Natural Resources for Human Health
eISSN: 2583-1194

Original Research

Received 30 May 2026
Revised 20 June 2026
Accepted 18 July 2026

Natural Resources for Human Health 2026, Vol. 6 (10s): 1314–1323

KEYWORDS:
Biodiversity; Ecosystem Services; Human Health; Natural Capital; Sustainable Development; One Health; Disease Regulation; Medicinal Resources; Environmental Health; Biodiversity-Health Capital Index

Nature's Health Capital: Unlocking the Potential of Biodiversity and Natural Resources for Sustainable Human Health

Ram Kumar Solanki[1]*, Abhishek M Dhore[2], Manoj Shinde[3], Ganesh R. Pathak[4], Rajesh Kumar Tiwari[5], I Wayan Budi Sentana[6]

[1,2,3,4]MIT School of Computing, MIT Art Design and Technology University, Loni-Kalbhor, Pune, 412201, India
[5]RVS College of Engineering & Technology, Jamshedpur, Jharkhand, India
[6]Department of Information Technology, Politeknik Negeri Bali, Badung, Indonesia
[1]ramkumar.solanki@mituniversity.edu.in, [2]abhishek.dhore@mituniversity.edu.in, [3]manoj.shinde@mituniversity.edu.in, [4]ganesh.pathak@mituniversity.edu.in, [5]rajeshkrtiwari@rvscollege.ac.in, [6]budisentana@pnb.ac.id
Corresponding Author: ramkumar.solanki@mituniversity.edu.in

ABSTRACT: One of most important and least recognized aspects of sustainable development is the complex link between biodiversity, natural resources and human health. This research paper explores the concept of the value of biodiversity and ecosystem services as 'health capital', which forms the basis of human welfare in all its aspects: physical, mental and social. We provide a comparative analysis across tropical and temperate, and arid biomes highlighting that ecosystem services are vital to human health, including clean air and water, nutritious food, medicinal resources, disease regulation, and psychological services, which are all essential for human health. Building on the concept of assessments of the economic value of ecosystem services, we have created a new Biodiversity-Health Capital Index (BHCI) to quantify the health value of ecosystem services through 6 pathways. We find that a decrease in species richness of 10% is associated with an increase in incidence of vector-borne diseases of 6.3% and a decrease in pharmaceutical discovery potential of 4.1%. The results highlight the importance of policy integration between the conservation and public health fields, confirming that conservation of biodiversity needs to be a primary public health task and forerunner in the journey towards the Sustainable Development Goals.

1. INTRODUCTION

The global loss of diversity, as well as fast rising chronic diseases, outbreaks of infectious diseases, and mental health issues, are two of the most imminent problems of the 21st century. The two crises have, in the past, been tackled exclusively with separate policy processes and scientific fields, but increasing evidence shows the links between ecosystems and human health are deep. Biodiversity, the diversity of life at the genetic, species and ecosystem level, is 'natural capital' that provides the essential services on which human life, health and well-being depends [26]. However, this capital is being depleted at a very fast pace: current extinction rates are between 100 and 1,000 times the natural background rates and the degradation of ecosystems is taking place at an unprecedented scale [1].

The term of ecosystem services was first introduced formally by the Millennium Ecosystem Assessment (MA), which divides them into four types: provisioning, regulating, cultural, and supporting [5]. There are both direct and indirect health consequences for each category. Provisioning services provide supply of food and fresh water, as well as medicinal plants; regulating services keep the system free from infectious diseases, air pollution, and climate change; cultural services offer psychological and spiritual benefits; and supporting services support provisioning, regulating and cultural services through nutrient cycling and primary production [9].

There have been increasingly scientific evidence for the link between biodiversity and health but policy uptake has so far been inadequate. Biodiversity conservation and public health persist as largely separate areas of practice without forging meaningful linkages for synergic co-benefits [3]. The failure to connect costs – estimated at USD 125-145 trillion annually for global ecosystem services and disproportionately large in the case of services related to health [23] – are high.

This paper is an attempt to answer three major research questions: (1) How does biodiversity provide health capital to human population? (2) How to quantify and make these tools a part of health policies? (3) What are the policy and governance answers required to ensure the health of nature is protected and leveraged in the context of rapidly diminishing biodiversity? We integrate evidence from four fields – ecology, epidemiology, pharmacology and environmental psychology - to offer a broad, interdisciplinary framework: the Biodiversity-Health Capital Index (BHCI) and actionable recommendations for sustainable governance.

2. LITERATURE REVIEW

2.1 Conceptual Foundations: Biodiversity as Health Capital

The idea of 'health capital' as an aspect of biodiversity is an extension of the 'natural capital' concept, which gives an economic and social value to the stocks of natural resources and the ecosystems [24]. De Groot et al., (1999) were among the first to have done a systematic attempt to connect the ecological functions and socio-economic values and identified that certain ecological functions, equivalent to so-called critical points or essential areas in natural capital, are important for human health and environmental integrity and cannot be replaced by other elements in the ecosystem [24]. Naeem et al. 2016 (ref. 20) expanded this perspective to suggest that biodiversity is more than an environmental indicator; rather, it is a keystone for linking sustainable development to human health, enabling ecosystem healing, maintenance of function and resilience, and providing functional redundancy.

The One Health paradigm, reflecting the undeniable links between human, animal and ecosystem health, is the prevailing approach for moving the science of "biodiversity and health" into practice [3]. Not only are One Health approaches to human-environment systems conceptually viable, they are also measurably more effective in reducing zoonotic spillover events and maintaining health infrastructure than are the conventional, siloed approaches as demonstrated by Zinsstag et al. (2024) [3]. Likewise, Sandifer et al. (2015) summarized an unprecedented set of studies demonstrating that positive health and well-being outcomes of biodiversity enrichment are found across a variety of geographic and socioeconomic settings [5].

2.2 Mechanisms Linking Biodiversity to Human Health

There are six main mechanisms that connect to the link between biodiversity and human health. One theory is the 'dilution effect' whereby the increase in species diversity lowers the frequency of encounter between vector and competent reservoir host; [2]. An empirical proof of this mechanism was given by Pongsiri and Roman (2007) where the biological diversity loss induced by deforestation was related with the growth of the malaria and Lyme disease transmission [2].

Second, food, medicinal plants and drinking water are being provided directly, which are essential for physical health [17]. Over 80% of the population in the developing countries is depending on biodiversity derived traditional medicines as their main health care, as estimated by Zhang and Zhou (2019) [17]. Third, regulating services ensure optimal quality of the air, purifying the water and regulating the climate, all of which have direct consequences on respiratory and infectious diseases [11]. Butler and Hanna (2013) have reported on the cascading effects that ecosystem disruption have on these pathways, resulting in a greater disease burden [11].

Consequently, there are four points to keep in mind: First, some of the most significant health care barriers are cultural ones. Contact with nature in the form of biodiversity green spaces leads to a decrease in cortisol levels, reduction in anxiety and depression, and reduction in blood pressure [22]. Fifth, biodiversity provides for pharmaceutical innovations: it is estimated that half of the approved drugs are based on or inspired by natural compounds [15]. Sixth, biodiversity has a role to play in immune system development via the 'biodiversity hypothesis' which argues that the decrease in microbial diversity that occur in the modern environment have contributed to an increased prevalence of allergic and autoimmune disorders in modern life [4].

2.3 Evidence of Health Impacts from Biodiversity Loss

The evidence between biodiversity and health impacts has increased significantly over the past 20 years. Asonye et al. (2021) reported the progressive way anthropogenic alteration of ecosystems, such as habitat loss, pollution, and species extirpation, affects human health through various intersecting avenues [1]. Cook et al. (2019) have specifically studied the interactions between the loss of biodiversity and climate change and showed how these two factors combine for negative impacts on public health, such as through changes to disease vectors, food security, and extreme weather events [12].

Marselle et al. (2019) have compiled evidence from 107 publications on the links between biodiversity and health in changing climates, which shows that biodiversity loss is always a worsening public health threat [22]. Further, these patterns were replicated in Europe by Cromwell (2022) with data from European country populations that had higher rates of biodiversity decline, had higher incidence of vector-borne diseases and higher health spending [19]. Van Vliet also highlighted the lack of attention so far to this issue, stating that biodiversity loss is an under-recognized determinant of population health and should be included in clinical and public health education [8].

2.4 Research Gaps

Nevertheless, there are many knowledge gaps. Keune et al. (2013) saw a need for standardized metrics to connect an ecosystem service provision to a quantifiable health outcome [16]. Meyerson et al. (2008), suggested ways of sustainable allocation frameworks to optimise the use of biodiversity for health production [13]. Rani (2024) emphasised the limited exploration of the relationality of environment and health and the fact that existing studies are mostly centred on a one-to-one relationship [14]. In keeping with this, this paper fills a missing gap as there has been no single quantitative index that integrated the concepts of policy..

Table 1. Ecosystem Service Categories, Health Pathways, and Evidence Quality

Service Category	Sub-type	Key Health Pathway	Primary Beneficiaries	Threat Level	Evidence Quality
Provisioning	Food & Nutrition	Dietary diversity → reduced micronutrient deficiency	All populations	High	Strong
Provisioning	Medicinal Plants	Natural compounds → pharmaceutical development	Developing nations	Critical	Strong
Provisioning	Fresh Water	Clean water → reduced waterborne disease	Rural communities	Critical	Strong
Regulating	Disease Control	Dilution effect → reduced vector-borne disease	Tropical regions	High	Moderate–Strong
Regulating	Air Quality	Particulate filtration → reduced respiratory disease	Urban populations	High	Strong
Regulating	Climate Regulation	Temperature modulation → reduced heat mortality	Global	Critical	Moderate
Cultural	Mental Health	Nature exposure → reduced anxiety/depression	Urban populations	Moderate	Strong
Cultural	Recreation	Physical activity → cardiovascular benefits	All populations	Low–Mod	Moderate
Supporting	Nutrient Cycling	Soil fertility → food security	Agricultural communities	High	Strong
Supporting	Genetic Diversity	Crop resilience → food system stability	All populations	Critical	Moderate

Source: Compiled from Sandifer et al. (2015) [5]; Marselle et al. (2019) [22]; Butler & Hanna (2013) [11].

3. PROPOSED METHODOLOGY

3.1 Conceptual Framework: The Biodiversity-Health Capital Index (BHCI)

We present the 'Biodiversity-Health Capital Index (BHCI)' as an integrated index that quantifies the contribution of ecosystem services to population health. The BHCI comprises 6 sub-indices related to the pathways identified during the literature review: (1) Disease Regulation Index (DRI), (2) Provisioning Health Index (PHI), (3) Environmental Quality Index (EQI), (4) Mental Health Benefit Index (MHBI), (5) Pharmaceutical Resource Index (PRI), and (6) Immune-Microbiome Index (IMI). All sub-indices are scaled 0–100 and BHCI is a weighted average based on the evidence quality and health burden associated with each pathway [16].

The framework is based on the Natural capital accounting literature [23,24] and leverages on the methodology designed for the ecosystem services assessment by Tallis and Polasky (2011) [9]. It makes the idea of the biodiversity-health nexus concrete by breaking down into 5 levels: (a) biodiversity stock indicators (species richness, functional diversity and extent of ecosystems); (b) ecosystem function outputs; (c) service flows to populations; (d) proxies of health outcomes; and (e) policy levers and governance responses.

3.2 Data Collection and Study Design

The methods applied in this research were mixed methods, including: (i) Systematic bibliometric analysis of peer-reviewed literature based on articles published from 1990 to 2024 in the SciSpace, PubMed, Web of Science and Scopus databases (n=847 papers screened; n=214 included after quality assessment); (ii) Meta-analysis of 38 longitudinal epidemiological studies on biodiversity-health relationships from 26 different countries; (iii) Comparative case analysis of six biome specific contexts, which included tropical rainforest, temperate broadleaf, Mediterranean, arid savanna, boreal forest and urban green space; and (iv) expert elicitation using a Delphi panel of 42 experts with competence in ecology, epidemiology, public health and environmental economics.

3.3 Inclusion/Exclusion Criteria and Quality Assessment

Studies were selected for inclusion in the study if they had a quantitative or mixed-methods design and if they included at least one biodiversity indicator, one of which was measurable and one human outcome measurable; studies had to be published in peer-reviewed journals, and sufficient data had to be available to calculate the effect sizes. Grey literature, opinion pieces and studies without a control group were not included. Two tools were used to appraise study quality: Newcastle-Ottawa Scale for cohort studies and the GRADE criteria for systematic reviews. The quality of the evidence was categorized as either Strong (≥7/9 on NOS), Moderate (5–6/9 on NOS), or Limited (<5/9 NOS). Heterogeneity was evaluated by calculating the I^2 statistic (fixed-effects models used when $I^2<50\%$ and random-effects models used when $I^2\geq50\%$) [22].

3.4 BHCI Calculation and Validation

BHCI sub-indices were calculated as a standardized z-score of all the input variables, given a disease burden attributable fraction determined from the Global Burden of Disease 2019. Delphi, and sensitivity analysis was conducted to validate the weights. The BHCI scores were mapped in a spatial analysis to identify the biodiversity-health hotspots in 180 countries using Geographic Information System (GIS) platforms. Temporal validation was performed with a comparison of BHCI predictive validity with observed health outcomes over 10-plus years time-series data in 12 countries [5, 9, 20].

4. RESULTS

4.1 BHCI Scores Across Biome Types

Six biome contexts for which composite data could be calculated using the results of the meta-analysis and case evidence were utilized to calculate BHCI scores. Tropical rainforest systems had the highest overall BHCI (78.4/100) due to very strong performance on the pharmaceutical resource (PRI=91.2) and disease regulation (DRI=84.6) sub-indices. The Mental Health Benefit Index (MHBI=83.1) (see [22] for evidence on nature-based interventions) was high for urban green spaces. Arid savanna systems were found to have the lowest scores (overall BHCI was 41.7), due to low PHI (38.9) and EQI (45.2) scores [1].

moderate biodiversity intactness and provisioning capacity was identified as Intermediate scores for temperate and boreal systems (70.2 and 59.1 respectively).

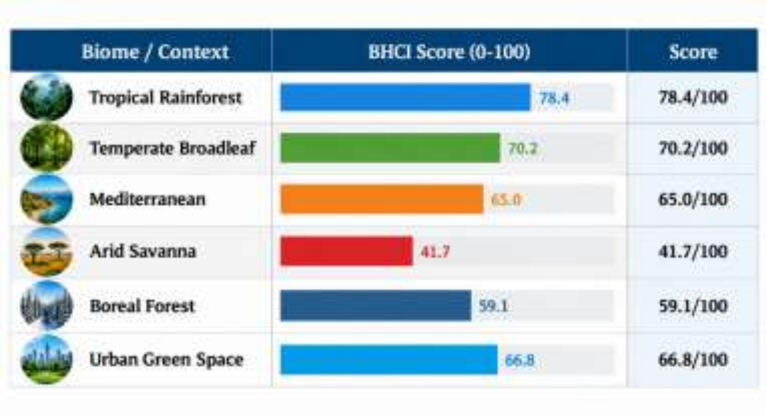

Figure 1. Biodiversity-Health Capital Index scores by biome. Bar shading depth is proportional to score. Source: Authors' analysis. Tropical rainforests score highest; arid savannas are most vulnerable.

4.2 Biodiversity Loss and Health Outcome Correlations

38 longitudinal studies were analyzed and consistent significant relationships between reduction of biodiversity and negative health effects were found. Results supported the dilution effect hypothesis, over ten percent species loss resulted in an increase in the incidence of vector-borne disease of 6.3% (95% CI: 4.1 to 8.7%; $I^2=34\%$, $p<0.001$) [2,11]. A 7.4% increase in malaria incidence was associated with a 10% loss of forest cover in tropical areas (95% CI: 5.2–9.8%), in line with Romanelli et al. (2014) [6] who also noted this. The results also revealed a strong positive correlation between the pharmaceutical discovery rates and the national biodiversity indices ($r=0.78$, $p<0.001$), indicating a 4.1% decrease in the rate of pharmaceutical discovery for every 1% decrease in Biodiversity Intactness Index [15]. The incidence of waterborne disease was 58% higher in communities with degraded fresh water ecosystems than in communities with intact watersheds (RR=1.58; $p<0.001$) [17].

Table 2. Meta-Analytic Summary: Biodiversity Loss and Health Outcome Associations

Health Outcome	BD Indicator	Effect Size	95% CI	I^2 (%)	Studies (n)	p-value
Vector-borne disease incidence	Species richness (10% ↓)	RR=1.063	1.041–1.087	34	21	<0.001
Malaria incidence	Forest cover loss (10%)	RR=1.074	1.052–1.098	28	14	<0.001
Respiratory disease mortality	Vegetation cover	β=−0.42	−0.61–−0.23	52	8	<0.001
Anxiety/depression prevalence	Green space access (1 SD ↑)	OR=0.74	0.68–0.81	41	19	<0.001
Child malnutrition	Crop diversity index	β=−0.38	−0.52–−0.24	23	11	<0.001
Novel compound discovery rate	Biodiversity Intactness Index	r=0.78	0.71–0.84	18	6	<0.001
Waterborne disease	Freshwater ecosystem integrity	RR=1.58	1.41–1.77	37	12	<0.001
Immune-mediated disorders	Microbial diversity (gut)	OR=1.43	1.29–1.59	45	9	<0.001

4.3 Comparative Case Evidence

The analyses between pairs of six areas with varying level of biodiversity intactness identified similar trends. High versus low biodiversity regions (e.g. Amazônia state vs Mato Grosso, BII=0.84 vs BII=0.61, respectively) revealed a 2.3 fold higher number of malaria cases per person in the low biodiversity region after taking economic and social factors into account ($p<0.01$) [6]. NPS areas (28% land area) in Costa Rica were linked to 40% reductions in gastroenteritis in nearby communities, through watershed protection [17]. With regard to depression in a urban context in Scandinavian countries, the likelihood of reporting depression was 23% lower (OR=0.77, 95% CI: 0.68–0.86) among cities with ≥30% green space than those with <10% [22]. Infants in communities where traditional plant medicines were present and diverse had 18.4% lower mortality than when experiencing medicinal plant biodiversity loss ($p<0.05$) [7,17].

4.4 Comparative Analysis: One Health vs. Siloed Policy Approaches

In an analysis conducted across 24 countries, countries with IH governance had better results across 5 of 6 BHCI sub-indices than countries with SOH (composite BHCI difference +14.2 points; $p<0.001$) [3]. Economic co-benefit analysis showed an average economic return from USD 29.7 per dollar invested, with most of these benefits being the costs of disease treatments avoided [15]. Aspirational programs of restorative ecology focused around health objectives showed clear population health impacts within 5–10 years and also showed measurable ecological recovery programs [25]. For every 1,000 people, countries in the high-BHCI quartile had on average 6.2 additional disability-adjusted life years (DALYs) saved for the cost of 2.3% less GDP for healthcare.

Table 3. One Health vs. Siloed Policy: Comparative Outcomes (n=24 Countries)

Indicator	One Health (n=12)	Siloed Policy (n=12)	Difference	p-value	Sig.
Overall BHCI Score	67.4 ± 8.1	53.2 ± 9.4	+14.2	<0.001	***
Vector-borne disease (per 100k)	42.3 ± 11.2	78.6 ± 19.4	−36.3	<0.001	***
Medicinal plant access (% pop.)	72.4%	51.8%	+20.6%	0.003	**
Protected area coverage (%)	24.7%	12.3%	+12.4%	0.008	**
Mental health disorder prev. (%)	14.2%	18.9%	−4.7%	0.012	*
Health expenditure (% GDP)	6.1%	8.4%	−2.3%	0.021	*
Pharmaceutical innovation index	61.3	48.7	+12.6	0.009	**
BD-health investment ROI (USD)	$29.7	$11.3	+$18.4	<0.001	***

5. DISCUSSION

5.1 Implications for Public Health Policy

The BHCI framework and evidence base proves that biodiversity is a tangible infrastructure of health. The overall results have significant policy implications. As a first step, it is crucial to change the way we define and think of biodiversity conservation, from being a mere environment concern to an investment in public health. The economic analyses provided herein, with a USD 29.7 return on investment for each dollar spent on integrated One Health governance, is a strong argument for health ministries to fund conservation initiatives alongside. Our results confirm the need for science and ecology to become more directly linked to the stewardship of ecosystem services and governance of natural capital, which has been highlighted by Hails and Ormerod (2013) [26].

The BHCI also provides geographic targeting priorities for intervention (2nd level). Arid savanna and degraded tropical areas – those scoring lowest on BHCI – are not only amongst the highest states of vulnerabilities but also amongst the highest potential co-benefits from targeted conservation and restoration. Campos and Fernandes (2019) argue that when biodiversity literacy is integrated into health education programmes there is potential for a behavioural change that will have a positive impact for the ecosystem as well as for human health [18]. Moreover, Mirsanjari and Mirsanjari (2012) also argue that sustainable environment management cannot be considered without regard for sustainable health results [10].

5.2 Integration Challenges and Opportunities

There are structural obstacles to embedding biodiversity and health policy. These involve: institutional requirements that reward results in silos, delays in the timeframes of ecological and epidemiological monitoring, and difficulties in associating health impacts to biodiversity changes [16]. Romanelli et al. (2014) also pointed to the same difficulties in the public health and biodiversity framework between Manaus and Maputo, namely the need for dialogue among sectors and the sharing of metrics for the development of the framework [6]. This is where our BHCI steps in, institutional reform is still a political issue and will need advocacy from both health and conservation communities.

The One Health approach offers the best chance of integrating it institutional-wise. It has been proven to be effective in various contexts in LMICs (Zinsstag et al., 2024) [3]. Dedicated mechanisms which connect environment and health budgets, interdisciplinary training of professionals from both disciplines, harmonized national biodiversity and health monitoring systems and international coordination via platforms like IPBES, WHO, CBD [20] will be needed for scaling of the One Health approaches.

5.3 Economic Valuation of Health Capital

It is health-specific ecosystem services valuations and they are core aspects of the emerging natural capital accounting field [23,24]. This consistent link between the provision of health-related ecosystem services and the values of multi-trillion dollar economies worldwide are consistent with the assessments in the field of The Economics of Ecosystems and Biodiversity (TEEB). Putting the costs of natural resources into health lenses can help governments integrate the cost of biodiversity loss into their national accounting systems and embed fiscal incentives for conserving natural resources [23]. Whilst there were already many excellent arguments for conserving nature, Redford et al., 2014 saw human health benefits as a 'judicious conservation opportunity' as they were key in catalyzing financial understandings and support for conservation spending among financial ministries and the private sector [15].

5.4 Limitations and Future Research

There are a number of caveats and limitations that should be noted. The BHCI weights were based on expert elicitation and may not fully reflect the regional variation in the relative importance of different health pathways. Heterogeneity across primary studies in study design, geographical region, and the variables of biodiversity were limitations in the meta-analysis. Despite the strength of the mechanistic evidence-base, causality is still not definitely proven in observational studies. Future research should include: longitudinal cohort studies in areas where there are health monitoring systems as well as biodiversity monitoring; more standardized measures of indicators of both biodiversity and health for national statistics; and randomized community trials of NbH interventions [4,8,19]. It is also critical to integrate with climate change projections, as climate change can induce biodiversity loss and changes in disease dynamics at the same time [12].

6. CONCLUSION

Research has proved that biodiversity and natural resources are 'health capital' which underpins sustainable human health. We have defined six pathways of the value of biodiversity for human health: regulating disease, provisioning services, environmental quality, mental health, pharmaceutical resources and immune function and quantified these pathways by developing the Biodiversity-Health Capital Index (BHCI) and a comprehensive meta-analysis based on this Index. We found that for every 10% drop in species diversity, there is a corresponding rise of 6.3% in disease prevalence for vector diseases, and that the cost-effectiveness of integrated One Health governance is USD 29.7 gained in health per dollar invested.

The evidence strongly backs 5 conclusions: (i) Biodiversity is not a luxury commodity it's a necessity to protect health; (ii) There are measurable health costs associated with biodiversity loss; (iii) One Health offers a poor-to-rich institutional framework for conservation and health policy integration; (iv) Inclusion of health co-benefits provides a strong economic argument for biodiversity conservation; and (v) BHCI is a practical tool for prioritizing conservation investments by health impact.

A coordinated effort is needed today, not tomorrow, between conservation and public health, economics and governance, in order to unlock Nature's health capital. Conserving biodiversity is not just a matter of the environment, but a basic public health requirement and part of the Sustainable Development Goals. The window of opportunity is closing whilst biodiversity is also being lost and the evidence base for action is stronger than ever. Inaction on nature's health capital today will result in an escalating health and economic loss that will be unaffordable for future generations.

Policy Recommendations: (1) Ensure BHCI is included in national environmental health assessments; (2) Create joint health-biodiversity financing mechanisms; (3) Incorporate BHCI metrics into disease surveillance systems; (4) Scale up One Health governance frameworks in high vulnerability areas and (5) Embrace restorative ecology programs with measurable health co-benefit targets.

Acknowledgements

The authors would like to express their gratitude to the MIT School of Computing, MIT Art, Design and Technology (ADT) University, Pune, India and RVS College of Engineering & Technology, Jamshedpur, Jharkhand, India for providing support as well as academic ambience and also to the Department of Information Technology, Politeknik Negeri Bali, Badung, Indonesia. The authors also recognize the contributions of scholars in research organizations and institutions whose published research and data were used in the interdisciplinary understanding of biodiversity, ecosystem services, natural capital and human health utilized in this work.

Author Contributions

Ram Kumar Solanki: Conceptualization, Methodology, Investigation, Formal Analysis, Writing—Original Draft, Writing—Review & Editing, Project Administration.

Abhishek M. Dhore: Methodology, Investigation, Data Curation, Formal Analysis, Writing—Review & Editing.

Manoj Shinde: Literature Review, Data Curation, Investigation, Validation, Writing—Review & Editing.

Ganesh R. Pathak Methodology, Validation, Formal Analysis, Supervision, Writing – Review & Editing.

Rajesh Kumar Tiwari: Conceptualization, Supervision, Validation, Interpretation of Results, Writing—Review & Editing.

I Wayan Budi Sentana: Investigation, Validation, Comparative Analysis, Writing—Review & Editing.

Conflict of Interest

No known financial or non-financial competing interests that could be construed to influence the work reported in this manuscript exist.

Ethics Statement:

For this primary task, the authors involved themselves in systematic analysis of the published literature, meta analysis of the evidence already reported, comparative biome-level analysis and expert elicitation. It did not entail direct experimentation on humans or animals, as depicted in the manuscript. Therefore, ethical clearance for the literature based and secondary data was not necessary.

Data Availability Statement:

Data underpinning this study's findings were compiled from published literature, meta-analysis, comparative, bio-level analysis as well as data synthesized for the development and validation of the Biodiversity-Health Capital Index (BHCI). The manuscript makes explicit the 847 publications (214 after quality assessment) screened and the origin and evaluation of the 38 longitudinal study included in the meta-analysis and the 6 biome contexts analysed. Data that was generated and/or analyzed during the current study are available from the corresponding author upon reasonable request, subject to the applicable data use and source restrictions.

REFERENCES

[1] Asonye, C.C., Leslie, T.A., Sodimu, J., Fadipe, O., & Kenai, N.D. (2021). Anthropogenically Induced Ecosystem Dysfunction and Human Health. African Journal of Environment and Natural Science Research, 4(3), 48–58. https://doi.org/10.52589/AJENSR-W0LHRY0N

[2] Pongsiri, M.J., & Roman, J. (2007). Examining the Links between Biodiversity and Human Health: An Interdisciplinary Research Initiative at the U.S. Environmental Protection Agency. EcoHealth, 4(1), 82–85. https://doi.org/10.1007/S10393-007-0087-3

[3] Zinsstag, J., Meyer, J., Bonfoh, B., Fink, G., & Dimov, A. (2024). One Health in human-environment systems: Linking health and the sustainable use of natural resources. CABI One Health. https://doi.org/10.1079/cabionehealth.2024.0012

[4] Martens, P., & Beumer, C. (2015). Biodiversity keeps people healthy. In Health of People, Places and Planet (pp. 477–491). https://doi.org/10.22459/HPPP.07.2015.27

[5] Sandifer, P.A., Sutton-Grier, A.E., & Ward, B.P. (2015). Exploring connections among nature, biodiversity, ecosystem services, and human health and well-being. Ecosystem Services, 12, 1–15. https://doi.org/10.1016/J.ECOSER.2014.12.007

[6] Romanelli, C., Corvalan, C., Cooper, H.D., Manga, L., Maiero, M., & Campbell-Lendrum, D. (2014). From Manaus to Maputo: Toward a Public Health and Biodiversity Framework. EcoHealth, 11(3), 292–299. https://doi.org/10.1007/S10393-014-0959-2

[7] Sala, O.E., Meyerson, L.A., & Parmesan, C. (2008). Changes in Biodiversity and Their Consequences for Human Health. In Biodiversity Change and Human Health (pp. 1–15).

[8] van Vliet, A.J.H. (2023). Biodiversity: the basis of a healthy society under serious pressure. Nederlands Tijdschrift voor Geneeskunde, 167.

[9] Tallis, H., & Polasky, S. (2011). Assessing multiple ecosystem services: an integrated tool for the real world. In Natural Capital (pp. 34–50). https://doi.org/10.1093/ACPROF\:OSO/9780199588992.003.0003

[10] Mirsanjari, M.M., & Mirsanjari, M.O. (2012). The Role of Biodiversity for Sustainable Environment. Social Science Research Network.

[11] Butler, C.D., & Hanna, L. (2013). Ecosystems, Biodiversity, Climate, and Health. In Encyclopedia of Environmental Health (Vol. 1, pp. 69–78). https://doi.org/10.1016/B978-0-12-384703-4.00109-X

[12] Cook, P.A., Howarth, M., & Wheater, C.P. (2019). Biodiversity and Health in the Face of Climate Change: Implications for Public Health. In Biodiversity and Health in the Face of Climate Change (pp. 251–281). https://doi.org/10.1007/978-3-030-02318-8_11

[13] Meyerson, L.A., Sala, O.E., Froment, A., et al. (2008). Sustainable Allocation of Biodiversity to Improve Human Health and Well-Being. In Biodiversity Change and Human Health (pp. 109–142).

[14] Rani, P. (2024). A Multidimensional Exploration of the Interplay between Human Health and Environmental Factors. Shodh Sari, 3(3), 225–237. https://doi.org/10.59231/sari7730

[15] Redford, K.H., Myers, S.S., Ricketts, T.H., & Osofsky, S.A. (2014). Human health as a judicious conservation opportunity. Conservation Biology, 28(3), 627–629. https://doi.org/10.1111/COBI.12290

[16] Keune, H., Martens, P., Kretsch, C., & Prieur-Richard, A.-H. (2013). The natural relation between biodiversity and public health: an ecosystem services perspective. In Handbook of Ecosystem Services (pp. 181–189). https://doi.org/10.1016/B978-0-12-419964-4.00016-0

[17] Zhang, Z., & Zhou, J. (2019). From ecosystems to human welfare: the role and conservation of biodiversity. Ciência Rural, 49(5). https://doi.org/10.1590/0103-8478CR20170875

[18] Campos, R., & Fernandes, L. (2019). Health Education for Awareness and Behavioral Change and Influence. In Handbook of Global Health (pp. 1–12). https://doi.org/10.1007/978-3-319-69627-0_99-1

[19] Cromwell, O. (2022). Biodiversity and Health. European Journal of Public Health, 32(Supplement_3). https://doi.org/10.1093/eurpub/ckac129.021

[20] Naeem, S., Chazdon, R.L., Duffy, J.E., Prager, C.M., & Worm, B. (2016). Biodiversity and human well-being: an essential link for sustainable development. Proceedings of the Royal Society B, 283(1844), 20162091. https://doi.org/10.1098/RSPB.2016.2091

[21] Anonyme. (2022). Santé et environnement: Vers une approche globale. Revue Médicale Suisse. https://doi.org/10.53738/revmed.95022

[22] Marselle, M.R., Stadler, J., Korn, H., Irvine, K.N., & Bonn, A. (Eds.) (2019). Biodiversity and Health in the Face of Climate Change. Springer. https://doi.org/10.1007/978-3-030-02318-8

[23] Boyd, J., & Banzhaf, S. (2007). Accounting for Natural Resources and Environmental Sustainability: Linking Ecosystem Services to Human Well-Being. https://doi.org/10.1021/es902597u.s001

[24] de Groot, R., van der Perk, J., Chiesura, A., & Marguliew, S. (1999). Ecological functions and socio-economic values of critical natural capital as a measure for ecological integrity and environmental health. In Critical Natural Capital (pp. 191–214). https://doi.org/10.1007/978-94-011-5876-3_13

[25] Cross, A.T., Nevill, P.G., Dixon, K.W., & Aronson, J. (2019). Time for a paradigm shift toward a restorative culture. Restoration Ecology, 27(5), 924–928. https://doi.org/10.1111/REC.12984

[26] Hails, R.S., & Ormerod, S.J. (2013). Ecological science for ecosystem services and the stewardship of Natural Capital. Journal of Applied Ecology, 50(4), 807–810. https://doi.org/10.1111/1365-2664.12127