

Planetary Health Interventions and the Need for a Unified Global Informatics Tool: A Narrative Review

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ABSTRACT

Planetary Health emphasises the sustainability of natural systems for human well-being, linking human health directly with environmental health. This interdisciplinary concept has gained importance as anthropogenic activities have led to climate changes and health impacts. Despite efforts, a cohesive approach to planetary health from local to global levels remains lacking. The present review analysed 24 sources, including grey literature and published studies, identifying 40 interventions aimed at improving planetary health. The majority of research, primarily from the United States, focuses on reducing air pollution and greenhouse gas emissions. Effective strategies highlighted include promoting active transportation, improving diets, increasing physical activity, and engaging with indigenous communities to protect both environmental and human health. However, a significant gap exists in integrating these interventions through a unified informatics tool, which could enhance coordination and implementation of planetary health measures globally. The review underscores the necessity for a more integrated approach and the development of a global database to consolidate and manage planetary health interventions effectively.

Keywords: Anthropogenic activities, Climate change, Public health, Sustainability

INTRODUCTION

Planetary health can be defined as the 'health of humanity and the health of nature on which it relies'. This modern science combines two systems into one concept. The first is the health of humans within human communities, and the second is the health and safety of the environment on which humans depend for sustainability [1]. The term 'Planetary Health' is different from 'One Health' and 'EcoHealth'. One Health works together for the health of humans, animals, plants, and the environment, while EcoHealth is a wider multidisciplinary approach towards ensuring the health of all living species on earth from unicellular to multicellular organisms together with environmental health. Planetary Health, on the other hand, deals with achieving the highest standard of health, equality, and well-being attainable through intricate attention to all social, democratic, and financial aspects of human civilisation and the associated health of the environment on which humans depend to flourish [2].

The Anthropocene epoch has witnessed enormous and multiple civilisational and technological advancements, causing devastating effects on the planet. As a consequence, climate health has been largely affected, leading to unpredictable changes in all ecosystems, ultimately posing a risk to species' survival [3]. Climate change undeniably presents as one of the major threats to human and environmental health [4]. The hazardous long-term changes in temperature and weather patterns affect the climate and worsen the quality of health, lifestyle, and habitat of all humans and animals. Without immediate actions to limit climate change and ensure planetary health, the adverse effects will continue to harm all life forms on Earth, leading to devastating outcomes that will make the planet unsuitable for healthy life existence [5,6].

ThereportsfromUnitedinSciencestatesthatgreenhousegasemissions and fossil fuel emissions are far higher than the pre-pandemic level after a temporary reduction during the Coronavirus Disease-2019 (COVID-19) lockdown [7]. This temperature rise has its influence on all components of Earth's ecosystem. Nearly all countries are facing hot days and heatwaves now-a-days, increasing the incidences of temperature-related diseases, abrupt wildfires, melting glaciers, water scarcity, droughts, and catastrophes, ultimately leading to the loss of biodiversity and health deterioration [8,9].

Climate change continues to be the greatest health threat to humanity. The World Health Organisation estimates 250,000 additional deaths due to malnutrition, heat stress, and diarrhoea caused by climate change from 2030-2050. Developing countries with substandard health infrastructure will be more susceptible to damage and calamity without proper assistance [10]. This calls for the urgent need to conceptualise and implement 'Planetary Health' that interconnects environment and global health by the precise delineation of several advantages and exchanges for public health and biological ecosystems of decisions concerning climatic change in line with the Sustainable Development Goal of taking immediate action to combat the changes in climate and its potential dangers [11-13].

The World Health Organisation uses the concept of Planetary Health to address the sustainable development goals by clearly recommending actionable strategies to governments, communities, healthcare providers, stakeholders, and individuals in society to safeguard human health through the health of the planet [14]. Planetary health can be implemented to develop ground breaking interventions to restore the health of the planet and thereby human health by interlinking all human systems and ecosystems. Planetary stewardship can be implemented right from the primary healthcare setting, creating local to global initiatives for the betterment of humans and the Earth [15,16].

The rising global climate change poses an ultimatum demanding immediate and effective sustainability actions to preserve the planet's health and human survival. Before the lavish and enormous resources of nature turn perishable, every citizen must take responsibility for safeguarding the environment. Given this, Planetary Health has an immense role and is extremely important to strengthen and conserve the durable nature to preserve healthy human existence [17,18]. To this end, the present narrative review was conducted to report on all the planetary health interventions worldwide and to recommend the creation of a global informatics tool that can bring to light all the existing interventions so that re-testing, evaluation, and implementation can be initiated on a global and regional level.

For the present narrative review, the authors searched the databases Google Scholar and PubMed using key search terms like 'Planetary

Health', 'Climate Health', 'Policies', 'Solutions', 'Problems', 'Impact', 'Interventions', 'Innovations', 'Programs', 'Climate Health Interventions', 'Climate Health Innovations'. Studies and grey literature selected were from the years 2007 to 2022. Literature search and data extraction were carried out in December 2022. [Table/Fig-1] shows a summary of study characteristics and interventions [19-42].

Planetary Health Interventions

The following [Table/Fig-1] shows the detailed description of all the planetary health interventions included for the present review.

Summary of Implemented Planetary Health Interventions:

The implemented planetary health interventions have focused on reducing pollution and improving healthcare access in

Study ID	Author	Year	Country	Study design	Actionable element	Intervention	Objective	Status of intervention
1	Tasoff H [19]	2007	Indonesia	Grey literature	Healthcare	Developing the healthcare facilities in rural Indonesia	To improve the access to healthcare and prevent illegal logging	Tested
2	Jones IJ et al., [20]	2020	Rural Borneo	Grey literature	Healthcare	Improving the healthcare facilities by offering discount coupons	To improve the access to healthcare and prevent illegal logging	Tested
3	Tsirimanana A [21]	2019	South-eastern Madagascar	Grey literature	Healthcare	Addressing the healthcare needs, farming technologies and hunger	To improve the access to healthcare and prevent illegal logging	Tested
4	Martins C [22]	2020	Brazil	Grey literature	Indigenous collaboration	Collaborating with indigenous people of amazon to improve their health need, farming techniques and promote traditional medicine	To collaborate and develop consensus with indigenous people for improving planetary health	Tested
5	Dong W et al., [23]	2019	Beijing	RCT	Air	Ionised air purifier to filter the indoor air	To lessen air pollution by improving quality of air and reducing emission	Tested
6	Ward TJ et al., [24]	2017	USA	RCT	Air	Environmental protection agency and filtrete ultra clean air purifier	To lessen air pollution by improving quality of air and reducing emission	Tested
7	Carmen Inoa V [25]	2018	-	Policy paper	Education	Communication techniques between people that would enhance environmental friendly behaviour	To promote health related awareness	Not tested
8	Osmond P and Sharif E [26]	2017	Sydney	Grey literature	Air	Increasing the greenery and water bodies as well as providing improved insulation	To lessen air pollution by improving quality of air and reducing emission	Not tested
9	Bedsworth LW and Hanak E [27]	2010	California	Policy paper	Climate health	Design and building norms to tackle extreme weather patterns	To collectively address public health issues in food, environment, weather patterns and health disaster management that affects the climate	Tested
10	Slovic AD et al., [28]	2016	-	Interventional study	Air	Promoting car-free days	To lessen air pollution by improving quality of air and reducing emission	Not tested
11	Wu X et al., [29]	2016	China	Intervention review	Disease prevention	Installing home water filters). Modifying building rules and land-use planning	Improving sanitation and preventing vector-borne diseases	Tested
12	Erwin KL [30]	2009	-	Policy paper	Water	Restoring and managing wetlands	Reduced utilisation of water and improved water sanitation	Not tested
13	Prior JH et al., [31]	2018	-	Intervention review	Physical activity	Integrated transport and public transport	To improve physical and environmental well-being	Not tested
					Land	Urban design that deepens urban vegetation and blue areas	Preserving ecosystems	Not tested
					Renewable energy	Effective energy production such as wind energy, direct solar energy, bioenergy, and hydropower	Production of renewable energy as an alternative and reduce fossil fuels	Not tested
					Diet	Encouraging the switching from eating cattle to eating plants;	Healthy survival of man and environment	Not tested
14	UNDP bulletin [32]	2021	-	Intervention review	Education	Advice and suggestions on reducing tobacco and negative farming techniques	To promote health related awareness	Not tested
					Ukraine	Education	Online sessions and workshops to promote knowledge and awareness	To promote health related awareness
			Colombia		Water	Specialised machinery to wash and sanitise hospital Personal Protective Equipments (PPE)	Reduced utilisation of water and improved water sanitation	Tested
			Malaysia		Air	A variety of interventions including technology transfer investments, policies and regulations, technical assistance, training, awareness-raising, coordination, and monitoring in different Hydrochlorofluorocarbons (HCFC)-consuming sectors	To lessen air pollution by improving quality of air and reducing emission	Tested
			Zimbabwe		Renewable energy	Establishment of all solar power systems in health institutions and storage areas	Production of renewable energy as an alternative and reduce fossil fuels	Tested
			Nepal		Disease management	A climate-informed health surveillance and early warning system	To monitor community health and provide early warning of any disease outbreak	Tested
			Timor-Leste		Disease management	Incorporation of data into the health emergency operation centre website.	To monitor community health and provide early warning of any disease outbreak	Tested

			Bangladesh		Disease management	A data-sharing arrangement with the Bangladesh Meteorological Department	To monitor community health and provide early warning of any disease outbreak	Tested
					Land	Switch from unneeded plastics to sustainable substitutes	Preserving ecosystems	Tested
			Philippines		Air	Promote climate action and clean air using social media.	To lessen air pollution by improving quality of air and reducing emission	Tested
15	Haines A [33]	2016	-	Policy paper	Diet	Consumption of more fruit and vegetables and less meat	Healthy survival of man and environment	Not tested
16	Iyer HS et al., [34]	2021	USA	Policy paper	Physical activity	Promote active transportation and e-bikes and bike-share programmes	To improve physical and environmental well-being	Not tested
17	News S [35]	2017	Sweden	Grey literature	Diet	Diet for a Green Planet programme	Healthy survival of man and environment	Tested
					Air	Drive to eliminate fossil fuels from Stockholm's public transportation,	To lessen air pollution by improving quality of air and reducing emission	Tested
18	Matthew Carl Ives [36]	2019	-	Grey literature	Renewable energy	Sensitive Intervention Points (SIP) and solar photovoltaics implementation	Production of renewable energy as an alternative and reduce fossil fuels	Not tested
19	Hancock T [37]	2021	USA	Intervention review	Air	A low-carbon, net-zero energy system	To lessen air pollution by improving quality of air and reducing emission	Not tested
					Physical activity	Active transportation	To improve physical and environmental well-being	Not tested
					Diet	A low-meat diet	Healthy survival of man and environment	Not tested
					Land	Greater "greening" of neighbourhoods	Preserving ecosystems	Not tested
20	Redvers N et al., [38]	2022	USA	Interventional study	Indigenous collaboration	Deep listening method to share knowledge, learn and work together towards improving the health of the environment and interlinked health of humans	To collaborate and develop consensus with indigenous people for improving planetary health	Tested
21	Orbinski J [39]	2019	Malawi	Grey literature	Climate change	Complex adaptive system to develop digital simulation tool to monitor and assess the environmental and public health interventions	To collectively address public health issues in food, environment, weather patterns and health disaster management that affects the climate	Tested
22	Montira Pongsiri [40]	2022	Nigeria	Grey literature	Disease management	Integration of the available data on the prevalence of drought, household economy details and risk of malnutrition	To monitor community health and provide early warning of any disease outbreak	Not tested
23	Christopher Golden [41]	2022	Madagascar	Grey literature	Agriculture	To collect data about soil moisture, crop production, crops that have failed to grow via remote sensing	To improve agricultural practices and increase food production	Not tested
24	Gilliam FS et al., [42]	2019	USA	Conceptual framework	Climate health	Hysteretic model to predict nitrogen deposition causing solid acidification, biodiversity loss, water quality, carbon and changes in nitrogen cycles	To collectively address public health issues in food, environment, weather patterns and health disaster management that affects the climate	Not tested

[Table/Fig-1]: Planetary health interventions [19-42].

regions like Indonesia, Borneo, Madagascar, and the Amazon. Efforts include conservation programs, alternative livelihoods to prevent illegal logging, and integrating traditional medicine into healthcare services, which have led to increased environmental awareness and healthier communities [21-24]. The United Nations Development Programme (UNDP) has also played a significant role by funding educational programs, promoting sustainable procurement practices, phasing out harmful chemicals, and installing solar power systems in healthcare facilities across Ukraine, Colombia, Malaysia, and Zimbabwe. These actions aim to reduce the impact of climate change on health and increase sustainability in healthcare [34]. In Nepal, climate-informed health surveillance systems have been established, and similar approaches have been adopted in Timor-Leste and Bangladesh. Some businesses use solar energy to reduce their carbon footprint, while others grow organic vegetables on their rooftops for the benefit of personnel and patients. On the other side, Philippine doctor associations creatively promote climate action and clean air using social media [34].

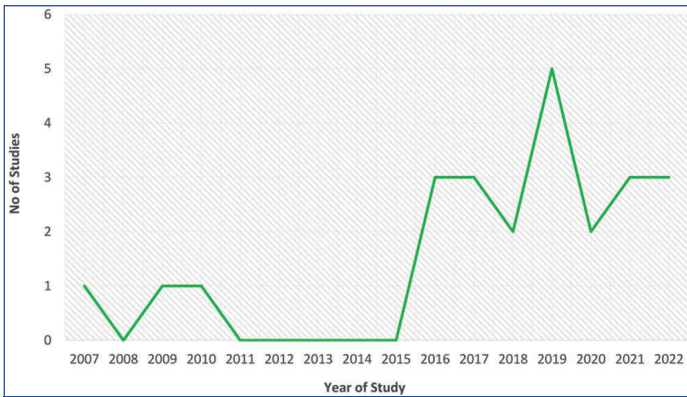
Summary of Proposed Planetary Health Interventions

Proposed interventions aim to address the broader impacts of climate change on human health by promoting healthy food habits, reducing harmful agricultural and tobacco use, and preserving

biodiversity [34]. Suggested strategies include increasing consumption of fruits and vegetables while reducing meat intake, altering crop production to enhance food security, and reducing fuel usage through car-free days [30,32,33,35]. Emphasising active transportation, like walking, cycling, and using e-bikes, can lead to health benefits and reduce environmental pollutants [33,36,39]. Reducing energy consumption and increasing renewable energy production, along with urban greening and improving building codes, are proposed to mitigate heat stress and lower greenhouse gas emissions [28,39]. The concept of sensitive intervention points, like adopting solar photo-voltaics, suggests that small changes can lead to significant environmental and social shifts [38]. Effective communication and psychological counselling are recommended to enhance environmental responsibility and support the successful implementation of these interventions [27].

Summary of the Characteristics of Extracted Data

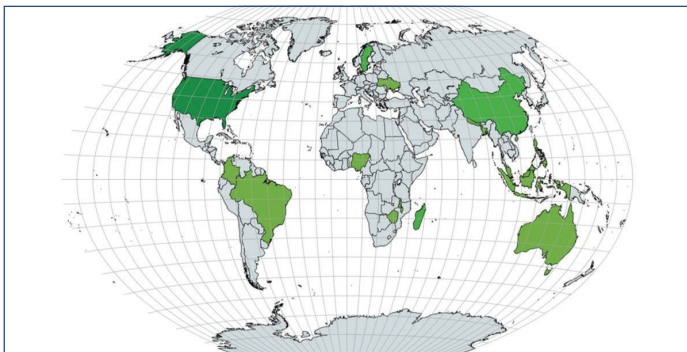
Timeline of articles included : For the present study, a total of 24 articles, including grey literature, were chosen that describe the interventions for planetary health. The majority of the articles were conducted in 2019 (n=5), followed by three articles each in 2017, 2021, and 2022 (n=3 each). [Table/Fig-2] shows the number of articles and the year each one was published.



[Table/Fig-2]: Timeline of articles included for the present review.

Global Mapping of Planetary Health Interventions

Out of the 24 studies and 40 interventions that were chosen, 5 of the 40 interventions to address planetary health issues were carried out in the United States (Study ID- 6, 16, 19, 20, 24), followed by two each in China (Study ID- 5, 11), Sweden {17 (2 interventions)}, and Madagascar (Study ID- 3, 23). There was one study conducted in each of Indonesia (Study ID- 1), rural Borneo (Study ID- 2), Brazil (Study ID- 4), Sydney (Study ID- 8), Ukraine (Study ID- 14), Colombia (Study ID- 14), Malaysia (Study ID- 14), Timor-Leste (Study ID- 14), Zimbabwe (Study ID- 14), Nepal (Study ID- 14), Bangladesh (Study ID- 14), Philippines (Study ID- 14), Malawi (Study ID- 21), and Nigeria (Study ID- 22). Six studies did not mention the country in which the intervention was proposed (Study ID- 7, 10, 12, 13, 15, 18). [Table/Fig-3] shows a globe with the locations of the included research marked on it.



[Table/Fig-3]: Global mapping of planetary health interventions.

Type of Study Design

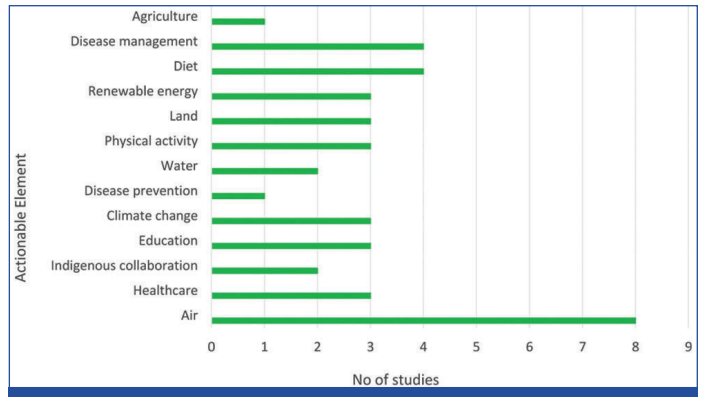
For the present review, a range of original research articles and grey literature were used. [Table/Fig-4] lists the type of study design and the study ID. Among the 24 studies, the majority were grey literature (n=10). Five policy papers and four intervention review papers were selected. In addition to this, interventional studies, two randomised controlled trials, and one conceptual framework were also analysed.

Study design	Study ID
Grey literature	1, 2, 3, 4, 8, 17, 18, 21, 22, 23
Policy paper	7, 9, 12, 15, 16
Interventions review	11, 13, 14, 19
Interventional study	10, 20
Randomised controlled trial	5, 6
Conceptual framework	24

[Table/Fig-4]: Study design of articles included. (For references to the study IDs, kindly refer to [Table/Fig-1])

Actionable Element

The element of focus of the 40 interventions described in the present review was grouped into seven main actionable elements. The number of studies under each actionable element is described in [Table/Fig-5]. Most of the interventions had 'Air' as an actionable element. Other actionable elements are described in [Table/Fig-5].



[Table/Fig-5]: Actionable elements.

Objective of Interventions

The broader objectives of each of the interventions included in this review were narrowed down and included under each actionable element. The common objectives of the 13 actionable elements are depicted in [Table/Fig-6].

Actionable element	Objectives
Air	To lessen air pollution by improving quality of air and reducing emission
Healthcare	To improve the access to healthcare and prevent illegal logging
Indigenous collaboration	To collaborate and develop consensus with indigenous people for improving planetary health
Education	To promote health related awareness
Climate change	To collectively address public health issues in food, environment, weather patterns and health disaster management that affects the climate
Disease prevention	Improving sanitation and preventing vector-borne diseases
Water	Reduced utilisation of water and improved water sanitation
Physical activity	To improve physical and environmental well-being
Land	Preserving eco-systems
Renewable energy	Production of renewable energy as an alternative and reduce fossil fuels
Diet	Healthy survival of man and environment
Disease management	To monitor community health and provide early warning of any disease outbreak
Agriculture	To improve agricultural practices and increase food production

[Table/Fig-6]: Actionable elements and objectives.

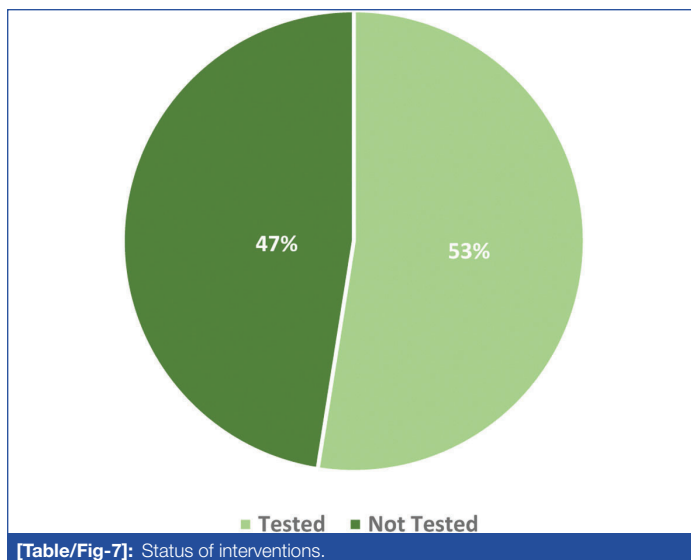
Status of Interventions

Our study has encompassed a wide variety of interventions, including those described in grey literature. Some of the interventions have been tested and are in the active state, while others are proposed and have yet to be tested for their efficacy. The present study analysed 40 interventions, of which 21 are tested and proven to improve planetary health *{Study ID 1 (1), 2 (1), 3 (1), 4 (1), 5 (1), 6 (1), 9 (1), 11 (1), 14 (9), 17 (2), 20 (1), 21 (1)}. Meanwhile, 19 interventions are in the conceptual or proposed state, which need active testing to prove their beneficial effects on enhancing planetary health *{Study ID 7 (1), 8 (1), 10 (1), 12 (1), 13 (4), 14 (1), 15 (1), 16 (1), 18 (1), 19 (4), 22 (1), 23 (1), 24 (1)}. The pie chart below in [Table/Fig-7] describes the number of studies included in this review, with their interventions tested and not tested.

*The number outside the bracket is the study ID and number mentioned inside the round bracket is number of interventions taken from that study.

Importance of Planetary Health

The current Anthropocene epoch is driven by massive population growth along with extensive use of unsustainable resources,



[Table/Fig-7]: Status of interventions.

having unfavourable effects on the climate and affecting the quality and availability of food, increasing the incidences of natural calamities, the emergence of zoonotic diseases, and causing global ecosystem deterioration, putting sustainability at stake [43-46]. This climate change will also have an impact on the frequency of homelessness while aggravating certain sensitivities of the homeless population, such as chronic illness and exposure to environmental threats. The social and health systems will also face additional challenges as a result [47]. Restoring lost biodiversity and enhancing human health via improving environmental health is still within our reach, but the challenge lies in integrating relevant information and evidence through research on the inter-dependability of human health and environmental change to conceptualise and successfully implement effective interventions on planetary health [33,48,49].

Planetary Health during COVID-19

Climate change and the emergence of new diseases are double threats to mankind. Alarming increases in the rate of deforestation, habitat loss, forest invasion, sea level rise, and global temperature rise have led to the destruction of natural ecosystems and paved the way for unprecedented infections caused by newer or mutated pathogens [50-52]. The recent COVID-19 pandemic has shattered healthcare systems and claimed over 6 million lives worldwide as of December 2022 [53]. The pandemic exposed the world's lack of readiness, making it a perfect opportunity for human civilisation to learn about preparedness, policy development, and integrative research for subsequent disease outbreaks that can be included in population as well as global health planning and assessment strategies [54].

This stresses the importance of managing and combating the economic, democratic, sociocultural, and ecological repercussions caused by COVID-19 by comprehending its perspectives and consequences in the context of planetary health [47,55].

Collaborative Approach to Achieving Planetary Health

The concept of planetary health was proposed to comprehend and manage how the activities of mankind have a detrimental influence on the natural ecosystem [56]. Novel approaches to combine the determinants and conditions that affect humans, as well as planet Earth, should be framed to ensure the well-being and sustainability of Mother Earth [57]. To understand the complex interactions between human and natural systems and to successfully develop and implement planetary health interventions for health and disease management, collaboration with local government authorities, policy makers, and stakeholders is the key component of the systemic approach [58,59]. Along with this, involving the participation of

community health workers will result in better outcomes as they are the preliminary point of contact for any health and environmental crises in a locality. They can engage in all health and ecological activities by acting as a mediator between the point of design and the point of action, thus promoting healthy well-being through environmental care [60].

What are the Current Gaps?

The present study reported on different interventions for planetary health. Although there are various articles that emphasise addressing climate change, the environment, and global health, many of the interventions conducted remain unnoticed as they are not made available on any public platform like television, public websites, or social media. Despite the enormous scientific data stored in the literature, a unified informatics tool is lacking to unite and represent all the current interventions across different geographical regions. Additionally, retesting of the interventions in different settings and evaluating those strategies are not performed. This lack of retesting causes a lack of awareness about proposed interventions, and the implementation of beneficial innovations on a global level to attain desired outcomes remains suboptimal.

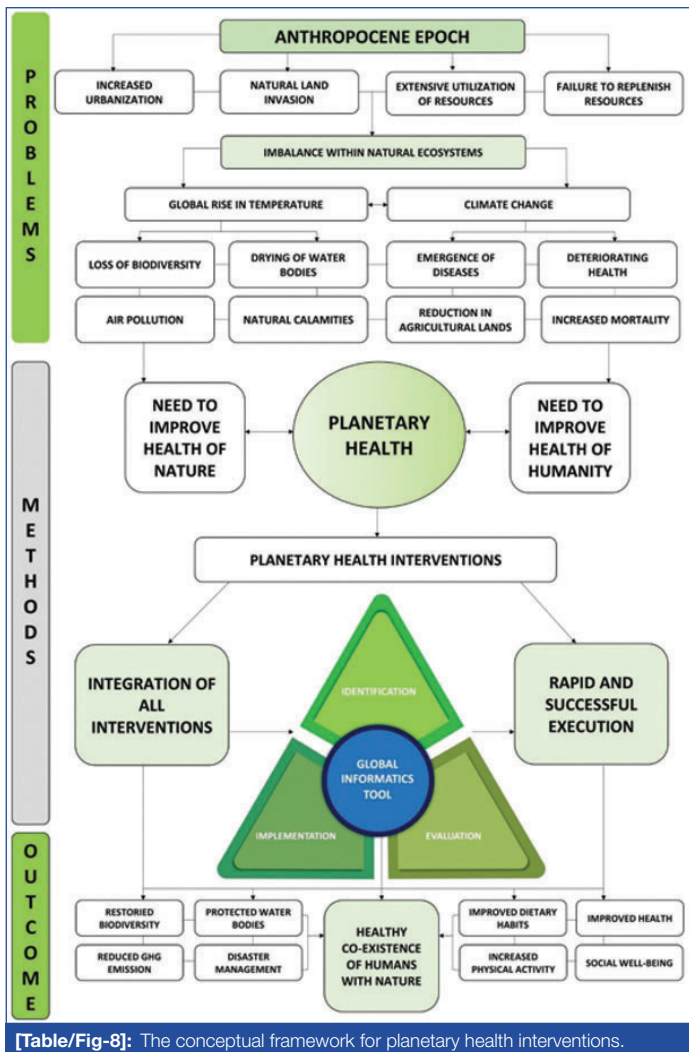
What should be done in the Future?

Recognising the importance of Planetary Health and the urgent need to implement interventions to address the drastic climatic changes and their impact on the Earth's ecosystems affecting land, water, health, and the lifestyle of all living species, future research should include more empirical studies to test the effectiveness of these interventions or to develop new methods to reduce the burden of climatic change on the globe. Furthermore, studies should focus on designing and developing a unified informatics tool that encompasses all existing climate health interventions and Planetary Health innovations under a single database. This unified informatics tool will help policymakers and stakeholders to design and implement effective strategies to address the global climatic crisis and enhance Planetary Health through an evidence-based approach. The informatics tool should be made user-friendly, accessible to all, reliable, and constantly updated to provide users with accurate and the latest information in the most feasible method.

An in-depth analysis of all the interventions in different countries across the world has been discussed in detail. All published and grey literature studies were included in the present review, and interventions even at nascent stages are discussed, giving more realistic and reproducible data to the scientific community. The present study can also serve as a base for the future development of a unified informatics tool for all existing interventions on planetary health. Environmental health has been the topic of research for many years, and thus the inclusion of all articles that emphasise environmental and human health is not possible. Several strategies and national policies are being implemented worldwide to reduce pollution, global warming, and effects on water, land, humans, and livestock. Owing to the concept of planetary health, the study has included all relevant articles to the best of the authors' knowledge, but this does not ensure complete inclusion of all the interventions adopted to sustain environmental health worldwide. Also, as the present study has reported only on evidence from articles published in the English language, results from other studies are not included due to language limitations.

Conceptual Framework

A conceptual framework to understand the impacts of climate change, planetary health interventions, and potential solutions for the integration of all interventions is described in [Table/Fig-8]. The framework has been designed by Bordage G., in "Conceptual framework to magnify and illuminate" [61].



[Table/Fig-8]: The conceptual framework for planetary health interventions.

CONCLUSION(S)

The present narrative review has comprehensively analysed and elaborately reported on the latest planetary health interventions around the globe. With increasing population and technology usage, humans have crossed their limits in intervening in natural ecosystems, leading to the destruction of ecological balance and eventually harming our health. The existing healthcare systems may be proficient in offering ‘curative medicine,’ but they are certainly incapable of assuring ‘preventive care’ with the enormous burden of climate change and environmental hazards threatening the very existence of life. Planetary health, the nascent branch of science that unites the health of humans and the health of natural systems on which humanity is dependent, is the solution to the urgent crises. Transformative interventions should be put into practice to reduce the impact of global warming, zoonoses, poor food quality, declining agricultural lands, deforestation, loss of biodiversity, and the startling rate of melting glaciers, sea-level rise, and climate change. Additionally, these interventions should be tested for efficacy, accessibility, and reproducibility across various settings to broaden the benefits of planetary health. Thus, the authors advocate the need to develop a global informatics tool that can be used to identify, assess, and implement successful planetary health interventions and strategies leading to improved man-nature interactions and established collective health.

Data availability statement: The data that supports the present study are available upon request from the corresponding author.

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