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CLIMATE-RELATED CHALLENGES, RISK, ENVIRONMENTAL HEALTH PROMOTION: AN INTERDISCIPLINARY APPROACH

DESAFIOS RELACIONADOS AO CLIMA, RISCOS E PROMOÇÃO DA SAÚDE AMBIENTAL: UMA ABORDAGEM INTERDISCIPLINAR

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Marcia Cristina Braga Nunes Varricchio[1]
Sandra Ávila Gaspar[2]
Marcelo Vacite[3]
Armando Isaac Nigri[4]
Marcos Tadeu Varricchio[5]
Nelson Bretas de Noronha Gomes[6]

1 Environmental Health, Parasitology, Bioethics Project of the Laboratory of Immune. Parasitology and Toxicological Analysis of the Faculty of Pharmacy of the Federal University of Rio de Janeiro (SAPB-LIPAT/FF/UFRJ). PhD in Sciences (Plant Biology and Biotechnology) from the Postgraduate Program in Plant Biotechnology (PPGBV – UFRJ). Master Degree in Psychosocial Attention from MEPPSO-IPUB/UFRJ. Carlos Chagas Filho Avenue, 373, Federal University of Rio de Janeiro, Rio de Janeiro - RJ, Brazil. Zip Code: 21941-170. *Email:* varichio2@gmail.com .

2 Postgraduate *lato sensu* in Education (Environmental Education). Agricultural Sciences from the Federal Rural University of Rio de Janeiro (UFRJ). Friends of Tingua Institute. Address: “H” Street, 300, Graminha, Engenheiro Paulo de Frontin – RJ, Brazil. ZIP code: 26650-000. *Email:* sandra.avila.gaspar@gmail.com.

3 Graduating in Law from Estácio de Sá University. President of the Brazilian Gypsy Union. Address: *Email:* marcelovaciteucb@hotmail.com.

4 Engenheiro Eletricista egresso da Pontifícia Universidade Católica do Rio de Janeiro (PUC-RJ). AI Nigri Consultoria. Av Lucio Costa 3.100 casa 103. Barra da Tijuca. CEP: 22620-172. Rio de Janeiro, Brasil. *Email:* armandonigri@gmail.com.

5 Electrical Engineer graduated from the Catholic University of Petrópolis (UCP). Volunteer of the Environmental Health, Parasitology, and Bioethics Project of the Immunoparasitology and Toxicological Analysis Laboratory of the Faculty of Pharmacy of the Federal University of Rio de Janeiro (SAPB-LIPAT/FF/UFRJ). Avenida Carlos Chagas Filho, 373, Cidade Universitária da Universidade Federal do Rio de Janeiro, Rio de Janeiro - RJ, Brazil. CEP: 21941-170. *Email:* mtvarricchio7@gmail.com.

6 Master's degree in Animal Pathology from the Federal University of Lavras (UFAL). Federal University of Lavras. Lavras, Minas Gerais, Brazil. *Email:* nelsonbretas@yahoo.com.br

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Paulo Sergio Torres Brioso[7]
Ricardo Machado Kuster[8]
Celso Luiz Salgueiro Lage[9]
Simone da Silva[10]
Alexandre dos Santos Pyrrho[11]

ABSTRACT

Climate change has intensified the frequency, severity, and geographic reach of extreme weather events, posing growing risks to human and environmental health worldwide. This study is a descriptive-analytical systematic literature review (PRISMA), combined with a case study of an interdisciplinary research group, examining scientific production and official data on global climate-related disasters from 2004 to 2024, with emphasis on historical trends and geographic distribution. Data were drawn from specialized databases and international organizations, including Scopus, Web of Science, ScienceDirect, IPCC, EM-DAT, NOAA, NASA, WMO, and UNDRR. Results show a marked acceleration of climate disasters in the last two decades: between 2004 and 2024, 7.348 events were recorded, causing approximately 1.23 million deaths, affecting 4.2 billion people, and generating an estimated US$2.97 trillion in economic losses, representing substantial increases relative to the 1980-1999 period. The most affected regions include the Americas, Europe, and other areas exposed to hurricanes, flooding, drought, and wildfires, with disproportionate impacts on developing countries and socially vulnerable populations. The findings reinforce the unequivocal scientific recognition of anthropogenic influence on extreme events and underscore the urgency of mitigation, adaptation, and climate justice measures. The study also highlights the interdisciplinary and intersectoral contribution of ethnobotany, traditional knowledge, bioethics, and environmental health promotion in addressing these challenges, in line with the One Health approach, promoted to “movement people” whose collectives (cultures and traditions) were under social vulnerability as social subjects and work was performed at local level. It is concluded that the current decade is critical for shaping the planetary climate trajectory, requiring integrated, culturally sensitive, and interdisciplinary strategies to reduce human suffering and promote the well-being of both: people and ecosystems.

7 Graduated in agronomic engineering Federal Rural University of Rio de Janeiro. PhD in Sciences – Genetics. Federal Rural University of Rio de Janeiro. Federal Rural University of Rio de Janeiro. Official Laboratory of Phytosanitary Diagnosis – Phytopathology. BR 465, km 07, Rua Itaperuna s/n, Seropédica, Rio de Janeiro, CEP: 23897-095. *E-mail:* brioso@bighost.com.br .

8 Department of Chemistry, Federal University of Espírito Santo (UFES). Postgraduate Program in Chemistry and Postgraduate Program in Pharmaceutical Sciences. Address: Fernando Ferrari Avenue, 514, 29075-910 - Vitória - ES, Brazil. *Email:* kusterrm@gmail.com

9 Senior Intellectual Property Specialist. Postgraduate and Research Division – INPI. Rua Mayrink Veiga, 9, 12th floor, Centro, Rio de Janeiro, RJ, Brazil. Zip Code: 20090-910. *E-mail:* clslage@gmail.com.

10 Center for Biobusiness of the Amazon (CBA/FUEA) / Galileo Institute of Technology and Education of the Amazon (ITEGAM). Manaus, Amazonas, Brazil. Zip Code: 69075-351. *E-mail:* simonydasilva@gmail.com.

11 PhD in Sciences (Biophysics) from the Federal University of Rio de Janeiro (UFRJ). Laboratory of Immunoparasitology and Toxicological Analysis of the Faculty of Pharmacy (UFRJ). Carlos Chagas Filho Avenue, 373, Federal University of Rio de Janeiro, Rio de Janeiro - RJ, Brazil. Zip Code : 21941-170. *E-mail :* pyrrho@farmacia.ufrj.br.

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Keywords: Climate-related challenges; Traditional knowledge; Social subject; Interdisciplinary Biotechnological applications; Environmental health.

RESUMO

As mudanças climáticas intensificaram a frequência, a gravidade e a abrangência geográfica de eventos climáticos extremos, impondo riscos crescentes à saúde humana e ambiental em todo o mundo. Este estudo consiste em uma revisão sistemática da literatura de caráter descritivo-analítico (metodologia PRISMA), combinada com um estudo de caso de um grupo de pesquisa interdisciplinar, examinando a produção científica e dados oficiais sobre desastres globais relacionados ao clima entre 2004 e 2024, com ênfase em tendências históricas e distribuição geográfica. Os dados foram obtidos de bases especializadas e organizações internacionais, incluindo Scopus, Web of Science, ScienceDirect, IPCC, EM-DAT, NOAA, NASA, OMM e UNDRR. Os resultados revelam uma aceleração acentuada dos desastres climáticos nas últimas duas décadas: entre 2004 e 2024, foram registrados 7.348 eventos, causando aproximadamente 1,23 milhão de mortes, afetando 4,2 bilhões de pessoas e gerando perdas econômicas estimadas em US$ 2,97 trilhões — números que representam aumentos substanciais em relação ao período de 1980 a 1999. As regiões mais afetadas incluem as Américas, a Europa e outras áreas expostas a furacões, inundações, secas e incêndios florestais, com impactos desproporcionais sobre países em desenvolvimento e populações socialmente vulneráveis. As conclusões reforçam o reconhecimento científico inequívoco da influência antropogênica nos eventos extremos e ressaltam a urgência de medidas de mitigação, adaptação e justiça climática. O estudo também destaca a contribuição interdisciplinar e intersetorial da etnobotânica, dos saberes tradicionais, da bioética e da promoção da saúde ambiental no enfrentamento desses desafios, em consonância com a abordagem de "Saúde Única" (*One Health*), voltada para grupos populacionais cujos coletivos (culturas e tradições) encontravam-se em situação de vulnerabilidade social, atuando como sujeitos sociais em nível local. Conclui-se que a década atual é decisiva para definir a trajetória climática do planeta, exigindo estratégias integradas, culturalmente sensíveis e interdisciplinares para reduzir o sofrimento humano e promover o bem-estar tanto das pessoas quanto dos ecossistemas.

Palavras-chave: Desafios relacionados ao clima; Saberes tradicionais; Sujeito social; Aplicações biotecnológicas interdisciplinares; Saúde ambiental.

INTRODUCTION

World Health Organization defined equity as the absence of unfair, avoidable or remediable differences among groups of people, whether those groups are defined socially, economically, demographically, or geographically or by other dimensions of inequality (e.g. sex, gender, ethnicity, disability, or sexual orientation). Therefore, health is a fundamental human right. So, health equity is achieved when everyone can attain their full potential for health and well-being. [1]

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Since 2010, it was defined that health equity is determined by the conditions in which people are born, grow, live, work, play and age, as well as biological determinants. Structural determinants (political, legal, and economic) with social norms and institutional processes shape the distribution of power and resources determined by these conditions. People's living conditions are often made worse by discrimination, stereotyping, and prejudice based on sex, gender, age, race, ethnicity, or disability, among other factors. Discriminatory practices are often embedded in institutional and systems processes, leading to groups being under-represented in decision-making at all levels or underserved. So, the right to health means to realize, systematically, the identifying and the elimination of inequities resulting from differences in health and in overall living conditions (social determinants and also needs, wants and demands) to remove unfair barriers like poverty, racism, and lack of medical care. [2]

The multidimensional concept of health understands the human being in its entirety. Health encompasses the body, mind, relationships with others, and the environment. This broad perspective helps to better care for people. The body and the functioning of the organs provide physical functionality. The Mental/Emotional dimension encompasses feelings and how to deal with stress and emotions. The Social aspect includes relationships with family, friends, and society. The Spiritual or Existential dimension highlights the search for meaning in life. The Environmental factor is the place where the person lives and the resources around them. [3]

Epidemiological indicators within the context of multidimensional health are being developed. Epidemiology and demography are deeply linked because they both study human populations. Demography analyzes population size, age, sex, and growth. Epidemiology uses this data to investigate how diseases and deaths are distributed within these groups, directly connecting them through demographic and epidemiological transitions. Therefore, the union between the two sciences allows for an understanding of public health, as they focus on the population with its age structure, in addition to vital indicators (birth rates, mortality rates, and migration explain the behavior of epidemics and disorders. [4]

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Between 2015 and 2021, neglected tropical diseases (NTD) deaths decreased from 139.000 to 119.000. According to the Global Report on Neglected Tropical Diseases (2025),[5] in 2023 affected population was 1.5 billion people. Globally estimates point to ~119.000 deaths from NTD. The Table 1 below presents a comparative epidemiologic summary of the leading causes of death worldwide based on the most recent data from the WHO (2023-2025) [5,6] and other international organizations cited below:

Table 1: Total numbers of the leading causes of death worldwide.

Cause	Estimated Deaths	Source	Notes
1. Neglected Tropical Diseases	**~119.000**	WHO 2025[5]	Reduction from 139K (2015)
Dengue	~40.000-50.000	WHO/OWD[5,7,8] 2024-2025	*Data: 2024 LAC outbreak=9,875 deaths*
Rabies	~59.000-70.000	WHO 2024-2025[5,7]	*Improved data collection 2022-2023*
Visceral Leishmaniasis	~3.500-4.000	WHO 2025[5]	Included in "neglected diseases"
Chagas Disease	~12.000	WHO 2025[5]	Endemic in Latin America
Schistosomiasis	~8.000-10.000	WHO 2025[5]	Parasitic, mainly Africa
Leprosy (Hansen's Disease)	~200-300	WHO 2025[5]	Cases in decline
Other NTDs	~3.000-5.000	WHO 2025[5]	Including: Onchocerciasis, African Trypanosomiasis, Lymphatic Filariasis, etc.
2.Malaria	**597.000**	WHO, 2023[6]	
3. Non-Communicable Chronic-Degenerative Diseases	**~43 million**	WHO 2024[7]	Aggregate total
- Cardiovascular Diseases	19 million	WHO 2024[7]	**Leading global cause of death**
- Cancer	10 million	WHO 2024[7]	All types
- COPD (chronic respiratory diseases)	4 million	WHO 2024[7]	Emphysema, chronic bronchitis
- Diabetes Mellitus	2 million	WHO 2024[7]	Type 1 and 2
- Other Chronic Diseases (not itemized)	~8 million	WHO 2024[7]	Stroke, hypertension, kidney disease, etc.
4. Infectious Chronic-Degenerative Diseases	**~10.88 million**	WHO 2024-2025[5,7]	Aggregate total
- Tuberculosis	1.25 million	WHO 2024[7]	*Returned as leading infectious cause (2023)*
- COVID-19	8.7 million	WHO 2024[7]	Cumulative since 2020
- Pneumonia & Lower	~2.18	WHO 2024[7]	*Possible overlap with TB*

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Respiratory Infections	million		
- HIV/AIDS	~600.000	WHO 2024[7]	Including TB+HIV
- Influenza	~400.000-500.000	WHO 2024[7]	Estimated annually
5.Infectious Diseases	**~10.88 million**	WHO 2024[7]	Estimated annually
6. Violent Deaths	**~2.36 million**	OWD/UNODC 2024[8,9]	Approximate total
- Road Traffic Accidents	~1.19 million	WHO/OWD 2024[7,8]	2nd leading cause of death in youth (5-29 years)
- Suicides	727.000	WHO 2024[7]	~1 person every 44 seconds
- Homicides	464.000	UNODC 2024[9]	Mainly in low/middle-income countries
- Armed Conflicts	80.000-89.000	UNODC 2024[9]	Varies with military activity
GLOBAL ESTIMATED TOTAL	**~55-56 million**	WHO 2024-2025	Data from 2023-2024

Primary Sources: WHO, 2023[6]; WHO Global Report on Neglected Tropical Diseases 2025[5] (Released October 22, 2025); WHO 2024[7] Global Health Observatory (UHC Communicable & NCDs Dashboard); OWD (Our World in Data) 2024[8] - Analysis of causes of death; UNODC 2024[9] - Violence and conflicts; WHO 2024[7] - COVID-19 accumulated toll.

Notes: Underreporting in low-income countries (especially NTDs). The table above reflects the most recent WHO consensus (2024-2025) [5,7].
WHO 2024[7] identifies TB as leading cause of death from a single infectious agent (regained 1st place after COVID-19).

Some estimates such as violent and climate deaths used supplementary UN sources,[10,11] furthermore, the WHO[7] and the World Meteorological Organization (WMO)[11] monitor the impacts of climate change on human health. So, the most relevant and recent data regarding deaths and the impacts on global health from climate disasters, note the increase, are shown in Table 2.

Table 2: Total of the impacts of climate change on human health in its multidimensional concept.

Indicator	**Period**	**Given**
Deaths from climate disasters	1970–2021	~2 million
Recorded disasters	1970–2021	~12.000 events
Economic losses	1970–2021	US$ 4.3 trillion
Mortality in developing countries	1970–2021	90% of deaths
Projection of additional deaths	2030–2050	~250.000/year
People in high-risk areas	Current	3.6 billion
Heat mortality (≥65 years)	Recent data	70% (increase in 2 decades)
Mortality attributed to climate change	Recent estimate	37% of heat-related deaths

Source: WHO, 2023[6]. WMO, 2025[12].

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So, the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC, 2021-2023)[13,14] made it clear that the link between extreme events and anthropogenic climate change is undeniable. Recent climate attribution studies demonstrate that most extreme events that have occurred in the last twenty years have been intensified by climate change caused by greenhouse gas emissions.

According to the report "Increasing likelihood of another extremely hot summer in Europe" by the World Weather Attribution group (2023)[15], it was possible to establish a quantifiable correlation between climate change and specific extreme events. For every 0.1°C increase in the global average temperature, approximately 360 new climate events are recorded in Brazil alone, indicating the exponential acceleration of the phenomenon on a planetary scale.[16]

According to UN Office for Disaster Risk Reduction - UNDRR reports (2024),[17] 91% of deaths from climate events occurred in developing countries, while 59% of economic losses were recorded in developed countries. This disparity reveals Differential Vulnerability (VD), that is, the concentration of vulnerability in poor nations, indicating: (a) greater exposure to extreme events; (b) lower infrastructure resilience; (c) limited resources for adaptation and response; (d) dependence on economic survival on vulnerable sectors such as agriculture and livestock.

Especially vulnerable populations include smallholder farmers and herders, lowland coastal communities, urban populations in at-risk areas, children and the elderly, as well as women in gender-unequal regions. Alongside all the unresolved health problems, extreme weather events represent one of the greatest challenges facing humanity in the 21st century. In the last twenty years (2004-2024), the world has witnessed an unprecedented escalation in the frequency and intensity of extreme weather and climate events, including hurricanes, storms, floods, droughts, heat waves, and wildfires. [18]

This literature review examines the historical evolution of global climate disasters, with a special focus on the main events of the last twenty years, statistical analysis, geographic distribution, emerging trends, and socioeconomic impacts. Data were collected

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from internationally recognized databases, as well as scientific articles indexed in specialized databases such as Scopus, Web of Science, and ScienceDirect.

METHODOLOGY

In summary, this work constitutes a descriptive-analytical systematic literature review (PRISMA - Preferred Reporting Items for Systematic reviews and Meta-Analyses) that examines the scientific production and official data on global climate accidents from 2004-2024, with an emphasis on the analysis of trends and geographical distribution of events. [19] Besides, this review is combined with a case study[20] whose historical evolution aggregates the interdisciplinary and intersectoral scientific production of the group.

The Boolean operators used were: AND (for intersection of concepts), OR (for expansion of concepts), NOT (for exclusion of unwanted concepts), NEAR/5 (for proximity of terms), and single and double quotes (for searching for exact expressions):

a) ("climate change" OR "global warming") AND ("extreme events" OR "natural disasters") AND (2004:2024);
b) ("hurricane" OR "typhoon" OR "cyclone") AND ("intensity" OR "frequency") AND (attribution OR anthropogenic);
c) (drought OR flood OR "heat wave") AND (mortality OR "economic loss") AND (2004-2024);
d) ("climate extremes" OR "weather extremes") AND (IPCC[13,14] OR EM-DAT [21] OR NOAA[22]) AND (global OR worldwide).

Inclusion Criteria: (a) studies published between 2004 and 2024; (b) articles on extreme weather events and natural disasters; (c) data from official organizations (IPCC, WMO, UNDRR, EM-DAT, NOAA, NASA) [11,12,13,14,17,21,22,23]; (d) climate attribution studies; (e) research on trends and impacts of extreme events; (f) languages: Portuguese, English, Spanish.

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Exclusion Criteria: (a) studies with incomplete or inconsistent data; (b) articles without a clear methodology; (c) documents prior to 2004; (d) exclusively theoretical studies without empirical data; (e) works not peer-reviewed (except for official reports from international organizations).

The main data sources consulted were:

a) EM-DAT (International Disaster Database) [21]: contains more than 27,000 disaster events since 1900, maintained by the Centre for Research on the Epidemiology of Disasters (CRED)[24] at the Catholic University of Louvain;

b) IPCC (Intergovernmental Panel on Climate Change)[13,14]: assessment reports including the Sixth Assessment Report (AR6, 2021-2023), synthesizing knowledge from 234-278 scientists in each thematic area;

c) WMO (World Meteorological Organization) [11,12]: annual reports on the State of the Global Climate, with contributions from more than 70 experts;

d) UNDRR (UN Office for Disaster Risk Reduction)[17]: atlas of climate events and global assessment reports; e) NOAA (National Oceanic and Atmospheric Administration) [22] : detailed data on hurricanes and extreme events in the United States, with historical series since 1980;

f) NASA (National Aeronautics and Space Administration) [23]: satellite data and analyses on climatic phenomena;

g) World Weather Attribution (WWA)[15] analyses attributing extreme events to anthropogenic climate change.

The search strategy was developed using Boolean operators and controlled descriptors in accordance with systematic research standards. Queries were performed in specialized databases.[11,12,13,14,17,21,22,23]

The methodology follows the comparative guidelines proposed by Seneviratne et al. (2012) [25] for knowledge synthesis in climate extremes research.

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RESULTS

I. HISTORICAL EVOLUTION OF CLIMATIC DISASTERS

Pre-Industrial Period (until 1900)

Before the Industrial Revolution, extreme weather events occurred within the natural variability of the climate, with frequency and intensity determined by natural cycles such as El Niño, La Niña, and variations in solar activity. Historical records indicate significant extreme events, such as the Great Irish Famine (1845-1852) and severe droughts on different continents, but with less frequency compared to the contemporary period. [25]

Industrial Period (1900-1980)

During this period, a gradual increase in greenhouse gas emissions was observed, particularly after World War II. The frequency of extreme events began to increase, although systematic documentation was still limited. Between 1980 and 1999, 4,212 natural disasters were recorded worldwide, claiming approximately 1.19 million lives and affecting 3.25 billion people, resulting in approximately US$1.63 trillion in economic losses. [21]

Contemporary Period (2000-2024): The Acceleration of Extreme Events

From 2000 onwards, an unprecedented acceleration in the frequency and intensity of climate accidents was observed. This period marks the transition to what scientists call the "new normal" of climate change, characterized by multiple simultaneous changes. [14]

Between 2000 and 2019 (a twenty-year period), 7.348 major disaster events were recorded, causing approximately 1.23 million deaths (an average of about 60,000 per year), affecting more than 4.2 billion people (many on more than one occasion), and generating approximately US$2.97 trillion in global economic losses. Compared with the period 1980-1999, the number of reported disasters increased substantially, while economic losses also rose. [17,24]

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This period also marks the unequivocal scientific recognition of human influence on extreme events, as documented in successive reports [13,14] and climate attribution studies. [15]

Major Extreme Events (2004-2024) - Events of Exceptional Magnitude:

Hurricane Katrina (August 2005, United States): Hurricane Katrina represents the most economically costly event in United States history, with total adjusted expenses for 2024 of US$201.3 billion. [22] The event caused 1.392 deaths and resulted in a 29% reduction in the population of New Orleans between 2005 and 2011. The hurricane breached multiple levees causing catastrophic flooding. [26]

Atlantic Hurricanes 2017 (Harvey, Irma, and Maria): The 2017 hurricane season was one of the most intense on record. Hurricane Harvey (August 2017) featured the largest tropical precipitation event ever recorded in United States history, with a maximum rainfall of 60.58 inches. The total cost of Harvey was US$160 billion, causing 88 direct deaths. [22]

Hurricane Irma (September 2017) reached category 5 for 37 consecutive hours and caused severe damage to the Caribbean, particularly Puerto Rico, with an estimated cost of US$ 58.2 billion in regional damages. Hurricane Maria (September 2017) was responsible for US$115.2 billion in economic losses and was considered the second deadliest storm to hit the American continent in the 21st century.

The three hurricanes of 2017 (Harvey, Irma, and Maria) combined caused more than $500 billion in damage. [27] Attribution studies demonstrate that the total rainfall from these six major Atlantic hurricanes (including Katrina, Dorian, and Florence) was 4 to 15 times more intense due to climate change. [28]

Hurricane Helene (September 2024, Southeastern USA): Hurricane Helene, with sustained winds of 140 miles per hour, was the strongest hurricane to hit the Big Bend region of Florida in recorded history. The event caused 230 deaths and economic losses of US$78.7 billion. Record rainfall exceeded 30 inches in North Carolina, causing historic flooding. [22]

Horn of Africa - Historic Drought (2020-2022): The Horn of Africa region faced its worst drought in 40 years, affecting Ethiopia, Kenya, Somalia, Eritrea, Djibouti, and Sudan.

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The drought was caused by five consecutive insufficient rainy seasons and resulted in the impact on 37 million people. According to United Nations estimates, 1.4 million children faced severe acute malnutrition, with the risk of increasing to 2 million if the drought persisted. [16,17]

A study by World Weather Attribution demonstrated that climate change caused by human activities has made agricultural drought in the Horn of Africa almost 100 times more likely. [15] The lack of water became critical, particularly when considering the increase in average temperature in the region.

Record Heat Waves (2024): In May 2024, states in India (Bihar and Odisha) experienced exceptional temperatures that caused the death of more than 20 people from heatstroke. New Delhi, the capital of India, recorded a record temperature of 49.9°C on May 28, 2024. [29]

In June 2024, Saudi Arabia experienced temperatures exceeding 50°C Celsius, resulting in 1.301 deaths during the Hajj pilgrimage. [30] Multiple heat records were set in various regions worldwide during the year 2024. [31]

Historic Floods in Brazil (May 2024): Rio Grande do Sul was affected by historic floods in May 2024, resulting in the displacement of approximately 420.000 people in Porto Alegre alone. The event represented one of the worst flood scenarios in recent historical records, consistent with projections [14] for the intensification of extreme hydrometeorological events.[16]

Floods in Europe (2021-2024): Storm Bernd (July 2021) caused more than 240 deaths in multiple European countries (Germany, Belgium, Austria, Croatia, Italy, Luxembourg, Netherlands and Switzerland). Storm Daniel (September 2023) hit Libya, Greece, Turkey and Bulgaria, destroying two dams in Libya and causing thousands of deaths. Storm Boris (September 2024) affected the Danube and central regions of Europe, particularly Slovakia, Hungary, Poland and the Czech Republic, causing more than 20 deaths. [16]

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II GLOBAL STATISTICS AND DATA ON CLIMATE DISASTERS

- Frequency and Mortality Data

From 1980 to 2019, more than 11.000 climate disasters attributed to extreme events were recorded [12], as shown in Table 3.

Table 3: Comparison of Climate Disasters by Period (1980-2024).

Period	Number of Disasters	Dead	People Affected	Losses (US$ trillions)
1980-1999	4.212	1.19 million	3.25 billion	1.63
2004-2024	7.348	1.23 million	4.2 billion	2.97
Variation (%)	+74%	+3%	+29%	+82%

Source: OMM (2024); UNDRR (2024)[12,17].

During this period, more than 2 million deaths and economic losses of US$3.47 trillion were documented. A 7-fold increase in economic losses resulting from extreme events was observed [17].

According to the WMO, UNDRR Global Disaster Risk Atlas (2021) [11,12,17], from 1970 to 2019, natural disasters accounted for 50% of all reported disasters, 45% of all documented deaths in the period, and 74% of all economic losses. A significant proportion of 91% of deaths caused by climate, weather, and water-related damage occurred in developing countries. On the other hand, most economic losses (59%) were recorded in developed countries, indicating an unfair distribution of impacts. [17] The Types of Events by Cause of Death are shown in Table 4:

Table 4: Mortality Distribution by Event Type (1970-2019).

Event Type	Total Deaths (1970-2019)	Percentage
Storms	577.000	28.8%
Floods	58.700	2.9%
Extreme Temperature Events	55.700	2.8%
Dry	557.000	27.8%
Others	752.600	37.7%

Source: OMM (2024); UNDRR (2024)[12,17]

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III. GEOGRAPHIC DISTRIBUTION OF CLIMATIC EVENTS

Regarding the main affected regions (WORLD METEOROLOGICAL ORGANIZATION - WMO, 2024) [12], the following stand out:

North and Central America, particularly the southeastern US and the Gulf of Mexico region, have been affected by increasingly intense hurricanes. Mexico faces intensified hurricane impacts in both the Atlantic and Pacific. The Caribbean constitutes a hotspot for intense tropical storms, with multiple islands suffering severe impact annually. In South America, Brazil experiences increased flooding in the South and Southeast, in addition to historic droughts in the Amazon. The Andean region faces glacier retreat that threatens the water security of millions of people.

The central-eastern European region faces storm-related flooding (Germany, Poland, Czech Republic, Hungary, Austria and neighbors). The Mediterranean region experiences intensified forest fires and drought events. The Iberian Peninsula suffers from extreme flooding (DANA phenomenon) and fires in Portugal.

South Asia, particularly India, is experiencing record heat waves. The Middle East, especially Saudi Arabia, has experienced temperatures above 50°C. Southeast Asia is facing intensified typhoons and monsoons. The Horn of Africa (Ethiopia, Kenya, Somalia, Eritrea, Djibouti, Sudan) faced its worst drought in 40 years (2020-2022). West and Central Africa (particularly Chad and Nigeria) experienced record flooding in 2024, damaging 639.000 homes and displacing over 1 million people.

In Oceania and the Pacific, Pacific islands are facing rising sea levels, intense storms, and long-term existential risk. Australia is experiencing intensified heat waves and droughts. In the Polar Regions, Antarctica and the Arctic are facing accelerated melting of glaciers and ice sheets, reduced Arctic sea ice cover, and ocean warming that compromises marine ecosystems.

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IV. INTERDISCIPLINARITY: INTERCULTURAL ENVIRONMENTAL TECHNOLOGY AS STRATEGY OF ENVIRONMENTAL HEALTH AND HEALTH EQUITY PROMOTION

Therefore, as an unfolding of research on access to Brazilian natural resources and the legal impediment of cultural appropriation [32], such initiatives were important for the settlement of humans and animals in their own locations under dignified conditions of access to the minimum resources that guarantee physical survival. This is especially true if, due to climatic accidents, there are power outages and the inability of people to move away from danger. Furthermore, the aim was cultural preservation through social technology, consequently, the preservation of the psycho-cultural identity of those who lost it sequentially throughout human history or lost everything abruptly in epidemics, pandemics, and climatic accidents. [33,34,35,36]

Triterpenoid compounds in latex obtained from specimens associated with mangrove environments in Espírito Santo, southeastern Brazil. According to the cited study, these compounds exhibited cytotoxic activity against a gastric carcinoma cell line and showed a favorable selectivity index when compared with a normal lymphocyte cell line. [37,38] Besides, investigations of *Euphorbia resinifera* have reported effects involving lipid peroxidation and lysosomal activity, including autophagy, and apoptosis (perhaps ferroptosis). [39,40] Such findings may contribute to the formulation of hypotheses concerning cellular mechanisms within the genus.

The subsidence of coastal cities, coupled with rising sea levels, exposes soil and ecosystems to hyper salinity. Environmental technology strategies aim to mechanically counteract this increase in salinity through the use of halophytic plants resistant to hypersalinity, [41] phytoremediation strategies to clean drinking water [42] besides the recovery or preservation of riparian vegetation. [43]

Worthy of note, in flood-prone areas, the avoidance of *Leptospira interrogans* serovar Manilae presence in the water has been evidenciated in laboratory, when testing Philippine

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herbal: *Momordica charantia*, *Cassia alata* and *Allium sativum* methanolic extracts. The respective minimum inhibitory concentrations were found to be as follows: 1.25 mg/mL (*M. charantia*), 2.5 mg/mL (*C. alata*), and >5 mg/mL (*A. sativum*). [44]

This literature summarized includes PRISMA systematic investigations of antiparasitic besides other biological activities that may be relevant biological activities upon vectors or to pathogens associated with neglected diseases, including Schistosomiasis, Leishmaniasis, and Chagas disease. [45,46,47] These diseases continue to be important public health challenges, particularly among socially and economically vulnerable populations, especially when under distress conditions of natural disasters and promiscuous survival conditions (any through fecal-oral contamination route as, Hepatites. [48]

Furthermore, in a well-known process, pyrolysis plants are widely used in biofactories, capable of reducing process costs while maintaining good efficiency. In short, a pyrolysis plant is a factory capable of transforming waste, plastic, old tires, or plant remains into oil, gas, and charcoal. This happens inside a closed furnace, without oxygen and under high temperatures. Thus, the waste becomes fuel and energy without igniting. The waste or chopped wood enters the system dry. The reactor heats the material between 300°C and 800°C without oxygen, and the transformation occurs: The material melts, liquefies, and evaporates as vapor and gas. By the way, the enzymatic composition of *E. tirucalli* latex provides a potentially relevant avenue for biotechnological investigation into sustainable process and circulary economy, as ethnoknowledge and ethnobothany assays had already shown [49] upon potential interest, to degrade persistent synthetic polymers such as plastics at room temperature [50,51] The occurrence of these enzymatic activities, besides antifungal action evidenced [52] support further investigation of purified enzymes or standardized fractions rather than direct application of raw latex.

In Environmental Technology, Bamboo genus has an efficient use as a potent windbreak to typhons. Also used as a phytoremediator to soil recovery from contamination of persistent, heavy metals, pro-carcinogens of war residues, besides endocrine disruptors, as a

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nature-based solution (NbS) for climate change mitigation, by African and Asian people. [53,54,55,56,57,58,59,60]

Indeed, the phytoremediation potential (phytoextraction and phytovolatilization) is promising for reducing air pollution, as preliminarily evidenced by *Euphorbia tirucalli* also tobacco smoke. [41,61] Meanwhile, excess light, heat, and excessive UV radiation could be modulated to bioindicators of heat and brightness through appliance the concept of leaf reflectance to novel assays. [62,63,64]

Panicum maximum is recognized for its phytoremediation potential, reduction of carbon, besides fix ability upon humidity and nitrogen resources to soils degenerated and in desertification process among African and Asian people, while *E. tirucalli* is also being investigated. [65]

Environmental technology procedures based on nature observation studies (ecophysiology studies, and particularly on traditional knowledge around the world) correspond to attempts to mitigate environmental problems at a local (territorial) level and on a small scale. However, it makes sense to be communicated because they can be adapted and improved, and especially, because they generate hope, self-esteem/empowerment and proactivity to people. [32,33]

DISCUSSION

ANALYSIS OF TRENDS IN CLIMATIC EVENTS

These events have caused massive human losses, large-scale population displacements, and economic impacts estimated in the trillions of dollars. The ideas of risk and vulnerability help public health teams see who needs help first. They show why some people get sicker than others. To reduce disaster health risks for high-risk groups, it is important to identify vulnerable populations and risk management capacity in a community, and to develop and implement appropriate vulnerability reduction strategies in Health Emergency and Disaster

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Risk Management - Health EDRM. [66,67] The analysis of trends in these events will be discussed.

Scientific evidence points to a consistent and accelerated increase in the frequency of extreme weather events. According to recent research, [16] for every 0.1°C increase in the global average temperature, approximately 360 new climate disasters are recorded in Brazil alone. In Brazil specifically, comparing the 1990s (6.523 climate disasters in municipalities) with the period 2020-2023 (16.306 climate disasters), there is a 150% increase in just four years. [68]

The IPCC (2023)[14] projects that for every additional 0.5°C of warming, there will be visible increases in the frequency and severity of extreme heat, storms, and droughts. Heat waves that occurred once every ten years in the pre-industrial era now occur approximately 3 times more frequently on a global scale, as demonstrated by multiple attribution studies. [28]

The IPCC[13,14] also highlights that rare events (occurring every 50-100 years) will become increasingly frequent as warming increases. The scientific knowledge assessed indicates a higher frequency of extreme weather events expected from 2030 onwards, regardless of the emissions scenario considered.

In addition to increased frequency, events are progressively becoming more intense. Climate attribution studies quantify these increases precisely:

- For Hurricanes: A higher proportion of hurricanes are reaching categories 4 and 5, with rapid intensification (current hurricanes reach higher categories more quickly), and more torrential rainfall. Hurricane Harvey (2017) had 19% more rain than it would have had without climate change. This increase in precipitation resulted in 14% more flooded areas and a quadrupling of financial losses in what ended up being a $90 billion storm. [27]

- For Heat Waves: Temperature records are being broken regularly. In 2024, the concentration of CO2 in the atmosphere reached 151% above pre-industrial levels, the highest in 800.000 years. Heat waves are on average 1.2°C warmer than in the past. Permafrost is melting at accelerated rates, releasing methane in a positive feedback process. [12]

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- For Droughts: Drought periods are becoming longer, soil drying is accelerating, and desertification is expanding geographically.

- For Floods: Extreme rainfall occurs in very short periods, river overflows cascade, and cumulative damage accumulates in affected regions.

- Climate Assignment

The science of climate attribution now allows us to precisely quantify how climate change intensifies specific extreme events. A seminal study analyzed six major Atlantic hurricanes (Katrina, Irma, Maria, Harvey, Dorian, Florence) that collectively caused over $500 billion in damages. Researchers found that the total rainfall from these events was 4 to 15 times more intense due to climate change. [28]

The Horn of Africa drought (2020-2022) provides another notable example. A World Weather Attribution report (2023)[15] concluded that climate change caused by human activities made agricultural drought in the Horn of Africa almost 100 times more likely.

Analyses of events between 2015 and 2017 showed that 62 of 77 reported events revealed considerable human influence. [69] Furthermore, the likelihood of heat waves has increased significantly due to human activity, according to several studies conducted since 2015.

Moreover, data[11,12,13,14,17] indicate an acceleration in the rate of climate change. Each of the last ten years has individually been one of the ten warmest on record. Ocean warming has accelerated, CO2 concentrations have reached record levels, and ocean acidification is occurring at rates not seen in the last 26.000 years. [12]

Population displacements due to extreme events reached their highest number in 16 years in 2024, a growing trend. There is increasing potential for irreversibility: ocean warming will continue for centuries even with reductions in future emissions, there is loss of ecosystems (many irreversible such as coral reefs), glacier retreat on an alarming scale, and possible collapse of critical climate systems. [12]

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ECONOMIC AND SOCIAL IMPACTS OF CLIMATE CHANGES

Direct Impacts

Extreme weather events have immediate and direct impacts on populations and infrastructure. Mortality is substantial: more than 2 million deaths were attributed to weather events between 1970 and 2019. [12] In addition to deaths, there are injuries, respiratory illnesses exacerbated by environmental extremes, malnutrition (particularly in drought contexts), and psychological trauma including post-traumatic stress disorder and depression.

Forced displacement and migration reached record levels in 2024, with more than 1 million people displaced in West and Central Africa alone. In Brazil, the Porto Alegre floods displaced 420.000 people. These displacements can be permanent or temporary, causing cascading humanitarian crises when multiple events occur in sequence.

Infrastructure suffers extensive damage, including the destruction of roads, bridges, power transmission lines, housing, water and sanitation systems, schools, and hospitals.

Indirect and Systemic Impacts

Indirect impacts amplify the initial damage through multiple channels. Food security is compromised: in the Horn of Africa, 37 million people were on the brink of famine, with 1.4 million children facing severe acute malnutrition. Impacts on food security result from livestock destruction, crop losses, and disruption of agricultural production chains.

Water security deteriorates with the accelerated melting of glaciers in Asia and the Americas, reduced rainfall in critical regions, and emerging conflicts over water resources. Economic security is affected through direct losses (infrastructure), indirect losses (supply chain, unemployment), food and commodity price crises, and increased inequality.

Health security suffers from malnutrition associated with droughts, post-disaster infectious diseases, psychological trauma, and the collapse of health systems. Political security is threatened by mass displacement, the possibility of conflict over resources, and prolonged humanitarian crises.

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Economic Impacts

Cumulative global economic losses demonstrate extraordinary magnitude. From 1970 to 2019, total losses amounted to US$3.47 trillion, with a daily average of US$383 million. In the period 2004-2024, losses totaled US$2.97 trillion, representing an 82% increase compared to the period 1980-1999. [21]

Storms and hurricanes account for the largest proportion of economic damage. Three hurricanes in 2017 (Harvey, Irma, Maria) combined resulted in US$339.2 billion in damage, representing 35% of total economic disaster losses worldwide from 1970 to 2019. [22]

In Brazil, the period 1995-2023 recorded R$ 547.2 billion in losses. Specifically, the period 2020-2023 (just 4 years) accounted for R$ 188.7 billion, equivalent to 80% of the losses of the entire previous decade (2010-2019), representing 0.5% of the national GDP - Gross Domestic Product (PIB in Portuguese language, meaning Internal Gross Product) accumulated over 4 years. [68]

INEQUALITY AND CLIMATE JUSTICE

A fundamental injustice characterizes the distribution of climate impacts. Developing countries suffer 91% of deaths from climate events but contribute minimally to historical greenhouse gas emissions. Developed countries account for 59% of economic losses (a smaller proportion in absolute terms). Least developed nations face economic losses that represent larger proportions of their GDPs.

The structural vulnerabilities of poor countries include inadequate infrastructure for protection against extreme events, economies dependent on climate-sensitive agriculture, limited resources for post-disaster reconstruction, and reduced adaptive capacity. These factors create cycles of poverty: extreme events impoverish families, cause loss of productive agricultural land, induce accelerated rural-urban migration, and amplify existing inequality. Differential impacts by gender are also documented. In patriarchal societies, women face increased vulnerability to extreme events. In the Horn of Africa, drought accelerated child

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marriage, as families weakened by lack of rain and food resorted in exchange for dowry to obtain resources.

Consolidated data from multiple sources [11,12,13,14,17,21,22,23] demonstrated that: (1) 7.348 climate disasters were recorded between 2004-2024 causing 1.23 million deaths and affecting 4.2 billion people; (2) economic losses reached US$ 2.97 trillion, an increase of 82% compared to the previous period; (3) the frequency of extreme events increased by 74% compared to the period 1980-1999; (4) Rare events have become commonplace, with heat waves occurring 3 times more frequently than in the pre-industrial era.

A review unequivocally documents the accelerated increase in extreme weather events over the past twenty years (2004-2024), their intensification, and the causal relationship with anthropogenic climate change. The science of climate attribution has established a causal relationship between climate change and extreme events, demonstrating that drought in the Horn of Africa was 100 times more likely, and major Atlantic hurricanes had 4-15 times more intense rainfall due to anthropogenic climate change. [31]

The geographical distribution reveals differential vulnerability, with 91% of deaths in developing countries, reflecting fundamental injustice. Future projections [14], indicate that even with mitigation actions, even more extreme events will be inevitable, as are already occurring (earthquakes, hurricanes, tsunamis, storms with flooding, volcanic eruptions, among others), bringing another concern: moreover the controversial upon the impact of magnetic fields in chronic exposition, [70,71,72]) climate disasters cause the loss of electricity and reduce mobility in the search for refuge and help, besides no mitigation of heat waves [62]. This requires the existence of strategies for local solutions urgently, also taking advantage of the millennial traditional knowledge from different peoples. [61,64]

All communities and countries are at risk of being exposed to disasters. The impact of disasters is directly associated with the resilience or susceptibility of individuals and communities to hazardous events. Understanding and identifying individual or community vulnerability is important for developing and implementing Disaster Risk Management

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(DRM) policies and programs to reduce disaster risk and increase resilience in communities. [67]

Vulnerability is defined as '*The conditions determined by physical, social, economic, and environmental factors or processes which increase the susceptibility of an individual, a community, assets, or systems to the impacts of hazards'*. [67]

So, vulnerability is determined by historical, political, cultural, institutional, and natural resource processes that shape people's lives and lifestyles, that may produce a range of underlying drivers of vulnerability. This includes living in disaster risk areas or in poor housing, ill-health, political tensions, or a lack of local institutions or preparedness measures (Social Vulnerability). [73] It is very important for determining disaster health risk for communities and people. Disaster risk does not only depend on disaster severity or the number of people affected, but also on people's susceptibility to the disaster impact. So, understanding levels of vulnerability in relation to hazard exposure helps to explain why some hazards result in severe impacts, while others don't.

Some population groups are more vulnerable to disasters due to characteristics such as age, gender and sexual identities, race, culture, religion, disability, socioeconomic status, geographical location, or migration status. It is important to ensure that marginalized and vulnerable populations are included and represented in evidence-based research and practice for health EDRM. [74] Vulnerable populations are defined as those at greater risk for poor health status and healthcare access. [75] So, vulnerability is one of the defining components of disaster risk. It is the human dimension of disasters and is the result of the range of economic, social, cultural, institutional, political and psychological factors that shape people's lives and the environment that they live in. [76]

Besides, the four principles of bioethics — autonomy, beneficence, nonmaleficence and justice — are commonly applied in health care, reducing assimetries. In Canadian health care contexts, many groups have been classified as vulnerable based on health outcomes and experience of adverse social determinants of health. Indeed, vulnerability needs not be considered a negative attribute, because to be human is to be vulnerable. So, it mandates an

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ethical duty to create just and equitable health care systems that promote autonomy, foster engagement, enhance cultural safety and support the well-being of all. [77]

Previously, health vulnerability had been redefined, [78] when a theoretical model was constructed based on the relationship of three components: 1) The social subject, with its concepts and sub-concepts; 2) The condition of precariousness and agency to which he is exposed; 3) Processes of enhancing or weakening health vulnerability. In our view, understanding the social subject and its dimensions can expand the understanding of climate impacts on multidimensional health, and the axes of action and prioritization of prevention and monitoring measures in socio-cultural-environmental health, as pointed. [79]

In order to adequately respond to these impacts of climate change on the health of the population and on the health system, the first critical step is to assess which populations and geographical areas are most vulnerable to different kinds of health impacts as well as the capacity of health systems to manage these. This process aims at identifying weaknesses in the systems that should protect population's health as well as adaptation options. Thereby, Vulnerability and Adaptation assessments serve as a baseline analysis against which changes in disease risks and protective measures can be monitored. They also provide the opportunity for building capacity and can strengthen the case for investment in health protection (context, focus level, application focus - policy or clinical. [80]

Environmental health relates to all aspects of human health, spanning natural and anthropogenic environments. As ecological degradation accelerates, public focus on environmental health has grown significantly. The Lancet editorial suggests that the conceptual framework of health should further expand to include social and environmental health. The WHO proposed the concept of "One Health" (2011)[1], operationalized this holism as "a comprehensive, integrated approach to sustainably balance and optimize health across humans, animals, and ecosystems". Building upon this, Concord incorporated environmental health into the health concept, so, encouraged individuals to assess health from a broader perspective, fostering harmony between humanity and nature, individuals and communities,

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and people and society. It was previously pointed out that the concept of health has a significant interdisciplinary nature, especially environmental health. [3]

The concept of health varies across disciplines and cultures. This inconsistency in health concepts reduces the comparability of the results from different studies and makes it difficult to effectively guide practice. Culturally, the understanding of health also varies. The concept of multidimensional health and individualized characteristics, with unique cultural content in different regions, brings attributes which can be summarized as follows: complexity, multidimensionality, continuity, dynamism, objectivity, and subjectivity. [3]

It is urgently necessary to establish health assessment standards with practical guiding value under the current level of medical development and the background of social culture, fully considering the health needs of different populations, thereby informing the creation of fairer, more sustainable, and impact-driven health policies. Global health is a field of research and practice dedicated to applying multidisciplinary, multi-sectoral and culturally sensitive approaches to reduce health disparities that transcend national boundaries aiming to identify a cross-cultural health framework for health promotion in a strategy to “seek common ground while respecting differences” as previously discussed. [3]

These approaches were particularly relevant to regions where neglected diseases, environmental degradation, and socioeconomic vulnerability occur simultaneously, including refugee settings,[81] populations affected by climate-related disasters and environmentally displaced persons, [82,83] ethnic groups [49,84,85,86,87], Indigenous peoples. [88]

The ethnobotanical dimension remained central to this discussion because Traditional Communities have historically developed knowledge concerning plants through long-term interaction with their environments, appreciated by ethnopsychiatry, public health, bioethics, always aiming for possible sustainable objectives and social technologic projects. [89,90]

Such approaches required respect for Traditional Knowledge, appropriate benefit-sharing frameworks, careful distinction between documenting traditional practices and validating biomedical or biotechnological claims. The possibility of using enzymes or fractions in plant biotechnology, including the treatment or transformation of persistent

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materials, is therefore an emerging hypothesis which may contribute to the recovery, transformation, or valorization of waste and, perhaps, other materials. [50,51]

The interdisciplinary nature of this research trajectory has also resulted in educational and technical products directed toward the dissemination of knowledge on biodiversity and cultural diversity [91,92], traditional knowledge, environmental sustainability, bioethics and the health of social vulnerable populations. These initiatives included educational booklets addressing the sustainable use of biodiversity, spiritual and mental health among traditional ethnic groups in Brazil, as well as, activities involving traditional knowledge and associated rights, ethic, psychosocial care, sustainability and human rights. [81,87,93,94,95,96,97,98,99]

Such initiatives represent complementary outputs of the research trajectory and illustrate the social and educational dimensions within which studies of biodiversity and traditional knowledge are developed. The value of interdisciplinary research upon biotechnologically relevant plants may extend beyond laboratory findings to perform include education, knowledge sharing, cultural respect, and socially responsible innovation, thinking in human rights and also promoting One Health. [33,35,81,83,84, 86,100,101,102,103,104]

Moreover, psychological suffering refers to a continuous spectrum of negative emotional experiences that do not necessarily meet the diagnostic criteria for a mental disorder. It is described as "a state of unease, distress, or emotional pain that may arise in response to adverse life circumstances, trauma, somatic medical problems, or as an initial manifestation of a mental pathology". It differs from mental disorder in that it: (a) is transient or situational; (b) responds to identifiable stressors; (c) does not necessarily result in functional disability; (d) resolves with psychosocial support without requiring specific clinical treatment. However, intense and prolonged psychological distress can evolve into a structured mental disorder. [105]

The concept of "psychosocial care" aims to treat the person holistically, considering both: the psychic/mental dimension and the social dimension. [106;107] Psychosocial Care (PC) is defined as a mental health care model that prioritizes the integration of clinical, psychological, social, and community interventions for people with mental disorders, psychological distress,

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and needs related to the use of alcohol and other drugs. According to the guidelines of the World Health Organization (WHO, 1990 [108,67,6] and Pan American Health Organization, [109,110] the psychosocial care is characterized by: (a) a territorial and community-based approach; (b) services based on scientific evidence; (c) respect for human rights and user autonomy; (d) articulation between different levels of care complexity; (e) active participation of the user and their family in the therapeutic process.

Indeed, besides, mental disorders and psychological suffering constitute a silent pandemic affecting more than 1.17 billion people globally. As previously discussed, [111] the conceptual evolution of the terms reflects a progressive humanization and destigmatization of mental health conditions. Current epidemiological data demonstrate that anxiety disorders and major depression are the most prevalent and disabling conditions, with the burden of mental illness peaking in adolescence and disproportionately affecting women. [18]

So, the trend of climate disasters will be for these incidences of disorders and psychological suffering to increase, due to the potential collective despair generated by real-time news, or even worse, alienation, neglect of oneself and others, or even a lack of reaction. In this sense, respect and take care of singularities of individuals and collectives is also preconized by the National Humanization Policy. [112,113,114]

In conclusion, unexpected and poorly understood climatic phenomena that culminate in the irreversibility of Global climate disasters beyond the environmental impact have the potential to cause harm in different segments of individual and social life. This issue needs to be analized, it’s prement to be discussed, while solutions that have worked at the local level, even if modest, need to be communicated.

It is strongly recommended that attention be focused on reducing pollutant emissions through analysis of industrial processes with their improvements, coupled with behavioral change through reduced consumerism, [115] besides better use of inputs and natural resources, supported by the dissemination of circular economy practices [116] to production of increment and empowerment of life: Life with quality and well-being.

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LIMITS

This study is a literature review and is therefore subject to the limitations inherent to secondary-source research.

CONTRIBUTION

Particular emphasis was placed on the potential of the plant species and their derived products for environmental and biological approaches related to climatic disasters. These examples illustrate the broader interdisciplinary dimension of the research program, particularly its emphasis on biodiversity, traditional knowledge, environmental sustainability, bioethics, health promotion, and knowledge dissemination. It was also demonstrated the commitment to translating scientific knowledge into accessible educational materials and strengthening dialogue between academic research and traditional and socially vulnerable populations, also under social environmental disruptions evidencing social suffering may be of interest to Global Health.

CONCLUSION

The current decade (2020-2030) constitutes a critical period for determining the planetary climate trajectory over centuries. It is concluded that the reality of increasing extreme climate events is undeniable, based on objective data from multiple international scientific institutions, and that urgent actions for mitigation (reducing emissions by 43% by 2030), adaptation (resilient infrastructure), and climate justice (funding for vulnerable nations) are imperative to reduce future human suffering.

In parallel, understanding the relevance of working with cultural competence and interdisciplinary research in environmental health corresponds to broadening the paradigm in favor of the well-being of living beings and promoting the concept of One Health.

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REFERENCIAS BIBLIOGRÁFICAS

1. WHO. WORLD HEALTH ORGANIZATION. Equity, Social Determinants and Public Health Programmes. *World Health Organization*; 2010. Accessed September 8, 2026. https://www.who.int/publications/i/item/9789241563970. Published online 2010.
2. CDC. CENTERS FOR DISEASE CONTROL AND PREVENTION. Social determinants of health: NCHHSTP health equity. *CDC.gov.* https://www.cdc.gov/health-disparities-hiv-std-tb-hepatitis/about/social-determinants-of-health.html. Published May 15, 2024. Updated August 17, 2026. Accessed September 8, 2026. Published online 2024.
3. ZHU, W.; CHEN, H.; ZHANG, Y.; ZHAO, Y.; JI, Y.; SUN, H. Health from a health promotion perspective: a concept analysis. *J Health Popul Nutr.* 2025 Oct 17; 44:369. Available at: https://pmc.ncbi.nlm.nih.gov/articles/PMC12535048/. Published online 2025. doi:10.1186/s41043-025-01055-2
4. IBGE - BRAZILIAN INSTITUTE OF GEOGRAPHY AND STATISTICS. 2022 Demographic Census. Rio de Janeiro: *IBGE, 2022*. Available at: https://censo2022.ibge.gov.br/. Accessed on: July 17, 2026. Published online 2022.
5. WHO. WORLD HEALTH ORGANIZATION. Global report on neglected tropical diseases 2025. Geneva: *World Health Organization*, 2025. ISBN 978-92-4-011404-3. Available a: https://www.who.int/teams/control-of-neglected-tropical-diseases/global-report-on-neglected-tropical-diseases-2025. Acessed in 14 Aug. 2026. 2025.
6. WHO. WORLD HEALTH ORGANIZATION. Climate change. *World Health Organization.* Published October 12, 2023. Accessed August 14, 2026. Available at: https://www.who.int/news-room/fact-sheets/detail/climate-change-and-health. 2023.
7. WHO. WORLD HEALTH ORGANIZATION. Global health estimates: leading causes of death. 2024. *Global Health Observatory.* 2024. Accessed August 14, 2026. Available at: https://www.who.int/data/gho/data/themes/mortality-and-global-health-estimates/ghe-leading-causes-of-death. 2024.
8. OWD. OUR WORLD IN DATA. War and Peace. Oxford: *Global Change Data Lab*, *2024.* Based on UCDP/PRIO/IHME Global Burden of Disease. Available at: https://ourworldindata.org/war-and-peace. Accessed on: 14 ago. 2026. Published online 2024.
9. UNODC. UNITED NATIONS OFFICE ON DRUGS AND CRIME (UNODC). Global Study on Homicide 2023. Vienna: *UNODC, 2023*. Available at:

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https://www.unodc.org/unodc/en/data-and-analysis/global-study-on-homicide.html. Acesso em: 23 set. 2026.

10. UNODC. UNITED NATIONS OFFICE ON DRUGS AND CRIME. Global Study on Homicide 2019. Vienna: *UNODC, 2019.* Available at: https://www.unodc.org/unodc/en/press/releases/2019/Juli/homicide-kills-far-more-people-than-armed-conflict--says-new-unodc-study.html. Accessed on: 14 ago. 2026. Published online 2019.
11. WMO. WORLD METEOROLOGICAL ORGANIZATION. State of the Global Climate 2023. Geneva: *WMO, 2024. WMO-No. 1347*. Available at: https://wmo.int/publication-series/state-of-global-climate-2023. Published online 2023.
12. WMO. WORLD METEOROLOGICAL ORGANIZATION. State of the Global Climate 2024. Geneva: *WMO, 2025. WMO-No. 1368.* Available at: https://wmo.int/publication-series/state-of-global-climate/state-of-global-climate-2024.
13. IPCC - INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE. Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge: *Cambridge University Press, 2021.* Available at: ipcc.ch. Acessed on: 23 sept. 2026.
14. IPCC. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE. Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Geneva. *IPCC.* Published online 2023.
15. WWA. WORLD WEATHER ATTRIBUTION. Human-caused climate change has made the exceptional wet Pakistan flooding in 2022 more likely and more severe. *World Weather Attribution Analysis.* [S. l.]: WWA, 14 set. 2. Published online 2023.
16. DANTAS, T. L. P. et al. Natural disasters and climate change in Brazil: trend analysis 1990-2024. Brasília: M*undogeo, 2024.* 1 technical report. Available at: https://mundogeo.com/2024/12/05/cemaden-analisa-secas-no-brasil-e-apresenta-diagnosticos-e-projecoes-futuras/. Published online 1990.
17. UNDRR. UNITED NATIONS OFFICE FOR DISASTER RISK REDUCTION. Horn of Africa Floods and Drought, 2020-2023: Forensic Analysis. *UNDRR; 2024.* Acessed on 8 sept 2026. Available at: https://www.undrr.org/resource/horn-africa-floods-and-dr. Published online 2020.
18. PYRRHO, A. dos S.; VARRICCHIO, M.C.B.N. Mental Disorders, Psychological Distress and Psychosocial Care: A Systematic Review Based on WHO, ICD-11 and Global Burden of Disease Studies. *SEIVA – Journal supporting the Environmental Health, Parasitology, and Bioethics Project (SAPB-LIPAT/FF/UFRJ Project).* Vol. 10 - No. 1 - Technical Article Mai 2026. Available at: https://sites.google.com/view/lipat/sapb-revista_seiva#h.5v29qbbclf8c. Published online 2026.

A Revista OWL Journal está licenciada com uma Licença Creative Commons Atribuição (CC BY)

19. PAGE, M. J.; MCKENZIE, J. E.; BOSSUYT, P. M.; BOUTRON, I.; HOFFMANN, T. C.; MULROW, C. D. et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*, v. 372, n. 71, 2021. Published online 2020.
20. STAKE, Robert E. The Art of Case Study Research. *Thousand Oaks*, CA: SAGE Publications, 1995.
21. EM-DAT. CENTRE FOR RESEARCH ON THE EPIDEMIOLOGY OF DISASTERS. *The International Disaster Database.* Brussels: Université Catholique de Louvain, 2024. Available at: https://www.emdat.be/. Published online 2024.
22. NOAA. NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION. Billion-dollar weather and climate disasters: summary statistics. Asheville, NC: *National Centers for Environmental Information, 2024*. Available at: https://www.nce. Published online 2024.
23. NASA. NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. Extreme Weather. *NASA Science.* September 16, 2026. https://science.nasa.gov/climate-change/extreme-weather/
24. CRED. CENTRE FOR RESEARCH ON THE EPIDEMIOLOGY OF DISASTERS, United Nations Office for Disaster Risk Reduction. The Human Cost of Disasters: An Overview of the Last 20 Years (2000-2019). *United Nations Office for Disaster Risk Reduction; 2026.*
25. SENEVIRATNE, S. I. et al. Changes in Climate Extremes and their Impacts on the Natural Physical Environment. In: FIELD, C. B. et al. (org.). *Managing the Risks of Extreme Events and Disasters to Advance Climate Change* Ad. Published online 2012.
26. EB. ENCYCLOPÆDIA BRITANNICA. Hurricane Katrina: Deaths, Damage, & Facts. In *Encyclopædia Britannica* [S. l.], 2026. Available at: https://www.britannica.com/event/Hurricane-Katrina. Published online 2026.
27. WEHNER, M. F. et al. Hurricane intensification and global climate change. In: PYLE, D. M. et al. (org.). Extreme Events: Observations, Modeling, and Economics. Washington, DC: *American Geophysical Union*, 2024. cap. 4, p. 55-78. In: 2024.
28. WWA. WORLD WEATHER ATTRIBUTION. Increasing likelihood of another extremely hot summer in Europe. *World Weather Attribution Analysis.* [S. l.]: WWA, 17 maio 2023. Available at: https://www.worldweatherattribution.org/incr. Published online 2024.
29. CLIMATE OBSERVATORY. Analysis of greenhouse gas emissions and their implications for the climate: annual report. São Paulo: *Climate Observatory*, 2025. Available at: https://www.oc.org.br. Accessed on: September 8, 2026. Published online 2025.
30. PUBLIC. Climate CALAMITY is the new reality: ten extreme phenomena of 2024. *Público*, Lisbon, December 30, 2024. Available at: https://www.publico.pt/2024/12/30/azul/noticia/calamidade-climatica-nova-realidade-dez-fenomen. Published online 2024.
31. BECK, T. M.; VAN DER LINDEN, E. C.; HEMBERG, M.; SCHWARZ, J.; MÜLLER, A. R. Mortality burden attributed to anthropogenic warming during Europe's 2022 record-breaking summer. npj *Climate and Atmospheric Science*, v. 7, art. 245, p. 1-13, 2024. DOI: 10.1038/s41612-024-00755-6. Published online 2022. doi:10.1038/s41612-024-00755-6

A Revista OWL Journal está licenciada com uma Licença Creative Commons Atribuição (CC BY)

32. VARRICCHIO, M.C.B.N. Analysis regarding the effectiveness of legislation on access to Brazilian genetic heritage, protection and access to associated traditional knowledge, as a sustainable use of biodiversity. Post-Doctoral Internship Final Report, 2019. *NATIONAL INSTITUTE OF INDUSTRIAL PROPERTY.* Official publication of the Brazilian Ministry of Economy. Supervisor: Prof. Dr. Celso Luiz de Salgueiro Lage. BRAZIL - Rio de Janeiro. January 2020. Thematic Technical Product on Brazilian Traditional/Ethnic Knowledge and Associated Rights. Available at: https://sites.google.com/view/lipat/sapb-artigos#h.phiqv323b8w6. https://drive.google.com/file/d/1-PzXHuo01xSpXLy5_uSwyKcWnUl-5_2A/view Accessed in 01 Sept, 2026. Published online 2019.
33. VARRICCHIO, MCBN; GORINI, C.; MACHADO, CVS / Duigó-Tukano et al. Intercultural education for citizen integration and social innovation for ethnic groups in urban areas of Rio de Janeiro. In: *ACADEMIC MEETING ON INTELLECTUAL PROPERTY, INNOVATION AND DEVELOPMENT*, September 14., 2022. Rio de Janeiro. [Oral presentation]. Rio de Janeiro: UFRJ, WIPO: INPI, 2022. Honorable Mention. Accessed on: May, 23, 2026. Published online 2022.
34. DE ALMEIDA, D. DA S./TUKANO et al. Social technology and people's mental health: informal work in an urban context. *Observatory of the Latin American Economy*. V.22, n.9, p.01-17, September 2024. ISSN 1696-8352. DOI: http. Published online 2024.
35. CLER, J. da S. et al. Traditional Knowledge approach at SAPB/LIPAT/FF/UFRJ intersectorial project. *Aracê Magazine*, São José dos Pinhais, v. 6, n. 2, p. 1183-1194, 2024. Available at: https://periodicos.newsciencepubl.com/arace/article/view/695. Published online 2024. doi:10.56238/arev6n2-042
36. CLER, J. da S. et al. The richness of inter-epistemological dialogue for comprehensive care: Humanities and Social Medicine through the Environmental Health, Parasitology, and Bioethics Project. *Aracê Magazine*, Curitiba, v. 7, n. 1, p. 241-259, 2025. Available at: https://periodicos.newsciencepubl.com/arace/article/view/2662. Published online 2025. doi:10.56238/arev7n1-014
37. SOUZA, L.S. DE; TOSTA, C. L.; BORLOT, J.R. P. de O.; VARRICCHIO, M.C.B.N.; KITAGAWA, R.R.; FILGUEIRAS, P.R. & KUSTER, R.M. Chemical profile and cytotoxic evaluation of aerial parts of *Euphorbia tirucalli* L. on gastric adenocarcinoma (AGS cells). *Natural Product Research*. Fev, 2023. Published online 2023. doi:10.1080/14786419.2023.2179623
38. GBIF SECRETARIAT. GBIF Backbone Taxonomy. Checklist dataset. *GBIF, 2023.* Acessed on 8 Sept, 2026. Published online 2026. doi:10.15468/39omei
39. LI L, QI YR, FENG YP, LIU W, YUAN T. Euphatexols C–G: five new triterpenoids from the latex of *Euphorbia resinifera*. *J Asian Nat Prod Res.* 2020;22(10):965-973. Published online 2020. doi:10.1080/10286020.2019.1676722

A Revista OWL Journal está licenciada com uma Licença Creative Commons Atribuição (CC BY)

40. HMIDOUCHE O, BOUFTINI K, CHAFIK A, KHOUCHLAA A, et al. Ethnomedicinal use, phytochemistry, pharmacology, and toxicology of *Euphorbia resinifera* O. Berg. (B): a review. *J Zool Bot Gard.* 2023;4(2):364–395. doi:10.3390/jzbg. Published online 2023.
41. GASPAR, S. A. et al. Environmental and economic values of salt tolerance: *Euphorbia tirucalli*: phytoremediation potential. *International Journal of Advanced Engineering Research and Science*, v. 10, n. 6, p. 27-39, 2023. Disponível em: https://ijaers.com/issue-detail/vol-10-issue-6/. Acesso em: 6 ago. 2026. Published online 2023. doi:10.22161/ijaers.106.5
42. KATHAR, Krisna Ridzi et al. Constructed Wetlands: Technology for Removing Drug Concentration from Water. *International Journal of Advanced Engineering Research and Science*, AI Publications, v. 10, n. 4, p. 108–119, 2023. Published online 2023. doi:10.22161/ijaers.104.13
43. DINCA, L.; MURARIU, G.; LUPOAE, M. Understanding the ecosystem services of riparian forests: patterns, gaps, and global trends. *Forests*, Basel, v. 16, n. 6, p. 947, 2025. Published online 2025. doi:10.3390/f16060947
44. VISTA, F.E.S.; DE GALICIA, B.P.D. Antibacterial Activity of *Crude Momordica charantia, Cassia alata, and Allium sativum* Methanolic Extracts on *Leptospira interrogans serovar Manilae*. *Acta Med Philipp*. 2024 Dec 13; 58 (22): 29–34. Available at: https://pmc.ncbi.nlm.nih.gov/articles/PMC11732591/. Published online 2024. doi: 10.47895/amp.vi0.8362
45. GOMES, N. B. DE N.; IABRUDI, R.C.; MACEDO REBELO, R. DE; GASPAR, S. A.; VARRICCHIO, M. C. B. N.; BRIOSO, P. S. T.; DA SILVA, S.; PYRRHO, A. DOS S. Leishmaniasis, natural products, bioeconomy and sustainable development. *Brazilian Journal of Development*, 2023. Available at: - https://ojs.brazilianjournals.com.br/ojs/index.php/BRJD/article/view/62510/44980. Published online 2023.
46. GOMES, N. B. DE N.; FREIRE SOUZA SILVA, F.; WASIM, N.; IABRUDI, R.C.; DA SILVA, S.; BRIOSO, P. S. T.; VARRICCHIO, M.C.B.N.; PYRRHO, A. DOS S. Schistosomiasis and Brazilian bioeconomic potential. *Brazilian Journal of Development*. Curitiba, v.9, n.10, p. 28700-28711, Oct., 2023a. Available at: https://ojs.brazilianjournals.com.br/ojs/index.php/BRJD/issue/view/220. Accessed in: Published online 2023.
47. MARTINS, C. H.; BREDER, J. S. M.; GOMES, N. B. de N.; VIEIRA, I. F.; SILVA, E. P. da; SILVA, S. da; KUSTER, R. M.; VARRICCHIO, M. C. B. N.; PYRRHO, A. dos S. (2026) Trypanosoma cruzi, Chagas disease and natural products: a systematic review (2000-2025). Revista OWL (OWL Journal) - Revista Interdisciplinar de Ensino e Educação, v. 4, n. 7, p. 1-28. DOI: https://doi.org/10.5281/zenodo.21387668.
48. GOMES NBN, MALFACINI SS, GASPAR SA, PYRRHO AS, VARRICCHIO MCBN. Natural Products Under Investigation for Hepatitis Viruses: A Systematic Literature Review

A Revista OWL Journal está licenciada com uma Licença Creative Commons Atribuição (CC BY)

(2000-2025). Unpublished manuscript. 2025. *INFO-SAPB. Journal Supporting the SAPB-LIPAT/FF/UFRJ Project.* Technical article. Volume 10 - n1 - Mai 2026. Available at: https://sites.google.com/view/lipat/sapb-revista_info-sapb?authuser=0#h.bib1rmcv03gu. Acessado em 23 de setembro de 2026.

49. VACITE, MŁ. et al. Health of the Urban Roma Population in Rio de Janeiro/Brazil. *Foco Magazine.* Curitiba (PR) v.16. n.10|e3258. p.01-21. Out, 2023. Published online 2023.
50. DELAUNAY DE SOUZA, N.; MACÊDO REBELO, R. de; NIGRI, A. I.; GASPAR, S.A.; BRIOSO, P.S.T.; VARRICCHIO, M.C.B.N.; DA SILVA, S. *Euphorbia tirucalli*: potential plastic digester and bioeconomy. *Brazilian Journal of Development.* 2023. Available at: https://ojs.brazilianjournals.com.br/ojs/index.php/BRJD/ article/view/62666/45093. Published online 2023.
51. DELAUNAY DE SOUZA, N.; FREIRE SOUZA SILVA, F.; GASPAR, S.A.; GORINI, C.C.; VARRICCHIO, M.C.B.N.; PYRRHO, A. dos S.; BRIOSO, P.S.T.; DA SILVA, S. *Euphorbia tirucalli* elicitor in *Vigna unguiculata* cultives: Bioprocess, Bioproduct and Biotechnological Potential Plastic Digester. *Contemporary: Journal of Ethics and Political Philosophy.* v. 3, n. 10, p. 16713-16730. 2023a, out. Available at: https://ojs.revistacontemporanea.com/ojs/index.php/home/issue/view/20. Published online 2023.
52. GASPAR S.A., SILVA FFS, ALVES E, et al. (2023). ***Investigation of the antifungal action of natural products on seeds of Euterpe oleraceae: bioproduct potential***. Individual chapter in: *Uniting Knowledge Integrated Scientific Research*. Seven Editora; 256-268. doi:10.56238/sevened2023.007-022.
53. PAUDYAL K, ADHIKARI S, SHARMA S, et al. Framework for Assessing Ecosystem Services From Bamboo Forests: Lessons From Asia and Africa. Bogor, Indonesia: *Center for International Forestry Research (CIFOR)*; 2019. Working Pa. Published online 2019.
54. DELAUNAY, N.; RANGEL, B. Soil contamination via industrial and agricultural activities and its damage to human health. Presentation: N. Delaunay. Lecture in the Extension Course: Geopharmacobotany and Bioproducts. FMPFase Cultural Center. 2019. Published *online* 2019: *SAPB-LIPAT/FF/UFRJ Project*.
55. BRANDLE, JR; TAKLE, E.; ZHOU, X. Windbreak practices. In: *North American Agroforestry: An Integrated Science and Practice.* 3rd ed. Madison: American Society of Agronomy, 2021. p. 105–134. Published online 2021. doi: 10.1002/9780891183785.ch5
56. OAHU RESOURCE CONSERVATION AND DEVELOPMENT COUNCIL. Bamboo as an alternative windbreak. Technical Report. Honolulu: *Oahu RC&D*, [2022]. Available at: https://oahurcd.org/our-projects/protecting-the-environment/bamboo-as-a. Published online 2022.
57. PAN, C.; ZHOU, G.; SHRESTHA, A.K.; CHEN, J.; KOZAK, R.; LI, N.; LI, J.; HE, Y.; SHENG, C.; WANG, G. Bamboo as a nature-based solution (NbS) for climate change

A Revista OWL Journal está licenciada com uma Licença Creative Commons Atribuição (CC BY)

mitigation: biomass, products, and carbon credits. *Climate*, vol. 11, no. 9, art. 175, 2023. Published online 2023. doi:10.3390/cli11090175

58. HANSEL - MARTINS, C.; BOLOGNANI, F. DE A.; BENTES LOPES, J.; PYRRHO, A. DOS S.; VARRICCHIO, M.C.B.N. Endocrine Disruptors, Mental Disorders: Strategies in Environmental Health. *Foco Magazine*. 2023. Available at: https: Published online 2023.
59. DUTTA, S.; GORAIN, S.; ROY, J. et al. Bamboo for global sustainability: A systematic review of its environmental and ecological implications, climate action, and biodiversity contributions. *Environmental Reviews*, vol. 33, no. 3, p. 1–15, 2025. Published online 2025. doi:10.1139/er-2025-0032
60. LI, C. et al. Research on the role of bamboo species in the restoration of Cr (VI) contaminated soil and water bodies. *Journal of Environmental Management*, v. 375, p. 115-128, Jan. 2025. Available at: https://www.sciencedirect.com/science/article/abs/pii/S0301479725015415. Acesso em: 23 set. 2026
61. REBELO, R. de M. et al. Environment: health and engineering - interdisciplinarity in focus. *Pedagogical Cad.*, v. 22, no. 1, 2025. ISSN 1983-0882. Available at: https://ojs.studiespublicacoes.com.br/ojs/index.php/cadped/issue/view/134. Accessed on: July 28, 2025. Published online 2025. doi:10.54033/cadpedv22n1-141
62. NIGRI, A.I.; VARRICCHIO, M.T.; VARRICCHIO, M.C.B.N.; PYRRHO, A. DOS S.. Transmission Lines and the Environment: A historical perspective on guidelines in Environmental Health. INFO-SAPB. Vol. 1 – No. 1, May 2017. INFO-SAPB. Journal supporting the SAPB-LIPAT/FF/UFRJ Project. Technical article. Available at: https://sites.google.com/view/lipat/sapb-revista_info-sapb?authuser=0#h.p_Ao3lwclpMYL6. Accessed in: Published online 2017.
63. GASPAR, S.A.; VARRICCHIO, M.T.; NIGRI, A.I.; VARRICCHIO, M.C.B.N.; DA SILVA, S.; LAGE, C.L.S. Electromagnetic Radiation (EMR), Albedo, Reflectance. Phytoremediation Potential of *Panicum maximum*. INFO-SAPB. Volume 7 – n2 - May 2023ª. Technical article. Available at: https://sites.google.com/view/lipat/sapb-revista_info-sapb?authuser=0#h.k55khaldc4tt. Published online 2023.
64. REBELO, R. DE M.; HAMMES, R.S.S.; VARRICCHIO, M.T.; MALFACINI, S. DA S.; DELAUNAY DE SOUZA, D.; DE FREITAS, F.A.; DA SILVA, S.; BRIOSO, P.S.T.; PYRRHO, A. DOS S.; VARRICCHIO, M.C.B.N. 2026. Environmental Health, Environmental Engineering and Environmental Technology: Interdisciplinarity In Focus. Chapter 11. Pg 178 – 198 In E-book: *Approaches and Knowledge in Environmental Studies*/ Dariane Cristina Catapan. Curitiba. Editora Studies Publicações, 2026. ISBN: 978-65-83309-65-5. In: 2026. doi:10.54033/stebook.978-65-83309-65-5
65. GASPAR S.A, VARRICCHIO MT, PYRRHO AS, KUSTER RM, SILVA EP, BRIOSO PST, SILVA S, VARRICCHIO MCBN. *Panicum maximum* (Jacq.): Integrative review. *OWL Journal* - Interdisciplinary Journal of Teaching and Education. 2026. Published online 2026.

A Revista OWL Journal está licenciada com uma Licença Creative Commons Atribuição (CC BY)

66. ALLEN, M. R. et al. Framing and Context. In: MASSON-DELMOTTE, V. et al. (org.). Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge: *Cambridge University Press*, 2021. cap. 1, p. 147-286. Disponível em: https://www.ipcc.ch/report/ar6/wg1/. Acessed on: 9 Jul. 2026. In: 2021.
67. WHO. WORLD HEALTH ORGANIZATION. Chapter 2.5: Identifying and engaging high-risk groups in disaster research. In: *WHO Guidance on Research Methods for Health Emergency and Disaster Risk Management*. Revised 2022. Available at: https://wkc.who.int/our-work/health-emergencies/research-methods/sections-and-chapters/section-2/chapter-2-5-high-risk-groups. Accessed September 8, 2026. 2022.
68. AGÊNCIA BRASIL. Climate disasters increased 250% in four years. Brasília, DF: Agência Brasil, 2024. Available at: https://agenciabrasil.ebc.com.br/. Published online 2024.
69. HERRING, S. C.; CHRISTIDIS, N.; HOELL, A.; HOERLING, M. P.; STOTT, P. A. (ed.). Explaining Extreme Events of 2017 From a Climate Perspective. *Bulletin of the American Meteorological Society*, v. 100, n. 1, p. S1-S117, 2019.
70. THÉRIAULT, G. et al. Cancer risks associated with occupational exposure to magnetic fields among utility workers in Ontario and Quebec, Canada and France, 1970-89. *Amer. J. Epidem.* 139: 550-572, 1994. Published online 1970.
71. KOIFMAN S.; THÉRIAULT, G. 50-60 Hz electric and magnetic fields and cancer: The use of field exposure measurements in epidemiological studies. In: *"Biologic Effects of Electric and Magnetic Fields" Vol. II.* (D. O. Carpen. Published online 1994.
72. KOIFMAN, S.; MATTOS, I. E. Extremely Low Frequency Electromagnetic Fields (50-60 Hz) and Cancer: An Annotated Literature Review. Work prepared for *ELETROBRAS, 1996*. Published online 1996.
73. MIGUEL, R. Robert Castel's reflections on the concepts of "risk" and "social vulnerability". In: *INTERNATIONAL JOURNEY ON PUBLIC POLICIES*, 7., 2015, Maranhão. [Papers...]. UFMA, 2015. Available at: https://edisciplinas.usp.br/pluginfile.php/4820896/mod_resource/content/1/CASTEL%201%20%282%29.pdf Accessed on: August 8, 2025. Published online 2015.
74. NEWNHAM, E. A.; HO, J. Y.; CHAN, E. Y. Y. Chapter 2.5: Identifying and engaging high-risk groups in disaster research. In: *WORLD HEALTH ORGANIZATION. Research methods for health emergency and disaster risk management.* Geneva: World Health Organization, 2022. In: 2022.
75. SHI L, STEVENS GD. Vulnerability and unmet health care needs: the influence of multiple risk factors. *J Gen Intern Med.* 2005;20(2):148-154. doi:10.1111/j.1525-1497.2005.40136.x. Published online 2005.
76. UNDRR. UNITED NATIONS OFFICE FOR DISASTER RISK REDUCTION. Vulnerability [Internet]. Geneva: *UNDRR; 2026* [cited 2026 Sep 8]. Available from: https://www.undrr.org/understanding-disaster-risk/terminology/hips. Published online 2026.

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77. CLARK, D.B.A.; PRETO, N. Exploring the concept of vulnerability in health care. *CMAJ*, 2018. Mar 19;190(11):E308–E309. Available at: https://pmc.ncbi.nlm.nih.gov/articles/PMC5860890/. Published online 2018. doi:10.1503/cmaj.180242
78. FLORÊNCIO, R.S.; MOREIRA, T.M.M. Modelo de vulnerabilidade em saúde: esclarecimento conceitual na perspectiva do sujeito-social. *Acta Paul Enferm*. 2021; 34: eAPE00353. Available at: https://acta-ape.org/article/modelo-de-vulnerabilidade-em-saude-esclarecimento-conceitual-na-perspectiva-do-sujeito-social/. Published online 2021. doi:10.37689/acta-ape/2021AO00353
79. MECC. MINISTRY OF THE ENVIRONMENT AND CLIMATE CHANGE (BRAZIL). Brazil advances in waste policy and establishes a Reverse Logistics System for Plastic Packaging. *MECC, 2025*. Available at: https://www.gov.br/mma/pt-br/noticias/brasil-avanca-na-politica-de-residuos-e-institui-sistema-de-logistica-reversa-de-embalagens-de-plastico. Accessed July 7, 2026. Published online 2025.
80. WHO. WORLD HEALTH ORGANIZATION. Guidance for conducting a national or subnational vulnerability and adaptation assessment of health systems to climate change: 2025/2026 update. Geneva: *WHO, 2026*. Available at: who.int. Acessed on: 23 set. 2026.
81. BORSATTO, C.Z.; CORTASIO, A.; GORINI, C.; LAGE, C.L.S.; PYRRHO, A. DOS S.; VARRICCHIO, M.C.B.N. Social Vulnerability and Care in Brazil: Environmental, ethnic, and political migrants. *SEIVA*. Volume 4-2 - Oct-2020. Journal supporting the SAPB-LIPAT/FF/UFRJ Project. Technical article. Available at: https://sites.google.com/view/lipat/sapb-revista_seiva?authuser=0#h.p_2VXMCTdGGOWw. Accessed on: 01 Sept, 2026. Published online 2020.
82. WASIM, N. WASIM, N.; MUSMANNO, P.G.; VACITE, M.; DE LUNA, L.; HOBAICA, P.E.M.; RONCARATI, E.; GASPAR, S.A.; WENDLING DA SILVA, A.V.; PYRRHO, A. DOS S.; VARRICCHIO, M.C.B.N. Actions for Refugees and Environmentally Displaced Persons. *SEIVA*. V.4- n.1 - May-2020. Journal supporting the SAPB-LIPAT/FF/UFRJ Project. Available at: https://sites.google.com/view/lipat/sapb-revista_seiva?authuser=0#h.p_HFWfQZtxGOBL. Available at: https://drive.google.com/file/d/1QmIdFq6sNtOf_y91OwTL0mM4hqbn38AS/view. Accessed on: Aug. 6, 2026. Published online 2020.
83. WASIM, N.; MUSMANNO, P.G.; NAGAMATSU, D.; GASPAR, S.A.; DA SILVA, S.; VARRICCHIO, M.C.B.N.; DA SILVA, J.; PYRRHO, A. DOS S. 2022. Biotechnological Potential of Natural Products in Climate Disasters with Psycho-Socio-Environmental Repercussions. *Project SAPB-LIPAT/FF/DAC/UFRJ*: Technical Product. Available at https://sites.google.com/view/lipat/sapb-artigos?authuser=0#h.s5rjv6a0xmdm. Published online 2021.

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84. CLER, J. da S.; VARRICCHIO, M. C. B. N. The school library as a space for sharing knowledge and the construction of an anti-racist society. *Foco Magazine*, Curitiba, v. 16, n. 8, p. 1-22, 2023. Published online 2023.
85. BRAZIL. Ministry of Health. Guiding document for comprehensive health care for the Roma people. Brasília, DF: *Ministry of Health*, 2023. Available at: https://www.gov.br/saude/pt-br/composicao/saps/equidade/publicacoes/povo-cigano-romani/guia-orientador-para-a-atencao-integral-a-saude-do-povo-cigano/view. Accessed on: October 5, 2025. Published online 2023.
86. MALFACINI, S. DA S.; EZEQUIEL, TDG; RAMOS, LH; XIMENES LINS, R.; BENTES LOPES, J.; BOLOGNANI, F. DE A.; FREITAS, JV DE M.; VARRICCHIO, MCBN; PYRRHO, A. DOS S. Health of the Black Population and Public Policies: Psychosocial Care and Interculturality In *Trajectories in health: experiences, challenges and innovations in the scenario.* [electronic book] Organization Wolney Gomes Almeida. 1st ed. -- Curitiba, PR: Editora Contemporânea, 2024. Chapter 9. P. 124 – 137. ISBN: 978-65-982396-5-7. DOI: 10.56083/edcont.978.65-982396-5-7. 2024. doi:10.56083/edcont.978.65-982396-5-7
87. CAVALCANTI, L. C. et al. Facing COVID-19: guidelines for Gypsy people. Journal of Social and Environmental Management, Deerfield Beach, v. 18, n. 11, e084, 2024. Available at: https://rgsa.openaccesspublications.org/rgsa/issue/view/84. Accessed on: August 6, 2026. Published online 2024. doi:10.24857/rgsa.v18n11-257
88. VARRICCHIO, M.C.B.N. et al. Equity in health and social technology: cultural competence and psychosocial care for indigenous peoples in an urban context in Rio de Janeiro/Brazil. *Medical Research Archives of European Medical Society*, [S. l.], v. 14, n. 3, Apr. 2026. Available at: https://esmed.org/MRA/mra/article/view/7374. Accessed on: Aug. 6, 2026. Published online 2026. doi:10.18103/mra.v14i3.7374
89. PATEL, V. et al. The Lancet Commission on global mental health and sustainable development. *The Lancet*, v. 392, n. 10157, p. 1553-1598, 2018. Published online 2018. doi:10.1016/S0140-6736(18)31612-X
90. WINTER, E. Evaluation of technical production and social technology: from conception to a future evaluation proposal. In: SEMINAR ON THE EVALUATION OF INTELLECTUAL PRODUCTION OF POST GRADUATE PROGRAMS, 2., 2018, Brasília, DF. Work. Brasília, DF: *CAPES, 2018*. Available at: https://www.gov.br/capes/pt-br/centrais-de-conteudo/20180821_SeminarioRepensandoaAvaliacao_EduardoWinter_INPI.pdf. Published online 2018.
91. GOMES, AM DE A.; MOURA, ERF; AMORIM, RF. The place of ethics and bioethics in medical training curricula. *Brazilian Journal of Medical Education*, v. 30, n. 2, p. 56–65, 2006. Published online 2006.
92. KOTTOW, M. Didactic aspects in intercultural bioethics. *Brazilian Journal of Medical Education* 35 (2) Jun 2011. Published online 2011. doi:10.1590/S0100-55022011000200017

A Revista OWL Journal está licenciada com uma Licença Creative Commons Atribuição (CC BY)

93. NAGAMATSU, D.; HOBAICA, P.E.M.; VARRICCHIO, M.T.; PYRRHO, A. DOS S.; CASTELO BRANCO, M.T.L.; VARRICCHIO, M.C.B.N. GEOPHARMACOBOTANY III: Semiological Aspects, Toxicology, Bioproducts from *Euphorbia tirucalli*. *Ebook. 2019.* Technical product. 17p. RJ: Editora Marcia Cristina Braga Nunes Varricchio. ISBN: 978-65-901189-1-2. Available at: https://sites.google.com/view/lipat/sapb-livros?authuser=0#h.p_ntfEULFFNrPd. Accessed in 2025, Nov 10. In: 2019.
94. MACHADO, C.A.F./Doethyró-TUKANO; MACHADO, C. V.da S./Duigó-TUKANO; ALVES, E./SATERÉ-MAWÉ; VACITE, M.; DE LUNA, L.; WASIM, N.; MUSMANNO, P.G.; DE OLIVEIRA, L. L.; DA SILVA, J.; PYRRHO, A. dos S.; VARRICCHIO, M.C.B.N.; LAGE, C.L.S. Sustainable use of biodiversity, spiritual health and mental health of traditional ethnic groups in Brazil. Booklet. Technical product of post-doctoral internship by INPI (Sept – Nov 2019) In: *VARRICCHIO, 2020*. Free circulation. November 2021. Available at: https://sites.google.com/view/lipat/sapb-artigos#h.13ef5mldd38i. In: 2019.
95. MACHADO, Caroline Valéria da Silva (DUIGÓ-TUKANO); MUSMANNO, Patrícia Guimarães; MACHADO, Carlos Antônio Fernandes (DOETHYRÓ-TUKANO); PYRRHO, Alexandre dos Santos; VARRICCHIO, Marcia Cristina Braga Nunes; LAGE, Celso Luiz Salgueiro. The impacts of the COVID-19 pandemic on indigenous communities. Abstract and oral presentation. *XXVI UNIFASE/FMP Scientific Week*: *Artificial Intelligence: for more human connections*. Petrópolis, RJ, Oct. 2020. Available at: SAPB-LIPAT/FF/UFRJ Project. Accessed on: Sep. 21, 2026.
96. PYRRHO, A. dos S.; VARRICCHIO, M.C.B.N. Coordinators: I PTBF/SAPB-LIPAT Clinical Bioethics Conference - Spirituality and Care: COVID19 and Urban Ethnicities (All videos available at https://sites.google.com/view/lipat/sapb-nossos vídeos July 2020). Environmental Health, Parasitology, Bioethic (SAPB) Project Partners: 7th Ward HGSCMRJ; CFQ and LAFFH - FMP/UNIFASE; AIAM; UCB; HUMANITY FIRST; Discipline Traditional Knowledge and Associated Rights/INPI (Post-Doctoral Internship Products by INPI). *SAPB-LIPAT/FF/UFRJ Project.* Published online 2020.
97. EHPB. ENVIRONMENTAL HEALTH, PARASITOLOGY, BIOETHICS (SAPB)-LIPAT/FF/UFRJ PROJECT; ASSOCIATED INSTITUTES. EDUCATIONAL ACTIONS IN BIOETHICS: Social Determinants Versus Sustainability, Psychosocial Care and Human Rights. Technical Product. *SAPB-LIPAT/FF/UFRJ Project 2021*. Available at: https://sites.google.com/view/lipat/sapb-artigos?authuser=0#h.mhnnl1bbojj1. Last accessed on: 04, Sept, 2026. Published online 2021.
98. BENTES LOPES, J. et al. (2024) Environmental potential of plant use: resource management in the face of climate uncertainty. Latin American Economy Observatory. V. 22, n .4, p. 01-33. Curitiba: PR. ISSN 1696-8352. DOI: https://doi.org/10.55905/oelv22n4-019. Available at: https://ojs.observatoriolatinoamericano.com/ojs/index.php/olel/issue/view/37.

A Revista OWL Journal está licenciada com uma Licença Creative Commons Atribuição (CC BY)

99. CEZAR, G. V. et al. Public policies and human rights: psychosocial care for people in an urban context in Rio de Janeiro. Public Policy & Cities Magazine, v. 15, n. 2, e3216, 2026. Published online 2026. doi:10.23900/2359-1552v15n2-47-2026
100. CRUZ FILHO, F.C. et al. (2023) Bioproduct with Plastic Digester Potential. The Teaching of Environmental Ethics by the SAPB-LIPAT/UFRJ PROJECT & UNIFASE-FMP. E-book Interdisciplinarity and Innovation in Scientific Research. ISBN nº 978-65-84976-74-0. São José dos Pinhais: PR. Seven Publicações Ltda.
101. CRUZ FILHO, F.C.; VARRICCHIO, M.C.B.N.; GORINI, C.C. Contributions to the teaching of environmental ethics by the Medical Residency Program at FMP-UNIFASE. INFO_SAPB. V. 8 – n.2 - Out 2024. *INFO-SAPB. Support Magazine for SAPB-LIPAT/FF/UFRJ Project.* Available at: https://sites.google.com/view/lipat/sapb-revista_info-sapb?authuser=0#h.sewngkll2zj3. Accessed in: Published online 2024.
102. XIMENES LINS, R. et al. Immunomodulation, Environment and Ethics: Health and Humanities. *Aracê Journal*, 2024. V. 7, N. 1, pg 513-526. Curitiba: New Science Publishers. ISSN: 2358-2472. DOI: https://doi.org/10.56238/arev7n1-030. Di. Published online 2024.
103. PIMENTEL DA SILVA, A.B. Public Health Policies for the Black Population – Actions of the SUS. Booklet In *SAPB Articles*. 2025. Available at: https://sites.google.com/view/lipat/sapb-artigos#h.gnpbso6hslh6. Accessed on: 05. Published online 2025.
104. HOBAICA, P. E. M. et al. Environmental technology, animal welfare, One Health. In: CATAPAN, Dariane Cristina (org.). *Sustainability and environmental management.* 1. ed. Curitiba: Editora Foco, 2025. cap. 4. In: 2025. doi:10.54033/stebook.978-65-83117-16-8_4
105. RADECKI, S. When does mental suffering become a mental disorder? *Blog on Mental Health and Well-being, 2022.* Available at: https://simoneradecki.com.br. Accessed on: September 12, 2026. Published online 2022.
106. AMARANTE, P. Psychiatric reform and mental health in Brazil: challenges and perspectives. Rio de Janeiro: *Fiocruz*, 2015. Published online 2015.
107. FIOCRUZ. Reforma psiquiátrica: um novo lugar social para a loucura. *IdeiaSUS*, Rio de Janeiro, 1 jul. 2024. Disponível em: https://ideiasus.fiocruz.br/postagem/reforma-psiquiatrica-um-novo-lugar-social-para-a-loucura/. Acesso em: 27 ago. 2026. Published online 2024.
108. WHO. WORLD HEALTH ORGANIZATION. Guidelines for the assessment of herbal medicines. *World Health Organization*; *1991*. WHO/TRM/91.4. Published online 1991.
109. PAHO. PAN AMERICAN HEALTH ORGANIZATION. Setting Up Community Mental Health Programmes. Washington, DC: *PAHO*; *1990*. Published online 1990.
110. PAHO. PAN AMERICAN HEALTH ORGANIZATION; WHO. WORLD HEALTH ORGANIZATION. Declaração de Caracas. Conferência Regional para a Reestruturação da Atenção Psiquiátrica na América Latina no Contexto dos Sistemas Locais de Saúde (SILOS).

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Caracas: 14 de novembro de 1990. Genebra: *WHO, 1990a*. Disponível em: https://www.paho.org/pt. Acesso em: 15 ago. 2026. 1990.

111. WALKER, E. R.; MCGEE, R. E.; DRUSS, B. G. Mortality in mental disorders and global disease burden implications: a systematic review and meta-analysis. *JAMA Psychiatry*, Chicago, v. 72, n. 4, p. 334-341, 2015. Published online 2015. doi:10.1001/jamapsychiatry.2014.2502

112. BRAZIL. Ministry of Health. Secretariat of Health Care. Technical Center for the National Humanization Policy. *HumanizaSUS: basic document for SUS managers and workers*. 4th ed., 2nd reprint. Brasília, DF: Ministry of Health Publishing House, 2009. 70 p. (Series B. Basic Health Texts). Published online in 2009.

113. ZUBIAURRE P. ZUBIAURRE, P. de M. The development of the Individual Therapeutic Project in mental health: an integrative review. In: *Archives of Health Sciences of UNIPAR*, Umuarama, v. 27, n. 6, p. 2788-2804, 2023. Published online 2023.

114. REED GM. What's in a name? Mental disorders, mental health conditions and psychosocial disability. *World Psychiatry*. 2024; 23(2):209-210. doi:10.1002/wps.21190. Published online 2024.

115. BRAZIL. Ministry of Science, Technology and Innovation. There is no doubt that these extreme events are associated with climate change, says scientist. Brasília, DF: *MCTI*, May 6, 2024. Available at: https://www.gov.br/mcti/. Published online in 2024.

116. DE SOUZA, M.P.; VARRICCHIO, M.T.; BRIOSO, P.S.T.; PYRRHO, A. DOS S.; DA SILVA, S.; KUSTER, R.M.; VARRICCHIO, M.C.B.N.; DE FREITAS, F.A.. Circular Economy: State of the Art, Conceptual Understanding and Application in Brazil - An Integrative Systematic Review (2000–2025). Campina Grande (PB). *OWL Journal.* Volume 4, Número 9 (2026). Published online 2026. doi:10.5281/zenodo.22549358

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