Aging at the Frontlines of Environmental Change: Vulnerability and Resilience of Elderly Populations under the Triple Planetary Crisis

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Abstract— **The contemporary world is facing a convergence of interconnected environmental challenges—climate change, biodiversity loss, and pollution—widely recognized as the triple planetary crisis. Together, these crises pose escalating risks to human health, livelihoods, and social systems, with disproportionate impacts on vulnerable population groups. Elderly populations are particularly at risk due to age-related physiological sensitivity, limited mobility, social isolation, and economic dependency, all of which constrain their capacity to anticipate, cope with, and recover from environmental stressors.**

Climate change intensifies extreme weather events such as heatwaves, floods, and storms, leading to increased morbidity and mortality among older adults. Concurrently, biodiversity loss undermines ecosystem services essential to elderly well-being, including food security, traditional medicinal resources, and mental health benefits derived from nature. Pollution further compounds these risks by aggravating chronic respiratory, cardiovascular, and neurological conditions that disproportionately affect aging populations.

Despite these heightened vulnerabilities, elderly individuals also possess significant resilience shaped by accumulated life experience, social cohesion, cultural values, and traditional ecological knowledge. Recognizing and strengthening these resilience capacities is essential for effective and inclusive environmental governance. This paper argues that addressing the triple planetary crisis requires age-sensitive policies, integrated adaptation strategies, and community-based interventions that explicitly include elderly populations. By centering older adults within environmental planning and disaster risk reduction frameworks, societies can better protect dignity, health, and well-being while fostering more equitable and resilient responses to planetary challenges.

Keywords— Elderly populations, Triple planetary crisis, Climate vulnerability, Biodiversity and health, Pollution exposure, Environmental resilience, Aging and adaptation, Disaster risk reduction, Inclusive governance

I. INTRODUCTION

1) The Triple Planetary Crisis and Aging Populations

The triple planetary crisis—comprising climate change, biodiversity loss, and pollution—represents one of the most profound threats to planetary stability and human well-being in the twenty-first century. Unsustainable development pathways, excessive resource extraction, and deep-rooted socio-economic inequalities drive these interrelated environmental emergencies. Together, they create reinforcing feedback loops that intensify ecological degradation while amplifying social and health vulnerabilities across populations.

Climate change, mainly driven by greenhouse gas emissions from fossil fuel use, land-use change, and industrial activities, manifests through rising temperatures, erratic precipitation patterns, sea-level rise, and increasingly frequent extreme weather events. These impacts place older adults at heightened risk, as age-related physiological changes reduce heat tolerance, immune response, and recovery capacity during environmental shocks. Extreme climate events often disrupt access to healthcare, social support systems, and basic services that elderly individuals rely on most.

Simultaneously, biodiversity loss erodes ecosystem services essential for human survival and quality of life. The degradation of ecosystems affects food systems, water availability, disease control, and cultural practices, all of which are particularly important for elderly populations, especially in rural and

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indigenous contexts. The loss of natural environments also affects mental health and social well-being, increasing loneliness and stress among older adults.

Pollution further compounds these challenges by contaminating air, water, and soil with toxic substances. Older populations are especially vulnerable to pollution-induced illnesses due to pre-existing health conditions and prolonged exposure over the life course. When combined, climate change, biodiversity loss, and pollution create cumulative and intersecting risks that place elderly populations on the frontlines of environmental change.

Understanding the intersection of aging and the triple planetary crisis is therefore essential. Addressing these challenges demands integrated, age-responsive approaches that not only reduce vulnerability but also recognize the resilience, knowledge, and social contributions of elderly populations within environmental governance and sustainable development strategies.

2) Potential Methodological Approaches

Empirical research on elderly vulnerability to environmental change and disasters can benefit from mixed-methods approaches, which combine quantitative and qualitative data to capture both statistical trends and lived experiences. For example, surveys and focus groups with elderly populations across diverse ecological and socio-economic contexts can provide insights into health risks, adaptive behaviors, and social support mechanisms (Creswell & Plano Clark, 2018).

Spatial vulnerability mapping is another critical approach. By integrating climate, pollution, and land-use data, researchers can identify high-risk regions and assess the spatial distribution of environmental exposures affecting older adults (Hagenlocher et al., 2019). Such mapping supports evidence-based targeting of interventions and resource allocation.

Additionally, longitudinal analysis of health-environment data can track the cumulative effects of environmental stressors on elderly populations over time. Linking health records with environmental exposure datasets enables a robust examination of correlations among climate events, pollution, and morbidity or mortality trends among older adults (Vardoulakis et al., 2018).

These methodological strategies, when combined, offer a comprehensive framework for understanding and mitigating the environmental vulnerabilities of aging populations.

II. Global Demographic Shift: The Rising Proportion of Elderly Populations

The world is undergoing a profound demographic transition characterized by a steadily increasing proportion of older adults in the global population. According to the United Nations (2023), the number of people aged 65 years and above is projected to rise from 761 million in 2021 to more than 1.6 billion by 2050, representing nearly 16% of the world's population. This shift is driven by declining fertility rates, increasing life expectancy, and advances in healthcare, nutrition, and living standards (Bloom et al., 2015; Lee & Mason, 2014).

While population aging is most pronounced in high-income countries, low- and middle-income countries (LMICs) are experiencing the most rapid increases in elderly populations, often without commensurate social, healthcare, and economic infrastructure (Beard et al., 2016). By 2050, nearly 80% of older adults will reside in LMICs (United Nations, 2023), where environmental vulnerabilities and social inequities are often more severe.

This demographic transformation has wide-ranging implications. Aging populations can contribute valuable knowledge, experience, and social stability, but they also face heightened health risks, greater dependency ratios, and increased demand for age-sensitive social and health services (World Health Organization [WHO], 2021). In the context of the triple planetary crisis—climate change, biodiversity loss, and pollution—the rising share of elderly populations means that a growing segment of society will be exposed to environmental hazards to which they are physiologically and socioeconomically more vulnerable (Hansen et al., 2018).

Recognizing the intersection between demographic change and environmental crises is essential for developing adaptation strategies that ensure the dignity, safety, and well-being of older adults in a rapidly changing world. This requires integrated approaches that address both the structural drivers of vulnerability and the promotion of resilience within aging communities.

III. Why Elderly Populations Are Disproportionately Impacted: Physiological, Social, and Economic Vulnerabilities

Elderly populations face a unique convergence of vulnerabilities that heighten their exposure and sensitivity to the adverse effects of the triple planetary crisis—climate change, biodiversity loss, and pollution. These vulnerabilities span physiological, social, and economic dimensions, creating compounded risks that limit adaptive capacity.

1) Physiological Vulnerabilities

Aging is associated with declines in thermoregulation, immune function, and organ reserve, making older adults more susceptible to environmental hazards such as heatwaves, air pollution, and infectious diseases (Basu & Samet, 2002; Kenney & Munce, 2003). Chronic conditions—such as cardiovascular disease, diabetes, and respiratory illnesses—are more prevalent in older age, increasing the risk of severe outcomes during environmental stress events (Hajat et al., 2014). Additionally, sensory impairments, reduced mobility, and slower physiological recovery can hinder timely evacuation and adaptation during disasters (Hansen et al., 2018).

2) Social Vulnerabilities

Older adults often experience social isolation due to the loss of a spouse, reduced mobility, or the migration of younger family members (Cattan et al., 2005). This isolation limits access to information, emergency warnings, and community support during crises (Klinenberg, 2002). In many contexts,

elderly individuals also have limited participation in decision-making processes, resulting in their needs being overlooked in disaster planning and environmental policies (HelpAge International, 2019). Cultural factors may further exacerbate vulnerability, as traditional caregiving structures erode under the pressures of urbanization and globalization (Aboderin & Beard, 2015).

3) Economic Vulnerabilities

Older adults are more likely to live on fixed incomes or pensions, which may be insufficient to cope with the additional costs of environmental adaptation, such as retrofitting homes, accessing healthcare, or relocating from hazard-prone areas (Béné, 2020). In low- and middle-income countries, elderly populations often lack adequate social protection and health insurance, leaving them disproportionately exposed to the economic consequences of environmental shocks (United Nations, 2023). Economic dependency on family members can also be precarious if younger household earners face climate-related job losses or displacement.

These physiological, social, and economic factors interact synergistically, creating cascading vulnerabilities that amplify the impacts of the triple planetary crisis on elderly populations. At the same time, these vulnerabilities highlight the urgent need for targeted, age-sensitive policies and resilience-building strategies to protect older adults amid accelerating environmental change.

IV. Research Aim

This study aims to examine the multifaceted vulnerabilities and resilience strategies of elderly populations in the context of the triple planetary crisis—climate change, biodiversity loss, and pollution. Specifically, the research seeks to identify and analyze the physiological, social, and economic factors that heighten older adults' susceptibility to environmental hazards. Investigate how these vulnerabilities intersect with the drivers and impacts of the triple planetary crisis. Document and evaluate resilience strategies employed by elderly individuals and communities, including traditional knowledge systems, social support networks, and adaptive health practices. Develop policy-relevant recommendations for integrating the needs and capacities of older adults into climate adaptation, biodiversity conservation, and pollution reduction strategies.

By adopting an integrated approach, this study aims to bridge the gap between gerontology and environmental sustainability research, contributing to the development of age-inclusive responses to planetary-scale environmental challenges (Beard et al., 2016; UNEP, 2021; IPCC, 2022).

V. Conceptual Framework

1) Intersection of Gerontology and Environmental Science

The intersection of gerontology—the multidisciplinary study of aging and older adulthood—and environmental science—the study of interactions between humans and their biophysical environment—provides a critical lens for understanding how environmental stressors uniquely affect elderly populations. This framework integrates biological, social, and ecological perspectives to examine the dual dynamics of aging and environmental change (Phillipson, 2013; Lawton & Nahemow, 1973).

From a gerontological perspective, aging involves gradual physiological changes such as reduced thermoregulatory capacity, immune function decline, and slower recovery from illness or injury (Kenney & Munce, 2003). These changes increase susceptibility to environmental hazards, including extreme temperatures, air pollution, and infectious diseases (Basu & Samet, 2002; Hajat et al., 2014). Cognitive and sensory changes in older age can also affect hazard perception and the ability to respond rapidly during environmental crises (Hansen et al., 2018).

From an environmental science perspective, the triple planetary crisis—climate change, biodiversity loss, and pollution—represents a systemic threat to ecosystems and human health (UNEP, 2021). Environmental stressors not only exacerbate health risks but also interact with socio-economic factors, such as poverty, mobility limitations, and inadequate infrastructure, to compound vulnerabilities among elderly populations (IPCC, 2022).

Integrating these perspectives highlights that vulnerability is not solely a product of biological aging but emerges from the interaction between intrinsic factors (e.g., health status, functional capacity) and extrinsic factors (e.g., environmental hazards, social support, policy context) (Wiles et al., 2012). This aligns with the person–environment fit model, which posits that well-being in older age depends on the balance between individual capabilities and environmental demands (Lawton & Nahemow, 1973). In the context of the triple planetary crisis, disruptions in this balance—such as intensifying heatwaves, reduced ecosystem services, and increased exposure to pollution—can push elderly populations toward greater vulnerability unless resilience strategies are effectively implemented.

By situating gerontology within the broader framework of environmental sustainability and climate adaptation, this conceptual approach provides a foundation for identifying targeted interventions that both reduce risks and enhance the adaptive capacity of older adults in an era of planetary change.

2) Vulnerability–Resilience Spectrum: Adapted from IPCC's Vulnerability Framework

The Intergovernmental Panel on Climate Change (IPCC) conceptualizes vulnerability as a function of three key components: exposure, sensitivity, and adaptive capacity (IPCC, 2022). This framework can be adapted to assess the position of elderly populations along a vulnerability–resilience spectrum in the context of the triple planetary crisis.

Exposure refers to the degree to which elderly individuals are exposed to environmental hazards, such as extreme temperatures, air pollution, and degraded ecosystems. Due to mobility limitations, many older adults reside in fixed locations, which can increase their exposure to localized environmental stressors (Carter et al., 2019).

Sensitivity captures the extent to which elderly populations

are physiologically or socially affected by these hazards. Age-related declines in thermoregulation, immune function, and respiratory capacity heighten their sensitivity to climate change impacts and pollution (Hajat et al., 2014). Social factors, such as isolation and inadequate social safety nets, can exacerbate this sensitivity.

Adaptive capacity reflects the ability of individuals and communities to prepare for, respond to, and recover from environmental stressors. In elderly populations, adaptive capacity may be limited by reduced physical mobility, lower income, technological barriers, and restricted access to healthcare and disaster preparedness resources (HelpAge International, 2021). However, adaptive capacity can be strengthened through targeted interventions, community engagement, and the inclusion of elderly voices in climate and environmental policy-making (Keating et al., 2021).

Positioning elderly populations along this spectrum—from high vulnerability to enhanced resilience—allows policymakers, researchers, and practitioners to identify where interventions can be most effective. By integrating the IPCC framework with gerontological insights, the model emphasizes the dynamic interplay between environmental hazards and the unique physiological, social, and economic characteristics of aging populations.

3) Social Determinants of Health and Well-being:

Elderly populations' vulnerability to the triple planetary crisis is strongly influenced by social determinants of health, which include access to healthcare, social support, and economic resources. These determinants shape older adults' ability to prevent, respond to, and recover from environmental stressors such as extreme heat, air pollution, and ecosystem degradation (Marmot et al., 2008; WHO, 2021).

Access to healthcare is critical for older adults, who often live with chronic conditions such as cardiovascular disease, diabetes, and respiratory illnesses that are exacerbated by climate and environmental hazards. Limited access to medical services, medications, and emergency care increases the risk of mortality and morbidity during environmental crises (Beard et al., 2016; Hajat et al., 2014).

Social support networks, including family, friends, neighbors, and community organizations, are essential for mitigating vulnerability. Older adults who are socially isolated face greater difficulty receiving timely information about hazards, evacuating during disasters, or accessing relief resources (Cattan et al., 2005; Klinenberg, 2002). Social cohesion and intergenerational networks can enhance resilience by facilitating resource sharing, caregiving, and psychosocial support.

Economic resources determine elderly individuals' capacity to adapt to environmental stressors. Fixed incomes, limited pensions, or reliance on family support can constrain the ability to invest in adaptive measures such as home retrofitting, clean energy sources, or relocation from hazard-prone areas (Béné, 2020). In low- and middle-income countries, inadequate social protection and healthcare coverage exacerbate economic vulnerability, leaving older populations disproportionately exposed to environmental hazards (United Nations, 2023).

Overall, social determinants interact dynamically with physiological and environmental factors, shaping the vulnerability–resilience continuum for elderly populations. Integrating social determinants into planning and policy is essential to develop age-inclusive interventions that reduce risk and enhance well-being in the face of the triple planetary crisis.

VI. Impact Pathways of the Triple Planetary Crisis on the Elderly

The global elderly population is increasing rapidly, with projections estimating that individuals aged 65 and above will comprise nearly 16% of the world's population by 2050 (United Nations, 2023). Concurrently, the Earth faces a triple planetary crisis—climate change, biodiversity loss, and pollution—which threatens the stability of ecosystems and human well-being (UNEP, 2021). Older adults are disproportionately affected due to the interplay of physiological, social, and economic vulnerabilities, rendering them particularly sensitive to environmental hazards.

1) Climate Change

Climate change drives more frequent and severe heatwaves, storms, floods, and droughts, which exacerbate pre-existing health conditions common in older age, including cardiovascular, respiratory, and metabolic diseases (Hajat et al., 2014; Kenney & Munce, 2003).

2) Climate Change: Heat Stress and Mortality Risks

Climate change has increased the frequency, intensity, and duration of extreme heat events worldwide, posing significant health risks, particularly for elderly populations (IPCC, 2022). Older adults are especially susceptible to heat stress due to age-related physiological changes, including reduced thermoregulation, diminished sweat response, cardiovascular limitations, and impaired hydration mechanisms (Kenney & Munce, 2003; Basu & Samet, 2002). These factors increase the likelihood of heat-related illnesses, including heat exhaustion and heatstroke, as well as exacerbation of chronic conditions such as cardiovascular and respiratory diseases.

Epidemiological studies indicate that heatwaves significantly elevate mortality rates among older adults, with those over 65 years experiencing the highest increases in morbidity and mortality during extreme temperature events (Hajat et al., 2014; Mora et al., 2017). Social and environmental factors—such as living alone, limited mobility, poor housing insulation, and a lack of air conditioning—further amplify vulnerability (Klinenberg, 2002). Urban areas, where the heat island effect is pronounced, pose additional risks for older residents due to concentrated heat exposure and limited green spaces for cooling (Stone et al., 2010).

Effective adaptation strategies include early warning systems, community-based heat response plans, urban greening, access to cooling centers, and health monitoring targeted at high-risk elderly populations (Harlan et al., 2014; WHO, 2021). Recognizing the link between climate change and heat-related mortality is critical for public health planning, especially as the global elderly population continues to rise,

increasing the proportion of individuals at risk (United Nations, 2023).

3) Climate Change: Increased Vulnerability to Vector-Borne Diseases

Climate change contributes to shifts in the geographic distribution, seasonality, and intensity of vector-borne diseases (VBDs) such as malaria, dengue, chikungunya, and tick-borne illnesses, posing heightened risks to elderly populations (Ryan et al., 2019). Older adults are particularly susceptible due to age-related declines in immune function, pre-existing chronic conditions, and reduced physiological resilience, which can lead to more severe disease outcomes and higher mortality rates compared to younger populations (Openshaw et al., 2017; Parham & Michael, 2010).

Environmental changes such as rising temperatures, altered rainfall patterns, and increased humidity create favorable conditions for vector proliferation and pathogen transmission (IPCC, 2022). Elderly individuals in both urban and rural settings may experience greater exposure due to limited mobility, residence in high-risk areas, or inadequate housing that fails to prevent vector entry (Beard et al., 2016). Social factors, including isolation and limited access to healthcare, further amplify vulnerability, as older adults may be less likely to receive timely diagnosis, treatment, or preventive interventions like vaccination, bed nets, or insect repellents (WHO, 2021).

Adaptive strategies to reduce VBD risk among the elderly include strengthening public health surveillance, ensuring age-sensitive vector control programs, improving housing infrastructure, promoting community-based education, and expanding access to healthcare and preventive services (Ryan et al., 2019; Tusting et al., 2016). Recognizing the intersection of climate change, vector ecology, and geriatric vulnerability is essential for safeguarding the health and well-being of older populations under the triple planetary crisis.

4) Climate Change: Displacement and Loss of Community Networks

Climate-induced disasters—including floods, hurricanes, wildfires, and droughts—are increasing in frequency and intensity due to climate change, posing severe threats to elderly populations (IPCC, 2022). Older adults are particularly vulnerable to displacement, as evacuation can be hindered by reduced mobility, chronic health conditions, cognitive impairments, and dependence on caregivers (Hutton et al., 2016).

Displacement often results in the loss of established community networks, which are crucial for social support, mental health, and access to resources (Aldrich & Meyer, 2015). The disruption of these networks can exacerbate social isolation, depression, and anxiety among older adults, reducing their ability to cope with and recover from environmental stressors (Fothergill & Peek, 2015). Moreover, relocation to unfamiliar environments may limit access to healthcare, familiar food sources, and culturally appropriate services, further compounding vulnerability (HelpAge International, 2019).

Elderly individuals displaced by climate disasters face long-term consequences, including increased dependence on family or institutional care, financial strain, and diminished resilience to future hazards. Targeted interventions, such as age-sensitive evacuation planning, accessible temporary shelters, psychosocial support programs, and efforts to maintain community cohesion, are essential to protect the well-being of older adults in disaster-prone areas (Keating et al., 2021; UNDRR, 2020).

Understanding the link between climate-induced displacement, loss of community networks, and the vulnerability of elderly populations is critical for developing policies that prioritize the needs of older adults in disaster risk reduction and climate adaptation strategies.

VII. Biodiversity Loss

Biodiversity loss undermines ecosystem services critical for food security, clean water, mental health, and traditional medicine, disproportionately impacting elderly populations who rely on local natural resources (Díaz et al., 2019; IPBES, 2019). Pollution, including air, water, and soil contamination, further exacerbates chronic diseases, accelerates cognitive decline, and increases mortality risk in older adults (Landrigan et al., 2018; WHO, 2021).

1) Biodiversity Loss: Reduced Access to Medicinal Plants and Ecosystem Services

Biodiversity underpins critical ecosystem services that support human health, nutrition, and well-being, including provisioning of food, clean water, medicinal resources, and cultural services (Díaz et al., 2019). The loss of biodiversity—driven by habitat destruction, overexploitation, pollution, and climate change—poses significant risks to elderly populations who rely on these services for both physical and mental health (IPBES, 2019).

Medicinal plants are a vital resource for older adults, especially in rural or low-resource settings where traditional remedies are integral to managing chronic conditions such as diabetes, hypertension, arthritis, and respiratory illnesses (Cunningham, 2001). Biodiversity loss reduces the availability and diversity of these plants, limiting access to culturally relevant and affordable healthcare alternatives (Shankar et al., 2017).

Beyond medicinal resources, ecosystem degradation also affects supporting and regulating services that influence elderly well-being. For example, reduced forest cover and wetland loss can compromise water quality, increase exposure to pollutants, and exacerbate the spread of infectious diseases. Similarly, the loss of green spaces and natural areas diminishes opportunities for physical activity, stress reduction, and social engagement, which are vital for mental and physical health in older adults (Hunter et al., 2019).

Maintaining biodiversity is thus closely linked to the resilience of elderly populations, as it ensures continued access to essential ecosystem services and culturally significant resources. Policy and conservation strategies should prioritize protecting habitats that support medicinal plants and other

ecosystem services critical to the health and well-being of older adults (UNEP, 2021; IPBES, 2019).

2) Biodiversity Loss: Impact on Food Security and Nutrition

Biodiversity plays a central role in sustaining food security and nutritional health, particularly for elderly populations in rural communities, who often rely on locally sourced foods, wild plants, and small-scale agriculture in their diets (FAO, 2019). Loss of plant and animal species due to habitat degradation, overexploitation, and climate change reduces dietary diversity and limits access to nutrient-rich foods, increasing the risk of malnutrition, micronutrient deficiencies, and diet-related chronic diseases among older adults (Johns et al., 2013).

Rural elderly populations are especially vulnerable because they frequently depend on subsistence farming, wild-harvested foods, and traditional dietary practices. Biodiversity decline undermines crop variety and livestock health, disrupting local food systems and diminishing the availability of fruits, vegetables, legumes, and protein sources critical for maintaining muscle mass, immunity, and overall health in aging populations (Khoury et al., 2014). Reduced dietary diversity exacerbates age-related health challenges such as sarcopenia, anemia, osteoporosis, and cardiovascular conditions (Beard et al., 2016).

Furthermore, the loss of pollinators and soil biodiversity reduces crop yields and resilience to climate shocks, making elderly-dependent households more susceptible to food insecurity during environmental crises (IPBES, 2019). Ensuring the conservation of agrobiodiversity, supporting traditional agricultural knowledge, and promoting diversified diets are essential strategies to safeguard the nutritional health and well-being of older adults in rural communities.

VIII. Pollution: Impacts on Elderly Health

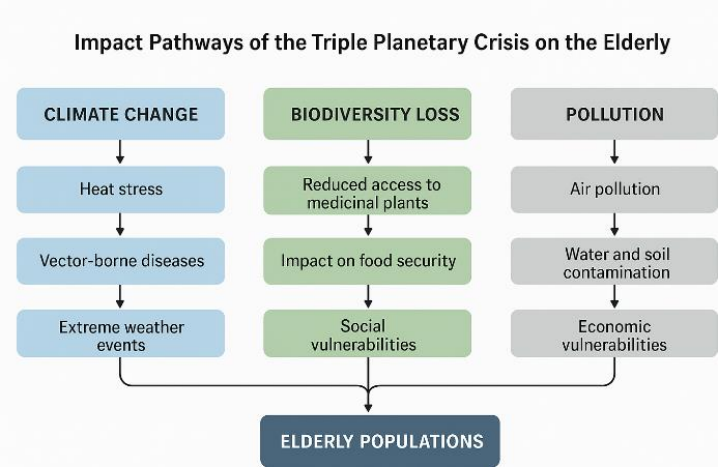
Pollution—including air, water, and soil contamination—poses a significant threat to elderly populations, who are physiologically more susceptible to its harmful effects (Landrigan et al., 2018). Age-related declines in cardiovascular, respiratory, and renal function make older adults particularly vulnerable to pollutants such as particulate matter, ozone, heavy metals, and chemical toxins. Chronic exposure can exacerbate existing conditions, accelerate cognitive decline, and increase morbidity and mortality rates among elderly individuals (Brook et al., 2010; Schraufnagel et al., 2019).

Air pollution is strongly associated with increased rates of cardiovascular disease, stroke, chronic obstructive pulmonary disease, and respiratory infections in older adults (Beck et al., 2020). Fine particulate matter (PM2.5) and ground-level ozone can trigger systemic inflammation, oxidative stress, and impaired lung function, disproportionately affecting elderly populations with pre-existing conditions (Landrigan et al., 2018).

Water pollution—caused by chemical runoff, heavy metals, and microbial contamination—can lead to gastrointestinal infections, kidney disease, and exacerbation of chronic illnesses in older adults (WHO, 2017). Elderly populations often have reduced renal clearance and immune function, heightening susceptibility to waterborne pathogens and toxins.

Soil contamination from pesticides, industrial chemicals, and heavy metals can affect food safety by bioaccumulating in the food chain, reducing nutritional quality, and increasing the risk of chronic diseases among older adults (Jiang et al., 2019).

Addressing pollution-related risks requires targeted interventions, including stricter environmental regulations, improved monitoring of air and water quality, and health policies prioritizing the protection of older adults. Public health strategies such as early warning systems, community education, and accessible healthcare services can mitigate pollution-related health impacts in elderly populations (WHO, 2021).



Source: Bhandari, 2021

IX. Loss of Cultural Identity and Psychological Well-Being Linked to Nature

The decline in human connection to nature has profound implications for both cultural identity and psychological well-being. A recent study led by Professor Miles Richardson from the University of Derby indicates that human connection to nature has declined by over 60% since 1800, paralleling a similar decline in the use of nature-related words in literature. This erosion of nature-relatedness is attributed to factors such as urbanization, biodiversity loss, and parents' failure to foster children's nature engagement. Modeling predicts that this trend will continue unless transformative policies and societal changes are implemented (Bhandari, 2021, 2025).

The loss of cultural identity is intricately linked to this disconnection from nature. For Indigenous communities, cultural practices are deeply intertwined with the natural environment. A scoping review by Carson (2024) highlights that Indigenous identity serves as a protective factor in mental well-being, with cultural connectedness associated with improved mental health outcomes. However, the erosion of traditional ecological knowledge and practices due to environmental degradation and cultural assimilation poses significant challenges to maintaining cultural identity and psychological resilience.

Psychologically, the decline in nature connectedness is

linked to various mental health issues. Research by Chang (2024) found that individuals with a stronger connection to nature experience lower levels of stress and anxiety. Similarly, studies by Dean (2018) and Barragan-Jason (2023) indicate that higher nature-relatedness is associated with fewer symptoms of depression, anxiety, and stress, as well as better overall health. These findings underscore the importance of nature in maintaining psychological well-being.

In response to these challenges, initiatives aimed at reconnecting individuals with nature have shown promise. Programs like "Dose of Nature" in the UK offer nature therapy as a cost-effective approach to mental health treatment, demonstrating significant improvements in mental health outcomes among participants. Similarly, the "Culture is Prevention Project" in California found that increased Native American cultural connectedness is associated with better mental and physical health outcomes, highlighting the protective role of cultural engagement in well-being.

The loss of cultural identity and psychological well-being is closely linked to a decline in connection to nature. Preserving and revitalizing cultural practices that foster this connection are essential for the mental health and resilience of communities, particularly Indigenous populations (Bhandari & Shvindina, 2021). Efforts to integrate nature-based interventions and cultural revitalization programs are crucial steps toward addressing these interconnected issues.

X. Pollution (Air, Water, Soil) and Its Impacts on Health

Air, water, and soil pollution pose significant threats to human health, particularly through increased susceptibility to respiratory and cardiovascular illnesses. Exposure to delicate particulate matter (PM2.5), nitrogen dioxide (NO_2), and other airborne pollutants has been strongly linked to chronic respiratory conditions such as asthma, chronic obstructive pulmonary disease (COPD), and lung cancer, as well as cardiovascular diseases including hypertension, heart attacks, and strokes (Landrigan et al., 2018; World Health Organization [WHO], 2021). Urban populations and vulnerable groups, including children and the elderly, are especially at risk due to prolonged exposure and pre-existing health vulnerabilities.

Long-term exposure to environmental toxins can lead to their accumulation in the human body, resulting in chronic health problems. Heavy metals such as lead, mercury, and cadmium, often found in contaminated water and soil, can bioaccumulate in tissues, impair kidney and liver function, disrupt endocrine systems, and affect neurodevelopment in children (Jaishankar et al., 2014). Similarly, persistent organic pollutants (POPs) can interfere with hormonal regulation and contribute to cancers and reproductive disorders. These bioaccumulated toxins illustrate the cumulative and insidious nature of pollution, emphasizing the importance of preventative environmental policies.

In addition to physical health impacts, living in polluted environments can negatively affect mental health. Research indicates that individuals residing in areas with high levels of air and noise pollution experience higher rates of stress, anxiety, depression, and cognitive decline (Power et al., 2016; Vert et al., 2017). Environmental degradation can create a sense of loss and helplessness, diminishing overall quality of life and contributing to psychological distress. Therefore, pollution is not only a physiological hazard but also a psychosocial stressor that undermines community well-being.

Overall, the interplay between pollution and health highlights the urgent need for interventions to reduce environmental contaminants, improve urban planning, and foster community awareness. Addressing pollution comprehensively can prevent both immediate and long-term adverse effects on physical and mental health.

XI. Social and Economic Vulnerabilities

Social and economic vulnerabilities significantly shape how populations experience and respond to environmental and health risks. Limited mobility, particularly among the elderly, persons with disabilities, and marginalized groups, reduces the ability to evacuate or access emergency services during disasters such as floods, storms, or heatwaves (Cutter et al., 2003). Physical limitations, lack of transportation, and unsafe infrastructure can exacerbate risk exposure, making timely evacuation and disaster preparedness challenging.

Economic constraints further compound vulnerability. Lower-income households often lack financial resources to recover from disasters, invest in protective measures, or access adequate healthcare (Peacock et al., 2005). Limited insurance coverage leaves many individuals exposed to catastrophic losses, deepening cycles of poverty and health inequities following environmental crises. These economic limitations intersect with social vulnerabilities, creating layered disadvantages that are difficult to overcome without targeted policy interventions.

The digital divide also plays a crucial role in vulnerability. Access to early warning systems, emergency alerts, and real-time information increasingly depends on digital technologies. Communities with limited internet access, lower digital literacy, or insufficient technological infrastructure are at higher risk during disasters due to delayed or inadequate information dissemination (van Deursen & van Dijk, 2019). This gap can prevent timely evacuation and limit opportunities for protective action, further exposing vulnerable populations to harm.

Social isolation, often associated with elderly populations and marginalized groups, can intensify the psychological impacts of environmental hazards. Loneliness and lack of social support networks reduce resilience, increase stress, and heighten mental health issues, including anxiety and depression (Cacioppo & Cacioppo, 2018). During disasters, socially isolated individuals may struggle to access help or maintain community connections, exacerbating both physical and psychological risks.

Together, these social and economic vulnerabilities illustrate

the multidimensional nature of risk exposure. Addressing them requires integrated strategies, including inclusive disaster planning, targeted financial support, digital access initiatives, and community-based mental health interventions, to ensure that the most vulnerable populations are protected and resilient.

XII. Resilience and Adaptive Capacity

Building resilience and enhancing adaptive capacity are essential for mitigating the impacts of environmental, social, and economic vulnerabilities, particularly among elderly populations. Community-based support systems, such as strong family networks, neighborhood watch programs, and local volunteer groups, have been shown to enhance adaptive capacity by providing timely assistance during crises and fostering social cohesion (Aldrich & Meyer, 2015). These informal support networks not only facilitate practical help—like transportation or caregiving—but also provide emotional support that strengthens psychological resilience.

Health system adaptation is another critical component of resilience. Developing climate-resilient healthcare infrastructure and services ensures that elderly populations can access necessary care during extreme weather events, pollution episodes, or disease outbreaks. Measures include mobile health units, emergency response training for healthcare providers, and specialized programs for chronic disease management in vulnerable populations (Ebi et al., 2021). Integrating public health preparedness with climate adaptation strategies enhances the overall capacity of health systems to respond effectively to emerging risks.

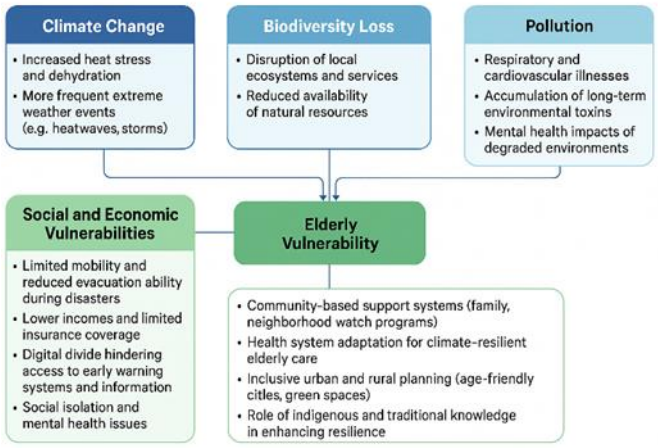
Inclusive urban and rural planning can significantly enhance adaptive capacity for elderly populations. Age-friendly cities with accessible public transportation, safe walkways, green spaces, and community centers promote physical activity, social interaction, and mental well-being (World Health Organization, 2007). Similarly, rural planning that incorporates climate-smart agriculture, resilient infrastructure, and accessible services ensures that older adults in remote areas maintain their independence and quality of life during environmental changes.

Indigenous and traditional knowledge also plays a vital role in fostering resilience. Local knowledge systems offer context-specific strategies for managing natural resources, preparing for climate-related hazards, and sustaining cultural practices that reinforce social cohesion (Berkes, 2018). Integrating traditional knowledge with modern adaptation strategies not only strengthens community resilience but also preserves cultural heritage and promotes intergenerational learning.

Together, these elements highlight that resilience and adaptive capacity are multidimensional and require coordinated efforts across social, health, environmental, and cultural systems. Prioritizing community engagement, inclusive planning, and the integration of traditional knowledge enhances both the physical and psychological well-being of elderly populations facing complex environmental and social challenges.

These environmental stressors operate through multiple impact pathways. Physiologically, older adults face reduced thermoregulation, impaired immunity, and slower recovery from illness or injury. Socially, isolation, limited mobility, and inadequate access to information hinder a timely response to environmental hazards. Economically, reliance on fixed incomes and limited access to adaptive resources constrain resilience (Basu & Samet, 2002; HelpAge International, 2019).

Understanding these impact pathways is essential for designing age-sensitive interventions, policies, and community-based adaptation strategies. By linking gerontological insights with environmental science, this approach highlights both the vulnerabilities and the resilience capacities of elderly populations, guiding efforts to protect their health, well-being, and quality of life under the triple planetary crisis.



Source: Bhandari, 2025a).

XIII. Policy and Governance Gaps

Elderly populations are particularly vulnerable to environmental hazards and disasters due to physiological, social, and economic factors. Despite this, the needs of the elderly are often not integrated into environmental and disaster risk reduction policies, limiting the effectiveness of interventions aimed at protecting this demographic (Fahrni et al., 2020). Policies frequently fail to account for the unique health, mobility, and social support requirements of older adults, leaving them disproportionately exposed during climate-related events, such as heatwaves, floods, and air pollution episodes (Plouffe et al., 2018).

Another critical gap is the inadequacy of social safety nets for the elderly. In many countries, pension systems, health insurance, and community support programs do not sufficiently address the economic and social vulnerabilities that exacerbate risk during environmental crises (HelpAge International, 2019). This insufficiency contributes to heightened susceptibility to both physical harm and social isolation.

Addressing these vulnerabilities requires an intersectional approach that integrates public health, social care, and environmental management. Such approaches ensure that interventions are not siloed but instead address the

multidimensional risks faced by older adults, combining strategies for disaster preparedness, health promotion, and community support (UNDRR, 2022). Intersectional policy frameworks are essential to enhance resilience, promote equity, and safeguard the well-being of elderly populations amid environmental change.

XIV. Conclusion

Elderly populations are among the most vulnerable groups in the context of the triple planetary crisis—climate change, biodiversity loss, and pollution. Their heightened susceptibility underscores the urgency of incorporating age-sensitive measures into environmental, disaster risk reduction, and public health policies (Plouffe, Kalache, & Leclerc, 2018). Protecting older adults is not only a matter of social justice but also a critical component of resilient societies.

Resilience can be achieved through coordinated action at global, national, and community levels. Integrating age-specific strategies into climate adaptation, biodiversity restoration, healthcare preparedness, and community engagement initiatives strengthens older adults' capacity to cope with and recover from environmental shocks (Fahrni, Corvalan, & Kjellstrom, 2020; UNDRR, 2022). By prioritizing inclusive policies, data-driven interventions, and intergenerational collaboration, societies can ensure that elderly populations are not left behind in the pursuit of sustainable and resilient futures.

XV. Recommendations

To address the vulnerabilities of elderly populations in the context of environmental change and disasters, the following recommendations are proposed:

- Policy: National and local policies should explicitly integrate the needs of aging populations into climate adaptation and biodiversity restoration strategies. This ensures that interventions consider older adults' unique health, mobility, and social support requirements (Plouffe, Kalache, & Leclerc, 2018).
- Healthcare: It is critical to develop age-specific emergency response protocols within health systems. Tailored approaches can enhance preparedness and reduce morbidity and mortality among older adults during climate-related and environmental disasters (Fahrni, Corvalan, & Kjellstrom, 2020).
- Community Engagement: Promoting intergenerational knowledge exchange strengthens community resilience. Older adults can share traditional ecological knowledge, while younger generations contribute technical and scientific insights, creating holistic solutions for climate adaptation and environmental management (HelpAge International, 2019).
- Data & Research: Enhancing elderly-specific environmental vulnerability mapping is essential. Targeted data collection and analysis can guide resource allocation, identify high-risk populations, and inform evidence-based interventions to reduce exposure and enhance adaptive capacity (UNDRR, 2022).

XVI. References

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