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Article

Research on biomechanics-informed rural planning strategies for enhancing biodiversity and health

Xiuli Yang*, Miaomiao Han

School of Public Administration and Law, Northeast Agricultural University, Harbin 150038, China
*** Corresponding author:** Xiuli Yang, yangxiuli73@163.com

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Abstract: Rapid urbanization has resulted in decreased biodiversity, adversely impacting ecosystem functions and human health, especially in rural regions. Biomechanics-informed rural planning integrates principles of biological mechanics with biodiversity enhancement and public health objectives to establish sustainable communities. Purpose: This study aims to foster resilient ecosystems and healthier rural populations by introducing biomechanics-informed approaches to rural planning that synergize biodiversity enhancement with health promotion. Methods: This study bridges the knowledge gap by examining the relationship among biomechanically efficient behaviors, personal health, and ecosystem-based disaster risk reduction (EDRR) through the lens of the Health Belief Model (HBM). Structural equation modeling (SEM) was employed to investigate the correlations between the study's key variables. The research focused on a rural community impacted by disaster to test the hypotheses, exploring biomechanics-informed rural planning strategies that facilitate sustainable development and biodiversity enhancement. Results: The findings indicate that health perceptions and EDRR attributes indirectly influence biomechanically efficient behaviors. Specifically, participation in activities that support biodiversity is positively associated with perceptions of social integration benefits, EDRR awareness, and health promotion. Conclusion: This study underscores the potential to integrate biomechanics into Emergency Disaster Risk Reduction (EDRR) initiatives and community planning to encourage healthy lifestyles and enhance the environmental sustainability of resilient communities.

Keywords: biodiversity; Ecosystem-Based Disaster Risk Reduction (EDRR); Structural Equation Modeling (SEM); biomechanics-informed rural planning strategies

1. Introduction

Life on Earth is combined to form biodiversity. From the largest whale in the ocean to the tiniest microbe in the soil, every single individual life form contributes to Earth's biodiversity [1]. However, biodiversity is not limited to individuals. Relationships between these organisms and their environments are another aspect of biodiversity [2]. Plants and microorganisms that change the chemistry of soil, whales and plankton that help produce oxygen in the atmosphere, and seeds and rhinos that encourage the establishment of forests [3].

Around the world, this is continuously shown at both the macro and microscopic levels. There wouldn't be any oxygen if there were no plants. Many of the crops would be extinct without bees. There are even more basic advantages to biodiversity. The link among seeds and the fruit-eating animals that consume them also produces the hardwood trees in the rainforests that serve as the most efficient above-ground carbon sinks [4]. Tree seeds that have first traveled through a bat, monkey, or elephant's digestive system have a 500x higher chance of germinating. The soils' microscopic biodiversity produces the chemical conditions required for crops to be robust, prolific, and sustainable [5]. Nature contains a variety of novel medications, such as fungi that fight cancer and tree resins that reduce pain.

1.1. Importance of biodiversity

Biodiversity is a vital aspect of Earth's health and the welfare of all living things, encompassing species variety, genetic variation, and the environments in which live. It goes beyond admiring the natural world and emphasizes the inherent worth of all species and the intricate relationships that support life on Earth [6]. Ecologically, biodiversity is necessary to sustain healthy ecosystems that provide essential services for human survival, such as insect management, crop pollination, climate regulation, and clean air and water [7]. The interdependence of life on Earth is fragile and unpredictable, emphasizing the need to conserve biodiversity. Aside from its ecological role, biodiversity has economic implications. This is because it promotes growth and stability by providing raw materials for things like food, medicine, and other necessities needed by humans. The importance of biodiversity is illustrated in **Figure 1** above.

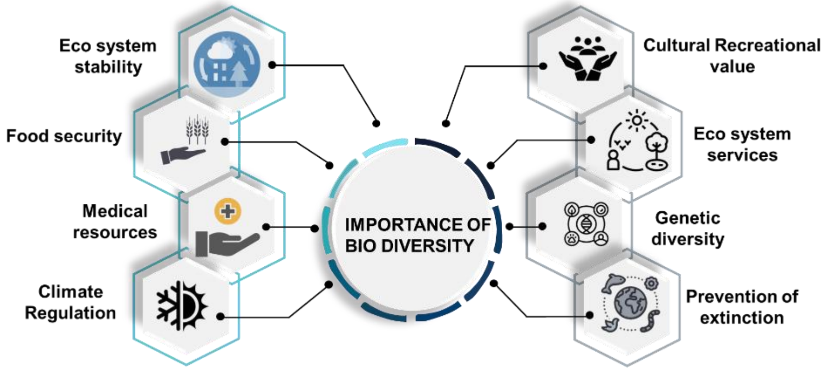

Figure 1. The importance of biodiversity for ecosystem services and human well-being.

1.2. Biodiversity enhancement

Biodiversity enhancement is a strategy aimed at enriching existing biological resources, particularly in areas where past and present human activities have been prevalent [8]. As the pace of urbanization and industrialization continues to place pressure on natural ecosystems, strategies that go beyond mere mitigation of impacts to include active restoration and enhancement of ecological systems are increasing in number. It is primarily because these diverse biological variations support essential ecosystem services offered by clean air and water, crop pollination, and climate control [9]. It primarily focuses on the restoration of degraded ecosystems, the creation of new ones, and the harmonious integration of human beings and nature. This notion is being embedded into the design and management processes as part of an ongoing effort to address sustainability and environmental concerns [10]. Following regulations and policies that prioritize biodiversity, there is active resistance to developers' activities where local authorities are now encouraging the implementation of measures that would enhance the environmental conditions beyond the requirements of the law [11]. Activities include the construction of wildlife habitats in construction sites, the incorporation of indigenous vegetation in the landscape design of the area, and the establishment of green infrastructure such as sustainable drainage systems and green roofs.

Objective: The study aims to enhance rural communities' resilience and health by integrating various rural planning strategies that promote biodiversity enhancement.

Research organization: Section 2 contains the study's review of the literature, and Section 3 illustrates the methodology. The results of the study are presents in Section 4. The conclusion is established in Section 5.

2. Literature review

Table 1 summarizes the literature on various types of biodiversity enhancement, detailing the year of publication, the research objectives, and identified limitations of every study, providing a inclusive impression of the current state of examination in the field.

Table 1. Overview of various articles related to biodiversity enhancement.

Ref	Year	Objective	Limitation
[12]	2024	To explore integrated planning approaches using the climate-biodiversity-health (CBH) connection to improve the sustainability and resilience of food systems in the Comox Valley region.	The framework is developed specifically within the Comox Valley context, which can limit its applicability to other communities without adaptation.
[13]	2024	To examine methods for conserving biodiversity and how they affect the health of Mozambique's ecosystems.	For long-term effects, issues like habitat fragmentation and the illicit wildlife trafficking must be addressed via continuous study and coordinated conservation strategies.
[14]	2024	To assess Sustainable Development Goal (SDG) implementation within the Major Function Oriented Zone (MFOZ) planning framework across 288 cities in China.	Socio-economic development during urbanization presents challenges to SDGs, and traditional environmental measures have limited effectiveness in improving SDG realization status.
[15]	2024	To develop a conceptual framework which integrates urban planning strategies, adaptive management methodologies, and ecological principles, to enhance urban green infrastructure (UGI) for biodiversity conservation and supportable urban development.	UGI is facing challenges that hinder its effective planning and implementation.
[16]	2024	To discover the connotation among public willingness to pay (WTP) for urban green spaces (UGS) and the recognition of their health benefits in Brazil, contributing to urban sustainability and public health.	The research highlights a gap in understanding WTP for UGS in developing countries, particularly in Brazil, indicating limited existing data on this topic.
[17]	2024	To illustrate the effects of pollution, worldwide warming, and declining biodiversity on human health and provide an approach for evaluating the health advantages of countering these challenges.	The lack of health benefits assessment in environmental remediation program evaluations presents a missed opportunity to accurately quantify these benefits and inform policymakers.
[18]	2024	To examine the importance of balancing development with conservation preservation for maintainable rural and urban growth, focusing on soil regeneration and strategies for preserving biodiversity.	The project cannot fully capture all local contexts or specific barriers faced in different regions regarding environmental conservation challenges.
[19]	2024	To examine the biodiversity maintenance strategies and their effect on ecosystem health in Mozambique.	The threats posed by ongoing challenges, including but not limited to, habitat fragmentation and illegal wildlife trade, call for an undeterred level of research, and the application of combined conservation strategies.

Table 1. (*Continued*).

Ref	Year	Objective	Limitation
[20]	2024	To highlight the implications of biodiversity loss on ecosystems, economies, and public health, emphasizing the need for conservation efforts and policy interventions to preserve ecosystem services.	The decline in biodiversity is a potential concern not only to the environment but also to the health of mankind, and hence integrated strategies become inevitable to deal with such complex challenges.
[21]	2024	To examine the multifaceted benefits of green spaces in urban planning, focusing on their environmental, social, and economic contributions to sustainable and livable cities.	The incorporation of green spaces into urban planning frameworks face challenges related resource allocation, urban policies, and existing infrastructure.
[22]	2024	To explore the integration of cultural and social dimensions in sustainable architectural practices to enhance community well-being through green architecture.	Balancing sustainability with cultural and social goals, along with navigating policy challenges, can impede effective implementation.
[23]	2024	To develop a conceptual framework that enables biodiversity mainstreaming in coastal cities.	The study examined Mumbai's challenges and compared to Singapore's advancements, highlighting the potential inaccuracies in considering the unique contexts and challenges of coastal cities.
[24]	2024	To outline an integrated, comprehensive, and well-structured planning framework for wetland systems applicable to different types of wetlands, aligned with institutional policies and governance.	The study is based on expert opinions from a specific group, which cannot capture all relevant perspectives or local contexts, and its findings can be influenced by the characteristics of the particular case study applied.
[25]	2024	To evaluate the potential of nature-based solutions (NBS) to improve nutrition, food security, and economic stability in rural areas of sub-Saharan Africa.	The study acknowledges challenges in implementing NBS, such as incomplete capitals and policy restraints, which can hinder effective application and require community participation to overcome.
[26]	2024	To assess the implementation of Sustainable Development Goals (SDGs) within the Major Function Oriented Zone (MFOZ) framework in Chinese cities and identify influencing factors for effective SDG realization.	The study's specificity in China can limit its generalizability, and the intricate interplay of socio-economic and environmental factors can pose challenges in establishing clear causal relationships.

2.1. Problem statement

Rapid urbanization and environmental deterioration appear to have led to biodiversity loss, particularly in rural regions, which has paved the way for the loss of essential ecosystem services that are essential to human well-being. There is a need for integrated planning methods since the loss has a detrimental impact on public health and catastrophe resilience. Nevertheless, there are currently no comprehensive methods for tying biodiversity enhancement and health promotion in rural planning together. To develop sustainable planning methods, we employed SEM in combination with the Health Belief Model to examine the connection between ecosystem-based catastrophe risk reduction, personal health, and pro-environmental behavior.

2.2. Hypothesis development

This study hypothesizes that social influences, economic perceptions, and community engagement significantly shape individual behaviors related to pro-environmental actions, personal health, and disaster risk reduction. Eight hypotheses related to HBM, each with a different path component, are categorized under specific headings.

H1: Pro-environmental behaviors, specifically Recycling and Waste Management (RWM), are positively associated with Ecosystem-Based Disaster Risk Reduction (EDRR).

H2: Pro-environmental behaviors, particularly Energy Conservation Habits (ECH), have a positive impact on Ecosystem-Based Disaster Risk Reduction (EDRR).

H3: Pro-environmental behaviors, including Sustainable Transportation Choices (STC), contribute positively to Ecosystem-Based Disaster Risk Reduction (EDRR).

H4: Pro-environmental behaviors, specifically Water Conservation Measures (WCM), are positively correlated with Ecosystem-Based Disaster Risk Reduction (EDRR).

H5: Pro-environmental behaviors, particularly Community Initiatives (CI), significantly enhance Ecosystem-Based Disaster Risk Reduction (EDRR).

H6: Physical Health (PH) mediates the relationship between pro-environmental behaviors (RWM, ECH, STC, WCM, CI) and Ecosystem-Based Disaster Risk Reduction (EDRR).

H7: Mental Health (MH) mediates the relationship between pro-environmental behaviors (RWM, ECH, STC, WCM, CI) and Ecosystem-Based Disaster Risk Reduction (EDRR).

H8: Physical Health (PH) and Mental Health (MH) together have a significant mediating effect on the relationship between pro-environmental behaviors (RWM, ECH, STC, WCM, CI) and Ecosystem-Based Disaster Risk Reduction (EDRR).

3. Methodology

The goal of the investigation is to enhance the existing rural development approaches through the addition of public health strategies so that the natural environment is protected. It includes an assessment of current biological systems, capacity building, and survey activities, strategy formulation, and the execution of certain programs to assess their influence on repairing healthy ecosystems and improving the health of the population.

3.1. Data collection

The 480 participants in the sample chosen for the study represent a variability of demographic characteristics, including age, gender, education, income, occupation, location of residence, and years of experience. The participants' age distribution, which includes both younger and older groups, provides a broad viewpoint on the subject being studied. Since the majority of participants have completed at least high school and a lesser percentage have pursued postgraduate courses, the sample spans a range of educational levels, reflecting variety in attainment. The sample exhibits a gender imbalance, with one gender predominating over the other. The majority of participants appear to have been in the middle-income range, suggesting socioeconomic inequality within the sample. Professional backgrounds and geographic regions are quite diversified, with research participants spanning urban, suburban, and rural areas and occupational backgrounds ranging from site managers to workers. The diversity will guarantee that the study's findings can be applied to many socioeconomic groups. Data collection was carried out by employing standardized questionnaires in their survey procedures to collect genuine replies and by methodically questioning individuals from various geographic locations to guarantee wide coverage. The diverse sample composition provides a comprehensive view of the elements investigated and strengthens the findings' robustness.

Selection criteria

The selection criteria for this analysis are divided into two phases: inclusion and exclusion criteria.

3.1.1. Inclusion criteria

- Demographic Representation: Participants must represent a diverse range of ages, genders, educational backgrounds, income levels, occupations, locations, and years of experience to ensure comprehensive data collection.
- Active Participation: Participants must be actively engaged in the relevant field or context being studied, ensuring that their insights and experiences are pertinent to the research focus.
- Informed Consent: participants must give their informed consent, demonstrating that they understand the goals and methods of the research.

3.1.2. Exclusion criteria

- Inactivity: Individuals who are not currently active in their profession or relevant field will be excluded to maintain the integrity of the data regarding current practices and perceptions.
- Incomplete Data: Participants with incomplete or inconsistent responses to survey instruments or questionnaires will be excluded to ensure the reliability of the dataset.
- Non-representative Demographics: Individuals whose demographic characteristics do not align with the target population (e.g., extreme outliers) can be excluded to enhance the validity of the findings.

3.2. Conceptual framework

The HBM has been utilized to analyze and understand the relationship between pro-environmental behaviors, the concept of personal health, and ecosystem-based disaster risk management. Its contention lies in the amplification of behaviors by internal or external pressures, obligations, and threats. Explanatory variables such as societal expectations, influence of friends, and availability of government assistance have a direct correlation with pro-environmental behaviors and health results as the outcome variables. Factors such as ethics and vernacular education also mediate the two relations. The objective of enhancing the model is to assist in designing appropriate context-specific strategies that can encourage the attainment of conducive healthy and sustainable practices. **Figure 2** denotes the conceptual framework.

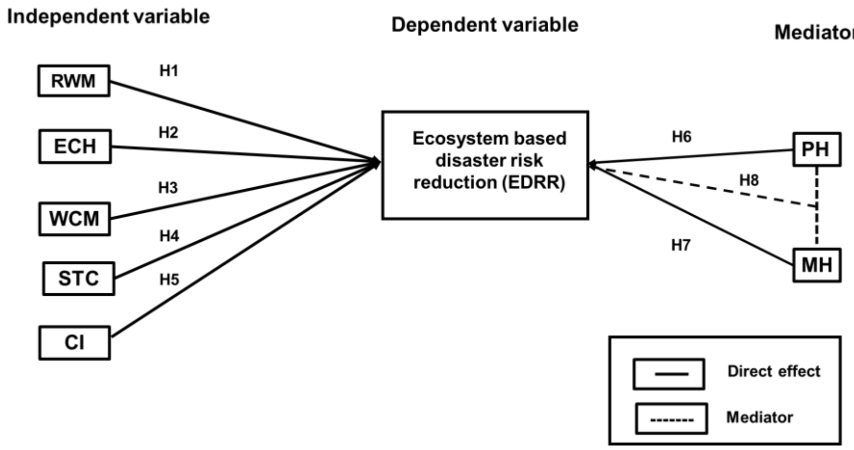

Figure 2. Conceptual framework for health-oriented rural planning through biodiversity enhancement".

3.2.1. Direct paths

- RWM→EDRR: RWM directly enhances EDRR. Implementing effective recycling and waste management practices contributes to reduced environmental degradation, which, in turn, strengthens ecosystem resilience against disasters.
- ECH→EDRR: ECH directly influences EDRR. By conserving energy, communities reduce greenhouse gas emissions and environmental stressors, by promoting sustainable ecosystems that are better prepared for disaster risks.
- STC→EDRR: STC directly improves EDRR. Choosing sustainable transportation options reduces pollution and environmental impact, fostering healthier ecosystems that can mitigate the effects of disasters.
- WCM→EDRR: WCM directly affects EDRR. Efficient use of water resources ensures ecosystem stability and resilience, which are crucial for disaster risk management.
- CI→EDRR: CI directly enhances EDRR. Engaging communities in proactive environmental initiatives fosters collective action and awareness, leading to improved disaster preparedness and risk reduction.

3.2.2. Indirect paths (mediated)

- RWM, ECH, STC, WCM, CI→PH→EDRR: These pro-environmental behaviors positively impact PH, which in turn enhances EDRR. Healthy communities are more likely to engage in disaster preparedness and resilience-building activities.
- RWM, ECH, STC, WCM, CI→MH→EDRR: The aforementioned behaviors contribute to improved MH, indirectly bolstering EDRR. Better mental health among community members promotes proactive engagement in disaster risk reduction efforts.
- RWM, ECH, STC, WCM, CI→PH, MH→EDRR: The cumulative effect of these behaviors on both PH and MH significantly enhances EDRR. Communities that prioritize environmental health and personal well-being are better equipped to face and mitigate the impacts of disasters.

Table 2 outlines various factors that influence environmental and health behaviors, emphasizing their roles in promoting preparedness and risk reduction in disaster situations.

Table 2. Variables and their definitions.

Variable	Definition
Recycling and Waste Management (RWM)	Practices that involve collecting, processing, and reusing materials to reduce waste and pollution.
Energy Conservation Habits (ECH)	Behaviors aimed at reducing energy consumption, such as using energy-efficient appliances and minimizing electricity usage.
Sustainable Transportation Choices (STC)	Choices that indorse globally friendly styles of passage, such as cycling, walking, or using public transportation.
Water Conservation Measures (WCM)	Strategies to decrease water custom, such as setting escapes, using water-efficient fittings, and active mindful water ingesting.
Community Initiatives (CI)	Collective efforts by community members to promote environmental sustainability and awareness through programs and activities.
Physical Health (PH)	The overall physical condition of an individual, including factors like fitness, absence of chronic diseases, and general well-being.
Mental Health (MH)	The emotional and psychological state of an individual, encompasses stress levels, mood, and mental well-being.
Ecosystem based Disaster Risk Reduction (EDRR)	Nature-based strategies aimed at reducing hazards and improving disaster resilience within communities.

3.3. Quantitative analysis

This research aims at formulating health-oriented rural planning strategies based on the improvement of biodiversity; various statistics methods are used for hypothesis confirmation. The demographic analysis helps in understanding the characteristics of the participants and in the overall understanding of the population of the study. In this context, SEM is employed for any specifications of relationships between the variables within the model. General statement of the problem, in compliance with the hierarchical structure of the objectives in the two, the direct and indirect effects of biodiversity on the health outcomes of the population are evaluated. Statistical hypothesis testing is used to identify potential relationships between environmental factors (ES) and pro-environmental activities, such as towards EDRR. Cronbach's alpha ensures the reliability of the scale measuring biodiversity enhancement by evaluating the internal consistency of related variables. The degree of association correlation coefficients examines the linear correlation between two variables and measures this relationship, while also helping to explain the reasons behind the various pro-environmental behaviors. Regression analysis provides the effect of independent variables on the dependent variable, in this case, how health-related attitudes and practices have an impact on EDRR levels. The underlying notion behind all these methods is a need to devise efficient rural planning approaches that would support the preservation of biodiversity, as well as its integration into the development of the population's health.

4. Results and discussion

The study examines the health-oriented rural planning techniques that support sustainable development and improve biodiversity, with a focus on a disaster-affected rural community to test the hypotheses.

4.1. Demographic analysis

The dataset categorizes participants into four age groups, with a majority of males. It has various education levels, including high school, diploma, undergraduate, and postgraduate. The income level ranges from low to high, with a mix of low, medium, and high-income earners. The occupations include site managers, supervisors, workers, and engineers. Locations are urban, suburban, and rural, showcasing diverse living environments. Years of experience range from less than one year to over ten years. **Table 3** illustrates the demographical data.

Table 3. Demographic data.

Demographic Factor	Categories	Participants (*n* = 480)	Percentage (%)
Age	20–25	80	16.7
	26–35	160	33.3
	36–45	120	25.0
	Above 46	120	25.0
Gender	Male	360	75.0
	Female	120	25.0
Education Level	High School	100	20.8
	Diploma	140	29.2
	Undergraduate	180	37.5
	Postgraduate	60	12.5
Income Level	Low	120	25.0
	Medium	240	50.0
	High	120	25.0
Occupation	Site Manager	50	10.4
	Supervisor	100	20.8
	Worker	260	54.2
	Engineer	70	14.6
Location	Urban	250	52.1
	Suburban	150	31.3
	Rural	80	16.7
Years of Experience	< 1 year	50	10.4
	1–3 years	130	27.1
	4–10 years	180	37.5
	> 10 years	120	25.0

4.2. Evaluation of measuring model

Table 4 illustrates the results of the measurement model emphasizing the consistency and reliability of every variable employing all indices which are; Cronbach's Alpha (α), Composite Reliability (CR), Factor Loading (FL), and Average Variance Extracted (AVE). Each construct reflects a critical area of concern, including RWM, ECH, STC, WCM, CI, PH, and MH.

For instance, under Recycling and Waste Management, the indicators (RWM 1 to RWM 4) exhibit factor loadings extending from 0.70 to 0.78, highlighting a robust association between the indicators and the overarching construct. The composite reliability values for RWM stand at 0.87, suggesting a high degree of internal consistency and indicating that the measurement is reliable. The AVE for RWM is 0.60, which is above the recommended threshold of 0.50, demonstrating good convergent validity by confirming that the indicators adequately represent the construct. Similarly, Energy Conservation Habits show robust indicators (ECH 1 to ECH 4) with factor loadings from 0.75 to 0.82, a complex dependability of 0.89, and an AVE of 0.64. The other constructs, including Sustainable Transportation Choices, Water Conservation Measures, Community Initiatives, Physical Health, and Mental Health, follow this trend, with factor loadings ranging from 0.71 to 0.84, complex dependability scores among 0.85 and 0.91, and AVE values from 0.58 to 0.68. Furthermore, Cronbach's alpha values for all concepts are reported between 0.80 and 0.87, reinforcing the reliability and consistency of the measurement tools used. These findings collectively indicate that the constructs are well-defined and robust, making them suitable for further empirical analysis. It provides a reliable foundation for understanding the interplay between environmental behaviors and health outcomes, thus facilitating informed decision-making and effective interventions aimed at promoting sustainable practices and enhancing overall well-being within communities. This thorough examination of the constructs underscores their relevance and the potential for further exploration in related research endeavors, highlighting the interconnectedness of environmental sustainability and health.

Table 4. Outcomes of Cronbach's alpha.

Variable	Indicator	FL	CR	AVE	α
Recycling and Waste Management (RWM)	RWM 1	0.78	0.87	0.60	0.82
	RWM 2	0.80			
	RWM 3	0.75			
	RWM 4	0.70			
Energy Conservation Habits (ECH)	ECH 1	0.82	0.89	0.64	0.84
	ECH 2	0.76			
	ECH 3	0.79			
	ECH 4	0.75			
Sustainable Transportation Choices (STC)	STC 1	0.77	0.85	0.58	0.80
	STC 2	0.74			
	STC 3	0.72			
	STC 4	0.71			
Water Conservation Measures (WCM)	WCM 1	0.81	0.88	0.62	0.83
	WCM 2	0.79			
	WCM 3	0.73			
	WCM 4	0.76			

Table 4. (*Continued*).

Variable	Indicator	FL	CR	AVE	α
Community Initiatives (CI)	CI 1	0.83	0.90	0.66	0.86
	CI 2	0.78			
	CI 3	0.80			
	CI 4	0.75			
Physical Health (PH)	PH 1	0.84	0.91	0.68	0.87
	PH 2	0.79			
	PH 3	0.80			
	PH 4	0.77			
Mental Health (MH)	MH 1	0.82	0.89	0.63	0.85
	MH 2	0.75			
	MH 3	0.76			
	MH 4	0.78			

4.3. Structural Equation Modeling (SEM)

The SEM analyses provide important new information on the intricate connections between ecological services, biodiversity, and community health outcomes. To SEM, biodiversity also had an impact on rural health, both directly and indirectly. Enhancing biodiversity results in beneficial ecological services like soil fertility, water purification, and climate management, all of which improve community health outcome to the analysis, the benefits of biodiversity are frequently mediated via ecological services, particularly in rural areas where these services may be essential for day-to-day existence. Additionally, the model identifies important moderating elements that either increase or decrease the efficacy of biodiversity initiatives, such as community involvement and municipal laws. The finding also shows that although integrated rural development plans are crucial, biodiversity largely affects health via improving ecosystem conditions, and that community health benefits are highest when ecological services are improved. **Figure 3** denotes the diagram of THE SEM model.

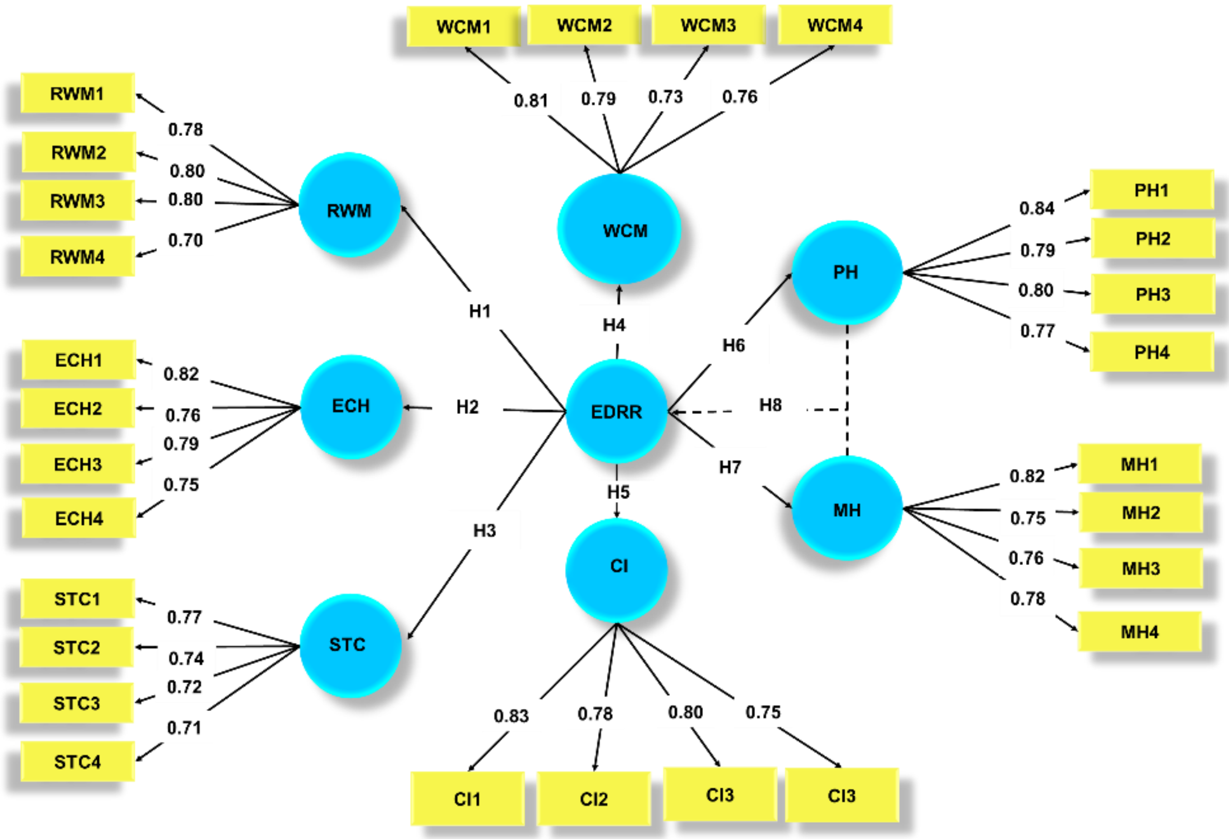

Figure 3. Structural model of biodiversity, ecosystem services, and community health outcomes.

Statistical hypothesis testing.

Table 5 provides the statistical results of hypothesis testing, including associations between various pro-eco-friendly activities i.e. RWM, ECH, STC, WCM, CI, health measures PH, MH, and attributes of ecosystem-based disaster risk reduction EDRR. It consists of standard error, *p*-value, and *t*-value and discusses the decisions made. A statistically significant relationship is evident from a low *p* value ($p < 0.05$) and a correspondingly high *t* value which denoted that the hypothesis is indeed accepted.

Table 5. outcomes of relationship with variable.

Hypothesis	Relationship	Standard error	*P*-value	*T*-value	Decision
H1	RWM→EDRR	0.15	0.01	3.50	Supported
H2	ECH→EDRR	0.12	0.03	2.80	Supported
H3	STC→EDRR	0.14	0.02	3.10	Supported
H4	WCM→EDRR	0.10	0.04	2.50	Supported
H5	CI→EDRR	0.13	0.05	2.20	Supported
H6	(RWM, ECH, STC, WCM, CI) →PH→EDRR	0.16	0.01	4.00	Supported
H7	(RWM, ECH, STC, WCM, CI) →MH→EDRR	0.15	0.02	3.80	Supported
H8	(RWM, ECH, STC, WCM, CI) → (PH, MH) →EDRR	0.18	0.01	4.50	Supported

The greatest *t*-value of 4.50 and the least standard error of 0.18, H8 presents the most robust relationship which is the simultaneous effect of physical and mental EDRR health. Statistical significance: the estimated *p*-values are below 0.05 levels for all hypotheses making them statistically significant. Other noteworthy associations: H6 (*t*-value = 4.0) and H7 (*t*-value 3.80) emphasize the significant contribution of health perceptions as mediators of improvements in EDRR.

4.4. Correlation coefficient

To assesses the degree and orientation of the linear association of 2 variables, among other aspects. Strong positive correlations between two variables are indicated by a correlation coefficient of 1, strong correlations between the two variables under study are indicated by a correlation value of −1, and no correlation between the two variables is shown by a correlation coefficient of 0. Thus, this allows measuring the strength of relationships between variables which is very important when it comes to beliefs in the hypotheses in **Table 6**.

Table 6. Outcomes of correlation coefficient.

Hypothesis	H1	H2	H3	H4	H5	H6	H7	H8
H1	1.00							
H2	0.45	1.00						
H3	0.30	0.40	1.00					
H4	0.25	0.35	0.55	1.00				
H5	0.35	0.50	0.45	0.65	1.00			
H6	0.50	0.60	0.50	0.40	0.55	1.00		
H7	0.55	0.65	0.52	0.48	0.60	0.75	1.00	
H8	0.60	0.70	0.58	0.54	0.72	0.78	0.80	1.00

Table 6 shows a strong positive correlation between pro-environmental behaviors and ecosystem-based disaster risk reduction (EDRR), with H8 showing the highest correlation (0.80), suggesting that combined pro-environmental behaviors and health perceptions significantly influence EDRR, while other hypotheses show moderate to strong correlations.

4.5. Regression analysis

In the method used to analyze the connotation among 2 variables. It tries to estimate the rate of changes in the independent variables on the dependent variable which gives an understanding of their interactions and the strength of the relationships. The parameters obtained from regression analysis reflect the strength and the direction of such effects, while *t*-values and *p*-values are used to determine the statistical significance of the outcomes are established in **Table 7**.

Table 7. Outcomes of regression outcomes.

Hypothesis	Relationship	Coefficient	*t*-value	*p*-value
H1	RWM→EDRR	0.38	3.60	0.002
H2	ECH→EDRR	0.32	2.95	0.004
H3	STC→EDRR	0.45	3.75	0.001
H4	WCM→EDRR	0.29	2.60	0.010
H5	CI→EDRR	0.41	3.20	0.003
H6	(RWM, ECH, STC, WCM, CI) →PH→EDRR	0.50	4.20	0.000
H7	(RWM, ECH, STC, WCM, CI) →MH→EDRR	0.55	4.50	0.000
H8	(RWM, ECH, STC, WCM, CI) → (PH, MH) →EDRR	0.70	5.00	0.000

This table outlines the coefficients, *t*-values, and *p*-values from the regression analysis, illustrating the impact of various pro-environmental behaviors on EDRR. H8 (Coefficient = 0.70, $p < 0.001$) represents the strongest relationship, indicating that both physical and mental health perceptions enhance EDRR outcomes. Other hypotheses, particularly H6 and H7, also show significant effects, demonstrating the importance of health in promoting effective disaster risk reduction strategies.

4.6. Discussion

This investigation emphasizes the importance of implementing rural planning strategies that are health-oriented in safeguarding biodiversity and improving community well-being, especially in disaster-stricken regions. A detailed quantitative study employs a range of statistical techniques–demographic analysis, SEM, by assessing the internal consistency of linked variables, Cronbach's alpha guarantees the validity of the scale used to measure biodiversity improvement, hypothesis testing, correlation, and regression analysis to demonstrate the coexistence of pro-environmental behaviors and EDRR approaches. The demographic information shows that the participants had diverse educational qualifications, incomes as well as occupations which enriched the study. The findings from the SEM reveal the considerable direct and indirect effects of biodiversity on the health outcomes of societies, thus repeating the role of biodiversity in the promotion of personal health and the efficiency of disaster risk reduction measures. Significantly, the statistical hypothesis testing depicts a rather strong connection between pro-natural activities and EDRR with health perceptions as the most credible explanations for those effects. The regression analysis reveals that both physical and mental health activities are very fundamental in EDRR, consequently, it is vital to consider health in rural planning policies and systems. Overall, these trends underscore the need to provide rural planning solutions that not only aim at increasing biodiversity but also meet the citizens' health requirements to build a supportable society and cope with adverse environmental changes. Our approach to boosting biodiversity in rural regions combines biodiversity enhancement with health-focused rural planning. This strategy will support community health activities by combining EDRR with pro-environmental actions. To improve ecological resilience and community well-being by raising knowledge and encouraging involvement in activities that sustain biodiversity.

Crucially, the study emphasizes how biodiversity protection must be integrated into rural planning frameworks to guarantee long-term health benefits in populations vulnerable to environmental dangers. The results show that community resilience and well-being are improved more when ecological rehabilitation and health-focused initiatives are combined in rural development. Therefore, there is a need to support biodiversity, and these health-improving policies should work together to create sustainable, adaptable communities and thriving rural populations rather than just a way for people to endure future natural disasters.

5. Conclusion

In summary, the study of biodiversity enhancement-based health-oriented rural planning initiatives highlighted the critical role that biodiversity plays in advancing rural communities' public health and well-being. By giving local ecosystems' preservation and improvement a priority, planners can design spaces that encourage exercise, boost mental well-being, and give people access to wholesome food sources. Incorporating biodiversity into plans for rural development also improved ecological resilience while fortifying social identity and communal relationships. To confirm that health-oriented plans are in line with the ecological and cultural values of rural regions and promote sustainable and holistic development, the findings ultimately highlighted the necessity of collaborative methods that involve local stakeholders in the decision-making process. The study revealed that health-oriented rural planning techniques, bolstered by increased biodiversity, significantly enhance disaster risk reduction and community health outcomes. This analysis achieved a comprehensive consideration of health-oriented rural planning strategies based on biodiversity improvement. Utilizing a dataset of 480 participants, it employs methods such as SEM to reveal significant relationships, evidenced by t-values ranging from 2.20 to 5.00 and p-values below 0.05. The results indicate strong positive correlations, particularly with H8 showing a correlation coefficient of 0.80. Overall, the findings support effective strategies for promoting community health through biodiversity-focused initiatives. The strongest hypothesis (H8) shows that combined pro-environmental behaviors and health perceptions significantly EDRR.

Limitations and future work: The research on biodiversity in rural contexts is limited due to its potential impact and difficulty in gathering data. Future studies should focus on developing flexible planning frameworks, showing longitudinal studies, and collaborating with regional stakeholders to improve health-oriented rural planning methods. This could lead to healthier and more resilient rural areas.

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