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Community Well-Being and Willingness as Key Drivers of Watershed Conservation in Mt. Magdiwata Watershed and Forest Reserve in Northeastern Mindanao, Philippines

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Abstract

Social dimensions of environmental conservation are crucial for the long-term success of watershed conservation efforts. This study investigates the intricate relationship between community well-being, socioeconomic factors, and watershed conservation efforts in rural areas, particularly in the Mt. Magdiwata Watershed Forest Reserve (MMWFR) in the Philippines. Using the Structural Equation Model (SEM), the findings highlight that the Quality of Life (QoL, R^2 = 0.55) is the most influential latent factor shaping local attitudes toward conservation, with the provision of safe evacuation areas and access to green spaces emerging as key priorities. Community willingness (R^2 = 0.39) to participate in watershed conservation is significantly influenced by socio-economic demographics (R^2 = 0.31), including civil status, household size, and agricultural dependence, highlighting the need for context-specific conservation strategies. The study also identifies water provisioning (R^2 = 0.14) as a significant motivator for participation, with accessibility and convenience being more critical than cost in driving community involvement. While the influence of awareness of local environmental policies is relatively low (R^2 = 0.08), it remains a crucial factor for fostering long-term behavioral change and policy support. The research highlights the importance of integrating socio-economic realities, improving service delivery, and increasing community awareness to develop effective and sustainable watershed conservation programs. Policy frameworks must integrate these relationships in ongoing advocacy for the efficient conservation of MMWFR as a protected area in the Philippine countryside.

Keywords: conservation; welfare; social participation; ecosystem service; integrated analysis

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1. Introduction

Understanding the social dimensions of environmental conservation is crucial for the long-term success of watershed management efforts, especially in areas where community participation is vital. Watersheds provide essential ecosystem services, such as water provisioning, yet their sustainability often depends on how local communities perceive

and engage with conservation initiatives. The Mt. Magdiwata Watershed and Forest Reserve (MMWFR) is a protected area and part of the Eastern Mindanao Biodiversity Corridor (EMBC), which has been utilized as an approach to advancing biodiversity conservation for social well-being [1,2]. MMWFR is recognized for providing a wide range of ecological services, including water, food, fiber, and wood, as well as opportunities for nearby communities, in a watershed with lush forest vegetation [3]. These services have long supported general welfare, ensuring the sustainability of livelihoods and communities in the face of various threats posed by anthropogenic activities, including mining. MMWFR management faces multifaceted stressors, including land disputes, climate vulnerability, and poverty. Conservation efficacy is, therefore, compromised by these persistent threats. Furthermore, despite the ecological significance of the Eastern Mindanao Biodiversity Corridor and the protected status of the Mt. Magdiwata Watershed Forest Reserve, peer-reviewed studies that empirically examine the relationship between community social dimensions (e.g., quality of life, tenure, participation) and conservation outcomes are scarce. Existing publications prioritize biodiversity planning or management effectiveness, with program documents noting ongoing efforts to build social datasets—highlighting a persistent research gap our study addresses [1,3,4]. Establishing the link between the ecological services of MMWFR, particularly those related to water, and social well-being provides empirical evidence to motivate participatory conservation efforts of the MMWFR.

Consequently, the ecosystem services-well-being nexus has gained scholarly attention. The relationship between ecosystem services and social well-being, which encompasses social aspects such as material security, health, community integration, cultural fulfillment, and environmental satisfaction, has become increasingly important and widely discussed, enriching insights for sustainability [5]. Aside from that, more studies explore the said relationship to effectively raise awareness and appreciation of the underlying support from nature for communities as exhibited in the works of Fagerholm et al. (2021) on nature in outdoor recreation and well-being during the pandemic period [6], Hu et al. (2021) on the interconnectedness of landscapes, well-being, and ecosystem services in China [7], and Castle et al. (2021) on agroforestry impacts on agricultural performance [8], social well-being, and ecosystem services in both low and middle income nations. All of these attempts capitalize on the established link between nature and well-being for effective policymaking and strategic conservation actions.

The Philippines endeavors to protect its biodiversity corridors as part of its national wealth, necessitating coordinated social participation and action. However, a study by Lasco et al. (2020) demonstrated 68% failure rates in Philippine community-based conservation [9], which this study aims to address by establishing empirical evidence of the link critical to social well-being, as represented by the perceived quality of life among local people in MMWFR. Reed et al. (2023) showed that evidence-based policies improve compliance by 40% [10]. This is also demonstrated by Huynh et al. (2022) in their examination of the relationships between nature and human welfare through cultural ecosystem services. Their study identified the synergistic relationships that can potentially harness nature's nonmaterial contributions to societies [11].

In pursuit of strengthening social support for conservation, this study has explored the villagers' attitudes and perceptions toward watershed preservation. Utilizing Structural Equation Modeling to address these gaps quantitatively, specifically to model latent constructs (e.g., Quality of Life (QoL)) with observational data. The research aims to uncover the underlying relationships among quality of life, willingness to participate, demographic characteristics, water provisioning, and awareness of conservation policies, offering insights that can inform more inclusive and effective policy frameworks for MMWFR stewardship. We hypothesized that water provisioning access may directly predict the conservation

willingness of the local people. We also assumed that QoL may mediate policy awareness among local villagers. This work addresses the limited studies on the social dimension of conserving MMWFR, which are almost nonexistent to date and have hindered the scientific basis and information for revising conservation programs, measures, and approaches. The key findings inform the recommendations for measures and policies that could potentially enhance the cooperation and participation of local people in MMWFR conservation.

2. Materials and Methods

2.1. Area of the Study

The study was conducted in a village at the Mt. Magdiwata Watershed Forest Reserve (MMWFR) in San Francisco, Agusan del Sur, Philippines. The village, known as Barangay Ormaca, is situated at the base of Mt. Magdiwata's slope within the protected area of MMWFR (Figure 1). It was selected from the six potential villages for the survey, considering population density, proximity to Mt. Magdiwata, and the peace and order conditions to ensure the safety of conducting data collection activities in the village. Barangay Ormaca is geographically situated at 8°27′ North and 125°60′ East and has an elevation of 59.4 masl [12]. The village population is estimated to be 1.11% of the municipality of San Francisco, Agusan del Sur's population, which is 893, based on the 2020 census data [12]. The majority of the people living in Barangay Ormaca are engaged in farming. The selection of the village for this study was based on the advice of the local government unit and the water concessionaire in the area as to its suitability, since the strategic location of the village (being close to Mt. Magdiwata) puts its people in the position to coexist responsibly with the natural resources (particularly the wildlife) of Mt. Magdiwata in MMWFR. Local stakeholders consider these village people to be the direct stewards of the mountain and its environs in MMWFR.

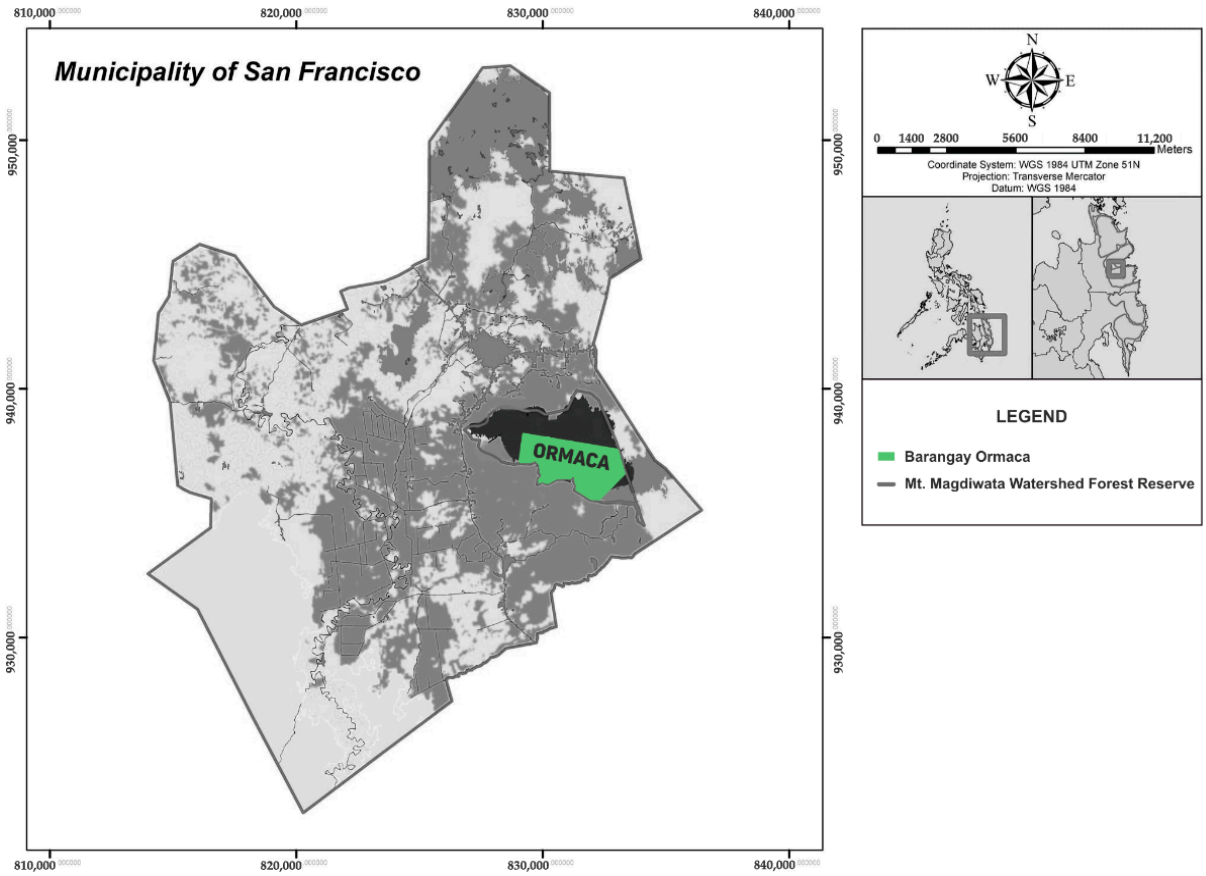

Figure 1. Location Map of Mt. Magdiwata Watershed Forest Reserve (MMWFR) and Barangay Ormaca in the Municipality of San Francisco, Agusan del Sur, Philippines.

2.2. Selection of the Respondents

The respondents were selected from the heads of households of residents in Barangay Ormaca. These household heads were chosen through cluster random sampling. The clusters were based on the "puroks", that is, the local term for the component subdivisions of a village or barangay. The sample size of puroks was determined using Cochran's formula (95% confidence level; 5% margin of error; $p = 0.5$ for maximum variability). This statistical method calculates the ideal sample size for surveying large populations while ensuring an accurate representation of the entire population. The same formula was also used to determine the number of households to be interviewed from each purok. Four puroks (Purok 1, Purok 2A, Purok 2B, and Purok 3) were selected randomly. However, most of the respondents were farmers and were busy with their farm activities. Hence, interviews were scheduled during non-farming hours (16:00–20:00) to maximize participation. Respondents were stratified by purok size, and then a sample size was randomly selected using Cochran's formula, taking into account their availability for interviews and willingness to participate. One hundred eighty-five (185) respondents were interviewed in this study.

2.3. Method of Data Collection

The study used both primary and secondary data to determine and explain the links between ecosystem services and the quality of life of the local respondents. Public and academic databases were examined for the secondary information to explore the links between ecosystem services and perceived quality of life (QoL). The public database refers to the Philippine Statistics Authority, and the academic databases include Google Scholar, ScienceDirect, and the Directory of Open Access Journals. Statistical data and research articles were retrieved from these databases for review and synthesis in the study. Articles were selected using keywords related to ecosystem services, human well-being, water use, community-based resource management, and willingness to pay. Secondary data was processed by summarizing the main findings of the literature for use as references. Primary data was obtained through direct interviews with the selected respondents who are household heads in selected puroks in Barangay Ormaca. A Socio-Economic Assessment and Monitoring System (SEAMS) questionnaire served as the guide for the interviews, outlining the required data for the study, including demographics, quality of life, policy awareness, attitudes towards conservation, and water provisioning. The involvement of the respondents in the interviews was secured through free, prior, and informed consent (FPIC), which signifies their willingness to undergo the interview process and share important, firsthand information.

2.4. Method of Data Analysis

Descriptive statistics, such as weighted means, counts, and percentages, were used to describe the data pertaining to the respondents' profiles in terms of socio-demographics, as well as economic and environmental aspects related to the quality of life as perceived by the respondents. Some of the variables, such as levels of awareness, willingness to participate in conservation, and perceived quality of life among the respondents, were evaluated using weighted scores to determine their respective levels. The *ggplot2*, *reshape*, and *tidyverse* packages were used to visualize the Likert scale results [13]. Correlation matrix development was performed using the *corrplot* package. The Principal Component Analysis (PCA) was used to visualize a dataset with multiple intercorrelated variables. It is used to extract important information from multivariate data and express it as a set of new variables called principal components. The PCA is used to identify directions of principal components along which the direction in the data is maximal. PCA reduces the dimensionality of multivariate data to several principal components that can be visualized graphically with minimal loss of information.

The PCA results are presented in a biplot, where the horizontal (*x*-axis) and vertical (*y*-axis) represent the first two principal components (those that capture the most variance in the dataset). In PCA, eigenvalues indicate how much variance each principal component explains. Usually, a threshold of $\geq$1 is set for retaining components, meaning only those that explain at least as much variance as an individual standardized variable are kept. An eigenvalue of 1 implies the component explains the same amount of variance as one original variable, while components with eigenvalues less than 1 are considered less informative. If the first two components have eigenvalues greater than 1, they are especially significant for interpreting the data. The percentages of explained variance shown in the biplot reflect how much of the total data variability is captured by each component. The *FactoMineR* package in R was used to run the PCA [14]. A Structural Equation Model (SEM) was utilized, employing Confirmatory Factor Analysis (CFA), to evaluate the model's reliability and validity, as well as to predict respondents' attitudes and perceptions toward watershed conservation. SEM was selected over regression models due to its capacity to: (1) Model latent constructs (e.g., QoL, willingness) with measurement error, (2) Test complex mediation pathways simultaneously, (3) Handle non-normal data via robust ML estimation [15]. SEM was used to trace the pathway among the latent variables (e.g., demographics, water provisioning, perceived quality of life, awareness, and willingness of the respondents towards watershed conservation. The SEM was evaluated using the Comparative Fit Index (CFI), the Tucker–Lewis Index (TLI), the root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR). Statistical analysis was performed using ANOVA, the Chi-square test, and *T*-Tests to test the differences. The *sem* and *cfa* packages were used to run the SEM [16]. All graphics and analyses were processed in R version 4.4.2.

2.5. Software and Computational Tools

Analyses used R v4.4.2 (R Core Team, 2024) with packages:

- lavaan v0.6–17 for R (4.4.2)
- FactoMineR v2.8 for PCA
- ggplot2 v3.5.0 for visualizations

Model Validation:

SEM fit indices met thresholds: $\chi^2/df = 2.1$ (<3), CFI = 0.93 (>0.90), RMSEA = 0.06 (<0.08), SRMR = 0.05 (<0.08).

3. Results

3.1. Socio-Economic Profile of the Village People in MMWFR

The cross-section of people and beneficiaries of the MMWFR's water provisioning service, particularly in the village of Ormaca, reveals that the majority of households are headed by middle-aged males (81%, Table 1). In comparison, only 19% are led by females. The average age of household heads is 46 years. Most are married and have been residing in the area for over 20 years.

Educational attainment among household heads is generally low, with most not having completed a college-level education. In terms of ethnicity, 46% trace their roots to the Visayas, indicating a pattern of historical in-migration to the MMWFR area. Household sizes typically range from 4 to 6 members.

With reference to the 2023 poverty threshold in the Philippines, the average monthly household income falls slightly above the poverty line. For a family of five, this equates to approximately Php 10,000 to Php 20,000 (USD 175–$349.04) per month [17]. Their incomes are primarily derived from agriculture, with a focus on producing crops such as rice, corn, bananas, and coconuts.

Table 1. Socio-demographic characteristics of MMWFR villagers.

Demographics		No. of Respondents	Percentage (%)	Demographics		No. of Respondents	Percentage (%)
Gender	Male	150	81	Ethnicity	Agusanon	28	15
	Female	35	19		Bisaya	86	46
		185	100		Cebuano	30	16
Age (years)	19–40	74	40		Manobo	12	6
	41–60	74	40		Others	29	16
	61–85	37	20			185	100
		185	100	Household size	1–3	69	37
Years of occupancy	1–30	128	69		4–6	99	54
	31–60	47	25		7–9	16	9
	61–90	7	4		10–12	1	1
	91–120	3	2			185	100
		185	100	Monthly Income (in USD, 2024 Exchange rate 1 USD = 57.3 PHP)	less than $174.5	68	36.8
Educational Attainment	Elementary graduate	18	10		$175–$349.04	85	45.9
	Elementary undergraduate	56	30		$350–$698.1	30	16.2
	High School graduate	47	25		>$872.6	1	0.5
	High School undergraduate	31	17		Refused to answer	1	0.5
	College graduate	10	5			185	100
	College undergraduate	16	9				
	No grade completed	1	1				
	Vocational	6	3				
		185	100				

3.2. Water Provisioning

As direct beneficiaries of the water provisioning service from MMWFR, water is primarily used for general daily household tasks, including bathing, laundry, washing, cleaning, cooking, and drinking. It is essential to the daily lives of the people residing in MMWFR. Households also use water to manage their farms or agricultural endeavors. Despite having a low income (which is close to the poverty threshold level), people in MMWFR have rated their quality of life in the area with a score of 14.2 on a scale of 1–19, especially those in Barangay Ormaca. They are also observed to be keen to adopt water-saving technologies to help conserve water. The Barangay Water and Sanitation Association (BAWASA) is the most common source of water for domestic and agricultural use among villagers in MMWFR.

Figure 2 illustrates the significance of water in the lives of people in the MMWFR. It is used daily at any time of the day in households. The people in the MMWFR have benefited from the streamlined water provisioning capacity of the watershed through a water concessionaire in the area. This water concessionaire has helped ensure the convenient availability of water to households and advocates for water conservation through its information, education, and communication (IEC) campaigns. It has hired employees to organize village meetings to educate people on how to conserve water. It has been coordinating with various environmental groups to enhance social participation in preserving the watershed, which is part of the Eastern Mindanao Biodiversity Corridor (EMBC). The people of the MMWFR have three primary uses of water in the area, namely: (1) domestic use (including office use), (2) agricultural use, and (3) industrial (non-agricultural) use. Domestic use refers to the use of water for household purposes, as well as in offices and business establishments. This particular use is for numerous household concerns associated with personal hygiene and household and area sanitation, such as bathing, house cleaning (including dishwashing and cleaning floors), laundry washing, cooking, gardening, and drinking.

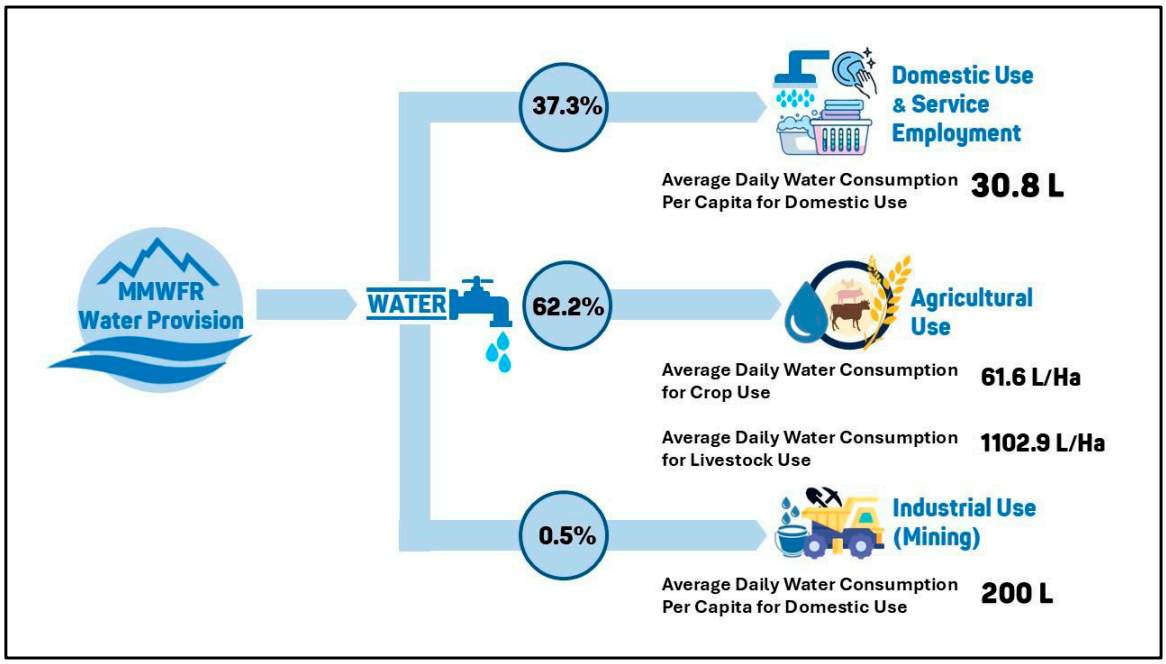

Figure 2. Major water uses among the local people in Mt. Magdiwata Watershed and Forest Reserve (MMWFR) in Agusan del Sur, Philippines. Note: The percentages refer to the % of respondents who use water for the purpose indicated in the diagram.

Potable water is also essential in offices and business establishments for office workers, business owners, and service providers to maintain cleanliness and adequate hydration. The agricultural use of water is primarily for watering plants and/or providing moisture to the soil for crop production, as well as for hydrating animals, bathing them, and maintaining sanitation in and around their enclosures. Although water from the water concessionaire in the area has helped meet the water needs for agriculture, most people who own farms for crop and livestock production rely on rain and nearby lakes, streams, or brooks as their primary sources of water. Industrial use is another application of water, which is employed by only one respondent who is involved in small-scale mining. Water is used in the processing of gold ores for extraction, a process considered water-intensive, with approximately 200 L/day. The most considerable amount of water is used for agriculture, followed by domestic and industrial uses.

Recent national figures for per capita water consumption are not currently available. However, older estimates place water consumption between 48 and 108 L per person per day [18]. The domestic water consumption of the villagers in MMWFR (30.8 L/day) is, therefore, below the national per capita consumption rate of around 48–108 L per day. Agriculture's water consumption is larger in livestock at 1102.9 L/ha/day than in crops at 61.6 L/ha/day (Figure 2).

3.3. The Quality of Life

The quality of life (QoL) of the villagers leans towards positive perceptions, indicating general satisfaction with key aspects of community development. In particular, residents expressed strong approval of establishing schools, housing conditions, and the availability of evacuation centers during natural calamities, with a 98% approval rating (Figure 3). A significant majority (78–97%) also reported satisfaction with access to health and water services, microfinance institutions, recreational areas, and green spaces.

Furthermore, between 58% and 76% of villagers reported being satisfied with their mental and physical well-being, noting access to electricity as a contributing factor. Many also felt a sense of safety and a strong sense of community cohesion.

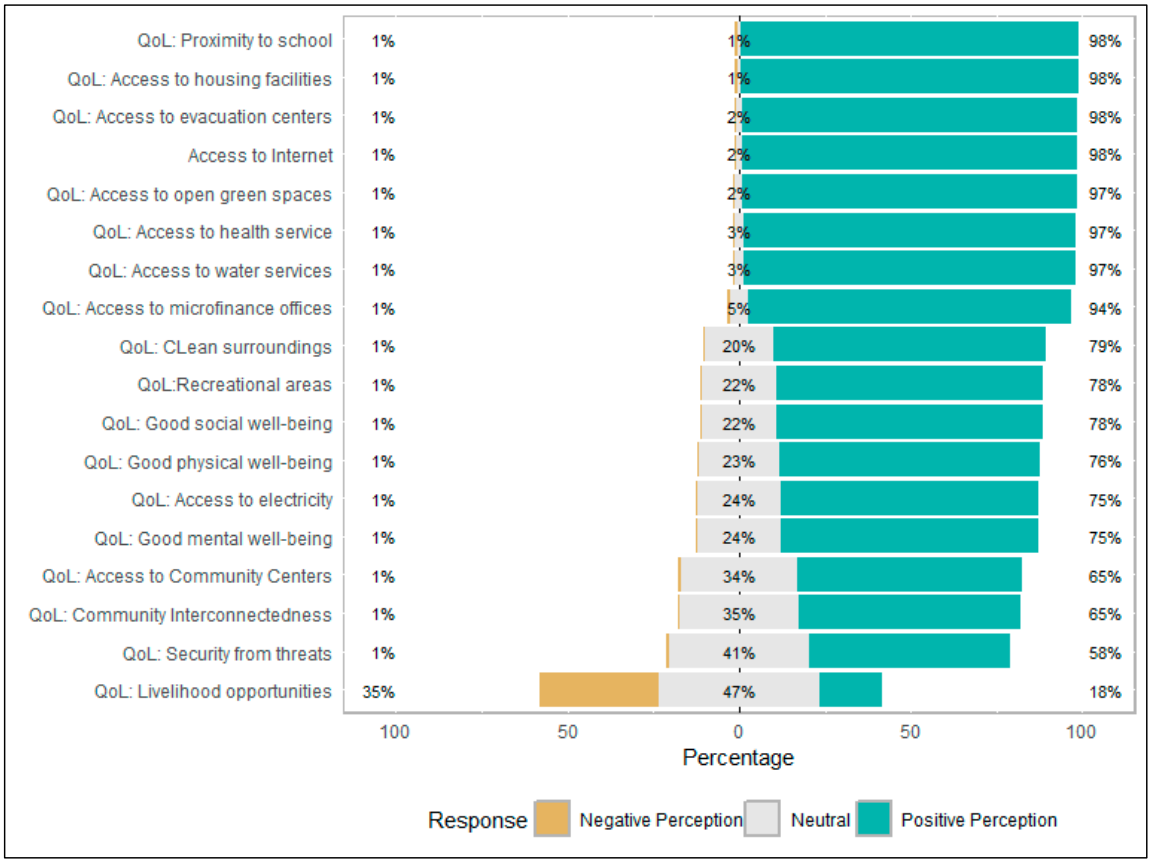

Figure 3. Likert scale on the level of perceptions of quality of life among respondents in Mt. Magdiwata Forest Reserve, San Francisco, Agusan del Sur, Philippines.

However, livelihood opportunities remain a point of concern. Nearly 35% of villagers expressed dissatisfaction with available income-generating options. Only 18% held a positive perception of these opportunities, while 47% were uncertain or ambivalent about them.

3.4. Awareness of the Local Policies Related to Water Management

Awareness of local policies and knowledge of water management interventions, responses were evenly split. This suggests that while half of the villagers are informed and engaged with government plans and programs, the other half remain unaware of activities related to watershed conservation.

3.5. Willingness to Participate in Watershed Conservation

Approximately 51% of the villagers are likely willing to adopt water-saving practices introduced to the community, while 29% remain undecided, and 17% are unlikely to follow these best practices.

For their openness to additional water services in the community, 66% expressed satisfaction with their current water facility and provider, and were not receptive to further services. However, 34% indicated a willingness to consider additional water services.

This hesitancy appears to stem from concerns about potential rate increases. 69% of household representatives expressed reluctance to pay higher fees for new facilities. Most are only willing to consider additional services if the rate increase does not exceed Php 100. Meanwhile, 24% are open to a rate increase between Php 100 and Php 300, while 7% are entirely unwilling to accept any price hike associated with new facilities.

3.6. Interlinkages Among Factors Affecting Social Dynamics Related to Water

A correlation matrix (Figure 4a) illustrates the interrelationships among demographic characteristics, water provisioning, quality of life, and the levels of awareness and willingness among village residents concerning water-related social dynamics. The matrix highlights strong associations among quality-of-life indicators. However, expected influencing factors such as demographics, income sources, and water provisioning exhibit comparatively weaker correlations. This pattern suggests that unmeasured variables exert a more substantial influence on shaping community attitudes and behaviors related to water norms within the watershed.

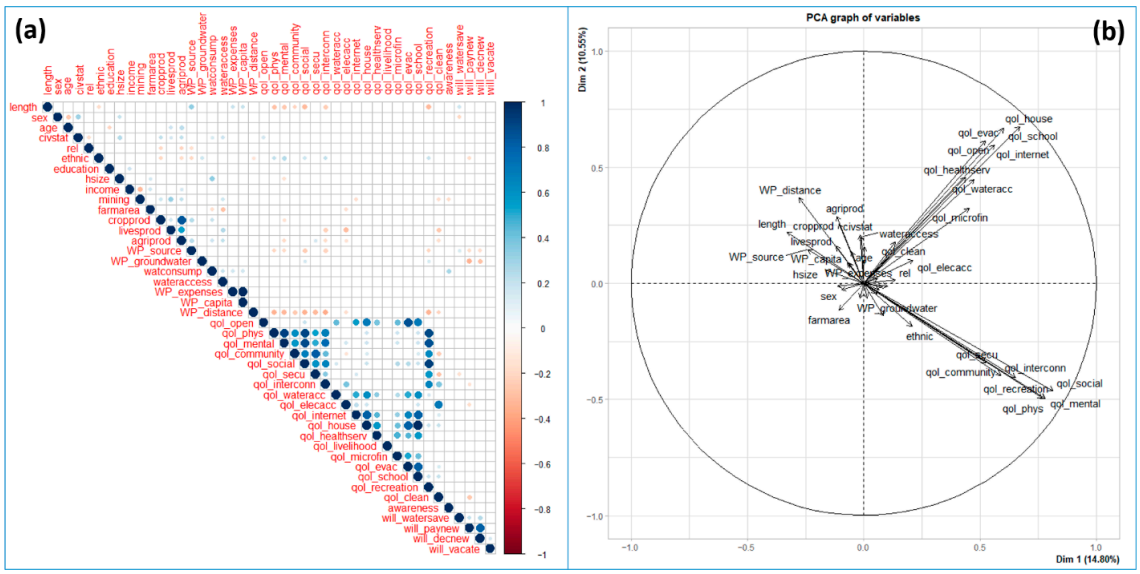

Figure 4. (**a**) Correlation plot displaying the correlation coefficients (r) among demographics, water provisioning, quality of life, and the awareness and willingness of village residents to participate in watershed conservation efforts. The color gradient beside the plot represents the strength and direction of the correlation, blue indicating positive correlations and red indicating negative ones. The size and brightness of the circles correspond to the magnitude of the correlation: larger and more vividly colored circles represent stronger relationships. In comparison, smaller and faded circles indicate weaker correlations. (**b**) Principal Component Analysis (PCA) showing the relationships among demographics, water provisioning, quality of life, and awareness and willingness of the village people to participate in watershed conservation efforts. The data represent responses from 185 respondents.

Furthermore, the weak correlations, indicated by the lighter shades of blue and red, between awareness and willingness to participate in government-led watershed conservation efforts suggest limited community engagement in these initiatives.

We further explored the interrelationships among variables influencing watershed-related social norms, attitudes, behaviors, and their corresponding satisfaction indices using Principal Component Analysis (Figure 4b). We used the two dimensions (with eigenvalues > 1), where dimension has 14.80% explained variance, while dimension 2 has 10.55%. The PCA biplot reveals strong associations among quality-of-life indicators, which are negatively correlated with variables related to water provisioning and demographics.

3.7. Determining the Best-Fit Variables Using the Structural Equation Model

To better capture the complexity of these relationships, a Structural Equation Model (SEM) was employed (Figure 5), grouping observed variables into latent constructs—

namely demographics, water provisioning, quality of life, awareness, and willingness to participate. This modeling approach offers a more nuanced interpretation of the underlying data structure, quantifying the influence of each latent variable on its associated components. With a Comparison Fit Index (CFI = 0.90) and Tucker–Lewis Index (TLI = 0.85), there is a great certainty for the goodness of fit of the model. Ultimately, this helps identify which constructs have the most significant impact on the perceived quality of life and community engagement in government-led watershed conservation efforts.

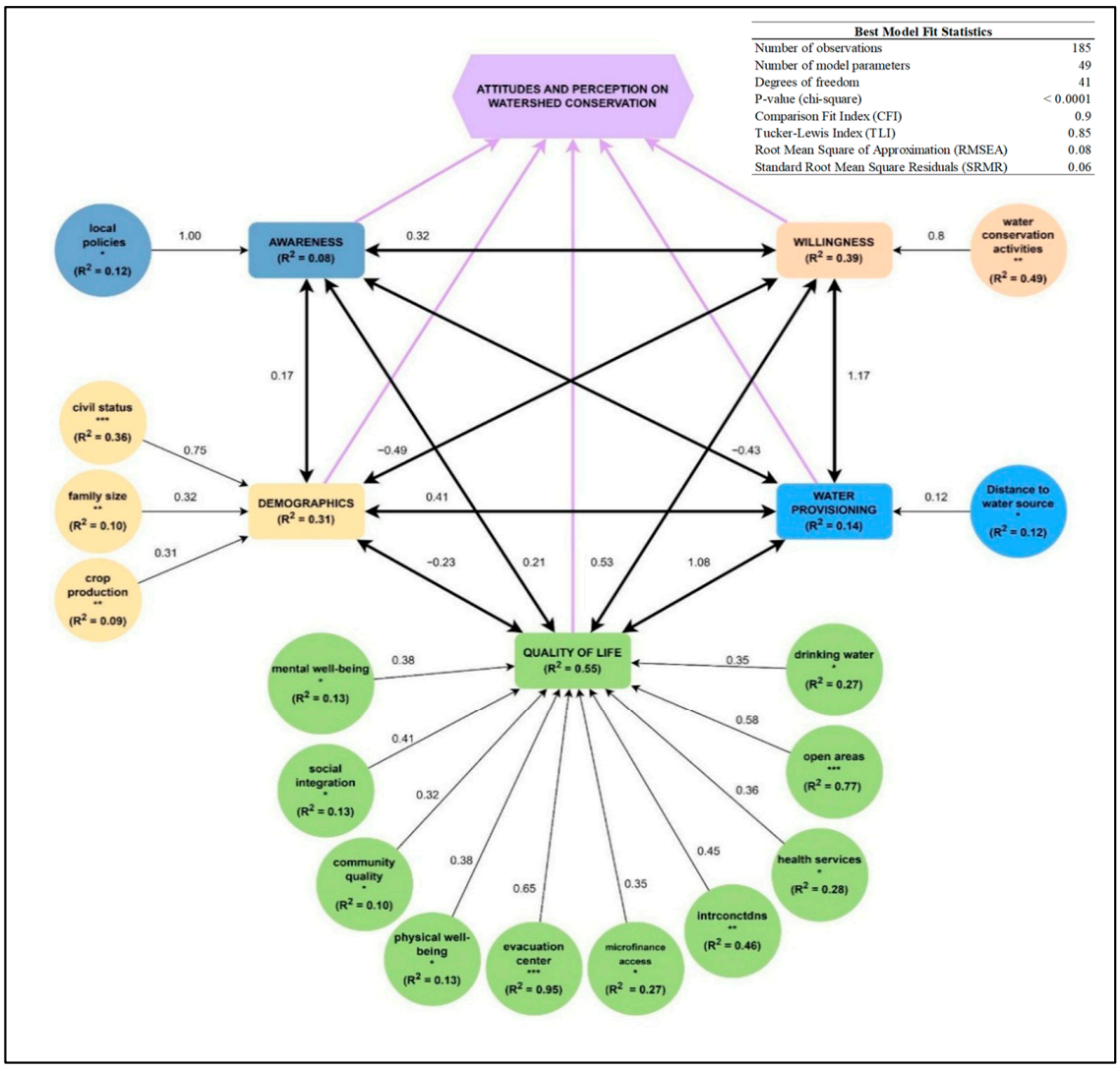

Figure 5. Structural equation model (SEM) exploring the effects of latent factors: awareness, demographics, quality of life, water provisioning, and willingness on the overall community's attitudes and perception on watershed conservation among the villagers of Barangay Ormaca in the Mt. Magdiwata Watershed Forest Reserve, Agusan del Sur, Philippines. Thin lines represent the pathway relationships between measured variables and their latent factor (e.g., demographics, awareness, etc.). The thick, solid black lines represent the relationships among latent factors. In contrast, the thick purple lines represent the relationships between latent factors and the overall community's attitudes and perceptions on watershed conservation. Colors represent each sub-model. The R^2 for component models is provided in the circles representing response variables, as well as in latent variables, based on the variance of both the fixed and random effects. Numbers beside the pathways indicate the effect size of the relationship. All coefficients are standardized and are, thus, directly comparable. Significance levels are denoted as follows: (***) for $p < 0.0001$, (**) for $p < 0.01$, and (*) for $p < 0.05$.

3.7.1. Quality of Life and Community Resilience in the Watershed Area

The final model was developed by including only those variables that showed significant differences. The results revealed that, in the context of water-related provisioning and local attitudes and perceptions about watershed conservation, the quality of life emerged as the most critical concern for villagers, shaping their overall well-being within the watershed area (R^2 = 0.55).

Given that the country frequently experiences typhoons and landslides, villagers identified the provision of evacuation areas as the highest priority (R^2 = 0.95). Quality of life was also strongly associated with the availability of open green spaces for recreation and leisure (R^2 = 0.77). Unity and interconnectedness within the community were also considered key contributors to happiness and well-being (R^2 = 0.46).

Other important indicators of a quality life included access to drinking water (R^2 = 0.27), health services (R^2 = 0.28), and microfinance institutions (R^2 = 0.27). Physical and mental well-being were also valued, though to a lesser extent (both R^2 = 0.13). Lastly, access to quality community services (R^2 = 0.10) and a socially integrated society (R^2 = 0.10) were also identified as contributing factors.

3.7.2. The Willingness to Participate in Conserving the Watershed Area

The second key factor influencing the overall attitudes and perceptions of the villagers of Omarca toward watershed conservation is their willingness to participate in government-led plans and programs aimed at preserving the Mt. Watershed Forest Reserve (MMWFR).

While the local community recognizes the watershed's importance to their daily water needs, the coefficient of determination (R^2 = 0.39) is relatively low, notable, given that the watershed serves as their primary water source. This may be attributed to several reservations held by the community. For instance, there is a notable reluctance to pay for new water services that may be introduced (R^2 = 0.05), likely due to concerns over increased water bills (R^2 = 0.06). Additionally, residents are hesitant to relocate from the watershed area, even if the government were to propose relocation for conservation purposes, such as addressing overpopulation and encroachment (R^2 = 0.04).

These findings suggest that while there is general willingness to engage in conservation efforts, certain trade-offs, such as higher costs or displacement, are met with resistance. This is reflected in the overall low coefficient of determination (R^2 = 0.39), indicating that villagers' support is conditional and influenced by perceived personal costs.

3.7.3. The Socio-Economic Demographics as a Factor in Conserving the Watershed Area

The socio-economic characteristics of the respondents accounted for 31% (R^2 = 0.31) of the variation in their overall attitudes and perceptions toward conserving the watershed area for water management. Among these demographic factors, civil status had the most decisive influence (R^2 = 0.36). Notably, 50% of the respondents were married, and this group exhibited the most significant impact on water-related attitudes and perceptions, especially concerning strategic conservation of the Mt. Watershed Forest Reserve (MMWFR).

Participation in water conservation efforts was also influenced by household size (R^2 = 0.10), with 54% of households consisting of an average of 4 to 6 members. Additionally, crop production emerged as another significant factor (R^2 = 0.09), suggesting that families heavily reliant on agricultural activities may consider the implications for their livelihoods when deciding whether to participate in government-led conservation initiatives.

3.7.4. Water Provisioning and Its Impact on Watershed Conservation Participation

Another key factor influencing the motivation of residents in the Omarca watershed area is the water provisioning system and its impact on their daily lives (R^2 = 0.14). Among the

various water-related factors, the distance from the water source to their household had the most significant influence (R^2 = 0.12), making it the most critical concern for villagers.

While water consumption and expenses are taken into account, they are primarily shaped by the availability and accessibility of water within the watershed. As a result, they exert minimal influence on residents' willingness to participate in watershed conservation efforts.

3.7.5. Community Awareness of Watershed Conservation Policies

The overall awareness of residents regarding watershed conservation efforts and the related government policies is relatively low (R^2 = 0.08). This weak correlation suggests that villagers may not be receiving adequate information and updates from local authorities, or that watershed-related matters are not prioritized in their daily lives. It is also possible that residents are more focused on farming and other livelihood activities, leaving them with little time or interest in staying informed about conservation policies.

4. Discussion

4.1. The Role of Quality of Life in Shaping Watershed Conservation Efforts

As shown in Figure 5, Quality of Life (QoL) emerged as the most critical latent factor shaping local attitudes toward watershed conservation (R^2 = 0.55). An R^2 of this magnitude is considered relatively high in socio-environmental studies [19], underscoring the strong link between community well-being and environmental stewardship in areas where daily needs depend directly on watershed resources.

Within QoL, the provision of safe and accessible evacuation areas had the highest explanatory power (R^2 = 0.95). In the Philippines, where typhoons, landslides, and floods are recurrent, respondents' prioritization of evacuation reflects acute awareness of disaster risk reduction as part of effective watershed management [9,20]. Green space access also showed a strong relationship (R^2 = 0.77), suggesting that, beyond ecological services, open spaces contribute to psychosocial well-being by reducing stress and enhancing community morale [21]. This mechanism may partly explain why conservation programs linked to visible quality-of-life benefits receive greater local support.

Social cohesion, reflected in community unity and interconnectedness, also played an important role (R^2 = 0.46). Stronger community ties facilitate collective action, reinforcing shared responsibility for watershed protection [22]. Other services, including access to drinking water (R^2 = 0.27), healthcare (R^2 = 0.28), and microfinance opportunities (R^2 = 0.27), reduce household vulnerability and build capacity to support long-term conservation efforts [23]. Notably, dissatisfaction with income opportunities (35% of respondents, Figure 3) aligns with the low scores for financial resilience, which points to the potential role of microcredit and livelihood programs in linking conservation with poverty reduction.

Physical and mental health (R^2 = 0.13) and community service access (R^2 = 0.10) showed weaker but still meaningful contributions, suggesting that QoL interventions must extend across both tangible (infrastructure, healthcare) and intangible (social capital, mental well-being) domains. Overall, the findings support the idea that enhancing QoL is not only a development imperative but also a strategic driver of watershed conservation. Policies that integrate environmental protection with social and economic development are likely to gain stronger local support and long-term sustainability.

4.2. Community Willingness to Engage in Collective Watershed Conservation

Community willingness to participate in watershed protection, specifically in relation to government-led initiatives for the Mt. Magdiwata Watershed Forest Reserve (MMWFR), had a moderate influence (R^2 = 0.39). While this figure indicates some openness to engage-

ment, it reveals a tension between the high value placed on watershed resources and the socio-economic constraints that limit participation.

For instance, willingness to contribute financially to water services was extremely low (R^2 = 0.05), reflecting household concerns over cost burdens in a largely low-income, rural setting [24,25]. Likewise, resistance to relocation for reforestation or decongestion (R^2 = 0.04) highlights the community's strong attachment to land, livelihoods, and social ties [26]. These findings were reinforced by interviews, where residents described fears of "losing both land and livelihood" if conservation required displacement.

Furthermore, there is a strong dependence of households in the Mt. Magdiwata Watershed and Forest Reserve on agriculture (62.2% Figure 2). About half (50.4%) of these agriculture-dependent households expressed a willingness to adopt water-saving practices, while more restrictive measures, such as relocation or resettlement, received little support. Some were unwilling to vacate the watershed if mandated (29.25%), and others resisted moving to new areas (23.5%). Most notably, a large majority (79.1%) expressed unwillingness to participate in conservation activities, reflecting possible livelihood pressures, mistrust of external initiatives, or limited awareness of long-term ecological benefits. Such resistance is consistent with studies showing that households reliant on farming often perceive conservation programs as threats to their land security and income [27,28].

Huynh et al. 2016 found that tangible benefits, such as improvements in livelihood conditions and income, can increase participation in resource management and thereby promote willingness to participate in conservation efforts [29]. This suggests that conservation participation in MMWFR may require integrative strategies that address livelihood needs while fostering trust and local ownership, such as community-based water management and incentive-driven conservation programs.

The overall conditional nature of participation (R^2 = 0.39) aligns with broader literature on community-based natural resource management, which stresses the role of distributive equity and fairness in shaping engagement [12,30]. As Leach et al. (1999) argue, perceptions of fairness in costs and benefits determine the legitimacy of conservation governance [31]. This suggests that, beyond awareness, trust-building and distributive justice are essential to fostering sustained participation.

4.3. Socio-Economic Demographics as a Factor in Watershed Conservation

Socio-economic demographics play a significant role in shaping community attitudes and behaviors toward watershed conservation. In this study, the demographic characteristics of respondents explained 31% of the variation in their overall perceptions and willingness to engage in watershed protection efforts. This highlights the importance of considering social context and household dynamics when developing conservation strategies.

As shown in Figure 5, among all demographic variables, civil status emerged as the most influential factor (R^2 = 0.36). With 50% of the respondents identified as married, this group demonstrated the highest levels of concern for water security and conservation. This may be because married individuals often bear greater responsibility for household welfare, including access to water and health-related concerns [32]. Their decisions are typically influenced not only by individual perspectives but by family-level priorities, making them key stakeholders in environmental management practices.

Household size was another factor influencing conservation participation (R^2 = 0.10), with 54% of households comprising 4 to 6 members. Larger households tend to have greater water consumption needs, which may heighten their sensitivity to issues related to water access and sustainability. Prior research has shown that household size is positively associated with water conservation behavior, especially in resource-limited settings [33].

Additionally, crop production (R^2 = 0.09) was found to be a relevant socio-economic indicator, particularly among families whose livelihoods are closely tied to agriculture. For these households, water is not just a domestic need but a critical input for farming activities. Their decisions to support or oppose watershed conservation efforts are likely influenced by the perceived trade-offs between ecological preservation and agricultural productivity [34]. Thus, addressing the concerns of farming communities (e.g., access to irrigation, land tenure, and sustainable farming practices) could enhance their participation in conservation programs.

Taken together, these findings highlight that socio-economic demographic (e.g., civil status, household size, and agricultural livelihood dependence) are key determinants of how communities interact with and value watershed resources. Conservation policies must, therefore, be tailored to the diverse socio-economic realities of local populations to ensure inclusive and sustainable environmental governance.

4.4. Linking Water Provisioning to Community Involvement in Watershed Protection

Water provisioning explained a smaller but still important share of conservation attitudes (R^2 = 0.14). Among its dimensions, physical distance to water sources was the strongest factor (R^2 = 0.12). In rural upland contexts, the time and labor involved in water collection often outweigh cost considerations, particularly for women and children who bear most of the responsibility [35,36]. Respondents emphasized that fetching water on long walks takes a considerable amount of time, underscoring how accessibility issues erode motivation for broader watershed protection.

By contrast, water consumption costs and related expenses had a negligible influence, confirming that service reliability and accessibility matter more than pricing [37,38]. This suggests that conservation programs framed only around ecological benefits may fail to gain traction unless they also address daily service delivery concerns.

Notably, the trade-offs between conservation and water access highlighted here echo those observed in willingness to participate (Section 4.2). Rather than treating these issues separately, watershed initiatives should adopt an approach that links ecological protection with improved water delivery systems, thereby ensuring tangible community benefits alongside conservation outcomes.

4.5. Awareness of Watershed Conservation and Local Policies

Awareness of watershed policies explained a modest proportion of community perceptions (R^2 = 0.08), yet its importance lies in its role as a prerequisite for long-term engagement. Low awareness is likely due to gaps in government communication, as many respondents reported limited exposure to information about conservation regulations [39]. Such gaps weaken alignment between government initiatives and community priorities.

Awareness-building is critical because informed communities are more likely to connect conservation to everyday concerns such as farming, water security, and health [31]. However, livelihood pressures often displace attention from environmental issues, as residents prioritize immediate income over long-term ecological stability [40]. This underscores the need for participatory awareness campaigns that are locally grounded and livelihood-integrated—for example, through farmer cooperatives, schools, and barangay meetings [41].

By embedding watershed protection in local education, media, and community institutions, awareness can gradually shift from a marginal factor to a central driver of collective action. Thus, while awareness currently exerts limited direct influence, it remains a crucial enabling condition for sustainable watershed governance. Strengthening awareness efforts, especially those that align conservation with local needs, can enhance the sustainability and inclusiveness of watershed governance.

4.6. Limitations of the Structural Equation Model

A key limitation of the SEM is the potential omission of relevant variables that may account for additional variance in the dependent constructs. Such omissions can contribute to low R^2 values and nonsignificant paths despite high covariances. Moreover, issues such as measurement error, multicollinearity, sample size constraints, and possible model misspecification may further limit the explanatory power and interpretability of the results.

5. Conclusions

This study underscores the multifaceted nature of community participation in watershed conservation. Among all factors, quality of life (QoL) emerged as the paramount driver, demonstrating that conservation gains the strongest support when it directly enhances the social, economic, and emotional well-being of local communities. Essential services such as safe evacuation sites, access to green spaces, healthcare, and drinking water are not merely amenities; they build resilience and, crucially, translate into tangible support for environmental stewardship by alleviating daily pressures.

While there is a general willingness to participate in conservation, this support is highly conditional and constrained by significant socio-economic trade-offs, including financial limitations and strong attachments to land. Socioeconomic demographics, particularly civil status, household size, and dependence on agriculture, profoundly shape how residents perceive and engage with conservation programs.

Water provisioning systems also reveal critical dynamics. The physical accessibility of water has a direct effect on local motivation, as long distances to water sources significantly erode willingness to prioritize broader watershed protection. At the same time, awareness of watershed policies, though showing limited direct impact at present, remains a fundamental prerequisite for fostering long-term behavioral change and inclusive governance.

Together, these findings highlight the urgent need for integrated, community-centered conservation strategies. Effective interventions must: (1) prioritize QoL improvements that alleviate immediate household pressures by expanding reliable access to clean water, healthcare, and safe community spaces; (2) explicitly address socio-economic constraints through measures that ease financial burdens and strengthen agricultural sustainability, such as livelihood diversification and support for smallholder farmers; and (3) build foundational awareness of watershed protection through participatory, locally grounded approaches such as community dialogues and culturally resonant education campaigns. Sustainable watershed governance ultimately hinges not only on protecting natural resources but on robustly supporting the communities whose lives and futures depend on them.

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during an official project meeting with DENR Region XIII, CRÈME, and partner stakeholders including local government units, and relevant offices on 11 April 2024. As the BD Corridor Project is a UNDP–GEF–DENR program, it does not operate under a conventional Institutional Review Board (IRB); instead, it follows the UNDP Social and Environmental Standards and complies with relevant Philippine laws, including the Data Privacy Act of 2012 (Republic Act No. 10173). The study adhered to ethical research principles by ensuring voluntary participation, informed consent, and confidentiality of all data collected.

Informed Consent Statement: Verbal informed consent was obtained from the participants. Verbal consent was obtained rather than written because it was deemed more appropriate for this study as it aligns with cultural norms, reduces potential intimidation associated with signing documents, and is suitable for the low-risk nature of the research. It also provides flexibility in field conditions where written consent may not be practical, while avoiding the creation of signed records that could compromise participant confidentiality.

Data Availability Statement: The raw data supporting the conclusions of this article will be made available by the authors on request.

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Abbreviations

The following abbreviations are used in this manuscript:

MMWFR	Mt. Magdiwata Watershed Forest Reserve
EMBC	Eastern Mindanao Biodiversity Corridor
SEM	Structural Equation Modeling
QoL	Quality of Life
SEAMS	Socio-Economic Assessment and Monitoring System
FPIC	Free, Prior, and Informed Consent
PCA	Principal Component Analysis
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
TLI	Tucker–Lewis Index
RMSEA	Root Mean Square Error of Approximation
SRMR	Standardized Root-Mean-Square Residual
BAWASA	Barangay Water and Sanitation Association
IEC	Information, Education, and Communication

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