193	0.227	0.210	0.239
Annual Crop	7,593.25	7991.267	8432.291	0.210	0.211	0.222
Brush/shrubs	6,554.11	6099.399	5467.672	0.186	0.179	0.167
Fishpond	16.27	0.000		0.000		0.000
Grassland	231.51	318.922	417.827	0.276	0.262	0.361
Inland Water	1,279.80	1062.969	992.822	0.166	0.187	0.155
Mangrove Forest	1,144.02	1161.032	1163.724	0.203	0.200	0.203
Open/Barren	207.79	229.996	412.569	0.221	0.359	0.397
Perennial Crop	733.72	725.256	724.942	0.198	0.200	0.198
Built Up	428.25	389.32	411.121	0.182	0.211	0.192

Source: NAMRIA

Results and Discussion in the Survey of Reforestation Beneficiaries

Reforestation goals of the Zumigui-Ziwanan River Watershed become evident with these ever supportive forty-eight (48) beneficiaries of reforestation program through the National Greening Program of the Department of Environment and Natural Resources Calanasan (DENR-CENRO Calanasan). With the total of 91.67% male, NGP program had been realized. Majority of the beneficiaries are male as they are primarily responsible for providing for their families, while most of their spouses were housewives. Most of them have an average age group of 46-60 years old and majority were Ilocano by ethnicity. Moreover, in terms of their educational attainment, Elementary level with 70.83% becomes dominated as beneficiaries as far as sometimes this group has limited access to white- and blue-collar jobs.



Table 5: Demographic profile of respondents

Demographic profile	n=48	Frequency	Percentage
Gender	Male	44	91.67%
	Female	4	8.33%
Age Group	18-30	3	6.25%
	31-45	11	22.92%
	46-60	22	45.83%
	61 and above	10	20.83%
	Aeta	10	20.83%
Ethnicity	Ilokano	23	47.92%
	Isnag	15	31.25%
Educational Attainment	Elementary	34	70.83%
	High School	10	20.83%
Reforestation Project Beneficiary	Yes	48	100.00%

Drivers of Forest Cover Change and Deforestation

Population pressures are one of the drivers in forest cover degradation these pressures mark significant effects on the land cover of the watershed. Poverty, identified by 47.92% of respondents, was a major driver of forest cover loss, as communities rely on livelihood and agricultural expansion for survival. This indicates that people along the watershed dependently survive through the resources provided by the watershed and its forest biodiversity richness. These impacts can be mitigated through government interventions such as livelihood and ecotourism programs, and community-based conservation initiatives with incentives. Furthermore, natural calamities contributed 68.75% as major driver in forest cover loss. This is aligned with the pronouncement of PAGASA (2024) that an average of 20 tropical cyclones enter the Philippines each year, with about 8 to 9 making landfall in the Philippines and 1 to 3 becoming super typhoons annually. Super typhoons significantly impact forest ecosystems, making rehabilitation and intervention essential. As natural disasters are a recurring challenge in the Philippines, conserving the Zumigui-Ziwanan River Watershed is crucial to protecting the livelihoods of the eight municipalities it serves.

Table 6: Observed activities that contributed to forest cover loss



Observed activities that contributed to forest cover loss	No response	Not a driver	Minor driver	Moderate driver	Major driver	Very major driver
Illegal logging/Timber Poaching	0.00%	2.08%	14.58%	52.08%	29.17%	2.08%
Kaingin	2.08%	0.00%	16.67%	41.67%	37.50%	2.08%
Road Construction/Infrastructure	4.17%	14.58%	70.83%	10.42%	0.00%	0.00%
Agricultural Expansion	0.00%	2.08%	8.33%	39.58%	47.92%	0.00%
Natural Calamities	0.00%	0.00%	8.33%	12.50%	68.75%	10.42%
Weak Law Enforcement	14.58%	0.00%	12.50%	52.08%	18.75%	0.00%
Poverty	0.00%	0.00%	4.17%	8.33%	39.58%	47.92%
Fuel wood	91.67%	0.00%	8.33%	0.00%	0.00%	0.00%

Primary Causes of Forest Degradation

The primary causes of forest degradation massively contributed by natural calamities and poverty as shown in the table accumulating 60.76%. These factors need to be addressed as far as sustainability of Zumigui-Ziwanan River watershed is concerned. Moreover, the 16.46% contribution of the Kaingin system of the community along the river watershed would significantly affect the forest covers and its natural resources, the biodiversity would be threatened and habitat would be compromised. The recorded 12.66% timber poaching also affects the watershed; thus, strict law enforcement must be prioritized in the area. The agencies concerned in the eight (8) municipalities should strengthened collaboration to mitigate these anthropogenic factors.

Table 7: Primary causes of forest degradation

Primary Causes of Forest Degradation	n=48	Percentage
Agricultural expansion	4	5.06%



Calamities	24	30.38%
Excessive use of herbicide or insecticide	1	1.27%
Fuelwood gathering	3	3.80%
Kaingin System	13	16.46%
Poverty	24	30.38%
Timber poaching	10	12.66%

Perceived Effectiveness of Reforestation Projects in Mitigating Deforestation and Promoting Sustainable Resource Management

Projects and Programs initiated by concerned agencies like Department of Environment and Natural Resources (DENR), PENRO, CENRO, MENRO and other Non-Government Agencies (NGOs) were included in this assessment particularly at the Zumigui-Ziwanan river watershed. The respondents revealed that awareness of reforestation initiatives to mitigate deforestation have slightly effective with 39.58% as viewed by the respondents. This indicated that projects and programs of the agencies to conserve, protect and sustain the area are not yet visible to the communities or not aware of the sole purpose of the reforestation initiatives. Awareness of the people and communities is still limited and so Information, Education, Communication (IEC) should be prioritized by the eight (8) municipalities as part of their annual programs. On the other perspective, 22.92% responded effectively to the reforestation initiatives on which 16.66% differences of those believing not effective and slightly effective. Overall, awareness of the communities in efficiency and effectiveness of the reforestation initiatives are also a driver factors in forest degradation as communities have limited access to information and natural conservation.

Table 8: Perceived effectiveness of reforestation initiatives

Awareness of Reforestation initiatives in Mitigating Deforestation (2015-2025)		
Perceived Overall Effectiveness of Reforestation Initiatives	n= 48	Percentage
Not effective	10	20.83%
Slightly Effective	19	39.58%
Moderately Effective	7	14.58%



Effective	11	22.92%
Very Effective	1	2.08%

These findings supported by a total of 39.25% anthropogenic factors like timber poaching, Kaingin system, agricultural expansion, fuelwood gathering and excessive use of pesticides contributed to forest degradation (see table 5)

Challenges in Reforestation Initiatives

Determinants of successful reforestation initiatives lie in the support of the implementing agency. This factor apparently challenges some projects and programs implemented due to limited access to funding. This dilemma already showed on this table the lack of funding on which portrayed by 37.01%. Sustainability of the projects lies in the funding support, especially for the operational and management costs that eventually were shouldered by the beneficiaries. These common problems revealed by poor maintenance of 32.28% as major challenges in successful reforestation. Accordingly, the study of Fernandez Jr and Bande (2019) identified three (3) kinds of challenges from their reforestation adopters that include challenges brought about by humans, challenges of financing and sustaining the project and challenges brought about by the natural environment. The adopters manifested that such challenges could be overcome if there is a will to succeed. Furthermore, successful reforestation achieved its intended end of promoting conservation, and sustainable development, addressing Sustainable development Goals 13 on climate action and SDG 15 of Life on Land

Table 9: Major obstacles to successful reforestation

Major Obstacles to Successful Reforestation	n=48	Percentage
Lack of funding	47	37.01%
Weak Law Enforcement	10	7.87%
Poor Maintenance	41	32.28%
Low Community Participation	3	2.36%
Natural Disasters	23	18.11%
Lack of Technical Knowledge	2	1.57%
Others: Specify	1	0.79%



Level of Agreement in Reforestation Projects

Reforestation has become the instrument of Environmental Education because of the learning by doing principle (Fernandez Jr., et al., 2021). The level of Agreement on reforestation projects agreed to Climate Change mitigation concluding 70.83%, this resolve of the communities aligned with the program of the Department of Environment and Natural Resources through the National Greening Program (NGP). As Climate change become the visible factors of the Zumigui-Ziwanan river watershed, communities believes that reforestation project would restore and sustain all life forms in the area. Moreover, respondents strongly agreed that reforestation projects can reduce deforestation and improved forest covers with a total of 25%. Additionally, community participation strengthens success agreed by 56.25%. This was supported by the study of Biedenweg et al., (2013) that inculcating reforestation to the hearts and consciousness of the family that they can do something for the welfare of the environment is a fulfillment that enables people to develop a sense of love, importance and concern for the natural environment.

Table 10: Level of agreement on reforestation projects

Level of agreement on reforestation projects	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Reduced Deforestation	0.00%	6.25%	12.50%	68.75%	12.50%
Improved Forest Cover	0.00%	6.25%	12.50%	68.75%	12.50%
Sustainable Livelihood	52.08%	41.67%	4.17%	2.08%	0.00%
Improved Biodiversity	0.00%	12.50%	18.75%	62.50%	4.17%
Proper Monitoring and Maintenance	2.08%	45.83%	22.92%	27.08%	2.08%
Community Participation Strengthens Success	0.00%	12.50%	20.83%	56.25%	8.33%
Climate Change Mitigation	0.00%	0.00%	6.25%	70.83%	20.83%

Correlation Analysis of Climate Change Mitigation and Improved Forest cover

The correlation analysis of the climate change mitigation in the level of agreement on reforestation projects has positive relationships with the improved forest cover. This indicates that while communities and government intervened in programs through reforestation projects, climate change is mitigated if forest cover is improved. On the other



hand, improved forest cover is directly related to the reduced deforestation as far as reforestation project is concerned. The success rate of these interventions measured on the efforts of the eight (8) municipalities to protect, conserve and sustain the Zumigui-Ziwanan river watershed (see table 10).

Table 11: Correlation analysis climate change mitigation and improved forest cover

	<i>Column 1</i>	<i>Column 2</i>	<i>Column 3</i>	<i>Column 4</i>	<i>Column 5</i>	<i>Column 6</i>	<i>Column 7</i>
Column 1	1						
Column 2	0.8710*	1					
Column 3	-0.2054	-0.2054	1				
Column 4	0.2928	0.2519	0.1033	1			
Column 5	-0.3267	-0.1976	0.1020	-0.0922	1		
Column 6	0.2418	0.1653	-0.3101	0.4365	-0.0520	1	
Column 7	-0.0591	0.0026	-0.0543	0.3226	0.1140	0.5020*	1

Degree of Behavioral influence on Reforestation Initiatives

Communities along the Zumigui-Ziwanan river watershed supported the reforestation initiatives with 64.58% encouraged others to protect forests while 60.42% would eventually practice sustainable land use, 58.33% participated in Tree planting and 47.92% will report illegal forest activities. This is great movement of the community to sustain the life of the watershed on which greatly appreciated, with the high percentage of anthropogenic factors (see table 4), these initiatives may conquer the dilemma of high forest degradation in the future. However, to sustain this initiative, regular monitoring and surveillance of the forestry advocates within the area of Zumigui-Ziwanan river watershed to prevent and control any illegal activities in the area. Watershed is the niche and habitat of different life forms from a different ecosystem; this is the veins of lifeforms from terrestrial and aquatic ecosystem. Thus, initiatives such as habitat reforestation, responsible land use, and the conservation and protection of different species of trees and shrubs, particularly native species, are key to maintaining a balanced and sustainable watershed (Villareal et al., 2025)



Table 12: Behavioral influence of reforestation initiatives

	Strongly Disagree	Disagree	Neutral	Agree	strongly Agree
Participate in Tree Planting	0.00%	2.08%	37.50%	58.33%	2.08%
Report Illegal Forest Activities	0.00%	12.50%	37.50%	47.92%	0.00%
Practice Sustainable Land Use	2.08%	4.17%	22.92%	60.42%	10.42%
Encouraged others to Protect Forest	0.00%	2.08%	25.00%	64.58%	8.33%

Correlation analysis of Behavioral Influence of Reforestation Initiatives

The positive relationship of the initiatives to encourage others to protect forests to practice sustainable land use is a testament of the integrity of the answer of the respondents in the willingness to restore and conserve the Zumigui-Ziwanan river watershed. As far as more individuals are encouraged to protect the forest, the successful rate of sustainable land use can be achieved for the long-term goal.

Table 13: Correlation analysis of behavioral influence of reforestation initiatives

	Participate in Tree Planting	Report Illegal Forest Activities	Practice Sustainable Land Use	Encouraged others to Protect Forest
Participate in Tree Planting	1			
Report Illegal Forest Activities	0.2604	1		
Practice Sustainable Land Use	0.2741	0.3247	1	
Encouraged others to Protect Forest	0.3027	0.3769	0.5784*	1



Willingness to Participate in Future Forest Conservation Initiatives

With the demand to protect, conserve and sustain the Zumigui-Ziwanan river watershed, communities definitely supported the future forest conservation initiatives with a response of 58.33% while 31.25% responded probably yes or not sure due to future activities. This data indicates that communities are also willing to learn, innovate and develop strategies in conserving their source of living. Sustainability should be inculcated in the families from the youngest to the oldest in the community on where there is a sustainable source of living and there will be sustainable social, environmental and economic opportunities. Government should also launch programs like scholarships to the community in exchange to the sustainability efforts of the Zumigui-Ziwanan river watersheds.

Table 14: Willingness to participate in future forest conservation initiatives

Willingness to Participate in Future Forest Conservation Initiatives	n=48	Percentage
Definitely Not	0	0.00%
Probably Not	2	4.17%
Unsure	3	6.25%
Probably Yes	15	31.25%
Definitely Yes	28	58.33%

Belief in Long-Term Benefits of Forest Conservation

The watershed is important ecologically because it sustains a variety of biodiversity and offers a habitat for a wide variety of flora and fauna, which helps to maintain the environmental sustainability of the area. The watershed is essential to the local economy and society since it provides water to the expanding semiurban populations and sustains agricultural operations (Cacal et al., 2024). The communities totally agree and strongly agree on the long-term benefits of forest Conservation with a 100% response. This measures the willingness to participate in any forest conservation initiative like tree



planting, sustainable land use, protecting the forest and reporting illegal forest activities (see table 14)

Table 15: Belief in long-term benefits of forest conservation

Belief in Long-Term Benefits of Forest Conservation	n=48	Percentage
Strongly Disagree	0	0.00%
Disagree	0	0.00%
Neutral	0	0.00%
Agree	33	68.75%
Strongly Agree	15	31.25%

Change in Awareness of Forest Conservation After Reforestation Programs

The beneficiaries of the reforestation programs change their attitude and behavior after implementation of the programs. It shows that 64.58% increased their awareness in forest conservation while 31.25% remain unchanged on their own perspective. The limitations of the implementation agency on reforestation can be of the Information Education Campaign (IEC) on reforestation programs as initiatives for forest conservation. As far as educational background of the respondents is concerned the 70.83% elementary (see table 1) contributed to the unchanged perspective because what is visible in the eyes is what is true on their perspective. In relation to this, concerned agencies should reevaluate their strategy in forest conservation to reduce the unchanged perspective for a successful implementation of the program because a team that does not understand and appreciate its own objective would limit the success rate of the program. Other factors include sustainability of the reforestation initiative of the concerned agencies, and how far already did they managed to restore from the beginning of the reforestation initiatives. Are the beneficiaries of the reforestation programs sustaining the projects after the funding was ended by the GO and NGOs. These factors affect the perspective of the respondents in reforestation initiatives as contributed to forest conservation.



Table 16: Change in awareness of forest conservation after reforestation programs

Change in Awareness of Forest Conservation After Reforestation Programs	n=48	Percentage
Greatly Increased	0	0.00%
Decreased	0	0.00%
Not Changed	15	31.25%
Increased	31	64.58%
Greatly Increased	2	4.17%

Recommendations and Closing Insights of the Respondents

With the recommendations and insights of the respondents, the community active participation and additional sustainable livelihood should be prioritized in the area with both showing 23.38%. Community active participation includes reforestation programs, tree planting activity, sustainable land use and reporting of illegal activities in the area. While additional sustainable livelihood believes to change the trajectory of forest degradation and change it into forest conservation and sustainability. However, in terms of the Significance of livelihood in the area, People are dependent on natural resources, and if they see that it is feasible to obtain resources from them, they are encouraged to extract more, especially when they do not have stable employment. When people have no source of income, they are compelled to rely on natural resources in order to survive (Ventura 2026) and this is also seconded by Allag (2026) that poverty and lack of employment compel some individuals to engage in illegal forest activities. The remaining forest resources serve as a source of livelihood, and communities may resort to kaingin (slash-and-burn farming), particularly when agricultural lands are limited or have been damaged by flooding. Meanwhile strengthening law enforcement and monitoring should also be prioritized as 16.68% revealed in the response of the communities. This observation aligned to the statement of Uddipa, Burgos and Tubban, 2025 who are closely implementing forest conservation activities in the barangay and law enforcement partnership of DENR that kaingin system, timber poaching, fuelwood collection and agricultural expansion were the common illegal activities in the



Table 17: Recommendations and closing insights

Recommendations and Closing Insights	n=48	Percentage
Strengthening Law Enforcement and Monitoring	13	16.88%
Community Active Participation	18	23.38%
Funding Support/Increase fund	11	14.29%
Technical Assistance Support	0	0.00%
Environmental Education/ Strengthen IEC	6	7.79%
Additional sustainable livelihood	18	23.38%
Construction of Flood Control	1	1.30%
Others	9	11.69%

Qualitative Component (KII)

Insights from concerned stakeholders, including personnel from the DENR- PENRO Apayao, DENR-CENRO Calanasan, Municipal Environment and Natural Resources Officer (MENRO) of LGU, the concerned Punong Barangay and the People's Organization President, were also gathered and analyzed. The results are presented.

Conclusions

Based on the findings of the study, the following conclusions are drawn:

1. The Zumigui-Ziwanan River Watershed exhibits a generally stable to improving forest cover, as evidenced by the increase in closed forest shown in the land cover map issued by the NAMRIA and as perceived by the respondents.
2. The computed deforestation rates are 0.185% for open forest and 0.21%-0.24% for closed forest. Despite these relatively low rates, this continuous trend indicates that forest resources remain under pressure.
3. Deforestation is mainly driven by socio-economic factors, particularly poverty and agricultural expansion. Survey respondents and key informants identified slash-and-burn farming and land expansion as common livelihood practices contributing to forest loss. Natural factors such as typhoons, heavy rainfall, and other climate-related events also contribute to forest cover change and environmental degradation.



4. Reforestation initiatives, particularly those under the National Greening Program, have contributed to forest recovery and increased environmental awareness, but their effectiveness is limited by weak monitoring systems, insufficient funding, and inadequate maintenance mechanisms.
5. There is a high level of willingness among community members to participate in forest conservation activities, indicating strong potential for participatory and community-based management approaches.
6. Persistent gaps in environmental awareness, technical capacity, and institutional coordination hinder the long-term success and sustainability of forest management programs.

Recommendations

In view of the conclusions drawn, the following recommendations are proposed:

1. **Strengthen Law Enforcement and Monitoring Systems**
Improve coordination among DENR, LGUs, and communities to enforce environmental laws and conduct regular monitoring in vulnerable areas.
2. **Develop and Promote Sustainable Livelihood Programs**
Introduce alternative livelihoods such as agroforestry, ecotourism, and forest-based enterprises to reduce forest dependence and poverty-driven deforestation.
3. **Increase Funding Support for Reforestation Programs**
Provide sustained funding for reforestation, including maintenance, monitoring, and community incentives, to ensure long-term success.
4. **Strengthening Environmental Education and IEC Campaign.**
Strengthen IEC campaigns to improve community awareness of forest conservation.
5. **Enhance Community Participation and Co-Management Approaches**
Promote participatory forest management through community involvement in watershed planning, implementation, and monitoring.
6. **Integrate Climate-Resilient Strategies in Watershed Management**
Integrate disaster risk reduction and climate adaptation measures into watershed management plans.
7. **Improve Institutional Coordination and Policy Alignment**
Strengthen collaboration among DENR, LGUs, NGOs, and stakeholders for effective program implementation.



8. Institutionalizing Continuous Monitoring and Research
Conduct regular forest cover and socio-economic assessments to support evidence-based management.

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