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„Integration of the One Health approach
with the Sendai Framework:
Enhancing pandemic risk management in times
of global and climate change“

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1. Introduction

1.1. Context and Topic

The ongoing Covid 19 pandemic has affected our lives, society, and civilization on several levels. The fight against pandemics has reached new heights during Covid 19. The shortcomings in preventing the spread of the virus have led to global health, social, political, institutional, economic, and cultural disruptions. In November 2021, according to the World Health Organization, the deaths caused by SARS-CoV-2 touched the five million mark. But is Covid 19 the worst-case scenario? What if the virus has the same transmission but higher mortality rates? What if asymptomatic carriers later become patients with severe symptoms? What if things were even worse? At the same time, natural disasters continue to cause damage and death around the globe, making climate change a high priority issue on the international political agenda. Our globalized world is faster and more interconnected than ever; the impacts of climate change are tremendous, and the processes causing this catastrophe progress rapidly. Therefore, political decisions based on short-term solutions have potential long-term impacts.

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) Report stresses that environmental degradation, resource exploitation, urbanization, land-use changes through agriculture, and wildlife trade and consumption are the main drivers of pandemic risk. Further, Covid 19 has cost us an estimated sixteen trillion dollars, compared to the approximate cost of twenty billion dollars for global pandemic prevention strategies, proving that prevention is an investment with high tangible and intangible returns (IPBES 2019).

In the Sixth Assessment Report, Climate Change 2021: The Physical Science Basis, the Intergovernmental Panel on Climate Change estimates that, if sincere actions to reduce carbon dioxide (CO₂) emissions are not taken, global temperature will increase by 1.5°C to 2°C in the next 20 years. This trend will intensify natural disasters like heat waves, extreme rainfalls, flooding, drought, sea-level rise, glacier melting, etc. The report clarifies that the main driver of climate change is greenhouse gases produced by human economic activities, and only radical changes in these activities can lead to a tolerable future (IPCC, 2021).

The United Nations Climate Change Conference COP26 in Glasgow from 31.10.21 until 12.11.2021 identifies climate change as the greatest risk. The goals of the conference are reducing emissions by 2030 and net zero emissions by the middle of the century; an adaptation through the restoration of ecosystems, warning systems, and resilience; a fund of 100 billion dollars for financing emission reduction and adaptation by 2020; and broad collaborations to combat the climate change crisis (<https://ukcop26.org/cop26-goals>).

The European Committee, along with the World Health Organization, will hold on the 29th November 2021 the International Treaty on pandemic prevention and preparedness to enhance global health security, which was agreed upon by 194 countries, headed by the United Nations (UN) and the G20 Group, in the World Health Assembly (WHO,2021).

Discussion points include governance deficiencies, compliance, transparency, cooperation, and the International Health Regulations (IHR) during the COVID 19 pandemic. The goal is the development of an international instrument focused on the prevention of zoonotic spill-overs with pandemic potential; laboratory biosecurity and biosafety; more authority and legitimacy for the UN and WHO to enhance compliance; open access and transparency of scientific research; resilience and capacities of health systems; and domestic and international equity regardless of race, ethnicity, sex, disability, and socioeconomic status (Gostin 2021).

“Without an internationally coordinated, all- government, all-society, One Health approach to pandemic preparedness and response, we remain vulnerable”

Dr. Tedros Adhanom Ghebreyesus, Director-General of the World Health Organization

1.2. Scope and Focus

The incorporation of numerous sectors is crucial for the risk assessment, prevention, preparedness, response, and recovery of pandemics. The complex interdependencies and the interconnectedness at the national and international levels became evident during the Covid 19 pandemic. The consequences and costs of Covid-19 in a year are comparable with all natural disasters between 2005–2015 combined. This study will focus on a broad approach to the multilateral collaboration possibilities essential for an effective outcome, and how the different tools, approaches, and frameworks can be used and implemented for pandemic risk management.

Global change impacts climate change due to increased greenhouse gas emissions through economic activities like industry practices and fossil fuel collection. In addition, increased interconnectivity and interdependency are also pandemic risk amplifiers since trade and traveling routes promote prompt global transmissions of infectious agents (Amuasi et al., 2020). Thus, climate change, one aspect of global change, entails multiple health risks (e.g., pollution, global warming impact) and influences the emergence and re-emergence of pandemic threats through the cascading effects of deforestation and forest encroachment, broader human-animal interfaces, ecosystem degradation, and habitat loss (Kumari and Raghubanshi 2020).

The principles of the Sendai Framework are derived from the Yokohama Strategy for a Safer World: Guidelines for Natural Disaster Prevention, Preparedness, and Mitigation, its Plan of Action 10, and the Hyogo Framework for Action. The principles outline a sustainable, comprehensive, and effective approach by recognizing that society engagement is vital for a more inclusive and non-discriminatory involvement in policymaking and to protect individuals, their health, property, environment, culture, human rights, and the right to development. The primary responsibility for disaster risk prevention and reduction rests on individual States, as transboundary and sustainable collaborations correspondingly share this responsibility. During Covid 19, shifts and transformations have been documented between these international partnerships; the closure of the Schengen Zone and other international

borders is an example. The multi-hazard approach depends on inclusive risk-informed decision-making, legislation and execution based on public, scientific and economic cross-sectoral coordination, empowerment of local authorities and communities, women and youth leadership, and incorporation of traditional knowledge. Though the factors responsible for a disaster are not always quantifiable, Covid 19 proved their significance.

Communicable and non-communicable diseases demand a truly comprehensive understanding of health and disease, and thereby a unity of approach that is achievable only through convergence of human, domestic animal, wildlife, plant, and environmental health, on a planetary scale

– One Health (Gruetzmacher et al., 2021)

To employ the One Health and the Sendai Framework approach to pandemic risk management and to potentially integrate One Health in the Sendai Framework is to achieve a more holistic and efficient methodology for pandemic risk management. This entails a study of the One Health concept and the Sendai Framework and their implementation in various sectors, disciplines, and policies, as well as a comparison of the principles, the possibilities, and limitations of compilation and suggestions of instrumentalization.

This thesis shows that it is time for us to break down the silos and work collaboratively. Mono-cultivation is not sustainable either in agriculture or in the decision-making process. Nature has the answers; when we do not listen, Nature screams louder. Global and climate changes are the results and origins of problems and solutions. It is a question of choice: what we know, what we learn, and what we want. Do we want a prosperous future for succeeding generations, even more prosperous than ours? If so, this will require a paradigm shift towards environmental protection, wildlife conservation, social equity, and sustainable development, to heal the wounds inflicted by escalating human activity. The connection between pandemics and global/climate change is evident from scientific research, and it is time that science must inform policy– and decision–making stakeholders to manage these systemic risks – risks with the potential to disrupt critical systems of the society (Renn 2016)– comprehensively and holistically.

1.3. Relevance and Importance

An in-depth understanding of the interlinkages between human, animal, and environmental health through Interdisciplinary and cross-sectoral collaborations will determine not only the future of pandemic risk management but also the progress of climate change. Climate change is a well-researched field in many disciplines, and research on pandemic risk management has gained importance in scientific fields beyond the medical due to SARS-CoV-2. Integrating health in disaster risk management and *vice versa* is essential to address and manage modern challenges. The integration of the Sendai Framework with the Sustainable Development Goals (SDGs). International Health Regulations are mentioned in the Sendai

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Framework, proving its openness to and acceptance of other relevant policies and tools, where health is highlighted.

This Master Thesis aims to shed new light on integrating the interdisciplinary and cross-sectoral research conducted by the One Health approach in the global disaster risk reduction tool, the Sendai Framework. A comprehensive pandemic risk management approach includes the human, animal, and ecosystem health considerations that are essential to address the challenges of today's world due to global and climate change.

1.4. Hypothesis and Research Questions

Hypothesis: The integration of One Health with the Sendai Framework enhances pandemic risk management. One Health Principles correlate to the priorities and health aspects of the Sendai Framework.

Research Question 1: Which challenges are faced by pandemic risk management in times of global and climate change?

Research Question 2: Is the integration of the One Health approach with the Sendai Framework possible? What are the advantages of pandemic risk management?

1.5. Structure Overview

The background begins with the framework chapter exploring the interlinkages between pandemics, global and climate change, and the theoretical framing of disaster risk and pandemic risk management. The Case Study explores the One Health approach and the Sendai Framework, mainly focused on health and pandemic aspects, policies, and methods.

The results support the association between the One Health Principles, the health aspects of the priorities, and the Bangkok Principles of the Sendai Framework. The connection is based on the linkage, common ground, and potential leverage between these components.

The discussion chapter provides an analysis of the hypothesis and the research questions based on the result findings, and the interpretation of the findings. The conclusions give an overview of holistic pandemic risk management.

The research purpose is achieved through a recent literature review from intergovernmental agencies and academic institutions, with a focus on pandemics.

This study did not investigate in depth the co-benefits of natural disaster risk reduction of the One Health integration with the Sendai Framework, and focused merely on the health aspects, especially in pandemic risk reduction.

The limitations are many; this is an effort to integrate the ideology of the One Health approach with that of the Sendai Framework. However, the surprises during this work were primarily positive and justified the research. The conspicuous absence of ocean health and the impacts of the degradation through pollution, overfishing, marine traffic, and other human activities in disaster risk management is a matter of concern. This study did not

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include an analysis of media coverage – especially social media and the risk communication
issues that arise during the Covid 19 pandemic, which play a major role in pandemic risk
governance.

2. Background

2.1. Framework

2.1.1. Pandemics, Global, and Climate Change

“Global change refers to the alterations of planet earth through anthropogenic activities and the interlinkages between them (Stauber, Chariton, and Apte 2016).”

“Global change: The global-scale changes resulting from the impact of human activity on the major processes that regulate the functioning of the biosphere (Duarte, 2015).”

The Silk Road of the Second Century BCE marked the beginning of global change and globalization, with international and intercontinental trade, human and animal mobilization, and exchange of products and philosophies. Epidemic diseases have been another similar feature of globalization since then. The new trade routes were a fertile ground for various infectious agents to thrive, with enormous consequences for non-immune populations. For example, between 165 and 180 AD, millions of Romans died due to smallpox. The furs carrying contagious fleas from China through Central Asia caused the bubonic plague to spread through Europe in 542 AD and the 14th century. From this perspective, modern globalization trends amplify pre-existing processes. People, products, and vectors of infectious diseases travel faster than ever.

Global interdependence, population growth, increased population density due to urbanization, migration, inequalities, ecological disturbances, and global warming are contemporary, interdisciplinary matters that are broadly discussed and will concern us in the future (Forum on Microbial Threats, 2006). The discourse on globalization began in the 1970s, producing plenty of definitions. According to OECD, "The term globalization is generally used to describe an increasing internationalization of markets for goods and services, the means of production, financial systems, competition, corporations, technology, and industries. Amongst other things, this gives rise to increased mobility of capital, faster propagation of technological innovations, and an increasing interdependency and uniformity of national markets (sic)." UNESCO perceives globalization as a multi-dimensional process identified by economic regulations, technological innovation, privatization of social state services, and flexible labor policies. In the last two centuries, traveling speed increased, while the incubation time until the manifestation of an infection stayed constant. Under conducive circumstances, the short incubation time can intensify an endemic incident into a pandemic disaster in a few days. Therefore, efficient monitoring of vector-borne contagious diseases and adequate health care services are crucial. Low prevalence often shows deficient surveillance, not the absence of disease and delays timely mitigation efforts (Forum on Microbial Threats 2006).

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Climate change is one aspect, or consequence, of accelerating global changes since carbon dioxide emissions are linked mainly to anthropogenic activities, e.g., industry practices, fossil fuel collection and consumption, natural resources exploitation and land use intensification, natural habitat degradation, and population increase, complemented by immense food, energy, and raw material needs.

Biodiversity and habitat loss, environmental degradation, deforestation and forest encroachment, extensive land use, and farming: these links between climate change and pandemics are a focus point of the One Health approach. Climate transformation is a natural phenomenon, though it is mainly human-driven through urbanization, human population increase, natural resources exploitation, industrialization, and environmental pollution, as illustrated in Figure 1. Nature-based solutions – conservation medicine, adaption strategies, sustainable management, and development– support the efforts to recover ecosystems and environmental services while preventing and mitigating pandemic and extreme natural disasters (Kumari and Raghubanshi 2020) in the future.



Fig. 1. Anthropogenic drivers of climate change (Kumari and Raghubanshi 2020).

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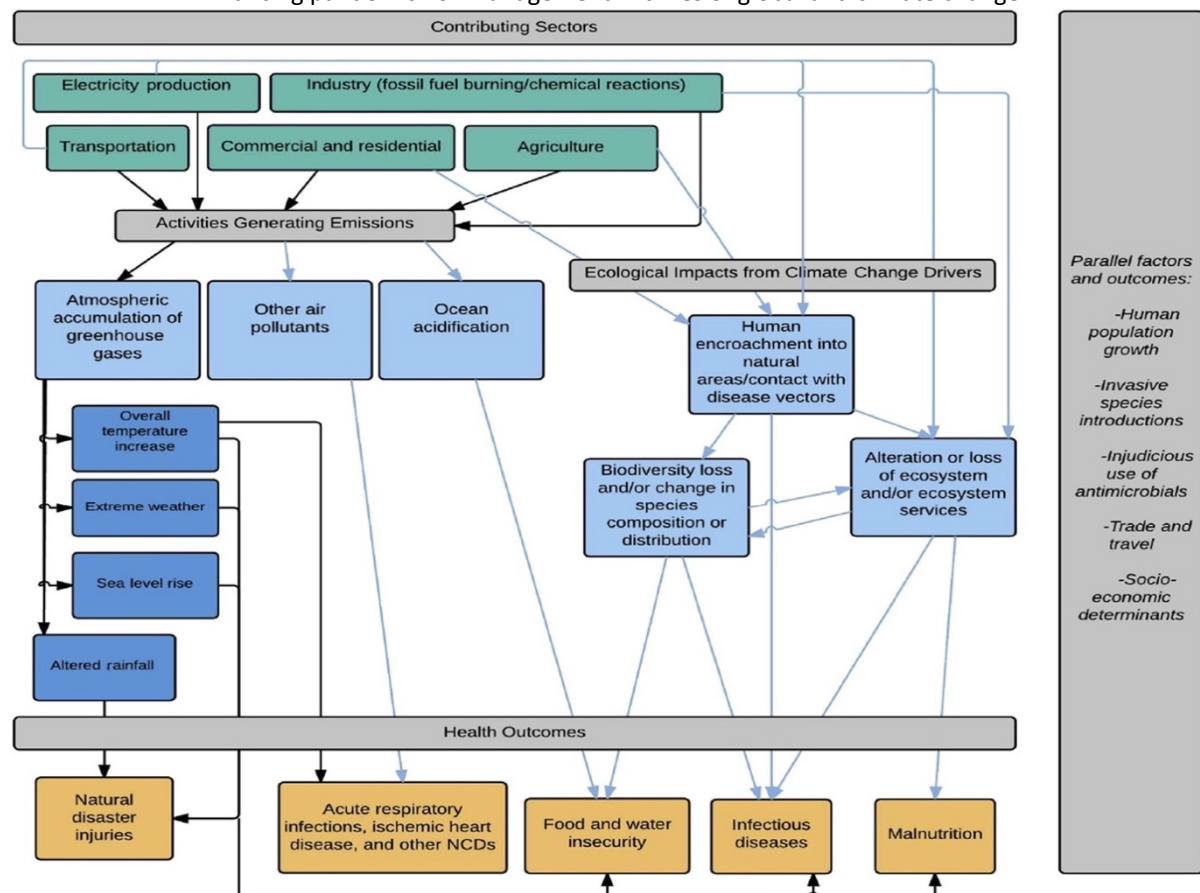


Fig. 2. The black arrows show how climate change affects health, and the blue arrows the underlying mechanisms of climate change (Machalaba et al., 2015).

Climate change amplifies health, natural and societal disaster risks. Interconnectivity and interdependencies are the underlying drivers of global and climate change and are crucial for prevention and mitigation mechanisms. Figure 2 depicts climate change factors, the main effects on health, and the interlinkages between the components. Changing environmental and socioeconomic settings can alter the pathogen, vector, host, and reservoir physiology, resulting in diverse disease-advantageous transmission pre-conditions. These concomitant complexities make modeling efforts challenging since distinct aspects like land-use methods, socioeconomic status, and health conditions influence each other, creating negative feedback circles (Machalaba et al., 2015).

The four global crises of the Anthropocene – climate change, biodiversity loss, public health crises, and global inequities – are interlinked and interdependent. Pandemics are a symptom or consequence of these. In the effort to combat these crises, opportunities arise, enabling co-benefits for distinct issues. For example, human health depends on healthy environmental conditions and can be severely disturbed by non-communicable diseases due to climate change (Di Marco et al., 2020). In addition, thoroughly planned investments against deforestation of tropical forests and wild animal trade can yield a high return in the form of enhanced pandemic prevention since deforestation and wild animal trade are the drivers of the spillover events that can potentially lead to a pandemic outbreak. Table 1 provides an overview of the costs of enhanced pandemic prevention actions and pandemic response costs (Dobson et al., 2020).

Table 1. Proposed pandemic prevention actions and comparison between pandemic prevention and pandemic response costs (Dobson et. al., 2020).

ITEM	VALUES (2020 \$)
Expenditures on preventive measures	
Annual funding for monitoring wildlife trade (CITES+)	\$250–\$750 M
Annual cost of programs to reduce spillovers	\$120–\$340 M
Annual cost of programs for early detection and control	\$217–\$279 M
Annual cost of programs to reduce spillover via livestock	\$476–\$852 M
Annual cost of reducing deforestation by half	\$1.53–\$9.59 B
Annual cost of ending wild meat trade in China	\$19.4 B
TOTAL GROSS PREVENTION COSTS (C)	\$22.0–\$31.2 B
Ancillary benefit of prevention	
Social cost of carbon	\$36.5/tonne
Annual CO ₂ emissions reduced from 50% less deforestation	118 Mt
Ancillary benefits from reduction in CO ₂ emissions	\$4.31 B
TOTAL PREVENTION COSTS NET OF CARBON BENEFITS (C)	\$177–\$26.9 B
Damages from COVID-19	
Lost GDP in world from COVID-19	\$5.6 T
Value of a statistical life (V) adjusted for COVID-19 mortality structure	\$5.34 M or \$10.0 M
Total COVID-19 world mortality (Q_0) forecast by 28 July 2020, 50th percentile with 95% error bounds	590,643 [473,209, 1,019,078]
Value of deaths in world from COVID-19 = $Q_0 \times V$	
Lowest (\$5.34 M × 2.5th percentile mortality forecast)	\$2.5 T
Middle (\$10 M × 50th percentile mortality forecast)	\$5.9 T
Highest (\$10 M × 97.5th percentile mortality forecast)	\$10.2 T
TOTAL DISEASE DAMAGES (D):	
Lowest (\$5.34 M × 2.5th percentile mortality forecast)	\$8.1 T
Middle (\$10 M × 50th percentile mortality forecast)	\$11.5 T
Highest (\$10 M × 97.5th percentile mortality forecast)	\$15.8 T

2.1.2. Disaster Risk Management

$$\text{RISK} = \text{HAZARD} \times \text{EXPOSURE} \times \text{VULNERABILITY}$$

Risk management is a relatively novel scientific field, compared to the permanent presence of risk throughout human history. Research and scientific development in risk management outline its complexity, raising the necessity for frameworks based on guidelines. This need led to numerous methodologies and tactics for risk assessment, management, and communication, practiced at the international, national, and local levels. The differences throughout the globe are evident, occasionally resulting in the inefficient realization of strategic risk management in terms of difficult risk communication, incompetent decisions, and wasteful usage of personnel and technical resources. These frameworks are used as procedures for responding individually to challenges, rather than as a global impact strategy (Jardine et al., 2003).

“Disaster risk is the result of the probability of occurrence and the potential damage of a hazard. The risk determinants are the hazard itself, the exposure, and the vulnerability of the object or system of interest. The dimensions of vulnerability are environmental, physical, geospatial, social-demographic, educational, health status, cultural, institutional, economic, and the possible combinations (Cardona 2013).”

The main risk management strategies are risk-informed (prevention, reduction, mitigation, risk transfer, risk acceptance), cautionary/precautionary (resilience and adaption), and discursive strategy (risk meaning and risk construction). Often, the combination of one or more of the three strategies is the key to sound risk management. The risk management processes are (Aven, 2016)

- a. context definition
- b. specification of the possible situation that could impact the risk object (ISO 31000)
- c. analysis of the potential damage of the risk
- d. risk probability calculation
- e. risk evaluation
- f. risk treatment

Climate changes impact pandemics by intensifying the existing and emerging risks through social and ecological alterations. Poverty-stricken countries exposed geographically to extreme hazards face a higher threat. Their socio-economic and health status, resources, and health service exclusion make their vulnerability multi-dimensional (Machalaba et al., 2015).

Vulnerability is characterized by

- a. exposure – the element that is exposed to a risk
- b. sensitivity – the grade of the potential damage
- c. capacity – the ability to adapt and cope with that risk.

The multidimensional nature of vulnerability has led to a plethora of definitions in various scientific disciplines like anthropology, ecology, economics, geography, biology, sociology, and politics, to name but a few. Vulnerability is mainly categorized in the social, physical, and economic domains, though, lately, institutional vulnerability has gained importance. The dimensions of vulnerability are temporal in terms of timeframe (before, during, after, long-term), spatial (individual, local, regional, and national), and systemic (environmental, social, political, institutional, economic, and infrastructure). The interconnection of these dimensions forms the vulnerability grade. Thus, reducing vulnerability stretches through many disciplines, which often overlap, like in the case of socioeconomic factors influencing the environment and vice versa (Fuchs et al., 2018).

A holistic approach to disaster risk management analyzes the community processes, practices, and decisions made in the past that affect the physical vulnerability and exposure during an extended period, as well as their drivers (social, economic, institutional, and cultural). Figure 3 shows that exposure in the holistic risk approach comprises hazard-dependent physical vulnerability, non-hazard-dependent social fragility, and lack of resilience. Improved socioeconomic status strengthens a society's recovery capacity, leading to "build back better" practices, increasing resilience against future disasters. The total risk components are the physical risks of a site and the aggravating indicators described in Figure 4. Risk assessment and risk evaluation enhance risk understanding, a crucial factor for risk mitigation, prevention and holistic risk strategies that comprehend physical vulnerability with its underlying mechanisms and socioeconomic impacts in case of an event. Figure 5 illustrates the map of global risk based on holistic risk evaluation. Reduction of present risks and prevention of future ones can be achieved through policies and strategies for which, besides the physical vulnerabilities and underlying mechanisms, non-hazard-dependent factors and the social context should be considered (Fraume et al., 2020).

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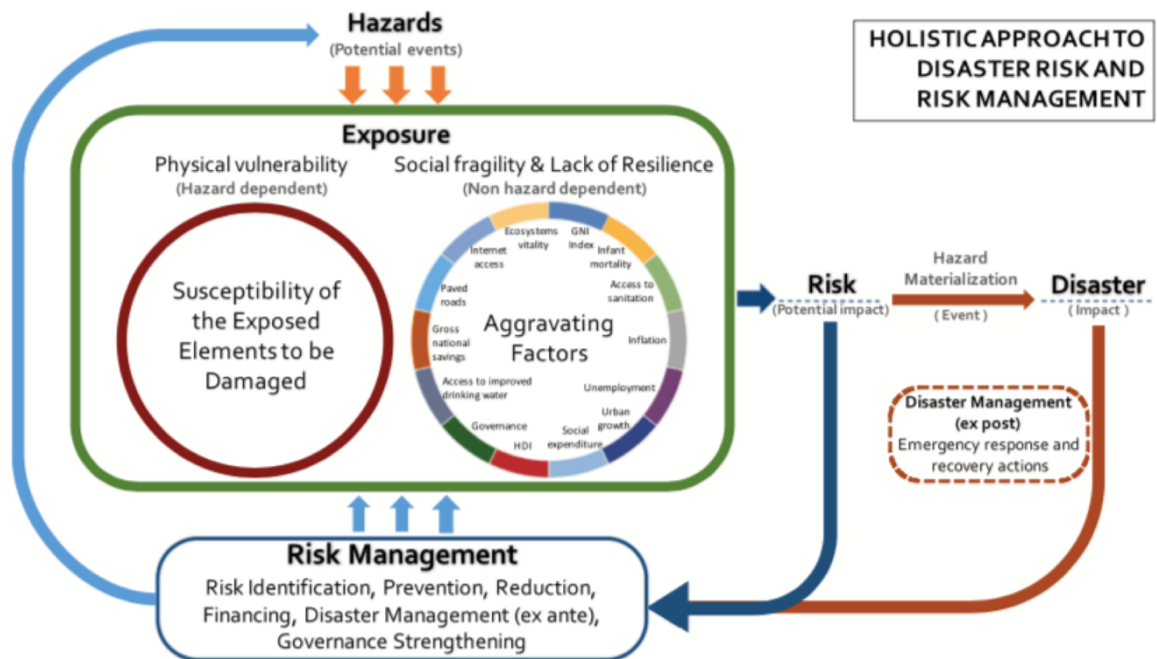


Fig. 3. A holistic approach to disaster risk management. Aggravating factors: ecosystem vitality, GNI Index, infant mortality, access to sanitation, inflation, unemployment, urban growth, social expenditure, HDI, governance, access to improved drinking water, gross national savings, paved roads, internet access (Fraume et al., 2020)

$F_{RF\ 1}$	AAL Earthquakes	$W_{RF\ 1}$	}	R_F	Physical risk	}	RT / CDRI	Total risk / Country Disaster Risk index
$F_{RF\ 2}$	AAL Tsunami	$W_{RF\ 2}$						
$F_{RF\ 3}$	AAL Tropical cyclones (Wind and storm surge)	$W_{RF\ 3}$						
$F_{RF\ 4}$	AAL Riverine floods	$W_{RF\ 4}$						
$F_{SF\ 1}$	Internet access (% of population) ^[i]	$W_{SF\ 1}$	}	F	Aggravating coefficient			
$F_{SF\ 2}$	Access to sanitation ^[ii]	$W_{SF\ 2}$						
$F_{SF\ 3}$	Access to improved drinking water ^[iii]	$W_{SF\ 3}$						
$F_{SF\ 4}$	GINI index ^[iv]	$W_{SF\ 4}$						
$F_{SF\ 5}$	Unemployment ^[v]	$W_{SF\ 5}$						
$F_{SF\ 6}$	Inflation ^[vi]	$W_{SF\ 6}$						
$F_{SF\ 7}$	Urban growth rate ^[vii]	$W_{SF\ 7}$						
$F_{LR\ 1}$	Gross National Savings ^[viii]	$W_{FR\ 1}$	}					
$F_{LR\ 2}$	Social expenditure ^[ix]	$W_{FR\ 2}$						
$F_{LR\ 3}$	Governance ^[x]	$W_{FR\ 3}$						
$F_{LR\ 4}$	Human Development Index ^[xi]	$W_{FR\ 4}$						
$F_{LR\ 5}$	Ecosystems vitality ^[xii]	$W_{FR\ 5}$						
$F_{LR\ 6}$	Paved roads ^[xiii]	$W_{FR\ 6}$						
$F_{LR\ 7}$	Infant mortality ^[xiv]	$W_{FR\ 7}$						

Fig. 4. Indicators for holistic risk evaluation (Fraume et al., 2020).

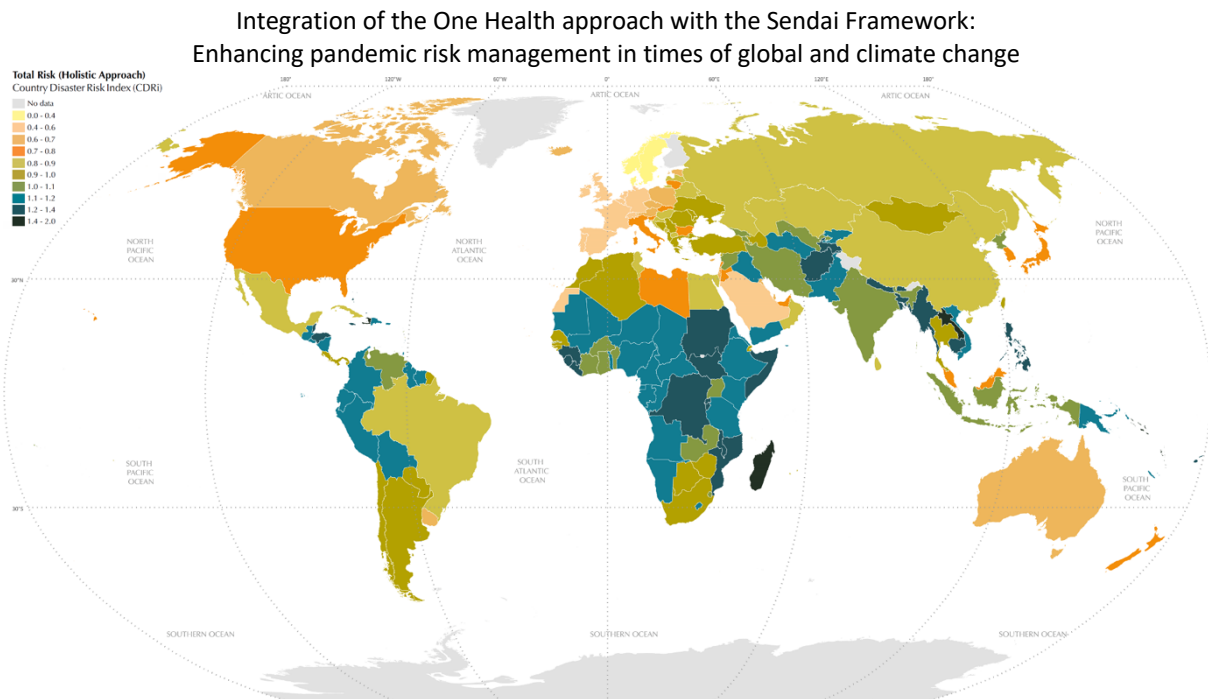


Fig. 5. Global holistic evaluation of total risk (Fraume et al., 2020).

2.1.3. Pandemic Risk Management

Pandemic risk management encounters increasing disaster risks due to climate and global change. The cascading effects of global changes on disease spillovers and outbreaks, spread, and damage are apparent in the current Covid 19 pandemic. Zoonoses cause 60% of infectious human diseases, 72% are wild animals, and the rest are domesticated. It is estimated that, after an infectious disease outbreak in a remote village of the global south, the infectious agent can reach a Megacity in 36 hours and spread globally (Walzer 2017). Covid 19 cost us trillions of dollars, more than the worldwide combined natural disaster damages in the past decade, while 300 viruses have been identified as infectious for humans and approximately 700.000 viruses estimated to be zoonotic from a total of 1.7 million (Caroll et al., 2018).

Novel concepts are required for establishing an interdisciplinary, cross-sectoral, and holistic approach to possible large-scale pandemics. Economic and technological development contribute to additional global health capacity, preventing and mitigating emerging and re-emerging diseases, resulting in a global harmonized epidemiological system for the control of diseases and the understanding of today's threats, opportunities, and interdependencies. Global strategies based on scientific evidence, innovative methods and tools developed by the industry, academia, public health institutes, and national and international policymakers, including public opinion, are appropriate for effectively addressing the epidemiological challenges in the modern and meta-modern world. Comprehensive governance and compliance are central to empowering the national potential in disease mitigation through legal frameworks and capacity building (Ethical and Legal Considerations in Mitigating Pandemic Disease: Workshop Summary 2007).

“Global Catastrophic biological risks – GCBRs – are defined as those events in which biological agents—whether naturally emerging or re-emerging, deliberately created and released, or laboratory engineered and escaped—could lead to sudden, extraordinary, widespread disaster beyond the collective capability of national and international governments and the private sector to control. If unchecked, GCBRs would lead to great suffering, loss of life, and sustained damage to national governments, international relationships, economies, societal stability, or global security.” (Adalja et al., 2018).

Pandemics and climate change are systemic phenomena, acting as non-stationary, non-linear risk multipliers. Pandemics are imminent, discrete, and directly discernable, with a contagion risk processing in weeks, months, and years. Conversely, the signs of progress of climate change are gradual and accumulate through years, decades, or even centuries (Pinner et al., I. 2020). Complexity, uncertainty, ambiguity, and transgression to other systems are the main characteristics of systemic risks, with highly unpredictable outcomes that are affected by grade and system. The processes of systemic elements at the micro-level impact the system at the macro-level, altering the systemic environment. Multidisciplinary perspectives and approaches of different contexts and future scenarios are essential to address the complex synergies, antagonisms, and positive and negative feedback loops of systemic risks. To conceptualize systemic risks, there are two equally indispensable approaches for the analysis and governance of systemic risks (Renn et al., 2020):

- i) The ontological approach – analytical realism: risk is not a mental construction, but is highly complex and dynamic, existing independently of the human perception, and presents a real-world phenomenon.
- ii) Epistemic analytical constructivism: risk is an epistemic mental construct illustrated in evidence-based models and not reality-based, produced by intentional scientific research, while empirical verification and prediction are impossible.

„Systemic risks refer to potential threats that endanger the functionality of systems of critical importance for society and their scope in time and space. The impacts may extend beyond the system of origin to affect other systems and functions (Renn 2016).

From this point of view, pandemic risks are systemic risks since their complex, uncertain nature enhances the ambiguity of such a phenomenon, while the effects and impacts reach beyond health and include the social, economic, and cultural sectors. Society tends to underestimate systemic risks despite their severity, unlike conventional risks that are spatio-temporally limited and affect distinct domains (Schweizer et al., 2021). Therefore, risk perception is a vital component of risk mitigation and risk communication, inter alia. The main risk perception factors are voluntariness, controllability, delay effect, the nature of risk (manmade or natural), the familiarity and habituation to a specific risk, the benefit of the risk, benefit distribution, media presence, and presentation of the risk (Schmidt 2004). In addition, the socio-economic context and the specifics of the local community can determine risk perception and understanding. Thus, risk perception results from scientific reason combined with social, cultural, and economic conclusions. At the same time, age, gender, education level, income, family situation, and experience shape the risk perception of individuals and communities on different scales. Hence, the need to study and analyze risk

perception in a more spherical and interdisciplinary fashion, combining research methods and contrasting the hard facts (e.g., technical) to the soft facts in a psychological, social, and cultural context and psychometric paradigm (Martins et al., 2019). The risk paradox is that risk perception does not correlate with empirical evidence (Renn 2014).

Pandemics have been a significant cause of life lost for a long for a long time. However, in the modern world of globalization, global and climate change, increased human and product transportation, population growth, migration, and other socio-economic factors, epidemiological circumstances are changed. At the same time, science, technology, and innovation provide opportunities for coping with emerging diseases as faster and direct communication channels. The hazard in pandemic risk management is a contagious agent (viral, bacterial, parasitic, fungal, or prions). The manner of transmission and transmission during incubation time, morbidity and mortality rate, absence of medical treatment or vaccination, the pathogenicity of the agent, and the immunity state (e.g., naivety) of the population, determine the severity of a pandemic hazard. The most hazardous pandemic agents are airborne RNA viruses due to their high mutation rates and the medical limitations in antiviral treatments. In addition, aerosol spreading is an efficient way for a virus to proliferate. At the same time, control measures are inadequate and difficult to implement, in contrast with other ways of viral transmission like blood, sperm, food or water, feces, and vectors. Another determinant for pandemic potential is the period of transmissibility, which varies from transmission during the incubation period in asymptomatic individuals to patients with severe symptoms who have fewer occasions to transmit the disease due to enforced isolation. Finally, the immunological naivety by the first contact of a population with a new pathogen, especially zoonotic, is crucial for the course of a pandemic. In this case, the population has no immunity protection, and more people would be infected and would transmit the disease without medical treatments or vaccinations developed (Adalja et al., 2018).



Fig. 6. Entrance of Black Death, Weymouth, England (Machalaba et al., 2015).

While multiple-drug-resistant bacteria put the public health system and medical procedures under pressure and threaten the lives of hospitalized patients, the development of antibiotics and the low replication rate of bacteria pose less of a pandemic threat. In addition, fungi are thermally constrained, and prion, parasites, protozoa have restricted

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transmission routes and pathogenicity, decreasing their pandemic potential (Adalja et al., 2018).

“Preparedness, including for potential pandemics, requires coordination and management of complex relationships across different sectors and between international, national, and local actors. We must work together in support of all societies as they prepare – in ways that reflect the interests of all people for whom preparations are being made. A community-based One Health approach is essential for reducing the risks to people that emerge at the interfaces between animals, humans, and ecosystems.”

– UN System Influenza Coordinator David Nabarro, 2013

One of the challenges addressed in the modern epidemiological context is the belief that a geographically distant disease outbreak is irrelevant to the lives of people and animals at any distance from the place of the event. The future of pandemic risk management is global, inter- and transdisciplinary, holistic, beyond national solipsism. As long as people, animals, food, and goods travel around the globe at immense speeds and distances, invisible infectious microorganisms will circulate, posing a constant threat to our societies. International partnerships based on egalitarian, bidirectional agreements are the sustainable way to control diseases globally. Cross-sectoral networking and strengthening the global public health capacity through better resource planning and preparedness for various epidemiological scenarios based on modeling tools is a feasible way to plan a rapid pandemic response to constrain the spread of the disease. The internet offers a vast opportunity to monitor, prevent and control diseases globally through information, data storage, and sharing (Forum on Microbial Threats 2006).

Disease mitigation efforts can have unexpected adverse economic, civil rights, and liberties outcomes, leading to new ethical and legal complications. The balance between individual rights and public health safety is challenging, as seen in quarantine practices and the isolation of infected persons. The responsibility and exposure of medical staff, securing public access to health institutions, actions like vaccination, monitoring, and reporting of emerging diseases are examples of the problems posed by global disease threats. In addition, past response patterns to infection occurrences make evident that factors like community information about the disease, the nature of the disease agent, media coverage, keeping incidents secret due to fear of possible economic losses from tourism or trade can influence the progress of an epidemic event (Ethical and Legal Considerations in Mitigating Pandemic Disease: Workshop Summary 2007).

The regulation of global public health and national sovereignty is possible through ethical and legal guidelines that target the coordinated international response to public health risks. Economic and institutional support can solve these concerns of the developing countries and lead to a sufficient global disease reporting and alert system. However, national and international trade is a sector that often struggles because of disease outbreaks and a reason for governments not to report disease incidents in a timely fashion, increasing the risk of pandemics.

The eradication of smallpox is an example of disease management, proving that international collaboration is a viable way to face epidemiological challenges. Still, mandatory vaccinations are against individual rights, making the discourse complex and emotional. The vaccination rate against smallpox was 80% among children worldwide, opening the way for the standard vaccinations against tuberculosis, diphtheria, pertussis, tetanus, measles, and poliomyelitis. Instead of preparing against individual threats, public health capacity building increases the resilience of public health systems in a connected and fast world. Prevention costs and benefits require an analysis based on the modern world. Considering current social, political, and legal circumstances while designing novel concepts for pandemic risk management strengthens human rights and civil liberties. The ethical concerns that accompany pandemic diseases are:

- a. equitable access to health care
- b. human rights
- c. the obligations of and to the health care workers
- d. the obligations of countries and institutions.

A global plan should include a harmonized system of international cooperation and coordination targeting the following:

- a. surveillance of infectious diseases
- b. support to developing countries through resources and compensation
- c. strengthening public health capacities
- d. protection of international trade during epidemiological events
- e. public engagement
- f. improved communication
- g. international capacity building
- h. sound governance, compliance, and transparency (*Ethical and Legal Considerations in Mitigating Pandemic Disease: Workshop Summary 2007*).

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Development of an infection has six components:

Agent of disease. The disease-causing organism, or pathogen, which can take the form of a bacteria, virus, fungus, or parasite.

Reservoir. The species—human, animal, or insect—in which the pathogen naturally resides. Pathogens can live in a reservoir for long periods without emerging to cause an epidemic. Reservoir hosts may not be seriously harmed by the pathogen.

Portal of exit. The path by which a pathogen leaves its reservoir or host. Examples include the respiratory tract, urinary tract, rectum, and cuts or lesions in skin.

Mode of transmission. The way a pathogen spreads from its reservoir host to the susceptible host. This can occur directly, via skin-to-skin contact or sexual relations, or through the spread of droplets from coughing or sneezing. It also can occur indirectly, as when organisms are carried on airborne particles, when intermediate objects such as handkerchiefs or bedding are the vehicle

of transmission, or when mosquitoes, ticks, and other vectors carry the pathogen.

Portal of entry. The place a pathogen enters a susceptible host. The mouth and nose are common portals of entry. Others include the skin (for hookworm), mucous membranes (for influenza or syphilis), and blood (for hepatitis B and HIV).

Susceptible host. Some host species can acquire the pathogen but do not naturally carry it, and may be affected or unaffected by it, potentially transmitting it to other species or populations or serving as a dead-end for transmission.

Importantly, human activities can facilitate the transmission of a pathogen at any of these six places—by, for example, enabling contact between reservoir and host species or inducing genetic selection for virulent strains that are more likely to be pathogenic to humans. Conversely, human intervention around any of the six components can stop the spread of an infectious disease.

Fig. 7 Chain of infection (Machalaba et al., 2015).

Pandemics impact human, animal, and environmental health, the economy, public life, and the political situation of the affected countries. WHO updated the International Health Regulations in 2005 after the severe acute respiratory syndrome (SARS) outbreak in 2003, improving the States Members' response to epidemic incidents. The revised IHR resulted in the timely detection and mitigation of the influenza pandemic in 2009. However, cases like the recurring Ebola epidemics in West Africa confirm that it is not possible for all countries to adopt the IHR at the same level in detection, reporting, mitigation, isolation, and proper health services (Jamison et al., 2018).

Covid 19, the ultra-dynamic phenomenon of climate and global change, makes it evident that environmental degradation and conflict between humans and Nature increases the possibility of zoonotic spillovers and the damage probability to humans, animals, and the environment. Pandemic risk management demands an interdisciplinary, multilateral, cross-sectoral consensus from a plethora of actors to identify, analyze, and evaluate the risks that accompany pandemics and climate change. One Health, as a science of delivery, generates holistic responses to climate change and its effects on planet earth. One Health principles comply with international disaster risk reduction policies and health regulations, providing pandemic risk management inputs with valuable answers and practices. Creating solid veterinary and human medicine public health institutions and supporting the collaboration between them in developing countries is crucial for pandemic risk reduction (Jonas 2014).

2.2. Case Study

2.2.1.1. Sendai Framework

On March 18, 2015, the 187 United Nations Member States ratified the Sendai Framework at the Third U.N. World Conference in Sendai, Miyagi, Japan. The Sendai Framework 2015-2030 aims to prevent and reduce new and existing disaster risks while developing preparedness for response and recovery. The Sendai Framework 2015-2030 is the statutory basis for risk reduction management. It aims to prevent and reduce new and existing disaster risks, preparedness for response, and recovery while strengthening resilience through risk-informed sustainable development[^]. The main factors are risk governance, resilience, and preparedness. Understanding disaster risk in all its dimensions constitutes its principal priority. In 2015, along with the Sendai Framework, the Paris Agreement on Climate Change, the Addis Ababa Action Agenda on Financing for Development, the New Urban Agenda, and the Sustainable Development Goals were also adopted, to create sound governance based on a multisectoral approach at the national and global levels for health, climate change, development and disaster risk (<https://www.undrr.org/implementing-sendai-framework/what-sendai-framework>).

The ideology of the Sendai Framework is people-centered, all-hazard, all-of-state, all-of-society, to strengthen risk reduction and risk resilience (Aitsi-Selmi, 2015).

The Hyogo Framework 2005-2015 is the predecessor of the Sendai Framework 2015-2030. The priorities of the Hyogo Framework are institutional instrumentalization to reduce disaster risk at the national and local level; issuing warnings and monitoring disaster risks; the culture of safety and resilience; monitoring and evaluation; early warning; identifying underlying factors; and preparedness. Hyogo Framework promotes the instrumentalization of the international synergies to diminish mortality in the disaster context. It demonstrates the urgency to eliminate poverty and to develop more sustainably, acknowledging the dependency between sustainable development and disaster risk management, policy efficiency, and social, health, cultural and educational resilience. Technically, the Hyogo Framework portrays a more simplistic disaster risk management view and system. The Sendai Framework, as its successor, presents a vast, integrative, and human-focused approach. Nevertheless, the Hyogo Framework recognizes that climate change correlates with disaster risks (Hyogo Framework 2005–2015).

“Prevent new and reduce existing disaster risk, the implementation of integrated and inclusive economic, structural, legal, social, health, cultural, educational, environmental, technological, political and institutional measures that prevent and reduce hazard exposure and vulnerability to disaster, increase preparedness for response and recovery, and thus strengthen resilience (A/RES/69/283, 2015, 283).

Priority 1: Understanding disaster risk

Disaster risk is a dynamic convolution of underlying factors and interactions amid cross-cutting fields like information collection and dissemination; disaggregation of data; spatio-temporal variations; climate observation; science; education; local knowledge; helping to understand risk; and producing policies and practices that strengthen international cooperation for efficient decision making.

Priority 2: Strengthening disaster risk governance to manage disaster risk

Strong disaster risk governance through multiple cross-sectoral stakeholders, institutions, and organizations at local, national, and global levels is essential to achieve disaster risk prevention, mitigation, preparedness, response, and recovery.

Priority 3: Investing in disaster risk reduction for resilience

Investing in resource allocation and risk transfer through insurances, risk reduction mechanisms of critical infrastructures, national health system resilience, food security, social safety, sustainable natural resources use.

Priority 4: To enhance disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation, and reconstruction



Fig. 8. Building Back Better aiming at resilience for future climate and health disaster risks (Vereinte Nationen 2021).

Seven global targets support the assessment of progress based on indicators, through reduction of

the global disaster mortality –number of people affected by disasters per 100.000;

A-1. Number of deaths and missing persons attributed to disasters, per 100,000 population.

A-2. Number of deaths attributed to disasters, per 100,000 population.

A-3. Number of missing persons attributed to disasters, per 100,000 population.
the global number of people affected by disasters per 100.000

B-1. Number of directly affected people attributed to disasters, per 100,000 population.

B-2. Number of injured or ill people attributed to disasters, per 100,000 population.

B-3. Number of people whose damaged dwellings were attributed to disasters.

B-4. Number of people whose destroyed dwellings were attributed to disasters.

B-5. Number of people whose livelihoods were disrupted or destroyed, attributed to disasters.

the economic loss of the global gross domestic product (GDP) due to disaster

C-1. Direct economic loss attributed to disasters in relation to global gross domestic product.

C-2. Direct agricultural loss attributed to disasters.

C-3. Direct economic loss to all other damaged or destroyed productive assets attributed to disasters.

C-4. Direct economic loss in the housing sector attributed to disasters.

disaster damage of critical infrastructure by 2030;

D-1. Damage to critical infrastructure attributed to disasters.

D-2. Number of destroyed or damaged health facilities attributed to disasters.

D-3. Number of destroyed or damaged educational facilities attributed to disasters.

D-4. Number of other destroyed or damaged critical infrastructure units and facilities attributed to disasters.

increase

national and local disaster reduction strategies by 2020;

E-1. Number of countries that adopt and implement national disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015-2030.

E-2. Percentage of local governments that adopt and implement local disaster risk reduction strategies in line with national strategies.

international cooperation for the implementation of the Framework

F-1. Total official international support, (official development assistance (ODA) plus other official flows), for national disaster risk reduction actions.

F-2. Total official international support (ODA plus other official flows) for national disaster risk reduction actions provided by multilateral agencies.

F-3. Total official international support (ODA plus other official flows) for national disaster risk reduction actions provided bilaterally.

F-4. Total official international support (ODA plus other official flows) for the transfer and exchange of disaster risk reduction-related technology.

F-5. Number of international, regional and bilateral programmes and initiatives for the transfer and exchange of science, technology and innovation in disaster risk reduction for developing countries.

F-6. Total official international support (ODA plus other official flows) for disaster risk reduction capacity-building.

F-7. Number of international, regional and bilateral programmes and initiatives for disaster risk reduction-related capacity-building in developing countries.

F-8. Number of developing countries supported by international, regional and bilateral initiatives to strengthen their disaster risk reduction-related statistical capacity.
multi-hazard early warning systems and disaster risk information and assessments to people by 2030.

G-1. Number of countries that have multi-hazard early warning systems.

G-2. Number of countries that have multi-hazard monitoring and forecasting systems.

G-3. Number of people per 100,000 that are covered by early warning information through local governments or through national dissemination mechanisms.

G-4. Percentage of local governments having a plan to act on early warnings.

G-5. Number of countries that have accessible, understandable, usable and relevant disaster risk information and assessment available to the people at the national and local levels.

G-6. Percentage of population exposed to or at risk from disasters protected through pre-emptive evacuation following early warning (Sendai Framework for Disaster Risk Reduction 2015 - 2030).

The Sendai Framework and the Sustainable Development Goals (SDG's) have a common socio-economic background and supplement the monitoring of the SDG's implementation as shown in Figure 9 and Table 2 (<https://www.undrr.org/implementing-sendai-framework/sf-and-sdgs>).

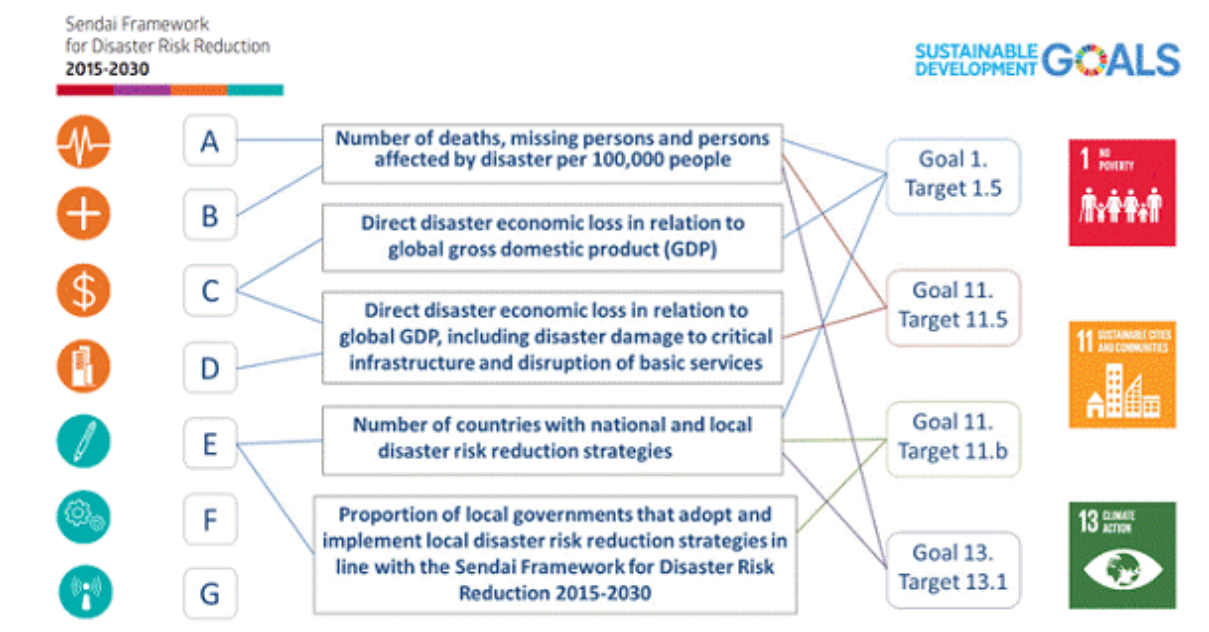


Fig. 9. Monitoring the SDG's with the monitoring indicators of the Sendai Framework (<https://www.undrr.org/implementing-sendai-framework/sf-and-sdgs>).

Table 2. Monitoring the SDG's with the monitoring indicators of the Sendai Framework
(<https://www.undrr.org/implementing-sendai-framework/sf-and-sdgs>).

SDG indicators		Sendai Framework indicators
Goal 1. End poverty in all its forms everywhere		
1.5.1	Number of deaths, missing persons and directly affected persons attributed to disasters per 100,000 population	A1 and B1
1.5.2	Direct economic loss attributed to disasters in relation to global gross domestic product (GDP)	C1
1.5.3	Number of countries that adopt and implement national disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015-2030	E1
1.5.4	Proportion of local governments that adopt and implement local disaster risk reduction strategies in line with national disaster risk reduction strategies	E2
Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable		
11.5.1	Number of deaths, missing persons and directly affected persons attributed to disasters per 100,000 population	A1 and B1
11.5.2	Direct economic loss in relation to global GDP, damage to critical infrastructure and number of disruptions to basic services, attributed to disasters	C1, D1, D5
11.b.1	Number of countries that adopt and implement national disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015-2030	E1
11.b.2	Proportion of local governments that adopt and implement local disaster risk reduction strategies in line with national disaster risk reduction strategies	E2
Goal 13. Take urgent action to combat climate change and its impacts		
13.1.1	Number of deaths, missing persons and directly affected persons attributed to disasters per 100,000 population	A1 and B1
13.1.2	Number of countries that adopt and implement national disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015-2030	E1
13.1.3	Proportion of local governments that adopt and implement local disaster risk reduction strategies in line with national disaster risk reduction strategies	E2

Preventing new disaster risks and reducing the existing ones by implementing integrated and inclusive economic, structural, legal, social, health, cultural, educational, environmental, technological, political, and institutional measures increases preparedness for response and recovery and thus strengthens resilience. The evolving elements that drive disaster risk are hazard, exposure, and the dimensions of the vulnerability of social and environmental systems. Risk is the probability of future dangerous events; however, it does not mean hazard. A vulnerable system is an exposed system, whereas exposure is elemental for risk and vulnerability.

2.2.1.2 Health Aspects of Sendai Framework

The Sendai Framework, with 35 health references, sets health at the core of disaster risk reduction management in the international policy-making process by leading the Health Emergency and Disaster Risk Management-Health EDRM-process. The Sendai Framework

offers coherence and consistency in national and international disaster risk reduction and Health Emergency policy. The World Health Organization integrates an all-hazard emergency risk management approach to promote health security and protect vulnerable social groups in the 13th General Programme of Work 2019–2023 of the World Health Assembly. Technical guidance, monitoring tool of the Sendai Framework targets- Sendai Framework Monitoring National Focal Point- and training are provided to the Member States. Three of the seven Sendai Framework Targets (A, B, D) are health-oriented (Wright et al., 2020). The Sendai Framework connects with the IHR of 2005 to enhance the detection and risk management process of health emergencies in an all-hazard approach (WHO, 2018, p.23). The health aspects in the priorities of the Sendai Framework are the following:

Table 3: Health aspects of the Sendai Framework Priorities (Health in the Context of the Sendai Framework for Disaster Risk Reduction, 2015)

<p><u>Priority 1: Understanding disaster risk</u></p> <p>"Policies and practices for disaster risk management should be based on an understanding of disaster risk in all its dimensions of vulnerability, capacity, exposure of persons and assets, hazard characteristics and the environment."</p>	<p><u>Priority 2: Strengthening disaster risk governance to manage disaster risk</u></p> <p>"Clear vision, plans, competence, guidance and coordination within and across sectors as well as participation of relevant stakeholders are needed. Strengthening disaster risk governance is therefore necessary and fosters collaboration and partnership across mechanisms and institutions for the implementation of instruments relevant to disaster risk reduction and sustainable development."</p>	<p><u>Priority 3: Investing in disaster risk reduction for resilience</u></p> <p>"Public and private investment in disaster risk prevention and reduction through structural and non-structural measures is essential to enhance the economic, social, health, and cultural resilience of persons, communities, countries, and their assets, as well as the environment."</p>	<p><u>Priority 4: Enhancing disaster preparedness for effective response and to "build back better" in recovery, rehabilitation, and reconstruction</u></p> <p>"The steady growth of disaster risk, including the increase of people and asset exposure, combined with the lessons learned from past disasters, indicates the need to further strengthen disaster preparedness for response, act in anticipation of events, integrate disaster risk reduction in response preparedness, and ensure that capacities are in place for effective response and recovery at all levels."</p>
Disaster risk and	Mainstream	Safe hospitals and	People-centered

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<p>Data loss (para 25a): "Enhance the development and dissemination of science-based methodologies and tools to record and share disaster losses and relevant disaggregated data and statistics, as well as to strengthen disaster risk modelling, assessment, mapping, monitoring and multi-hazard early warning systems;"</p> <p>Safe hospitals and health infrastructure (para 25f): "Develop effective global and regional campaigns as instruments for public awareness and education, building on the existing ones (for example, the "One Million Safe Schools and Hospitals" initiative...), to promote a culture of disaster prevention, resilience and responsible citizenship, generate understanding of disaster risk, support mutual learning, share experiences. Encourage public and private stakeholders to actively engage in such initiatives, and develop new ones at local, national, regional and global levels."</p>	<p>disaster risk reduction in health (para 27a): "Mainstream and integrate disaster risk reduction within and across all sectors. Review and promote the coherence and further development, as appropriate, of national and local frameworks of laws, regulations and public policies."</p> <p>Safety enhancing laws and regulations (para 27d): "Encourage the establishment of necessary mechanisms and incentives to ensure high levels of compliance with existing safety-enhancing provisions of sectoral laws and regulations, including those addressing land use and urban planning, building codes, environmental and resource management and health and safety standards, and update them, where needed, to ensure an adequate focus on disaster risk management;"</p> <p>Coherence of instruments and tools (para 28b):</p>	<p>health facilities (para 30c): "Strengthen disaster-resilient public and private investment, particularly through structural and non-structural and functional disaster risk prevention and reduction measures in critical facilities, in particular schools and hospitals and physical infrastructures; building better from the start to withstand hazards through proper design and construction, including the use of the principles of universal design and the standardization of building materials; retrofitting and rebuilding; nurturing a culture of maintenance; and taking into account economic, social, structural, technological and environmental impact assessments."</p> <p>Health system resilience and disaster risk management for health (para 30i): "Enhance the resilience of national health systems, including by</p>	<p>early warning, communication and technological systems (para 33b): "Invest in, develop, maintain and strengthen people-centred multi-hazard, multisectoral forecasting and early warning systems, disaster risk and emergency communications mechanisms, social technologies and hazard- monitoring telecommunications systems. Develop such systems through a participatory process."</p> <p>Safe hospitals (para 33c): "Promote the resilience of new and existing critical infrastructure, including ... hospitals and other health facilities, to ensure that they remain safe, effective and operational during and after disaster in order to provide life-saving and essential services."</p> <p>Stockpiling (para 33d): "Establish community centres for the promotion of public awareness and the stockpiling of necessary materials to implement rescue and relief activities."</p>
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<p>Innovation and technology (para 25i): "Enhance access to and support for innovation and technology as well as in long-term, multi-hazard and solution-driven research and development in disaster risk management."</p>	<p>Foster collaboration across global and regional mechanisms and institutions for the implementation and coherence of instruments and tools relevant to disaster risk reduction, such as for climate change, biodiversity, sustainable development, poverty eradication, environment, agriculture, health, food and nutrition and others, as appropriate;"</p> <p>Epidemics and pandemics (para 28d): "Promote transboundary cooperation to enable policy and planning for the implementation of ecosystem-based approaches, to build resilience and reduce disaster risk, including epidemic risk. "</p>	<p>integrating disaster risk management into primary, secondary and tertiary health care, especially at the local level; developing the capacity of health workers in understanding disaster risk and applying and implementing disaster risk reduction approaches in health work; promoting and enhancing the training capacities in the field of disaster medicine; and supporting and training community health groups in disaster risk reduction approaches in health programmes, in collaboration with other sectors, as well as in the implementation of the International Health Regulations (2005) of the World Health Organization."</p> <p>Access to basic health care services (para 30j): "Strengthen the design and implementation of inclusive policies and social safety net mechanisms, including through community</p>	<p>Training (para 33f): "Train existing workforce and voluntary workers in disaster response and strengthen technical and logistical capacities to ensure better response in emergencies."</p> <p>Health data (para 33n): "Establish a mechanism of case registry and a database of mortality caused by disaster in order to improve the prevention of morbidity and mortality."</p> <p>Mental health (para 33o): "Enhance recovery schemes to provide psychosocial support and mental health services for all people in need."</p>
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		<p>involvement, integrated with livelihood enhancement programmes, and access to basic health care services, including maternal, new born & child health, sexual & reproductive health, food security & nutrition, housing and education, towards the eradication of poverty, to find durable solutions in the post disaster phase and to empower and assist people disproportionately affected by disasters.”</p> <p>Life threatening and chronic diseases (para 30k): “Include people with life threatening and chronic diseases in the design of policies and plans to manage their risks before, during and after disasters, including having access to life- saving services.”</p> <p>Ecosystem and environment health (para 30n): “Strengthen the sustainable use and management of ecosystems and implement integrated environmental and</p>	
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		<p>natural resource management approaches that incorporate disaster risk reduction;"</p> <p>Animal health (para 30 p): "Strengthen the protection of livelihoods and productive assets, including livestock, working animals, tools and seeds;"</p> <p>Sendai Framework implementation (para 31e): "Enhance cooperation between health authorities and other relevant stakeholders to strengthen country capacity for disaster risk management for health, the implementation of the International Health Regulations (2005) and the building of resilient." health systems."</p>	
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"The Bangkok Principles for the Implementation of the Health aspects of the Sendai Framework for Disaster Risk Reduction" serve as the health specification of the Sendai Framework. Founded in 2016 in Bangkok, Thailand, during the International Conference held by the Royal Thai Government, the United Nations Office for Disaster Risk Reduction (UNISDR), and the World Health Organization (WHO), the Bangkok Principles place health at the heart of disaster risk reduction in a holistic approach. The Sendai Framework involves disaster risk coordination, planning, and strategy to multisectoral all-hazard scenarios and resilient health systems. In addition, it reinforces alliances with the World Health Organization in the International Health Regulations (IHR), the Paris Agreement for Climate Change, the Sustainable Development Goals (SDGs) *inter alia*.

Table 4: The Bangkok Principles are as follows (World Health Organization, 2016):

1. Promote systematic integration of health into national and sub-national disaster risk reduction policies and plans and the inclusion of emergency and disaster risk management programmes in national and sub-national health strategies.

Key actions include:

- Promote a whole-of-government, a whole-of-society approach, with population at risk and communities at the centre of emergency and disaster risk management measures, led by strong political commitment of Governments.
- Develop, or revise multi-sectoral policies, integrated plans and programmes for emergency and disaster risk reduction to include the health sector component, and manage health risks of emergencies and disasters with appropriate levels of resources to support implementation.
- o Increase the participation of health sector representatives in multi-sectoral emergency and disaster risk management committees and platforms at all levels
- Strengthen the integration of biological hazards, including epidemics, pandemics, and diseases at the human-animal-ecosystem interface, into all-hazards multi- sectoral disaster risk management
- Adapt and apply monitoring and reporting frameworks, as appropriate, for disaster risk reduction to track the progress of implementation of plans at all levels including health components.
- Integrate health needs fully into post-disaster needs assessment and recovery planning.
- Strengthen the design and implementation of gender-responsive and inclusive disaster risk reduction policies and plans, with community involvement, to address the vulnerabilities and capacities of women and children, people with disabilities, older persons, migrants, and other population at risk and protection needs before, during and after disasters.

2. Enhance cooperation between health authorities and other relevant stakeholders to strengthen country capacity for disaster risk management for health, the implementation of the International Health Regulations (2005) and building of resilient health systems.

Key actions include:

- Integrate disaster risk management into primary, secondary and tertiary health care and related services.
- Strengthen the essential capacities for emergency and disaster risk management for health and building resilience of health systems at all levels, including in policies and legislation, planning and coordination, human and financial resources, monitoring and evaluation, information management, health infrastructure and logistics, health and related services, risk communication and community capacity development.
- Strengthen coordination bodies, committees and platforms at all levels for emergency and disaster risk management for health, including multisectoral and multistakeholder participation.
- Strengthen multisectoral planning and action to manage health risks from all types of hazards, including the implementation of the International Health Regulations (2005)

3. Stimulate people-centered public and private investment in emergency and disaster risk reduction, including in health facilities and infrastructure.

Key actions include:

- Enhance the safety functionality and resilience of critical health infrastructure and facilities by conducting safety assessments, strengthening the implementation of the Safe

<p>Hospital Initiative, and applying the principles of “Building back better” in recovery and reconstruction, in coordination with communities.</p> <ul style="list-style-type: none"> – Promote investment in research and development and enhance innovation and the use of modern technologies and modelling for managing disaster risks including for biological hazards.
<p>4. Integrate disaster risk reduction into health education and training and strengthen capacity building of health workers in disaster risk reduction.</p> <p>Key actions include:</p> <ul style="list-style-type: none"> – Promote collaborative multidisciplinary training on multi-sectoral action to reduce the risks of diseases and disasters. – Strengthen the integration of emergency and disaster risk management into education and training of health workers at all levels, including those providing basic health services at the community level.
<p>5. Incorporate disaster-related mortality, morbidity and disability data into multi-hazards early warning system, health core indicators and national risk assessments.</p> <p>Key actions include:</p> <ul style="list-style-type: none"> – Collect and integrate disaggregated data on exposures, and vulnerabilities and capacities, for all hazard risk assessment, including base-line data for planning and monitoring purposes. – Include biological hazards and zoonotic diseases as well as chemical and radiation hazards in disaster risk assessment and multi-hazard early warning systems. – Include health-related disaster losses (illness, injury, psychosocial effects, as well as damage, and disruption of health facilities and services) and other relevant disaggregated data by sex, age and disability in disaster loss databases. – Include indicators for disaster risk management in minimum health core indicators.
<p>6. Advocate for, and support cross-sectoral, transboundary collaboration including information sharing, and science and technology for all hazards, including biological hazards.</p> <p>Key actions include:</p> <ul style="list-style-type: none"> – Compile and disseminate best practices and case studies on mainstreaming disaster reduction in health. – Promote the use of innovative communication approaches for dissemination of early warning messages, including outbreaks and emergencies, particularly to at-risk communities. – Strengthen cross-border and intersectoral mechanisms for assessing and managing risks, such as coordinated vaccination campaigns and disease surveillance. – Promote the development and application of evidence-based practices through health science and technology and targeted operational research for all-hazards emergency and disaster risk management.
<p>7. Promote coherence and further development of local and national policies and strategies, legal frameworks, regulations, and institutional arrangements.</p> <p>Key actions include:</p> <ul style="list-style-type: none"> – Create enabling environment for coherence of policies and strategies of the Sendai Framework for DRR, SDGs, climate change adaptation and other relevant instruments.

- Ensure coherence and alignment of national, regional and global DRR frameworks and those related to emergency and disaster risk management for health such as the International Health Regulations (2005) and the Global Health Security Agenda.
- Integrate DRR into national and local development plans and address financing for DRR, including the health component.

2.2.1.3. A Global Warning System

Integrating health with Emergency and Disaster Risk Management (EDRM) requires strategic health emergency risk assessment and risk identification and analysis-capacity assessment strategic capacity planning (World Health Organization 2019).

A global warning system integrated with the PHEIC mechanism (Public Health Emergency of International Concern) can support the International Health Regulations (IHR), the Independent Panel for Pandemic Preparedness and Response (IPPPR), the Independent Oversight and Advisory Committee for the WHO Health Emergencies Program (IOAC) and the WHO's Review Committee of the IHR and the States Parties, to enforce the decision-making process and transparency during the decision-making process. Further, the acceptance of the State Parties nourished by a transparent and open approach based on risk governance leads to intensified compliance. The criteria for the early warning system should be negotiated internationally. Different countries fight against Covid 19 differently, because they have had different experiences about what works and what does not. The addition of environmental, socio-economic, and cultural features in the summary of these recent experiences can serve as the basis of an efficient global warning system. Iceland relied on scientific advice that was specifically focused on death prevention by SARS-COV-2, achieving seven deaths per 100.000 people, while in the USA and UK, the rate is 80 deaths per 100.000 people (Scudellari 2020).

The use of dynamic risk maps constructed on the basis of vulnerability indices for pandemic threats (e.g., viral features, geographical distance, sharing borders, connectivity to high prevalence locations) and response capacity assists countries to conduct more specific monitoring and tailor their preparation levels to the severity of an outbreak. In addition, a safety roster can prevent the use of the warning system for political and/or economic benefits or sabotage among States Parties. This suggestion combines two trends that evaluate future pandemic prevention: the traffic light system and a regional PHERC mechanism (public health emergency of regional concern). It does not separate the global dimension from the local but instead, through an algorithm based on the vulnerability indices of any region of the world, focuses on real-time risk assessment. It can also correlate with the infection control measurement (e.g., if the country that faces the outbreak stops the air connection to other countries, the disease risk declines) (Wenham et al., 2020).

2.2.2.1. One Health

In 1948, the World Health Organization defined *Health as a state of complete physical, mental, and social wellbeing and not merely the absence of disease or infirmity*. One Health recognizes the unbreakable interlinkage of human, animal, and ecological health, as shown in Figure 10, and aims to improve health on a global scale attained by the interdisciplinary collaboration of veterinarians, physicians, epidemiologists, conservation medicine and environmental specialists, anthropologists, sociologists, economists, policy- and decision-makers. One Health is an inter-disciplinary science promoting cross-sectoral collaborations to secure global health comprehensively by shedding light on the interlinkages between phenomena and the underlying pandemic risk drivers (Gibbs, 2014).

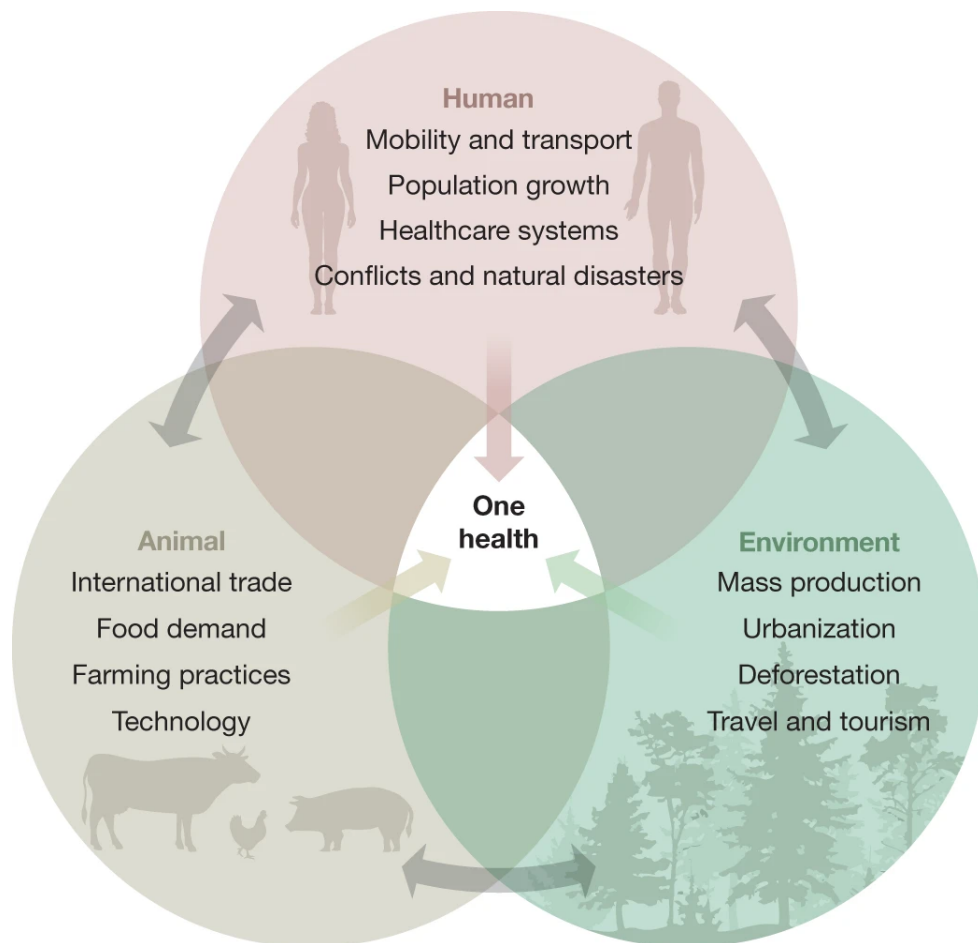


Figure 10. One Health interlinkages (Bedford et. al., 2019).

“One Health issues include zoonotic diseases, antimicrobial resistance, food safety and food security, vector-borne diseases, environmental contamination, and other health threats shared by people, animals, and the environment. Even the fields of chronic disease, mental health, injury, occupational health, and noncommunicable diseases can benefit from a One Health approach involving collaboration across disciplines and sectors (<https://www.cdc.gov/onehealth/basics/index.html>).”

Zoonosis is “any infection that is naturally transmissible from vertebrate animals to humans (Taylor et al., 2001). The domestication of animals and the beginning of agriculture 14.000

years ago enhanced the disease spread between humans, animals, and their shared environment. One Health seeks interdisciplinary education and collaboration between medical and veterinary institutions focusing on environmental medicine, zoonotic diseases, and their ecological effects (Kahn et al., 2016).

“Communicable and non-communicable diseases demand a truly comprehensive understanding of health and disease, and thereby a unity of approach that is achievable only through convergence of human, domestic animal, wildlife, plant, and environmental health, on a planetary scale” (Evans et al., 2020)

One Health is a multi-dimensional approach that can contribute to the fight against climate change by

- facilitating food security and safety
- reducing methane emissions by rethinking the extensive ruminant livestock production
- creating novel methods for safer water, sanitation, and hygiene (WASH) adapted to the increased precipitation and flooding events due to climate change, resulting in faster washing of and spreading of microbiological agents
- enabling integrated Surveillance and Report Systems (iSRS) to identify diseases before spillover events from animals to humans occur
- adding One Health in veterinary and human medicine education programs (Zinsstag et al., 2018)

The global change of the 21st century came along with global health challenges due to climate change and environmental degradation. In 2004, the Wildlife Conservation Society (WCS) hosted a symposium on “Building Inter-disciplinary Bridges to Health in a Globalized World” at The Rockefeller University with experts, scientists, and stakeholders across numerous disciplines to address present and future health challenges in a holistic manner. The outcome was the “Manhattan Principles” under the definition “One World – One Health,”(in short, “One Health”) (Gruetzmacher et al., 2021).

Table 5. The Manhattan Principles of One Health
(http://www.oneworldonehealth.org/sept2004/owoh_sept04.html)

1.	Recognize the essential link between human, domestic animal, and wildlife health and the threat disease poses to people, food supplies, and economies, and the biodiversity essential to maintaining the healthy environments and functioning ecosystems we all require.
2.	Recognize that decisions regarding land and water use have real health implications. Alterations in the resilience of ecosystems and shifts in patterns of disease emergence and spread manifest themselves when we fail to recognize this relationship.
3.	Include wildlife health science as an essential component of global disease prevention, surveillance, monitoring, control, and mitigation.
4.	Devise adaptive, holistic, and forward-looking approaches to preventing, monitoring, controlling, and mitigating emerging and resurging diseases that take the

complex interconnections among species into complete account.
5. Seek opportunities to fully integrate biodiversity conservation perspectives and human needs (including those related to domestic animal health) when developing solutions to infectious disease threats.
6. Reduce the demand for and better regulate the international live wildlife and bushmeat trade not only to protect wildlife populations but to lessen the risks of disease movement, cross-species transmission, and the development of novel pathogen-host relationships. The costs of this worldwide trade in terms of impacts on public health, agriculture, and conservation are enormous. Therefore, the global community must address this trade as the real threat to global socio-economic security.
7. Restrict the mass culling of free-ranging wildlife species for disease control to situations where there is a multidisciplinary, international scientific consensus that a wildlife population poses an urgent, significant threat to human health, food security, or wildlife health more broadly.
8. Increase investment in the global human and animal health infrastructure commensurate with the serious nature of emerging and resurging disease threats to people, domestic animals, and wildlife. Enhancing capacity for global human and animal health surveillance and transparent, timely information-sharing (that takes language barriers into account) can help improve coordination of responses among governmental and non-governmental agencies, public and animal health institutions, and vaccine/pharmaceutical companies manufacturers.
9. Form collaborative relationships among governments, local people, and the private and public (i.e., non-profit) sectors to meet global health and biodiversity conservation challenges.
10. Provide adequate resources and support for global wildlife health surveillance network that exchange disease information with the public health and agricultural animal health communities as part of early warning systems for the emergence and resurgence of disease threats.
11. Invest in educating and raising awareness among the world's people and influencing the policy process to increase recognition that we must better understand the relationships between health and ecosystem integrity to improve prospects for a healthier planet.

Two hundred experts from 47 countries working in governments, academia, policy, civil society, EcoHealth, and Planetary Health participated in the 'One Planet, One Health, One Future' conference on October 25, 2019, held by the Climate and Environmental Foreign Policy Division at the German Federal Foreign Office and the Wildlife Conservation Society (WCS). The 'Berlin Principles on One Health,' were established by 12 experts from policy, sociology, philosophy, economics, ecology, meteorology, human medicine, veterinary medicine, and other fields as a Call for Action to adapt the 'Manhattan Principles' to the contemporary challenges of environmental health, climate change, zoonotic spill-overs, and antimicrobial resistance.

The Berlin Principles are an opportunity to break down the single discipline and sector silos and connect knowledge, data, experiences between academia, economy, and politics. One Health advocates solidarity and environmental justice to combat public health challenges, biodiversity loss, and climate change impacts, by incorporating socio-economic and political

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contexts that affect health and call for multilateral, democratic action (Gruetzmacher et al., 2021).

Table 6: The following are the Berlin Principles (<https://oneworldonehealth.wcs.org/About-Us/Mission/The-2019-Berlin-Principles-on-One-Health.aspx>).

1) Recognize and take action to: retain the essential health links between humans, wildlife, domesticated animals and plants, and all nature; and ensure the conservation and protection of biodiversity, which interwoven with intact and functional ecosystems provides the critical foundational infrastructure of life, health, and well-being on our planet;
2) Take action to develop strong institutions that integrate an understanding of human and animal health with the health of the environment and invest in the translation of robust science-based knowledge into policy and practice;
3) Take action to combat the current climate crisis, which is creating new severe threats to human, animal, and environmental health and exacerbating existing challenges;
4) Recognize that decisions regarding land, air, sea, and freshwater use directly impact the health and well-being of humans, animals, and ecosystems and that alterations in ecosystems paired with decreased resilience generate shifts in communicable and non-communicable disease emergence, exacerbation, and spread; and take action accordingly to eliminate or mitigate these impacts;
5) Devise adaptive, holistic, and forward-looking approaches to the detection, prevention, monitoring, control, and mitigation of emerging/resurging diseases and exacerbating communicable and non-communicable diseases that incorporate the complex interconnections among species, ecosystems, and human society, while accounting fully for harmful economic drivers, and perverse subsidies;
6) Take action to meaningfully integrate biodiversity conservation perspectives and human health and well-being when developing solutions for communicable and non-communicable disease threats;
7) Increase cross-sectoral investment in the global human, livestock, wildlife, plant, and ecosystem health infrastructure and international funding mechanisms for the protection of ecosystems, commensurate with the serious nature of emerging/resurging and exacerbating communicable and non-communicable disease threats to life on our planet;
8) Enhance capacity for cross-sectoral and trans-disciplinary health surveillance and clear, timely information sharing to improve coordination of responses among governments and NGOs, health, academia, and other institutions, industry, and other stakeholders;
9) Form participatory, collaborative relationships among governments, NGOs, and Indigenous Peoples and local communities while strengthening the public sector to meet the challenges of global health and biodiversity conservation;
10) Invest in educating and raising awareness for global citizenship and holistic planetary health approaches among children and adults in schools, communities, and universities while also influencing policy processes to increase recognition that human health ultimately depends on ecosystem integrity and a healthy planet.

2.2.2.2. Viruses, Conservation Medicine, and the Environment

High virulence, replication and mutation rates, genomic size, and segmentation put viruses at the top of pandemic threats. Specifically, the stable and adaptable genome and the cytoplasmatic replication of RNA viruses elevate their zoonotic potential. Nuclear replication, usually found by DNA viruses, pre-supposes specific hosts for viral reproduction, while cytoplasmatic replication is less host-specific, resulting in multiple susceptible hosts. These are constrained conclusions since examples like smallpox virus - DNA virus - replicates in the cellular cytoplasm and influenza virus - RNA virus - in the nucleus. In the relevant literature, the common assumption was that influenza viruses present the most significant pandemic risk. Covid 19 proved that revising the pandemic risk assessment is essential. Paramyxoviruses, (specifically 36havi-, henipa-, rubulavirus), and the entero- rhinovirus (picornaviruses) pose an emerging global risk (Adalja et al., 2018).

Further, there is evidence that animals hosting RNA viruses (e.g., Ebola-, influenza, SARS - viruses) act as incubators for mutations that elevate the zoonotic viral potential or the human disease severity by introducing new strains (Ezenwa et al., 2015). Therefore, it is crucial to implement continuous and thorough viral risk-based surveillance. Table 7 gives an overview of zoonotic disease systems (Ezenwa et al., 2015).

Table 7. Zoonotic disease systems (Ezenwa et al., 2015).

Influenza/influenza A virus (global, 1800s –present)	What drives the emergence of pandemic strains?	Environment	In temperate regions, absolute humidity interacts with levels of susceptibility and human-to-human contact patterns to influence the timing of pandemic influenza outbreaks.
		Population	The diversity of influenza virus strains circulating in bird populations is driven by both population mechanisms (transmission ecology) and pathogen characteristics (substitution rates).
		Gene	Pandemic virus strains in human populations have arisen from the introduction of genes from avian and swine influenza viruses.
		Molecule	Under experimental conditions, molecular changes in the hemagglutinin (HA) protein from highly pathogenic avian influenza (H5) can facilitate efficient mammal-to-mammal transmission.
SARS / SARS coronavirus (SARS-	What is the transmission	Community	Isolation and phylogenetic analysis of virus from multiple

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CoV) (global pandemic, 2002–2003)	cycle that caused the global SARS epidemic?		bat species identified bats as the natural reservoir for SARS.
		Population	Specific individuals with disproportionately high contact rates (super spreaders) were responsible for a majority of virus transmission events in humans.
		Cell	Single amino acid substitutions in SARS-CoV of palm civet origin can enhance viral entry into human angiotensin-converting enzyme 2 (ACE2) receptor-expressing cells.
		Gene	The receptor binding domain of the SARS-CoV Spike protein underwent rapid evolution in nonreservoir “intermediate” hosts such as palm civets, potentially facilitating virus transmission to humans.
Hendra virus, (Australia, 1994–What factors influence present)	What factors influence present disease spillover from bat reservoirs to horses and humans?	Environment/ecosystem	Shifting bat distributions and changes in migratory behavior are facilitated by anthropogenic habitat modification.
		Population/individual	Temporal and spatial pulses of virus shedding in bats may be influenced by individual host traits such as nutritional stress or reproductive status. The amount of virus released in any area is a function of local bat density and the shedding status of individual bats in the population.
		Cell	Only a subset of exposed horses are identified as spillover cases. Upon exposure, some horses eliminate infection with a strong innate immune response and some mount an acquired response after asymptomatic infection or clinical disease,

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			while others experience fulminating infection.
Hantavirus pulmonary syndrome / Sin Nombre virus (SNV) (southwestern United States, 1993)	Was this a new disease agent? What caused spillover to humans?	Environment/ecosystem	Increased precipitation due to El Niño promoted enhanced primary production in the spring.
		Population	Rodent reservoir populations greatly increased in size as a result of improved food availability.
		Individual	Most human exposures occur in peridomestic environments where the host of SNV, deer mice, thrive. The breeding season of deer mice is up to two months longer in peridomestic settings, and infection rates tend to be higher in these environments.
		Gene	Phylogenetic reconstruction of virus samples collected from cryogenically preserved mice determined that the virus was present in rodents prior to the 1993 human outbreak.
Lyme disease / Borrelia burgdorferi (northeastern US, 1975–present)	What accounts for temporal and spatial variation in human infection risk?	Community	Oak tree masting influences acorn abundance, which determines the future population density of reservoir hosts. The diversity of hosts available on which ticks can feed determines both the abundance of ticks and the infection rates of these ticks.
		Individual	White-footed mice, which are the hosts most likely to pass the Lyme bacterium to feeding ticks, do not show negative effects of infection, suggesting that the bacterium might be a mutualist rather than a parasite on this key host species.
		Cell	Mice show a weak antibody response to experimental infection, but a strong innate

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			response, suggesting that they might trade investment in long-term adaptive immunity for investment in short-term immunity.
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The extensive land use, biodiversity, and habitat loss through anthropogenic activities impact the conservation of wildlife and ecosystems. Deforestation is the price for crops and countrified lands, resulting in habitat changes. These changes have a variety of effects on the populations per se and their behavior. Habitat fragmentation, degradation, loss, and isolation can diminish populations, alter the permeability for predators and parasites, such as population habits like movement and avoiding the habitat limits. Fragmentation constructs a more extended edge surface of the habitat, providing an increased interface between disease hosts and humans (Loh et. al., 2016). Changes in land use induce the main driver of a spill-over from wild animals to humans; therefore, for biosecurity, intact landscapes should be restored and preserved (Plowright et al., 2021). The restoration of ecosystems and conservation of biodiversity has a dual significance: a decreased interface between humans and wild animals, preserving the human, animal, and environmental health, also because biodiversity acts as dilution and buffer zone for pathogens (Cunningham et. al., 2017); intact ecosystems and nature restoration prevent not only future pandemics but also natural disasters, which have a great short- and long-term impact on local populations (e.g., life-loss, critical infrastructure damage, socio-economic disruptions, inadequate nutrition and education of children). Besides, fragmented habitats can be more prone to natural disasters like floods and fires. Figure 11 Illustrates the process of land use-induced spill-overs and Figure 12 the cascading stressors and consequences of zoonotic spill-overs (Plowright et al., 2021).

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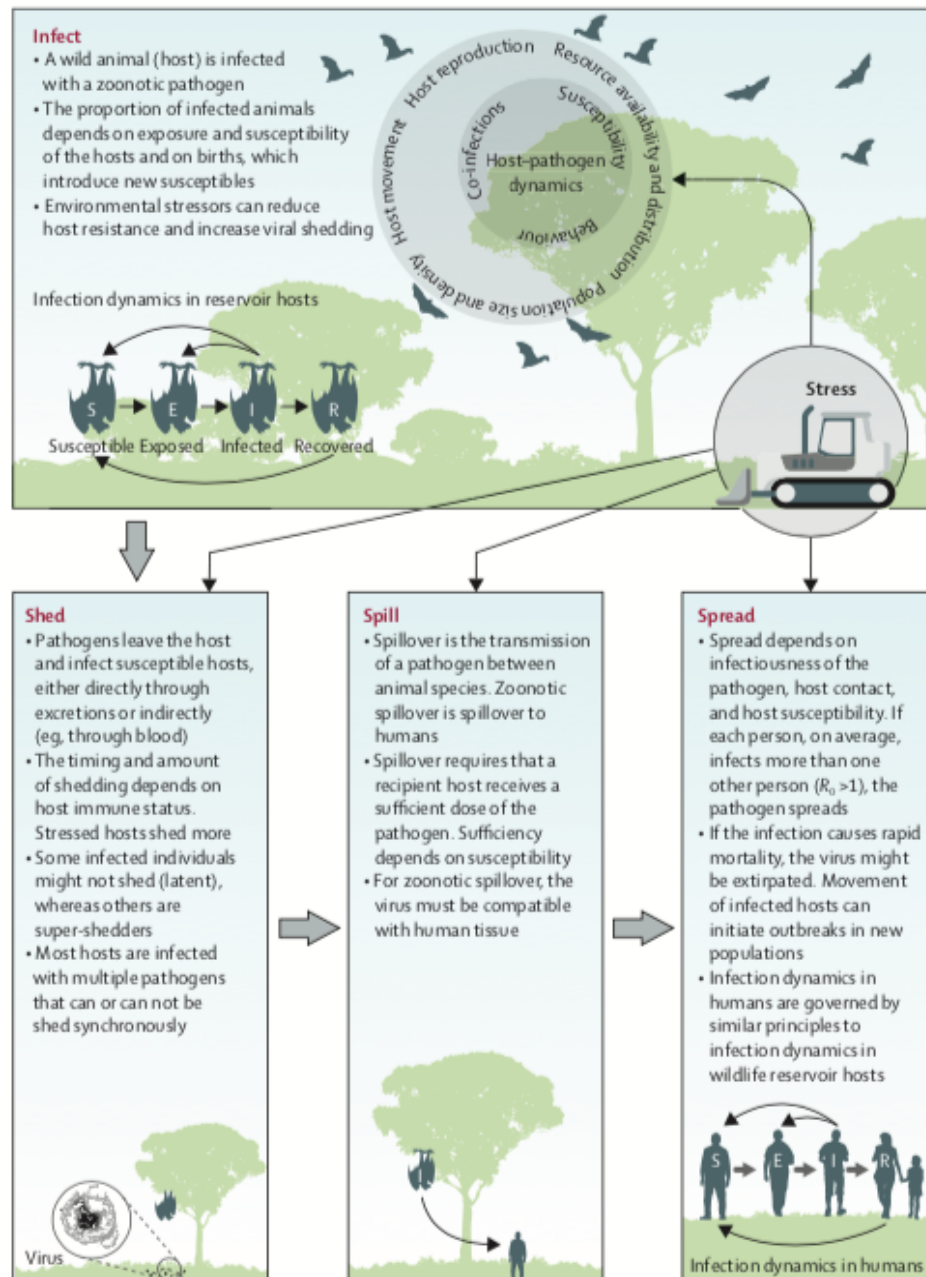


Fig. 11. Spill-over process due to land-use changes (Plowright et. al., 2021).

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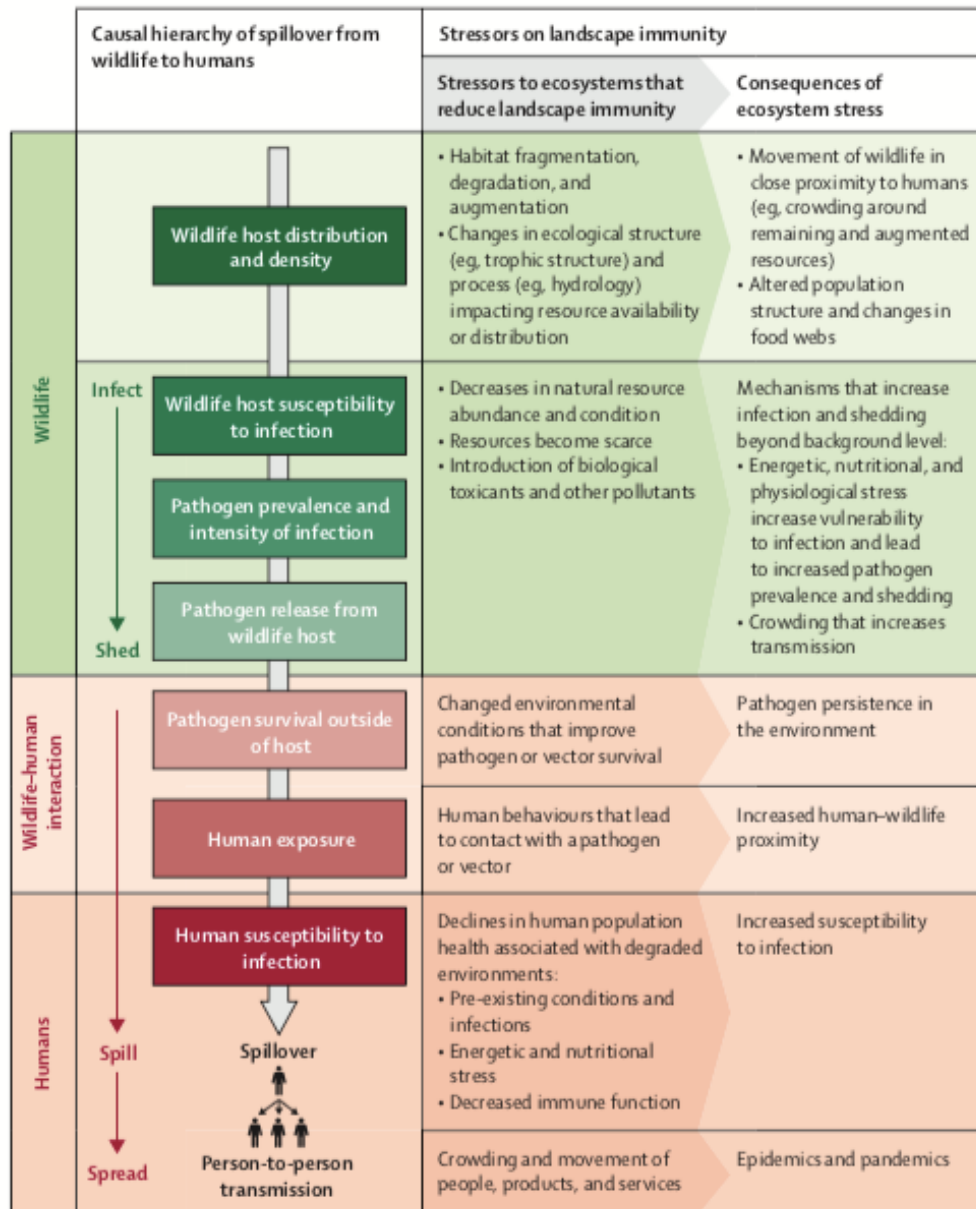


Fig. 12. The process of land use-induced spill-overs (Plowright et. al., 2021).

Introduction of invading species and new animal and plant pathogens through plant and wild animals hosting pathogens through the globe is a procedure called "pathogen pollution." The cause is mainly human activities like international wildlife trade, contaminated products, and marine time. For example, the fungus *Batrachochytrium dendrobatidis* caused the extinction of hundreds of amphibian species (Cunningham et. al., 2017).

International trade and traveling are vectors for invasive species. Wildlife trade and consumption of animals pose severe health risks for humans and animals while threatening global species conservation. Live animal markets, the so-called 'wet markets' present a further human-wild animals interface. Animal-to-animal exchange and geographic spread of pathogens are some of the factors that make wet markets dangerous. Further, the capture process and transport cause severe stress to animals. The next cascade effect is the immunity depression through stress, making animals more vulnerable to diseases, and new

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or latent viruses. Animals from different regions are captured, stressed, meet different species from distant geographic regions, and exchange ‘immunity history’ on a long transport journey to an urban center, often in another country. This was the origin of Covid 19 in winter 2019 in Wuhan, China.

2.2.2.3. Cross-sectoral International Collaborations

"COVID-19 has painfully reminded us that the health of humans, animals, and the environment around the world is closely connected: Nobody is safe until everybody is safe. This is what we have to bear in mind to prevent future pandemics. The establishment of the One Health

High-Level Expert Panel thus marks an important step in the right direction.

Germany and France will continue to support the panel's work."

—Mr. Heiko Maas, Minister for Foreign Affairs, Germany

One Health aims to prevent pandemic risks through inter-disciplinary research in ecology, veterinary medicine, and human activities based on their life situation and traditions, rather than the management of such events. The focus lies in the interrelation between human activity that causes environmental degradation, wildlife ecology and pathology, and socio-economic features that elevate the spill-over risks. In May 2021, the new One Health High-Level Expert Panel informed the G7 countries (Germany, France, Italy, United Kingdom, United States, Canada, and Japan) about the benefits of the One Health approach in the combat against pandemics. The panel will assist with interdisciplinary scientific experts, the World Health Organization (WHO), the United Nations Environment Program (UNEP), the Food and Agriculture Organization (FAO), and the World Organization for Animal Health (OIE), designing a pandemic risk prevention and preparedness plan (WHO Joint News Release 20.5.2021). Additionally, the G7 countries are committed to stopping and recovering biodiversity loss, becoming nature-positive, and leading for an inclusive global system, supported through investment, conservation, and accountability (G7 2030 Nature Compact).

The Tripartite is a multidisciplinary, multisectoral, and transnational One Health alliance between WHO, FAO, OIE, and UNEP. *'Taking a Multisectoral, One Health Approach: A Tripartite Guide to Addressing Zoonotic Diseases in Countries'* is a comprehensive tool for countries to follow the One Health paradigm in the pandemic context and protect human, animal, and environmental health, while enhancing national capacities and international partnerships through coordination, planning, preparedness, surveillance, monitoring and evaluation, risk assessments, risk reduction, risk communication and information sharing (World Health Organization, Food, and Agriculture Organization of the United Nations, and International Office of Epizootics, 2019).

Established by USAID (United States Agency for International Development) Emerging Pandemic Threats in 2009, PREDICT is a project functioning under One Health guidance from

the UC Davis One Health Institute, USAID, EcoHealth Alliance, Metabiota, Wildlife Conservation Society, and the Smithsonian Institution. The project promotes global surveillance of corona- (SARS, MERS, COVID), paramyxo- (Nipah and influenza), filoviruses (Ebola). Further, PREDICT runs more than 60 laboratories in 24 African and Asian countries, enhancing education and training more than six thousand local staff. The main research objectives are identifying viral genetic diversity and epidemiological hot spots by testing 164.000 human and animal samples with PCR and Next-generation sequencing (Islam et al., 2019). As a result, PREDICT identified 958 unknown (e.g., Ebola Zaire and Bombali, Marburg virus, MERS, and SARS-like coronaviruses) and 215 familiar strains and viruses (The PREDICT Legacy, 2009-2020).

2.2.2.4. Implementation and Methodologies

In 2013, researchers of the PREDICT project, EcoHealth Alliance and Wuhan Institute of Virology, reported in an article in "Nature Magazine" the first isolation of SARS-like wild coronavirus in samples from a horseshoe bat colony. The spike protein of this virus is the zoonotic potential of coronaviruses, binding to the human angiotensin-converting enzyme II (ACE2) receptors and invading cells; the mode of transmission of SARS in 2002. Notably, the infection rate in the bat colony investigated was higher in October than in spring -April, May- during the survey in 2011-2012, indicating the seasonality of coronavirus (Ge et al., 2013). This example is indicative of One Health practice, considering the Covid19 pandemic, which originated from a coronavirus found in living bats in China, and underlines the urgency of surveillance based on risk, according to viral characteristics and spill-over probability.

A spill-over marks humans as sentinels for animal diseases. The trans-disciplinary risk-based surveillance strategy of the PREDICT project, through the One Health approach, targets to enhance

- capacity
- infrastructure
- training
- epidemiological analysis (Carroll et al., 2018).

On the other hand, spill-overs also occur from humans to wild animals, posing a conservation threat. Examples like the documented human herpes virus infection of a captive gorilla (Kelly et al., 2017), respiratory disease of gorillas in a well-visited wildlife park in Rwanda, and tuberculosis in primates and elephants (Palacios et al., 2011, Montali et al., 2011), raising conservation concerns. In addition, weak immune systems due to other diseases or stress through habitat changes influence the pathogen susceptibility of animals (Morse et al., 2012). Spill-over factors are the phylogenetic proximity between hosts and humans, viral richness (the number of viruses that carry a host), population density and human contact with host (hunting, captivity, consumption), and human behavior (Olival et al., 2017). Bats are the prime reservoirs of viruses with zoonotic potential (e.g., Ebola and

coronaviruses), followed by rodents and primates (Olival et al., 2017). Through surveillance based on the principles of One Health, human, animal, and environmental health is protected at the local and global levels. Identifying potential hot-spots, natural reservoirs, disease vectors, building laboratories, training staff, strengthening capacities, knowledge exchange between stakeholders, and building trans-sectoral, national, and disciplinary collaborations are the key features of efficient zoonotic pathogen surveillance (Kelly et al., 2017).

The WHO's pandemic alert system ranges from Phase 1 (low risk) to Phase 6 (full pandemic):
Phase 1: A virus in animals has caused no known infections in humans.

Phase 2: An animal virus has caused infection in humans.

Phase 3: There are scattered cases or small clusters of disease in humans. If the illness spreads from human to human, it is not broad enough to cause community-level outbreaks.

Phase 4: The disease is spreading from person to person with confirmed outbreaks at the community level.

Phase 5: The disease spreads between humans in more than one country of one of the WHO regions.

Phase 6: At least one more country in a different region from Phase 5 has community-level outbreaks.

The dynamics of zoonotic pathogens with the potential to cause a pandemic outbreak are classified into three stages, as shown in Figure 13. In the first stage, the pathogen circulates among animal hosts without transmission to humans. Stage two marks the spill-over event leading to an endemic or epidemic condition. The first two stages are the most frequent. A pandemic spread takes place in stage three, caused by worldwide human transportation and trade routes, exposing the human population to the pathogen agent across the globe (Morse et al., 2012).

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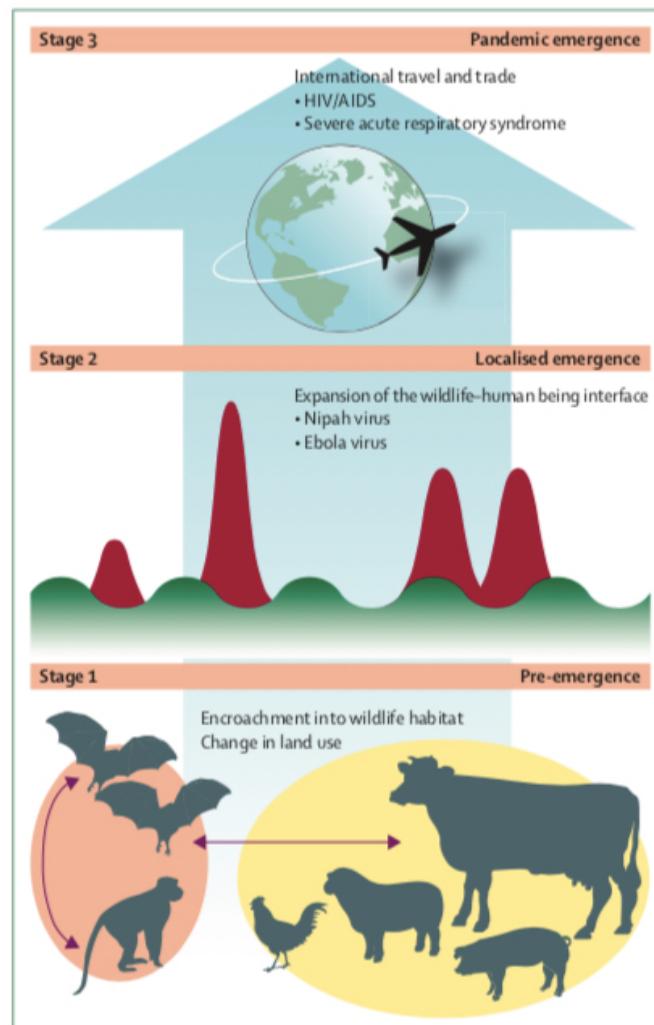


Fig. 13. (Morse et al., 2012)

The Global Virome Project aims at the mitigation of viral outbreaks by identifying

- undiscovered viruses in wildlife reservoirs worldwide
- socio-economic drivers that promote spillovers
- spill-over dynamics
- interface features
- human factors

Risk frameworks based on the virus and host interactions, ecological and demographical factors aim at the specification of zoonotic potential., Experiments on receptor-binding domains in vitro and vivo provide insights that help triage new viruses or viral strains. The large volume of molecular data produced is open and reinforces surveillance, prevention, diagnostics, treatment development, and resources allocation. Metadata, the nature of viruses and the interaction with hosts, geospatial characteristics, interface features, and data correlation are valuable for risk modeling to improve and protect health, conservation, biosecurity, and food security. Science-based pandemic risk management will help stakeholders act before a pandemic, encouraging economic and social effects through global pandemic prevention. The development of therapies and vaccines in case of a pandemic cannot keep pace with the velocity of global viral transmission (Carroll et al., 2018). An all-

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species surveillance approach can support health security intelligence with indicators to
create an early-warning open-source system that operates on conditions that promote
diseases (Bowsher et al., 2021).

3. Methodology

Crafting the hypothesis and research questions was a fast process due to the overwhelming COVID-19 pandemic, the researcher's veterinary profession, and the scope of the master's -- risk prevention and disaster management. In the investigation of the research questions, the formation of a cause-effect relationship between climate change, global change, and pandemics through a case study of the topics served as context for the One Health approach and the Sendai Framework. To analyze the complex interrelations between pandemics, global change, and climate change, qualitative data were obtained from peer-reviewed scientific articles in ResearchGate, Elsevier, Scopus, and multiple journals from the fields of risk management and public health, and One Health. The most used keywords were "risk," "pandemic risk," "Sendai Framework," "health aspects," "Bangkok Principles," "One Health," "health," "climate change," "global change," "spill-over," "zoonosis," "COVID," "conservation medicine," "biodiversity," "deforestation," "environmental degradation," "habitat loss," "virus," "underlying drivers," and "systemic risk." The relevant bibliography was selected based on the relevance to the topic and the publishing date, with a preference for the most recent because COVID-19 changed the framework of pandemic risk management.

The case study research was conducted through the thematic analysis of the One Health and Sendai Framework related to pandemic risk management. The Berlin Principles, priorities, and Bangkok Principles consist of the foundation of the One Health approach and the Sendai Framework, respectively, making the data selection process impartial. The correspondence between the variables was controlled by the researcher's subjective perception based on the comprehension of veterinary and medical topics, the knowledge gained through the master's studies, and the knowledge gained through this thesis. The evaluation of the potential integration of the ten four Berlin Principles in the four priorities with the 16 health-relevant aspects and the seven Bangkok Principles was based on the examination and thematic analysis of each component and the identification of patterns, coherence, gaps, and complementation potential between them.

Statistical software programs for qualitative analysis (e.g., MAXQDA) would be beneficial for identifying the mutuality between the Berlin Principles, the priorities, and the Bangkok Principles. The evaluation of the potential integration of the One Health with the Sendai Framework, aiming to enhance pandemic risk management, by the researcher was selected due to the researchers' interdisciplinary background. However, this approach has limitations in the interpretation of the results. A different evaluation by other researchers is conceivable and could lead to new observations and paths for integrating the One Health approach with the Sendai Framework and reducing disaster risk.

One Health research is multi-disciplinary and complex, human, animal, and environmental health besides socio-economic features. Therefore, this study followed the "Framework for One Health research" (Lebov et al., 2017).

Evaluating which Berlin Principle can be advantageous for every priority, paragraph, Bangkok Principle, and key action of the Sendai Framework was demanding. Nonetheless, the researcher decided upon the best scientific knowledge and belief during a cautious process.

4. Results

1. The first One Health Principle is a call to the following:

"Recognize and take action to retain the essential health links between humans, wildlife, domesticated animals and plants, and all nature; and ensure the conservation and protection of biodiversity, which interwoven with intact and functional ecosystems provides the critical foundational infrastructure of life, health, and well-being on our planet."

Diagnosing the complex interconnections and interactions between the health of humans, animals, and nature, as a whole, promotes an advanced understanding of pandemic risk and how it develops, the first priority of the Sendai Framework. Pandemic risks are multidimensional systemic risks, with numerous environmental and socio-economic factors involved in the pandemic risk progress. Therefore, identifying and analyzing the complex underlying drivers of a pandemic deepens the understanding of pandemic risk and also supports its prevention and mitigation efforts at the policy level. Furthermore, to reduce the current and future risks due to climate change, a wide-ranging understanding of the complex natural processes and the impacts of human activity on ecosystems is essential.

- Priority 1: Understanding disaster risk

"Policies and practices for disaster risk management should be based on an understanding of disaster risk in all its dimensions of vulnerability, capacity, exposure of persons and assets, hazard characteristics and the environment."

To secure sustainable investment for pandemic risk reduction and resilience with high returns, considering the fragile health links between humans, animals, and the environment is vital. Embedding biodiversity protection in policy planning reduces the underlying factors of pandemic risk and promotes environmental health through ecosystem conservation.

- Priority 2: Strengthening disaster risk governance to manage disaster risk

"Clear vision, plans, competence, guidance and coordination within and across sectors as well as participation of relevant stakeholders are needed. Strengthening disaster risk governance is therefore necessary and fosters collaboration and partnership across mechanisms and institutions for the implementation of instruments relevant to disaster risk reduction and sustainable development."

– Epidemics and pandemics (para 28d): *"Promote transboundary cooperation to enable policy and planning for the implementation of ecosystem-based approaches, to build resilience and reduce disaster risk, including epidemic risk."*

- Priority 3: Investing in disaster risk reduction for resilience

"Public and private investment in disaster risk prevention and reduction through structural and non-structural measures is essential to enhance the economic, social, health, and cultural resilience of persons, communities, countries, and their assets, as well as the environment. "

– Ecosystem and environment health (para 30n): *"Strengthen the sustainable use and management of ecosystems and implement integrated environmental and natural resource management approaches that incorporate disaster risk reduction."*

– *Animal health (para 30p): “Strengthen the protection of livelihoods and productive assets, including livestock, working animals, tools and seeds.”*

The recovery of ecosystems and biodiversity protection during recovery and rehabilitation promotes sustainability in a holistic way for the “Build Back Better” process, reducing future pandemic and natural disaster risks. Incorporating conservation and ecosystem protection in the recovery processes helps in a sustainable matter for nature and the generations to come.

- *Priority 4: Enhancing disaster preparedness for effective response and to “build back better” in recovery, rehabilitation, and reconstruction*

“The steady growth of disaster risk, including the increase of people and assets exposure, combined with the lessons learned from past disasters, indicates the need to further strengthen disaster preparedness for response, take action in anticipation of events, integrate disaster risk reduction in response preparedness and that ensure capacities are in place for effective response and recovery at all levels. “

The revision of multi-sectoral policies and programs for pandemic and disaster risk management to comprehensively manage health risks should essentially include human health and the health of wild and domesticated animals and the health of their ecosystems.

- *Bangkok Principle 1. “Promote systematic integration of health into national and sub-national disaster risk reduction policies and plans and the inclusion of emergency and disaster risk management programmes in national and sub-national health strategies. “*

b. “Develop, or revise multi-sectoral policies, integrated plans and programmes for emergency and disaster risk reduction to include the health sector component, and manage health risks of emergencies and disasters with appropriate levels of resources to support implementation.”

d. “Strengthen the integration of biological hazards, including epidemics, pandemics, and diseases at the human-animal-ecosystem interface, into all-hazards multi- sectoral disaster risk management. “

2. *“Take action to develop strong institutions that integrate an understanding of human and animal health with the health of the environment and invest in the translation of robust science-based knowledge into policy and practice.”*

Inter- and cross-disciplinary science-based knowledge forwards the understanding of disaster risk, contributing to in-depth and practical policy-making. In addition, the dissemination of the produced data, methodologies, and tools through open-source ensures their availability for further use in modeling, mapping, monitoring, and warning.

- *Priority 1: Understanding disaster risk*

“Policies and practices for disaster risk management should be based on an understanding of disaster risk in all its dimensions of vulnerability, capacity, exposure of persons and assets, hazard characteristics and the environment.”

– *Disaster risk and loss Data (para 25a): “Enhance the development and dissemination of science-based methodologies and tools to record and share disaster losses and relevant disaggregated data and statistics, as well as to strengthen disaster risk modelling, assessment, mapping, monitoring and multi-hazard early warning systems.”*

The second Berlin Principle is also in line with the second priority of the Sendai Framework. Integrating human, animal, and environmental health extends pandemic risk governance through wide collaborations, comparing and uniting the mechanisms among trans-sectoral institutions. While the coherence of instruments, tools, and global policies increases, the local aspects of climate change impacts, biodiversity loss, environmental degradation, and health can be considered in the national frameworks. Additionally, updating pandemic safety regulations through specifications and guidelines, including land-use changes through agriculture, wildlife trade, and consumption, reinforces efforts to reduce pandemic risk and encourages resilience in regional and national level.

- Priority 2: Strengthening disaster risk governance to manage disaster risk

“Clear vision, plans, competence, guidance and coordination within and across sectors as well as participation of relevant stakeholders are needed. Strengthening disaster risk governance is therefore necessary and fosters collaboration and partnership across mechanisms and institutions for the implementation of instruments relevant to disaster risk reduction and sustainable development. ”

– *Mainstream disaster risk reduction in health" (para 27a): "Mainstream and integrate disaster risk reduction within and across all sectors. Review and promote the coherence and further development, as appropriate, of national and local frameworks of laws, regulations and public policies."*

– *Safety enhancing laws and regulations (para 27d): "Encourage the establishment of necessary mechanisms and incentives to ensure high levels of compliance with existing safety- enhancing provisions of sectoral laws and regulations, including those addressing land use and urban planning, building codes, environmental and resource management and health and safety standards, and update them, where needed, to ensure an adequate focus on disaster risk management."*

– *Coherence of instruments and tools (para 28b): "Foster collaboration across global and regional mechanisms and institutions for the implementation and coherence of instruments and tools relevant to disaster risk reduction, such as for climate change, biodiversity, sustainable development, poverty eradication, environment, agriculture, health, food and nutrition and others, as appropriate."*

– *Epidemics and pandemics (para 28d): "Promote transboundary cooperation to enable policy and planning for the implementation of ecosystem-based approaches, to build resilience and reduce disaster risk, including epidemic risk."*

Incorporating science-based knowledge of human, animal, and environmental health in the preparedness and recovery policies supports the “Build Back Better” practices sustainably, in line with the fourth priority of the Sendai Framework.

- Priority 4: Enhancing disaster preparedness for effective response and to “build back better” in recovery, rehabilitation and reconstruction

“The steady growth of disaster risk, including the increase of people and assets exposure, combined with the lessons learned from past disasters, indicates the need to further strengthen disaster preparedness for response, take action in anticipation of events, integrate disaster risk reduction in response preparedness and that ensure capacities are in place for effective response and recovery at all levels. ”

The second Berlin Principle complements the first, sixth, and seventh Bangkok Principle of the Sendai Framework. Integrating human, animal, and environmental health into policies, strategies and planning adds value to pandemic and disaster risk management in both a sustainable and holistic manner. Furthermore, it promotes multi-sectoral, cross-border participation, coherent and efficient policies, and comprises the significance for pandemics' human-animal-ecosystem interfaces with scientific knowledge.

- *Bangkok Principle 1. "Promote systematic integration of health into national and sub-national disaster risk reduction policies and plans and the inclusion of emergency and disaster risk management programmes in national and sub-national health strategies. "*
 - b. "Develop, or revise multi-sectoral policies, integrated plans and programmes for emergency and disaster risk reduction to include the health sector component and manage health risks of emergencies and disasters with appropriate levels of resources to support implementation. "*
 - c. "Increase the participation of health sector representatives in multi-sectoral emergency and disaster risk management committees and platforms at all levels "*
 - d. "Strengthen the integration of biological hazards, including epidemics, pandemics, and diseases at the human-animal-ecosystem interface, into all-hazards multi- sectoral disaster risk management "*
- *Bangkok Principle 6. "Advocate for, and support cross-sectoral, transboundary collaboration including information sharing, and science and technology for all hazards, including biological hazards. "*
 - a. "Compile and disseminate best practices and case studies on mainstreaming disaster reduction in health. "*
 - b. "Promote the development and application of evidence-based practices through health science and technology and targeted operational research for all-hazards emergency and disaster risk management. "*
 - c. "Strengthen cross-border and intersectoral mechanisms for assessing and managing risks, such as coordinated vaccination campaigns and disease surveillance. "*
- *Bangkok Principle 7. "Promote coherence and further development of local and national policies and strategies, legal frameworks, regulations, and institutional arrangements. "*
 - a. "Create enabling environment for coherence of policies and strategies of the Sendai Framework for DRR, SDGs, climate change adaptation and other relevant instruments. "*

3. *"Take action to combat the current climate crisis, which is creating new severe threats to human, animal, and environmental health and exacerbating existing challenges;"*
Improving safety regulations and laws is essential to update the current risk assessment based on climate change and prevent and mitigate future threats by increasing the coherence of climate change instruments through cross-sectoral collaborations involving global and national institutions, aiming for biodiversity and ecosystem conservation, health protection, food safety, and poverty elimination. Climate change ecosystem-based solutions are feasible and co-benefit pandemic risk reduction in the long term. Measurements against

climate change strengthen preparedness and recovery processes and reinforce “Build Back Better” practices.

- Priority 2: Strengthening disaster risk governance to manage disaster risk

“Safety enhancing laws and regulations (para 27d): “Encourage the establishment of necessary mechanisms and incentives to ensure high levels of compliance with existing safety- enhancing provisions of sectoral laws and regulations, including those addressing land use and urban planning, building codes, environmental and resource management and health and safety standards, and update them, where needed, to ensure an adequate focus on disaster risk management.”

– Coherence of instruments and tools (para 28b): “Foster collaboration across global and regional mechanisms and institutions for the implementation and coherence of instruments and tools relevant to disaster risk reduction, such as for climate change, biodiversity, sustainable development, poverty eradication, environment, agriculture, health, food and nutrition and others, as appropriate.”

– Epidemics and pandemics (para 28d): “Promote transboundary cooperation to enable policy and planning for the implementation of ecosystem-based approaches, to build resilience and reduce disaster risk, including epidemic risk.”

- Priority 4: Enhancing disaster preparedness for effective response and to “build back better” in recovery, rehabilitation, and reconstruction

“The steady growth of disaster risk, including the increase of people and assets exposure, combined with the lessons learned from past disasters, indicates the need to further strengthen disaster preparedness for response, take action in anticipation of events, integrate disaster risk reduction in response preparedness and that ensure capacities are in place for effective response and recovery at all levels. “

Science-based evidence is indispensable in the fight against climate change and stimulates efficiency and coherence. Therefore, the seventh Bangkok Principle conveys the cooperation between the Sendai Framework, the Sustainable Development Goals, and climate change–relevant frameworks.

- *Bangkok Principle 6. “Advocate for, and support cross-sectoral, transboundary collaboration including information sharing, and science and technology for all hazards, including biological hazards. “*

b. “Promote the development and application of evidence-based practices through health science and technology and targeted operational research for all-hazards emergency and disaster risk management. “

- *Bangkok Principle 7. “Promote coherence and further development of local and national policies and strategies, legal frameworks, regulations, and institutional arrangements. “*

a. “Create enabling environment for coherence of policies and strategies of the Sendai Framework for DRR, SDGs, climate change adaptation and other relevant instruments. “

4. *“Recognize that decisions regarding land, air, sea, and freshwater use directly impact the health and well-being of humans, animals, and ecosystems and that alterations in ecosystems paired with decreased resilience generate shifts in communicable and non-*

communicable disease emergence, exacerbation, and spread; and take action accordingly to eliminate or mitigate these impacts."

Acknowledging the impacts of anthropogenic activities on human, animal, and environmental health and the emergence and re-emergence of diseases is crucial to understanding pandemic risks. Policies well-versed on ecosystem vulnerabilities and the underlying drivers of pandemics are efficient in preventing pandemic risks. Furthermore, these findings can enhance pandemic risk governance by binding the appropriate stakeholders in collaborations and partnerships to elaborate ecosystem-based solutions and enrich safety regulations and mechanisms that will mitigate pandemic risk by addressing the aspects of economic activities like land use and resource exploitation. These global collective aspects adaption leads to the homogenization of instruments, thus enhancing their coherence and compliance. During recovery, incorporating practices and directing investments in sustainable development and the feasible use of earth's resources promote resilience that will lessen the human pressure on the environment in the future.

- Priority 1: Understanding disaster risk

"Policies and practices for disaster risk management should be based on an understanding of disaster risk in all its dimensions of vulnerability, capacity, exposure of persons and assets, hazard characteristics and the environment."

- Priority 2: Strengthening disaster risk governance to manage disaster risk

Clear vision, plans, competence, guidance and coordination within and across sectors as well as participation of relevant stakeholders are needed. Strengthening disaster risk governance is therefore necessary and fosters collaboration and partnership across mechanisms and institutions for the implementation of instruments relevant to disaster risk reduction and sustainable development

– *Safety enhancing laws and regulations (para 27d): "Encourage the establishment of necessary mechanisms and incentives to ensure high levels of compliance with existing safety- enhancing provisions of sectoral laws and regulations, including those addressing land use and urban planning, building codes, environmental and resource management and health and safety standards, and update them, where needed, to ensure an adequate focus on disaster risk management."*

– *Coherence of instruments and tools (para 28b): "Foster collaboration across global and regional mechanisms and institutions for the implementation and coherence of instruments and tools relevant to disaster risk reduction, such as for climate change, biodiversity, sustainable development, poverty eradication, environment, agriculture, health, food and nutrition and others, as appropriate."*

– *Epidemics and pandemics (para 28d): "Promote transboundary cooperation to enable policy and planning for the implementation of ecosystem-based approaches, to build resilience and reduce disaster risk, including epidemic risk."*

- Priority 3: Investing in disaster risk reduction for resilience

Public and private investment in disaster risk prevention and reduction through structural and non-structural measures are essential to enhance the economic, social, health and cultural resilience of persons, communities, countries and their assets, as well as the environment.

– *Ecosystem and environment health (para 30n): "Strengthen the sustainable use and management of ecosystems and implement integrated environmental and natural resource management approaches that incorporate disaster risk reduction."*

- *Priority 4: Enhancing disaster preparedness for effective response and to "build back better" in recovery, rehabilitation and reconstruction*

"The steady growth of disaster risk, including the increase of people and assets exposure, combined with the lessons learned from past disasters, indicates the need to further strengthen disaster preparedness for response, take action in anticipation of events, integrate disaster risk reduction in response preparedness and that ensure capacities are in place for effective response and recovery at all levels. "

Incorporating the potential impacts on the health of humans, animals, and ecosystems in decision- and policy-making promotes the holistic integration of health into policies and plans, which leads to all-hazard risk management and improves multi-sectoral participation, cooperation, and planning, strengthening policy, legislation capacity, and resilience.

- *Bangkok Principle 1. "Promote systematic integration of health into national and sub-national disaster risk reduction policies and plans and the inclusion of emergency and disaster risk management programmes in national and sub-national health strategies. "*

a. "Promote a whole-of-government, a whole-of-society approach, with population at risk and communities at the centre of emergency and disaster risk management measures, led by strong political commitment of Governments. "

b. "Develop, or revise multi-sectoral policies, integrated plans and programmes for emergency and disaster risk reduction to include the health sector component and manage health risks of emergencies and disasters with appropriate levels of resources to support implementation.

c. Increase the participation of health sector representatives in multi-sectoral emergency and disaster risk management committees and platforms at all levels. "

d. "Strengthen the integration of biological hazards, including epidemics, pandemics, and diseases at the human-animal-ecosystem interface, into all-hazards multi- sectoral disaster risk management. "

f. "Integrate health needs fully into post-disaster needs assessment and recovery planning. "

- *Bangkok Principle 2. "Enhance cooperation between health authorities and other relevant stakeholders to strengthen country capacity for disaster risk management for health, the implementation of the International Health Regulations (2005) and building of resilient health systems. "*

b. "Strengthen the essential capacities for emergency and disaster risk management for health and building resilience of health systems at all levels, including in policies and legislation, planning and coordination, human and financial resources, monitoring and evaluation, information management, health infrastructure and logistics, health and related services, risk communication and community capacity development. "

c. "Strengthen coordination bodies, committees and platforms at all levels for emergency and disaster risk management for health, including multisectoral and multistakeholder participation. "

d. "Strengthen multisectoral planning and action to manage health risks from all types of hazards, including the implementation of the International Health Regulations (2005). "

- *Bangkok Principle 3. "Stimulate people-centered public and private investment in emergency and disaster risk reduction, including in health facilities and infrastructure. "*
- b. Promote investment in research and development and enhance innovation and the use of modern technologies and modelling for managing disaster risks including for biological hazards.*

- *Bangkok Principle 4. " Integrate disaster risk reduction into health education and training and strengthen capacity building of health workers in disaster risk reduction.*

a. Promote collaborative multidisciplinary training on multi-sectoral action to reduce the risks of diseases and disasters. "

- *Bangkok Principle 6: "Advocate for, and support cross-sectoral, transboundary collaboration including information sharing, and science and technology for all hazards, including biological hazards. "*

a. "Compile and disseminate best practices and case studies on mainstreaming disaster reduction in health. "

b. "Promote the use of innovative communication approaches for dissemination of early warning messages, including outbreaks and emergencies, particularly to at- risk communities.

d. Promote the development and application of evidence-based practices through health science and technology and targeted operational research for all-hazards emergency and disaster risk management. "

- *Bangkok Principle 7. "Promote coherence and further development of local and national policies and strategies, legal frameworks, regulations, and institutional arrangements. "*

a. "Create enabling environment for coherence of policies and strategies of the Sendai Framework for DRR, SDGs, climate change adaptation and other relevant instruments"

5. "Devise adaptive, holistic, and forward-looking approaches to the detection, prevention, monitoring, control, and mitigation of emerging/resurging diseases and exacerbating communicable and non-communicable diseases that incorporate the complex interconnections among species, ecosystems, and human society, while accounting fully for harmful economic drivers, and perverse subsidies."

Data produced by trans-disciplinary wide-ranging combined with the fifth Berlin Principle, including zoonotic in disaster risk assessment and comprehensive health indicators containing the health of animals and the environment, can result in more sensitive warning systems. In particular, animal mortality and morbidity monitoring with the identification of infectious agents can be highly relevant in preventing and transmitting spill-over events. The transboundary sharing of information on the health status of host animals with health authorities strengthens early-warning systems for pandemics. The generated data and the identification of economic activities that elevate vulnerability and exposure of pandemic risks like wild-life trade and deforestation are milestones of pandemic risk and essential to

Integration of the One Health approach with the Sendai Framework:
Enhancing pandemic risk management in times of global and climate change
understand pandemic risk comprehensively. The dissemination of these findings through open-source systems leads to wide-ranging modeling and early-warning systems.

- Priority 1: Understanding disaster risk

"Policies and practices for disaster risk management should be based on an understanding of disaster risk in all its dimensions of vulnerability, capacity, exposure of persons and assets, hazard characteristics and the environment."

– *Disaster risk and loss Data (para 25a): "Enhance the development and dissemination of science-based methodologies and tools to record and share disaster losses and relevant disaggregated data and statistics, as well as to strengthen disaster risk modelling, assessment, mapping, monitoring and multi-hazard early warning systems."*

- *Bangkok Principle 1. "Promote systematic integration of health into national and sub-national disaster risk reduction policies and plans and the inclusion of emergency and disaster risk management programmes in national and sub-national health strategies. "*

d. "Strengthen the integration of biological hazards, including epidemics, pandemics, and diseases at the human-animal-ecosystem interface, into all-hazards multi- sectoral disaster risk management. "

e. "Adapt and apply monitoring and reporting frameworks, as appropriate, for disaster risk reduction to track the progress of implementation of plans at all levels including health components. "

- *Bangkok Principle 5. "Incorporate disaster-related mortality, morbidity and disability data into multi-hazards early warning system, health core indicators and national risk assessments. "*

b. "Include biological hazards and zoonotic diseases as well as chemical and radiation hazards in disaster risk assessment and multi-hazard early warning systems. "

- *Bangkok Principle 6. "Advocate for, and support cross-sectoral, transboundary collaboration including information sharing, and science and technology for all hazards, including biological hazards. "*

b. "Promote the use of innovative communication approaches for dissemination of early warning messages, including outbreaks and emergencies, particularly to at- risk communities

6. "Take action to meaningfully integrate biodiversity conservation perspectives and human health and well-being when developing solutions for communicable and non-communicable disease threats; "

The sixth Berlin Principle adds an ecological sustainability value to human health, as described by the WHO, as not a mere absence of disease. Incorporating the One Health approach in terms of ecosystem conservation and health in national policies and strategies for risk reduction and epidemic prevention supports the international policy coherence and joint development. Meanwhile, aspects of biodiversity protection and conservation in international frameworks enhance the global risk governance of pandemics and climate change by increasing the coherence and compliance of the achieved tools and mechanisms.

- Priority 2: Strengthening disaster risk governance to manage disaster risk

"Clear vision, plans, competence, guidance and coordination within and across sectors as well as participation of relevant stakeholders are needed. Strengthening disaster risk

governance is therefore necessary and fosters collaboration and partnership across mechanisms and institutions for the implementation of instruments relevant to disaster risk reduction and sustainable development. “

– (para 27a): “Mainstream and integrate disaster risk reduction within and across all sectors. Review and promote the coherence and further development, as appropriate, of national and local frameworks of laws, regulations and public policies.”

– Safety enhancing laws and regulations (para 27d): “Encourage the establishment of necessary mechanisms and incentives to ensure high levels of compliance with existing safety- enhancing provisions of sectoral laws and regulations, including those addressing land use and urban planning, building codes, environmental and resource management and health and safety standards, and update them, where needed, to ensure an adequate focus on disaster risk management.”

– Coherence of instruments and tools (para 28b): “Foster collaboration across global and regional mechanisms and institutions for the implementation and coherence of instruments and tools relevant to disaster risk reduction, such as for climate change, biodiversity, sustainable development, poverty eradication, environment, agriculture, health, food and nutrition and others, as appropriate.”

– Epidemics and pandemics (para 28d): “Promote transboundary cooperation to enable policy and planning for the implementation of ecosystem-based approaches, to build resilience and reduce disaster risk, including epidemic risk.”

- Bangkok Principle 1. “Promote systematic integration of health into national and sub-national disaster risk reduction policies and plans and the inclusion of emergency and disaster risk management programmes in national and sub-national health strategies. “*

- a. “Promote a whole-of-government, a whole-of-society approach, with population at risk and communities at the centre of emergency and disaster risk management measures, led by strong political commitment of Governments. “*

- b. “Develop, or revise multi-sectoral policies, integrated plans and programmes for emergency and disaster risk reduction to include the health sector component and manage health risks of emergencies and disasters with appropriate levels of resources to support implementation.*

- c. “Increase the participation of health sector representatives in multi-sectoral emergency and disaster risk management committees and platforms at all levels. “*

- d. “Strengthen the integration of biological hazards, including epidemics, pandemics, and diseases at the human-animal-ecosystem interface, into all-hazards multi- sectoral disaster risk management. “*

- e. “Adapt and apply monitoring and reporting frameworks, as appropriate, for disaster risk reduction to track the progress of implementation of plans at all levels including health components. “*

- f. “Integrate health needs fully into post-disaster needs assessment and recovery planning. “*

- Bangkok Principle 7. “Promote coherence and further development of local and national policies and strategies, legal frameworks, regulations, and institutional arrangements. “*

a. *“Create enabling environment for coherence of policies and strategies of the Sendai Framework for DRR, SDGs, climate change adaptation and other relevant instruments. ”*

7. *“Increase cross-sectoral investment in the global human, livestock, wildlife, plant, and ecosystem health infrastructure and international funding mechanisms for the protection of ecosystems, commensurate with the serious nature of emerging/resurging and exacerbating communicable and non-communicable disease threats to life on our planet. ”*

One Health stresses the need for investment in human and natural infrastructure across sectors to comprehensively protect the human, animal, and environmental health from emerging and re-emerging diseases. The third Bangkok Principle focuses merely on humans, while the seventh Berlin Principle includes all the elements of life and is ecosystem-based. There are more similarities with the third priority of the Sendai Framework since it also refers to investments in environmental health and includes disaster risk reduction practices. Additionally, paragraph 30n suggests investments in the sustainable use of ecosystems and resources. Moreover, paragraph 30p merely mentions the health of livestock without recognizing the significance of wild animals for human and animal health, a point that is clear in the seventh Berlin Principle.

- Priority 3: Investing in disaster risk reduction for resilience

“Public and private investment in disaster risk prevention and reduction through structural and non-structural measures are essential to enhance the economic, social, health and cultural resilience of persons, communities, countries and their assets, as well as the environment. ”

– Ecosystem and environment health (para 30n): *“Strengthen the sustainable use and management of ecosystems and implement integrated environmental and natural resource management approaches that incorporate disaster risk reduction.”*

– Animal health (para 30p): *“Strengthen the protection of livelihoods and productive assets, including livestock, working animals, tools and seeds.”*

- Bangkok Principle 3. *“Stimulate people-centered public and private investment in emergency and disaster risk reduction, including in health facilities and infrastructure. ”*

b. *“Promote investment in research and development and enhance innovation and the use of modern technologies and modelling for managing disaster risks including for biological hazards. ”*

8. *“Enhance capacity for cross-sectoral and trans-disciplinary health surveillance and clear, timely information sharing to improve coordination of responses among governments and NGOs, health, academia, and other institutions, industry, and other stakeholders. ”*

The 8th Berlin Principle reinforces the early-warning, communication, and technological systems, as mentioned in paragraph 28d of the fourth priority of the Sendai Framework. In extension, trans-disciplinary surveillance requires participatory mechanisms to facilitate comprehensive forecasting.

- Priority 2: Strengthening disaster risk governance to manage disaster risk

“Clear vision, plans, competence, guidance and coordination within and across sectors as well as participation of relevant stakeholders are needed. Strengthening disaster risk

governance is therefore necessary and fosters collaboration and partnership across mechanisms and institutions for the implementation of instruments relevant to disaster risk reduction and sustainable development. “

– Epidemics and pandemics (para 28d): “Promote transboundary cooperation to enable policy and planning for the implementation of ecosystem-based approaches, to build resilience and reduce disaster risk, including epidemic risk.”

One Health’s trans-disciplinary research and surveillance at the human-animal-ecosystem interface can contribute to the holistic integration of health into disaster risk reduction policies and strategies through the inclusion of human, animal, and environmental health, in addition to facilitating efficient collaborations between health authorities and relevant stakeholders, thus strengthening national health capacities and resilience.

The mentioning of international regulations in the health principles of the Sendai Framework proves the openness for the needed collaborations between different agencies and policies globally.

- *Bangkok Principle 1. “Promote systematic integration of health into national and sub-national disaster risk reduction policies and plans and the inclusion of emergency and disaster risk management programmes in national and sub-national health strategies. “*

d. “Strengthen the integration of biological hazards, including epidemics, pandemics, and diseases at the human-animal-ecosystem interface, into all-hazards multi- sectoral disaster risk management. “

- *Bangkok Principle 2: “Enhance cooperation between health authorities and other relevant stakeholders to strengthen country capacity for disaster risk management for health, the implementation of the International Health Regulations (2005) and building of resilient health systems. “*

b. “Strengthen the essential capacities for emergency and disaster risk management for health and building resilience of health systems at all levels, including in policies and legislation, planning and coordination, human and financial resources, monitoring and evaluation, information management, health infrastructure and logistics, health and related services, risk communication and community capacity development. “

c. “Strengthen coordination bodies, committees and platforms at all levels for emergency and disaster risk management for health, including multisectoral and multi-stakeholder participation. “

9. *“Form participatory, collaborative relationships among governments, NGOs, and Indigenous Peoples and local communities while strengthening the public sector to meet the challenges of global health and biodiversity conservation. “*

Knowledge based on the traditions and experiences of local communities and native populations provide insights into vulnerability and exposure that increase risk understanding and lead to inclusive policies and practices based on participation, thereby strengthening risk governance through collaborations between various actors, institutions, and parts of the society. These cross-sectoral partnerships focused on protecting health and biodiversity provide the opportunity to incorporate pandemic risk reduction and resilience in multiple

levels and sectors of public life. Enhanced pandemic and natural risk resilience encourages proper natural resources' use and the preservation of environmental health.

- Priority 1: Understanding disaster risk

"Policies and practices for disaster risk management should be based on an understanding of disaster risk in all its dimensions of vulnerability, capacity, exposure of persons and assets, hazard characteristics and the environment."

- Priority 2: Strengthening disaster risk governance to manage disaster risk

"Clear vision, plans, competence, guidance and coordination within and across sectors as well as participation of relevant stakeholders are needed. Strengthening disaster risk governance is therefore necessary and fosters collaboration and partnership across mechanisms and institutions for the implementation of instruments relevant to disaster risk reduction and sustainable development. "

–Mainstream disaster risk reduction in health" (para 27a): "Mainstream and integrate disaster risk reduction within and across all sectors. Review and promote the coherence and further development, as appropriate, of national and local frameworks of laws, regulations and public policies."

–Epidemics and pandemics (para 28d): "Promote transboundary cooperation to enable policy and planning for the implementation of ecosystem-based approaches, to build resilience and reduce disaster risk, including epidemic risk."

- Priority 3: Investing in disaster risk reduction for resilience

– Ecosystem and environment health (para 30n): "Strengthen the sustainable use and management of ecosystems and implement integrated environmental and natural resource management approaches that incorporate disaster risk reduction;"

In line with the ninth Berlin Principle, the first Bangkok Principle supports community involvement, especially that of minority and socially vulnerable groups, to achieve a whole-society all-hazard disaster risk management.

- *Bangkok Principle 1: "Promote systematic integration of health into national and sub-national disaster risk reduction policies and plans and the inclusion of emergency and disaster risk management programmes in national and sub-national health strategies. "*

b. "Develop, or revise multi-sectoral policies, integrated plans and programmes for emergency and disaster risk reduction to include the health sector component and manage health risks of emergencies and disasters with appropriate levels of resources to support implementation. "

d. "Strengthen the integration of biological hazards, including epidemics, pandemics, and diseases at the human-animal-ecosystem interface, into all-hazards multi- sectoral disaster risk management. "

g. "Strengthen the design and implementation of gender-responsive and inclusive disaster risk reduction policies and plans, with community involvement, to address the vulnerabilities and capacities of women and children, people with disabilities, older persons, migrants, and other population at risk and protection needs before, during and after disasters. "

10. *"Invest in educating and raising awareness for global citizenship and holistic planetary health approaches among children and adults in schools, communities, and*

universities while also influencing policy processes to increase recognition that human health ultimately depends on ecosystem integrity and a healthy planet.”

Education is a crucial point in the One Health approach and Sendai Framework and provides the ground for future risk reduction and resilience against climate change, pandemics, and natural disasters. One Health promotes investment in raising awareness embedded in education focused on the connection between human, animal, and planetary health. A holistic approach to health increases society's resilience against natural disasters and pandemic risks as well as their sources like climate change and environmental degradation. The paragraph 30j of the third priority of the Sendai Framework, expresses the significance of social safety net mechanisms including education. However, this perquisition should not be taken for granted since institutional vulnerability burdens risk reduction, resilience, and awareness raising. The same priority in paragraph 30n puts environmental and resource management concerning disaster risk reduction and promotes the incorporation of sustainable techniques in disaster risk reduction, which is in line with the 10th Berlin Principle's view that planetary and ecosystem health are indispensable for human health.

- Priority 3: Investing in disaster risk reduction for resilience

“Public and private investment in disaster risk prevention and reduction through structural and non-structural measures are essential to enhance the economic, social, health and cultural resilience of persons, communities, countries and their assets, as well as the environment. “

– Access to basic health care services (para 30j): *“Strengthen the design and implementation of inclusive policies and social safety net mechanisms, including through community involvement, integrated with livelihood enhancement programmes, and access to basic health care services, including maternal, new born & child health, sexual & reproductive health, food security & nutrition, housing and education, towards the eradication of poverty, to find durable solutions in the post disaster phase and to empower and assist people disproportionately affected by disasters.”*

– Ecosystem and environment health (para 30n): *“Strengthen the sustainable use and management of ecosystems and implement integrated environmental and natural resource management approaches that incorporate disaster risk reduction;”*

Bangkok Principle 4 emphasizes the education of health workers' education compared to the tenth Berlin Principle that has a more of a whole-society approach. Nevertheless, in broad cross-sectoral collaborations, One Health trains local staff across the globe through the laboratories conducting interdisciplinary research and introducing modern technology and scientific techniques and equipment for the detection and analysis of biological hazards like infectious agents with pandemic potential.

- *Bangkok Principle 4: “Integrate disaster risk reduction into health education and training and strengthen capacity building of health workers in disaster risk reduction.*

a. Promote collaborative multidisciplinary training on multi-sectoral action to reduce the risks of diseases and disasters. “

- *Bangkok Principle 6. “Advocate for, and support cross-sectoral, transboundary collaboration including information sharing, and science and technology for all hazards, including biological hazards. “*

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d. “Promote the development and application of evidence-based practices through health science and technology and targeted operational research for all-hazards emergency and disaster risk management. “

Table 8: The potential integration of the One Health Berlin Principles with the Bangkok Principles and priorities of the Sendai Framework.

One Health Berlin Principles	Sendai Framework Priorities — Health Aspects	Sendai Framework Bangkok Principles
1. Recognize and take action to retain the essential health links between humans, wildlife, domesticated animals and plants, and all nature; and ensure the conservation and protection of biodiversity, which interwoven with intact and functional ecosystems provides the critical foundational infrastructure of life, health, and well-being on our planet.	<p><u>Priority 1: Understanding disaster risk</u></p> <p><u>Priority 2: Strengthening disaster risk governance to manage disaster risk</u></p> <p><i>-Paragraph 28d: Epidemics and pandemics</i></p> <p><u>Priority 3: Investing in disaster risk reduction for resilience</u></p> <p><i>-Paragraph 30n: Ecosystem and environment health</i></p> <p><i>-Paragraph 30 p: Animal health</i></p> <p><u>Priority 4: Enhancing disaster preparedness for effective response and to “Build Back Better” in recovery, rehabilitation and reconstruction</u></p>	<p>1. Systematic integration of health into national and sub-national disaster risk reduction policies and plans and the inclusion of emergency and disaster risk management programmes in national and sub-national health strategies.</p> <p>b. Develop, or revise multi-sectoral policies, integrated plans and programmes for emergency and disaster risk reduction to include the health sector component, and manage health risks of emergencies and disasters with appropriate levels of resources to support implementation.</p> <p>d. Strengthen the integration of biological hazards, including epidemics, pandemics, and diseases at the human-animal-ecosystem interface, into all-hazards multi-sectoral disaster risk management.</p>
2. Take action to develop strong institutions that integrate an understanding of human and animal health with the health of the environment and invest in the translation of robust science-based knowledge into policy and practice.	<p><u>Priority 1: Understanding disaster risk</u></p> <p><i>Paragraph 25a: Disaster risk and loss Data</i></p> <p><u>Priority 2: Strengthening disaster risk governance to manage disaster risk</u></p> <p><i>Paragraph 27a: Mainstream disaster risk reduction in health</i></p> <p><i>Paragraph 27d: Safety enhancing laws and regulations</i></p> <p><i>Paragraph 28b: Coherence of instruments and tools</i></p> <p><i>Paragraph 28d: Epidemics and pandemics</i></p> <p><u>Priority 4: Enhancing disaster preparedness for effective response and to “Build Back Better” in recovery, rehabilitation and reconstruction</u></p>	<p>1. Promote systematic integration of health into national and sub-national disaster risk reduction policies and plans and the inclusion of emergency and disaster risk management programmes in national and sub-national health strategies.</p> <p>b. Develop, or revise multi-sectoral policies, integrated plans and programmes for emergency and disaster risk reduction to include the health sector component, and manage health risks of emergencies and disasters with appropriate levels of resources to support implementation.</p> <p>c. Increase the participation of health sector representatives in multi-sectoral emergency and disaster risk management committees and platforms at all levels.</p> <p>d. Strengthen the integration of biological hazards, including epidemics, pandemics, and diseases at the human-animal-ecosystem</p>

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		<p>interface, into all-hazards multi-sectoral disaster risk management.</p> <p>6. Advocate for, and support cross-sectoral, transboundary collaboration including information sharing, and science and technology for all hazards, including biological hazards.</p> <p>a. Compile and disseminate best practices and case studies on mainstreaming disaster reduction in health.</p> <p>b. Promote the development and application of evidence-based practices through health science and technology and targeted operational research for all-hazards emergency and disaster risk management.</p> <p>c. Strengthen cross-border and intersectoral mechanisms for assessing and managing risks, such as coordinated vaccination campaigns and disease surveillance.</p> <p>7. Promote coherence and further development of local and national policies and strategies, legal frameworks, regulations, and institutional arrangements.</p> <p>a. Create enabling environment for coherence of policies and strategies of the Sendai Framework for DRR, SDGs, climate change adaptation and other relevant instruments.</p>
<p>3. Take action to combat the current climate crisis, which is creating new severe threats to human, animal, and environmental health and exacerbating existing challenges.</p>	<p><u>Priority 2: Strengthening disaster risk governance to manage disaster risk</u></p> <p><i>Paragraph 27d: Safety enhancing laws and regulations</i></p> <p><i>Paragraph 28b: Coherence of instruments and tools</i></p> <p><i>Paragraph 28d: Epidemics and pandemics</i></p> <p><u>Priority 4: Enhancing disaster preparedness for effective response and to “build back better” in recovery, rehabilitation and reconstruction</u></p>	<p>6. Advocate for, and support cross-sectoral, transboundary collaboration including information sharing, and science and technology for all hazards, including biological hazards.</p> <p>b. Promote the development and application of evidence-based practices through health science and technology and targeted operational research for all-hazards emergency and disaster risk management.</p> <p>7. Promote coherence and further development of local and national policies and strategies, legal frameworks, regulations, and institutional arrangements.</p> <p>a. Create enabling environment for coherence of policies and strategies of the Sendai Framework for DRR, SDGs, climate change adaptation</p>

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		and other relevant instruments.
<p>4. Recognize that decisions regarding land, air, sea, and freshwater use directly impact the health and well-being of humans, animals, and ecosystems and that alterations in ecosystems paired with decreased resilience generate shifts in communicable and non-communicable disease emergence, exacerbation, and spread; and take action accordingly to eliminate or mitigate these impacts.</p>	<p><u>Priority 1: Understanding disaster risk</u></p> <p><u>Priority 2: Strengthening disaster risk governance to manage disaster risk</u></p> <p><i>Paragraph 27d: Safety enhancing laws and regulations</i></p> <p><i>Paragraph 28b: Coherence of instruments and tools</i></p> <p><i>Paragraph 28d: Epidemics and pandemics</i></p> <p><u>Priority 3: Investing in disaster risk reduction for resilience</u></p> <p><i>-Paragraph 30n: Ecosystem and environment health</i></p> <p><u>Priority 4: Enhancing disaster preparedness for effective response and to “build back better” in recovery, rehabilitation and reconstruction</u></p>	<p>1. Promote systematic integration of health into national and sub-national disaster risk reduction policies and plans and the inclusion of emergency and disaster risk management programmes in national and sub-national health strategies.</p> <p>a. Promote a whole-of-government, a whole-of-society approach, with population at risk and communities at the centre of emergency and disaster risk management measures, led by strong political commitment of Governments.</p> <p>b. Develop, or revise multi-sectoral policies, integrated plans and programmes for emergency and disaster risk reduction to include the health sector component, and manage health risks of emergencies and disasters with appropriate levels of resources to support implementation.</p> <p>c. Increase the participation of health sector representatives in multi-sectoral emergency and disaster risk management committees and platforms at all levels.</p> <p>d. Strengthen the integration of biological hazards, including epidemics, pandemics, and diseases at the human-animal-ecosystem interface, into all-hazards multi-sectoral disaster risk management.</p> <p>f. Integrate health needs fully into post-disaster needs assessment and recovery planning.</p> <p>2. Enhance cooperation between health authorities and other relevant stakeholders to strengthen country capacity for disaster risk management for health, the implementation of the International Health Regulations (2005) and building of resilient health systems.</p> <p>b. Strengthen the essential capacities for emergency and disaster risk management for health and building resilience of health systems at all levels, including in policies and legislation, planning and coordination, human and financial resources, monitoring and evaluation, information management, health infrastructure</p>

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		<p>and logistics, health and related services, risk communication and community capacity development.</p> <p>c. Strengthen coordination bodies, committees and platforms at all levels for emergency and disaster risk management for health, including multisectoral and multistakeholder participation.</p> <p>d. Strengthen multisectoral planning and action to manage health risks from all types of hazards, including the implementation of the International Health Regulations (2005).</p> <p>3. Stimulate people-centered public and private investment in emergency and disaster risk reduction, including in health facilities and infrastructure.</p> <p>b. Promote investment in research and development and enhance innovation and the use of modern technologies and modelling for managing disaster risks including for biological hazards.</p> <p>4. Integrate disaster risk reduction into health education and training and strengthen capacity building of health workers in disaster risk reduction.</p> <p>a. Promote collaborative multidisciplinary training on multi-sectoral action to reduce the risks of diseases and disasters.</p> <p>6. Advocate for, and support cross-sectoral, transboundary collaboration including information sharing, and science and technology for all hazards, including biological hazards.</p> <p>a. Compile and disseminate best practices and case studies on mainstreaming disaster reduction in health.</p> <p>b. Promote the use of innovative communication approaches for dissemination of early warning messages, including outbreaks and emergencies, particularly to at-risk communities.</p> <p>d. Promote the development and application of evidence-based practices through health science and technology and targeted operational research for all-hazards</p>
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		<p>emergency and disaster risk management.</p> <p>7. Promote coherence and further development of local and national policies and strategies, legal frameworks, regulations, and institutional arrangements.</p> <p>a. Create enabling environment for coherence of policies and strategies of the Sendai Framework for DRR, SDGs, climate change adaptation and other relevant instruments.</p>
<p>5. Devise adaptive, holistic, and forward-looking approaches to the detection, prevention, monitoring, control, and mitigation of emerging/resurging diseases and exacerbating communicable and non-communicable diseases that incorporate the complex interconnections among species, ecosystems, and human society, while accounting fully for harmful economic drivers, and perverse subsidies.</p>	<p><u>Priority 1: Understanding disaster risk</u> <i>Paragraph 25a: Disaster risk and loss Data</i></p>	<p>1. Promote systematic integration of health into national and sub-national disaster risk reduction policies and plans and the inclusion of emergency and disaster risk management programmes in national and sub-national health strategies.</p> <p>d. Strengthen the integration of biological hazards, including epidemics, pandemics, and diseases at the human-animal-ecosystem interface, into all-hazards multi-sectoral disaster risk management.</p> <p>e. Adapt and apply monitoring and reporting frameworks, as appropriate, for disaster risk reduction to track the progress of implementation of plans at all levels including health components.</p> <p>5. Incorporate disaster-related mortality, morbidity and disability data into multi-hazards early warning system, health core indicators and national risk assessments.</p> <p>b. Include biological hazards and zoonotic diseases as well as chemical and radiation hazards in disaster risk assessment and multi-hazard early warning systems.</p> <p>6. Advocate for, and support cross-sectoral, transboundary collaboration including information sharing, and science and technology for all hazards, including biological hazards.</p> <p>b. Promote the use of innovative communication approaches for dissemination of early warning messages, including outbreaks and emergencies, particularly to at-risk communities.</p>
<p>6. Take action to meaningfully</p>	<p><u>Priority 2: Strengthening disaster</u></p>	<p>1. Promote systematic integration</p>

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<p>integrate biodiversity conservation perspectives and human health and well-being when developing solutions for communicable and non-communicable disease threats.</p>	<p><u><i>risk governance to manage disaster risk</i></u> <i>-Paragraph 27a: "Mainstream and integrate disaster risk reduction within and across all sectors.</i> <i>Paragraph 27d: Safety enhancing laws and regulations</i> <i>Paragraph 28b: Coherence of instruments and tools</i> <i>Paragraph 28d: Epidemics and pandemics</i></p>	<p>of health into national and sub-national disaster risk reduction policies and plans and the inclusion of emergency and disaster risk management programmes in national and sub-national health strategies.</p> <p>a. Promote a whole-of-government, a whole-of-society approach, with population at risk and communities at the centre of emergency and disaster risk management measures, led by strong political commitment of Governments.</p> <p>b. Develop, or revise multi-sectoral policies, integrated plans and programmes for emergency and disaster risk reduction to include the health sector component, and manage health risks of emergencies and disasters with appropriate levels of resources to support implementation.</p> <p>c. Increase the participation of health sector representatives in multi-sectoral emergency and disaster risk management committees and platforms at all levels.</p> <p>d. Strengthen the integration of biological hazards, including epidemics, pandemics, and diseases at the human-animal-ecosystem interface, into all-hazards multi-sectoral disaster risk management.</p> <p>e. Adapt and apply monitoring and reporting frameworks, as appropriate, for disaster risk reduction to track the progress of implementation of plans at all levels including health components.</p> <p>f. Integrate health needs fully into post-disaster needs assessment and recovery planning.</p> <p>7. Promote coherence and further development of local and national policies and strategies, legal frameworks, regulations, and institutional arrangements.</p> <p>a. Create enabling environment for coherence of policies and strategies of the Sendai Framework for DRR, SDGs, climate change adaptation and other relevant instruments.</p>
<p>7. Increase cross-sectoral investment in the global human, livestock, wildlife, plant, and ecosystem health infrastructure and</p>	<p><u><i>Priority 3: Investing in disaster risk reduction for resilience</i></u> <i>-Paragraph 30n: Ecosystem and environment health</i></p>	<p>3. Stimulate people-centered public and private investment in emergency and disaster risk reduction, including in health</p>

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international funding mechanisms for the protection of ecosystems, commensurate with the serious nature of emerging/resurging and exacerbating communicable and non-communicable disease threats to life on our planet.	- <i>Paragraph 30p: Animal health</i>	facilities and infrastructure. b. Promote investment in research and development and enhance innovation and the use of modern technologies and modelling for managing disaster risks including for biological hazards.
8. Enhance capacity for cross-sectoral and trans-disciplinary health surveillance and clear, timely information sharing to improve coordination of responses among governments and NGOs, health, academia, and other institutions, industry, and other stakeholders.	<ul style="list-style-type: none"> • <u>Priority 2: Strengthening disaster risk governance to manage disaster risk</u> – <i>Paragraph 28d: Epidemics and pandemics</i> 	<p>1. Promote systematic integration of health into national and sub-national disaster risk reduction policies and plans and the inclusion of emergency and disaster risk management programmes in national and sub-national health strategies.</p> <p>d. Strengthen the integration of biological hazards, including epidemics, pandemics, and diseases at the human-animal-ecosystem interface, into all-hazards multi-sectoral disaster risk management.</p> <p>2. Enhance cooperation between health authorities and other relevant stakeholders to strengthen country capacity for disaster risk management for health, the implementation of the International Health Regulations (2005) and building of resilient health systems.</p> <p>b. Strengthen the essential capacities for emergency and disaster risk management for health and building resilience of health systems at all levels, including in policies and legislation, planning and coordination, human and financial resources, monitoring and evaluation, information management, health infrastructure and logistics, health and related services, risk communication and community capacity development.</p> <p>c. Strengthen coordination bodies, committees and platforms at all levels for emergency and disaster risk management for health, including multisectoral and multistakeholder participation.</p>
9. Form participatory, collaborative relationships among governments, NGOs, and Indigenous Peoples and local communities while	<u>Priority 1: Understanding disaster risk</u> <u>Priority 2: Strengthening disaster risk governance to manage disaster</u>	1. Promote systematic integration of health into national and sub-national disaster risk reduction policies and plans and the inclusion

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<p>strengthening the public sector to meet the challenges of global health and biodiversity conservation.</p>	<p><u>risk</u> -Paragraph 27a: "Mainstream and integrate disaster risk reduction within and across all sectors. Paragraph 28d: Epidemics and pandemics</p> <p><u>Priority 3: Investing in disaster risk reduction for resilience</u> -Paragraph 30n: Ecosystem and environment health</p>	<p>of emergency and disaster risk management programmes in national and sub-national health strategies.</p> <p>b. Develop, or revise multi-sectoral policies, integrated plans and programmes for emergency and disaster risk reduction to include the health sector component, and manage health risks of emergencies and disasters with appropriate levels of resources to support implementation.</p> <p>d. Strengthen the integration of biological hazards, including epidemics, pandemics, and diseases at the human-animal-ecosystem interface, into all-hazards multi-sectoral disaster risk management –</p> <p>– Strengthen the design and implementation of gender-responsive and inclusive disaster risk reduction policies and plans, with community involvement, to address the vulnerabilities and capacities of women and children, people with disabilities, older persons, migrants, and other population at risk and protection needs before, during and after disasters.</p> <p>g. Strengthen the design and implementation of gender-responsive and inclusive disaster risk reduction policies and plans, with community involvement, to address the vulnerabilities and capacities of women and children, people with disabilities, older persons, migrants, and other population at risk and protection needs before, during and after disasters.</p>
<p>10. Invest in educating and raising awareness for global citizenship and holistic planetary health approaches among children and adults in schools, communities, and universities while also influencing policy processes to increase recognition that human health ultimately depends on ecosystem integrity and a healthy planet.</p>	<p><u>Priority 3: Investing in disaster risk reduction for resilience</u> – Paragraph 30j: Access to basic health care services – Paragraph 30n: Ecosystem and environment health</p>	<p>4. Integrate disaster risk reduction into health education and training and strengthen capacity building of health workers in disaster risk reduction.</p> <p>a. Promote collaborative multidisciplinary training on multi-sectoral action to reduce the risks of diseases and disasters.</p> <p>6. Advocate for, and support cross-sectoral, transboundary collaboration including information sharing, and science and technology for all hazards, including biological hazards.</p> <p>d. Promote the development and</p>

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		application of evidence-based practices through health science and technology and targeted operational research for all-hazards emergency and disaster risk management.
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The Berlin Principles correlate and can potentially supplement five times with the first and fourth priorities of the Sendai Framework, four times with the second priority, and three times with the third priority. The Berlin Principles correspond with the key actions of the first Bangkok Principle twenty-two times, five times with the second Bangkok Principle, two times with the third and fourth Bangkok Principle, one time with the fifth, thirteen times with the sixth, and four times with the seventh. Table x. categorizes the patterns and relationships between the One Health and the Sendai Framework. From the 16 health-relevant paragraphs from the four Sendai Framework priorities, nine paragraphs had the potential for enhancement through the Berlin Principles and seventeen of the total twenty-four key actions of the Bangkok Principles, as illustrated in Table 9..

Table 9: Times of correspondence between the Berlin Principles, the Sendai framework priorities (P1, P2, P3, P4), the health-relevant paragraphs of the priorities (25a, 27a, 27d, 28b, 30j, 30n, 30p, 33b), the Bangkok Principles and their key actions (1a, 1b, 1c, 1d, 1e, 1f, 1g, 2a, 2b, 2c, 2d, 3a, 3b, 4a, 4b, 5a, 5b, 5c, 5d, 6a, 6b, 6c, 6d, 7a, 7b, 7c).

Priority Paragraph	Times of correlation	Bangkok Priorities	Times of correlation	Bangkok Priorities	Times of correlation
P1 25a	2	1a	1	4b	2
P1 25f	0	1b	5	5a	0
P1 25i	0	1c	3	5b	1
P2 27a	3	1d	7	5c	0
P2 27d	4	1e	2	5d	0
P2 28b	4	1f	2	6a	2
P2 28d	7	1g	1	6b	4
P3 30c	0	2a	0	6c	1
P3 30i	0	2b	2	6d	2
P3 30j	1	2c	2	7a	4
P3 30k	0	2d	1	7b	0
P3 30n	5	3a	0	7c	0
P3 30p	1	3b	3		
P3 31e	0	4a	2		

5. Discussion

The study indicates the correspondence and coherence between the ten One Health Berlin Principles, the four priorities, and the seven Bangkok Principles of the Sendai Framework in support of the integration of the One Health approach with the Sendai Framework in order to holistically enhance pandemic risk management. Thus, the comprehensive protection of human, animal, and environmental health reduces pandemic risks and simultaneously co-benefits the fight against climate change's progress and impacts.

5.1. Hypothesis and Research Questions

Hypothesis: The integration of One Health with the Sendai Framework enhances pandemic risk management. One Health Principles correlate to the priorities and health aspects of the Sendai Framework.

The results indicate that the integration of One Health with the Sendai Framework is beneficial for pandemic risk management as it holistically strengthens the Sendai Framework to address the modern challenges in pandemic risk management. Furthermore, broad collaborations between international representatives of One Health and the Sendai Framework are essential for pragmatic and solution-based paradigm shifts to prevent similar or worse future pandemic challenges and climate change impacts.

Research Question 1: Which challenges does pandemic risk management face in times of global and climate change?

The analysis identifies that global and climate change act as underlying drivers and multipliers of pandemic risk. Climate change results from global change and human activities – e.g., resource exploitation and consummation, environmental degradation and pollution, deforestation, urbanization, and population growth, which dramatically alter our planet. Overall, climate change and its effects such as temperature increase and pollution harm people's health, exposing them to more significant health risks during a pandemic. Moreover, the ability to travel faster than ever before in human history and the volume of travelers lead to an uncontrollable spread of infectious agents around the globe within hours. The interconnections within the system produce cascading effects that are difficult to foresee and mitigate. A holistic approach to pandemic risk management is therefore essential to address the social, economic, institutional, and cultural procedures, interconnections, interdependencies, and vulnerabilities that form pandemic risk in addition to the environmental impacts due to climate change.

Research Question 2: Is the integration of the One Health approach with the Sendai Framework possible? What are the advantages for pandemic risk management?

This study suggests that integration is achievable due to the high correspondence, coherence, and correlation between the One Health approach and the Sendai Framework. Integrating the ten Berlin Principles of One Health with the seven Bangkok Principles and four priorities of the Sendai Framework reinforces the utility of the Sendai Framework in holistic pandemic risk management. Furthermore, One Health is an interdisciplinary science that provides the Sendai Framework with scientific data and methods from various scientific fields that enhance the pandemic risk management process across multiple levels and

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stages. Science-based decision- and policy-making are indispensable for effectively
preventing and mitigating pandemic and environmental risks.

5.2. Interpretation: In line with this hypothesis, the study proves a correlation between the Berlin Principles of One Health and the Bangkok Principles and priorities of the Sendai Framework. COVID-19 demonstrated that pandemics cannot be fought only at the national level. The Sendai Framework, signed by 182 Nations in a global effort to reduce disaster risk, can substantially support the global collaboration against pandemics and is enriched by the One Health approach.

The results build on the existing evidence that biodiversity and habitat loss, environmental degradation, deforestation and forest encroachment, extensive land use, and farming increase pandemic risk (Machalaba et al. 2015; Di Marco et al. 2020; Pinner et al. I., 2020; Adalja et al., 2018; Kumari and Raghubanshi 2020; The Impact of Globalization on Infectious Disease Emergence and Control: Exploring the Consequences and Opportunities, Workshop Summary – Forum on Microbial Threats, 2006). The results also agree with the research, highlighting the need for interdisciplinary and cross-sectoral collaborations between veterinarians, physicians, epidemiologists, and conservation medicine and environmental specialists, anthropologists, sociologists, economists, policy- and decision-makers, academia, the industry, finance, the technology sector, and the civil society at local, national, and global level (Ethical and Legal Considerations in Mitigating Pandemic Disease: Workshop Summary, 2007; Gruetzmacher et al., 2021; Jonas 2014; Gibbs, 2014; Kahn et al., 2016; Kelly et al. 2017).

The research provides in-depth insights into the relationship between the One Health approach and the Sendai Framework. The fourth Berlin Principle *"recognize that decisions regarding land, air, sea, and freshwater use directly impact the health and well-being of humans, animals, and ecosystems and that alterations in ecosystems paired with decreased resilience generate shifts in communicable and non-communicable disease emergence, exacerbation, and spread; and take action accordingly to eliminate or mitigate these impacts;"* this correlates with all four priorities of the Sendai Framework and with six out of the seven Bangkok Principles (1, 2, 3, 4, 6, 7), displaying the highest correspondence of all Berlin Principles. Paragraph 27a: *"Mainstream disaster risk reduction in health: Mainstream and integrate disaster risk reduction within and across all sectors. Review and promote the coherence and further development, as appropriate, of national and local frameworks of laws, regulations and public policies."*, paragraph 28d: *"Epidemics and pandemics: Promote transboundary cooperation to enable policy and planning for the implementation of ecosystem-based approaches, to build resilience and reduce disaster risk, including epidemic risk."*, and the first Bangkok Principle with the fourth key action *"Strengthen the integration of biological hazards, including epidemics, pandemics, and diseases at the human-animal-ecosystem interface, into all-hazards multi- sectoral disaster risk management"* correlate seven times with the Berlin Principles. From a total of 14 health-related paragraphs from the priorities of the Sendai Framework, six did not correlate with any Berlin Principle. On the other side, 19 of the 26 Bangkok Principles' key actions correspond with the Berlin Principles. In total, the priorities of the Sendai Framework and the Bangkok Principles correlate with the

Berlin Principles 26 and 47 times, respectively. In association, there are 23 links between the targets of the Sustainable Development Goals and the targets of the Sendai Framework, as calculated from Fig. (Wright et al. 2020).

5.3. Limitations

The generalizability of the results is limited by the researcher's methodological choice of subjective evaluation of the correspondence between the Berlin Principles, the priorities, and the Bangkok Principles of the Sendai Framework. Furthermore, the exclusion of the interaction between pandemic risk and climate change risks as a confounding variable in the study results constrain the potential of the integration of the One Health approach with the Sendai Framework. Nevertheless, the choice of data is objective since the Berlin and Bangkok Principles and priorities constitute the foundation of the One Health approach and the Sendai Framework, respectively. Further research is needed to establish the policy processes required in order to integrate One Health with the Sendai framework. Future studies should further consider the potential use of One Health, especially in relation to the disaster risk reduction of natural hazards.

6. Conclusion

COVID-19 revealed the real danger represented by pandemics in relation to the interconnectivity and interdependencies of the modern world. Pandemics and climate change are interwoven systemic risks and synchronous risk amplifiers or generators of conventional risks that require comprehensive management liberated from siloed thinking and practices.

Land-use changes, ecosystem degradation, human encroachment in forests, habitat fragmentation and loss, expand the human-animal interfaces, thus increasing the risk of spill-over events. In addition, industrialization, urbanization, immense resource needs, fossil fuel collection, and greenhouse gas emissions are global economic trends that drive climate change, with global warming being the biggest concern. However, the international political agenda addresses most issues without being free of criticism about the lack of meaningful actions.

This thesis verifies the hypothesis that the integration of One Health with the Sendai Framework enhances pandemic risk management by addressing the complex challenges arising from global and climate change. This integration is achievable due to the high correspondence between the Berlin Principles of the One Health approach, the priorities and health-relevant paragraphs, and the Bangkok Principles of the Sendai Framework.

Based on a qualitative analysis of the Berlin Principles, the priorities, and the Bangkok Principles of the Sendai Framework, it can be concluded that pandemic risk can be holistically managed through the integration of the One Health approach with the Sendai Framework. Furthermore, by analyzing the correspondence between the One Health approach and the Sendai Framework, this thesis has shown the Berlin Priorities that can distinctively enforce the priorities and Bangkok Principles.

Further research is needed to determine the potential co-benefits of integrating the One Health approach with the Sendai Framework in the fight against climate change. Also, the potential use of the Sendai Framework targets for monitoring and reporting One Health implementation is a point of interest for future studies. Additionally, investigating and revising the policy-making process to incorporate tools to enhance their functionality is an issue that will solve the bureaucratic burdens and lead to holistic and comprehensive solutions for the emerging multifaceted challenges.

7. Summary

The introduction presented the up-to-date political agenda in relation to the contemporary global issues of pandemics and climate change. The outline of the study's scope and focus framed the estimated costs of COVID-19 and impacts of climate change on health and introduced the Sendai Framework and the One Health approach to the reader. The importance of the thesis lies in pointing out the cross-sectoral collaborations necessary to manage systemic risks such as pandemics and climate change. In this context, the hypothesis and the two research questions underline the study's relevance by addressing the contemporary global challenges of pandemics, and climate change. The introduction ends with an overview of the study.

The chapter on background establishes the connection between pandemics and global, and climate change and offers an estimation of the tangible benefits of pandemic prevention over pandemic response. The chapter then goes on to discuss disaster risk management processes, aspects, and approaches. After the fundamental attitudes of disaster risk management, the pandemic risk is analyzed as a systemic risk, focusing on zoonotic diseases, viral attributes, spill-over cascading effects, transmission ways, and ethical concerns during pandemics. A global plan is then proposed to prevent and mitigate pandemic risks effectively.

The case study presents the Sendai Framework and the One Health approach. The priorities and principles are illustrated based on health relevance and their implementation in pandemic risk reduction. Lastly, the need for cross-sectoral collaborations is highlighted.

The next chapter deals with the qualitative research methodology description of the data collection, the selection of subjective evaluation, and its limitations and advantages. Finally, the potential for enhancement and enrichment between the One Health Berlin Principles, the priorities, and the Bangkok Principles of the Sendai Framework is analyzed in text, followed by a table listing the Berlin Principles with the corresponding priorities and Bangkok principles in the results.

In the "discussion" section, the hypothesis and research questions are answered based on the results. The , section ends with the interpretation and the limitations of the findings.

The conclusion gives an overview of the thesis and its key aspects, stressing that we must break the silos and work in broad cross-sectoral collaborations to respond effectively to modern challenges.

8. References

10 Years of Emerging Pandemic Threat (EPT) PREDICT Program to Prevent Viral Pandemics: are we ready for Disease X? Conference Paper · November 2019

Adalja, A., Watson, M., Toner, E., et al. (2018). The Characteristics of Pandemic Pathogens. Johns Hopkins University Center for Health Security.

Aitsi-Selmi, A., and Murray, V. 2015. "The Sendai Framework: Disaster risk reduction through a health lens." *Bull. World Health Organ* 93: 362.

Aven, Terje. 2016. "Risk Assessment and Risk Management: Review of Recent Advances on Their Foundation." *European Journal of Operational Research* 253 (1): 1–13. <https://doi.org/10.1016/j.ejor.2015.12.023>.

Bangkok Principles for the implementation of the health aspects of the Sendai Framework for Disaster Risk Reduction 2015–2030. Geneva: United Nations Office for Disaster Risk Reduction; 2016

Birkmann, J., O. D. Cardona, M. L. Carreño, A. H. Barbat, M. Pelling, S. Schneiderbauer, S. Duarte, C.M., 2015. Global change and the future ocean: a grand challenge for marine sciences. *Front. Mar. Sci.* 1, 1e16.

Bowsher, Gemma, Tracey McNamara, Rose Bernard, and Richard Sullivan. 2021. "Veterinary Intelligence: Integrating Zoonotic Threats into Global Health Security." *Journal of the Royal Society of Medicine*, August, 014107682110353. <https://doi.org/10.1177/01410768211035355>.

Brahmbhatt, Milan, and Olga Jonas. 2015. "International Cooperative Responses to Pandemic Threats;" 17.

Cardona, O.D., M.K. van Aalst, J. Birkmann, M. Fordham, G. McGregor, R. Perez, R.S. Pulwarty, E.L.F. Schipper, and B.T. Sinh, 2012: Determinants of risk: exposure and vulnerability. In: *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation* [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change (IPCC). Cambridge University Press, Cambridge, UK, and New York, NY, USA, pp. 65-108.

Cindy Jardine, Steve Hrudey, John Shortreed, Lorraine Craig, Daniel Krewski, Chris Furgal & Stephen McColl (2003) Risk Management Frameworks for Human Health and Environmental Risks, *Journal of Toxicology and Environmental Health, Part B: Critical Reviews*, 6:6, 569-718

Cunningham, Andrew A., Peter Daszak, and James L. N. Wood. 2017. "One Health, Emerging Infectious Diseases and Wildlife: Two Decades of Progress?" *Philosophical Transactions of*

Integration of the One Health approach with the Sendai Framework:
Enhancing pandemic risk management in times of global and climate change
the Royal Society B: Biological Sciences 372 (1725): 20160167.
<https://doi.org/10.1098/rstb.2016.0167>.

Di Marco, Moreno, Michelle L. Baker, Peter Daszak, Paul De Barro, Evan A. Eskew, Cecile M. Godde, Tom D. Harwood, et al. 2020. "Opinion: Sustainable Development Must Account for Pandemic Risk." *Proceedings of the National Academy of Sciences* 117 (8): 3888–92. <https://doi.org/10.1073/pnas.2001655117>.

Dobson, Andrew P., Stuart L. Pimm, Lee Hannah, Les Kaufman, Jorge A. Ahumada, Amy W. Ando, Aaron Bernstein, et al. 2020. "Ecology and Economics for Pandemic Prevention." *Science* 369 (6502): 379–81. <https://doi.org/10.1126/science.abc3189>.

Economic and Social Commission for Asia and the Pacific Committee on Disaster Risk Reduction Seventh session. Scaling up subregional and regional cooperation frameworks to manage cascading risks. Bangkok and online, 25–27 August 2021 Items 3 and 4 of the provisional agenda

Evans, Tom, Sarah Olson, James Watson, Kim Gruetzmacher, Mathieu Pruvot, Stacy Jupiter, Stephanie Wang, Tom Clements, and Katie Jung. 2020. "Links Between Ecological Integrity, Emerging Infectious Diseases Originating from Wildlife, and Other Aspects of Human Health - An Overview of the Literature." *Wildlife Conservation Society*. <https://doi.org/10.19121/2020.Report.37426>.

Ezenwa, Vanessa O., Anne-Helene Prieur-Richard, Benjamin Roche, Xavier Bailly, Pierre Becquart, Gabriel E. García-Peña, Parvies R. Hosseini, et al. 2015. "Interdisciplinarity and Infectious Diseases: An Ebola Case Study." Edited by Glenn F Rall. *PLOS Pathogens* 11 (8): e1004992. <https://doi.org/10.1371/journal.ppat.1004992>.

Fuchs, Sven, and Thomas Thaler. 2018. Vulnerability and resilience to natural hazards.

Ge, Xing-Yi, Jia-Lu Li, Xing-Lou Yang, Aleksei A. Chmura, Guangjian Zhu, Jonathan H. Epstein, Jonna K. Mazet, et al. 2013. "Isolation and Characterization of a Bat SARS-like Coronavirus That Uses the ACE2 Receptor." *Nature* 503 (7477): 535–38. <https://doi.org/10.1038/nature12711>.

Gibbs, E. Paul J. 2014. "The Evolution of One Health: A Decade of Progress and Challenges for the Future." *Veterinary Record* 174 (4): 85–91. <https://doi.org/10.1136/vr.g143>.

Health in the Context of the Sendai Framework for Disaster Risk Reduction.2015. Factsheet:. United Nations Office for Disaster Risk Reduction

Institute of Medicine 2006. The Impact of Globalization on Infectious Disease Emergence and Control: Exploring the Consequences and Opportunities: Workshop Summary. Washington, DC: The National Academies Press. <https://doi.org/10.17226/11588>.

Institute of Medicine 2007. Ethical and Legal Considerations in Mitigating Pandemic Disease: Workshop Summary. Washington, DC: The National Academies Press. <https://doi.org/10.17226/11917>.

International Conference on the Implementation of the Health Aspect of the Sendai Framework for Disaster Risk Reduction 2015-2030, Bangkok Principles for the implementation of the health aspects of the Sendai Framework for Disaster Risk Reduction 2015-2030, 2016

IPBES (2019): Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. S. Díaz, J. Settele, E. S. Brondízio, H. T. Ngo, M. Guèze, J. Agard, A. Arneth, P. Balvanera, K. A. Brauman, S. H. M. Butchart, K. M. A. Chan, L. A. Garibaldi, K. Ichii, J. Liu, S. M. Subramanian, G. F. Midgley, P. Miloslavich, Z. Molnár, D. Obura, A. Pfaff, S. Polasky, A. Purvis, J. Razzaque, B. Reyers, R. Roy Chowdhury, Y. J. Shin, I. J. Visseren-Hamakers, K. J. Willis, and C. N. Zayas (eds.). IPBES secretariat, Bonn, Germany. 56 pages. <https://doi.org/10.5281/zenodo.3553579>

IPCC, 2021: Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press. In Press.

Jamison, D. T., H. Gelband, S. Horton, P. Jha, R. Laxminarayan, C. N. Mock, and R. Nugent, editors. 2018. Disease Control Priorities: Improving Health and Reducing Poverty. Disease Control Priorities (third edition), Volume 9. Washington, DC: World Bank. doi:10.1596/978-1-4648-0527-1. License: Creative Commons Attribution CC BY 3.0 IGO

Jardine, Cindy, Steve Hrudey, John Shortreed, Lorraine Craig, Daniel Krewski, Chris Furgal, and Stephen McColl. 2003. "Risk Management Frameworks for Human Health and Environmental Risks." *Journal of Toxicology and Environmental Health, Part B* 6 (6): 569–718. <https://doi.org/10.1080/10937400390208608>.

Jonas, O.B. (2014), 'Pandemic Risk', background paper for the World Development Report 2014

Kahn, Laura H, Thomas P Monath, Bob H Bokma, E Paul Gibbs, and A Alonso Aguirre. n.d. "Chapter 3: One Health, One Medicine," 15.

Kelly, Terra R., William B. Karesh, Christine Kreuder Johnson, Kirsten V.K. Gilardi, Simon J. Anthony, Tracey Goldstein, Sarah H. Olson, Catherine Machalaba, and Jonna A.K. Mazet. 2017. "One Health Proof of Concept: Bringing a Transdisciplinary Approach to Surveillance for Zoonotic Viruses at the Human-Wild Animal Interface." *Preventive Veterinary Medicine* 137 (February): 112–18. <https://doi.org/10.1016/j.prevetmed.2016.11.023>.

Kim Gruetzmacher, William B. Karesh, John H. Amuasi, Adnan Arshad, Andrew Farlow, Sabine Gabrysch, Jens Jetzkowitz, Susan Lieberman, Clare Palmer, Andrea S. Winkler, Chris Walzer, The Berlin principles on one health – Bridging global health and conservation, *Science of The Total Environment*, Volume 764, 2021, 142919, ISSN 0048-9697, <https://doi.org/10.1016/j.scitotenv.2020.142919>.

Kienberger, et al. 2013. "Framing Vulnerability, Risk and Societal Responses: The MOVE Framework." *Natural Hazards* 67 (2): 193–211. <https://doi.org/10.1007/s11069-013-0558-5>.

Kumari, Tanu, and A.S. Raghubanshi. 2020. "The Link between Ecosystem Health and Future Pandemic Risk: An Awakening Facet." *Climate Change and Environmental Sustainability* 8 (2): 247. <https://doi.org/10.5958/2320-642X.2020.00026.5>.

Loh, Elizabeth H, Kris A Murray, and Carlos Zambrana-Torrel. n.d. "50 PUBLICATIONS 3,542 CITATIONS SEE PROFILE," 2.

Machalaba, Catherine, Cristina Romanelli, Peter Stoett, Sarah E. Baum, Timothy A. Bouley, Peter Daszak, and William B. Karesh. 2015. "Climate Change and Health: Transcending Silos to Find Solutions." *Annals of Global Health* 81 (3): 445. <https://doi.org/10.1016/j.aogh.2015.08.002>.

Maini, R., Clarke, L., Blanchard, K. et al. The Sendai Framework for Disaster Risk Reduction and Its Indicators—Where Does Health Fit in?. *Int J Disaster Risk Sci* 8, 150–155 (2017). <https://doi.org/10.1007/s13753-017-0120-2>

Martins, Nunes, Lourenço, and Velez-Castro. 2019. "Flash Flood Risk Perception by the Population of Mindelo, S. Vicente (Cape Verde)." *Water* 11 (9): 1895. <https://doi.org/10.3390/w11091895>.

Marulanda Fraume, Mabel-Cristina, Omar-Darío Cardona A, Paula Marulanda Fraume, Martha-Liliana Carreño T, and Alex H. Barbat. 2020. "Evaluating Risk from a Holistic Perspective to Improve Resilience: The United Nations Evaluation at Global Level." *Safety Science* 127 (July): 104739. <https://doi.org/10.1016/j.ssci.2020.104739>.

Monteil, Charlotte, Peter Simmons, and Anna Hicks. 2020. "Post-Disaster Recovery and Sociocultural Change: Rethinking Social Capital Development for the New Social Fabric."

Morse, Stephen S, Jonna AK Mazet, Mark Woolhouse, Colin R Parrish, Dennis Carroll, William B Karesh, Carlos Zambrana-Torrel, W Ian Lipkin, and Peter Daszak. 2012. "Prediction and Prevention of the next Pandemic Zoonosis." *The Lancet* 380 (9857): 1956–65. [https://doi.org/10.1016/S0140-6736\(12\)61684-5](https://doi.org/10.1016/S0140-6736(12)61684-5).

Olival, K., Hosseini, P., Zambrana-Torrel, C. *et al.* Host and viral traits predict zoonotic spillover from mammals. *Nature* **546**, 646–650 (2017).
<https://doi.org/10.1038/nature22975>

Palacios, G., Lowenstine, L.J., Cranfield, M.R., Gilardi, K.V.K., Lukasik-Braum, M., Kinani, J., Mudakikwa, A., Nyirakaragire, E., Bussetti, A.V., Savji, N., Hutchison, S., Egholm, M., Lipkin, W.I., 2011. Human metapneumovirus infection in wild mountain gorillas, Rwanda. *Emerg. Infect. Dis.* 17, 711–713, <http://dx.doi.org/10.3201/eid1704100883>.

Pandemic Influenza Preparedness and Response: A WHO Guidance Document. Geneva: World Health Organization; 2009. 4, THE WHO PANDEMIC PHASES. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK143061/>

Pinner, Dickon, Matt Rogers, and Hamid Samandari. 2020. "Addressing Climate Change in a Post-Pandemic World," 6.

Plowright, Raina K, Jamie K Reaser, Harvey Locke, Stephen J Woodley, Jonathan A Patz, Daniel J Becker, Gabriel Oppler, Peter J Hudson, and Gary M Tabor. 2021. "Land Use-Induced Spillover: A Call to Action to Safeguard Environmental, Animal, and Human Health." *The Lancet Planetary Health*, March, S2542519621000310. [https://doi.org/10.1016/S2542-5196\(21\)00031-0](https://doi.org/10.1016/S2542-5196(21)00031-0).

PREDICT Consortium. Advancing Global Health Security at the Frontiers of Disease Emergence. One Health Institute, University of California, Davis, December 2020, 596 pp.

Renn, Ortwin, Manfred Laubichler, Klaus Lucas, Wolfgang Kröger, Jochen Schanze, Roland W. Scholz, and Pia-Johanna Schweizer. 2020. "Systemic Risks from Different Perspectives." *Risk Analysis*, December, risa.13657. <https://doi.org/10.1111/risa.13657>.

Renn, O. (2014). *Das Risikoparadox: Warum wir uns vor dem Falschen fürchten*. Frankfurt am Main, Germany: S. Fischer Verlag.

Renn, O. (2016). Systemic risks: The new kid on the block. *Environment: Science and Policy for Sustainable Development*, 58(2), 26–36.

Schmidt, Markus. n.d. "Investigating Risk Perception: A Short Introduction," 16.

Schweizer, Pia-Johanna, Robert Goble, and Ortwin Renn. 2021. "Social Perception of Systemic Risks." *Risk Analysis*, October, risa.13831. <https://doi.org/10.1111/risa.13831>.

Integration of the One Health approach with the Sendai Framework:
Enhancing pandemic risk management in times of global and climate change
Scudellari, Megan. 2020. "How Iceland Hammered COVID with Science." *Nature* 587 (7835): 536–39. <https://doi.org/10.1038/d41586-020-03284-3>.

Sendai framework for disaster risk reduction 2015–2030. In: UN world conference on disaster risk reduction, 2015 March 14–18, Sendai, Japan. Geneva: United Nations Office for Disaster Risk Reduction; 2015.

Taylor LH, Latham SM, Woolhouse ME. Risk factors for human disease emergence. *Philos Trans R Soc Lond B Biol Sci*. 2001 Jul 29;356(1411):983-9. doi: 10.1098/rstb.2001.0888. PMID: 11516376; PMCID: PMC1088493.

The Impact of Globalization on Infectious Disease Emergence and Control: Exploring the Consequences and Opportunities, Workshop Summary - Forum on Microbial Threats. 2006. Washington, D.C.: National Academies Press. <https://doi.org/10.17226/11588>.

United Nations (A/RES/69/283: Sendai Framework for Disaster Risk Reduction 2015–2030, 2015, 283. Resolution adopted by the General Assembly on 3 June 2015

United Nations, Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters, 22 January 2005, A/CONF.206/6, available at: <https://www.refworld.org/docid/42b98a704.html> [accessed 11 November 2021]

Vereinte Nationen, ed. 2021. Towards Post-COVID-19 Resilient Economies. Economic and Social Survey of Asia and the Pacific 2021. New York: United Nations.

Vereinte Nationen, ed. 2021. Towards Post-COVID-19 Resilient Economies. Economic and Social Survey of Asia and the Pacific 2021. New York: United Nations.

Vulnerability and Resilience to Natural Hazards. 2018. Cambridge New York Port Melbourne New Delhi Singapore: Cambridge University Press. <https://ubdata.univie.ac.at/AC14550988>.

Walzer, Chris. 2017. "Beyond One Health—Zoological Medicine in the Anthropocene." *Frontiers in Veterinary Science* 4 (June): 102. <https://doi.org/10.3389/fvets.2017.00102>.

Walzer, Chris. 2020. "COVID-19 and the Curse of Piecemeal Perspectives." *Frontiers in Veterinary Science* 7 (September): 582983. <https://doi.org/10.3389/fvets.2020.582983>.

Wenham, Clare, Alexandra Phelan, Mark Eccleston-Turner, and Sam Halabi. n.d. "ILIAID IHR REFORM WHITE PAPER 1 REFORMING THE DECLARATION POWER FOR GLOBAL PUBLIC HEALTH EMERGENCIES UNDER THE INTERNATIONAL HEALTH REGULATIONS (2005)," 25.

WHO Technical Guidance Notes on Sendai Framework Reporting for Ministries of Health. 2020.

Integration of the One Health approach with the Sendai Framework:
Enhancing pandemic risk management in times of global and climate change
WHO: Technical Workshop on Concepts and Technical Guidance for Health EDRM (Geneva, 21–23 November 2018) p.23

WHO 20 May 2021 New international expert panel to address the emergence and spread of zoonotic diseases Joint News Release Geneva/Paris/Rome

Wright, Natalie, Lucy Fagan, Jostacio M. Lapitan, Ryoma Kayano, Jonathan Abrahams, Qudsia Huda, and Virginia Murray. 2020. "Health Emergency and Disaster Risk Management: Five Years into Implementation of the Sendai Framework." *International Journal of Disaster Risk Science* 11 (2): 206–17. <https://doi.org/10.1007/s13753-020-00274-x>.

Zinsstag, Jakob, Lisa Crump, Esther Schelling, Jan Hattendorf, Yahya Osman Maidane, Kadra Osman Ali, Abdifatah Muhummed, et al. n.d. "Climate Change and One Health," 9.

<https://www.undrr.org/implementing-sendai-framework/sf-and-sdgs>
(http://www.oneworldonehealth.org/sept2004/owoh_sept04.html
<https://www.cdc.gov/onehealth/basics/index.html>

9. Abstract

As the world witnesses ongoing deaths due to SARS-CoV-2, the complex and unpredictable impacts of the pandemic reveal the interwoven interdependencies that challenge pandemic risk management. The effects of global and climate change on humans, animals, and the environment are caused by pollution, ecosystem degradation, deforestation, habitat loss and fragmentation, biodiversity decline, overfishing, land-use changes, urbanization, industrialization, and social inequities that escalate the conflict between humans and nature. The One Health approach advocates the irreversible bond of human, animal, and environmental health. The Sendai Framework for Disaster Risk Reduction 2015–2030 was endorsed by the United Nations Office for Disaster Risk Reduction and ratified by 187 Member States aiming to substantially reduce disaster risks.

This study investigates the interlinkages between pandemics, global changes and climate change and evaluates the potential of integrating the One Health approach with the Sendai Framework to enhance pandemic risk comprehensively. The qualitative research is based on the One Health Berlin Principles, the Sendai Framework priorities, and Bangkok Principles related to pandemic risk management.

The findings demonstrate a strong correlation and correspondence between the One Health approach and the Sendai Framework with considerable potential to enhance pandemic risk management.

10. Kurzfassung

Die weltweiten Todesfälle aufgrund der SARS-CoV-2 neben den komplexen und nicht prädiktablen Folgen der Pandemie offenbaren die verflochtenen Interdependenzen die für das Risiko Management der Pandemien Herausforderungen stellen. Die Auswirkungen des globalen Wandels und des Klimawandels auf Menschen, Tiere, und Umwelt durch Umweltverschmutzung, Ökosystemdegradation, Abholzung, Verlust und Fragmentierung der Habitate, Biodiversitätsverlust, Überfischung der Meere, Veränderungen in der Bodennutzung, Urbanisierung, Industrialisierung, und soziale Diskrepanzen führen zur Eskalierung des Konfliktes zwischen Mensch und Natur.

Der One Health Ansatz vertritt die unwiderrufliche Verbindung der Gesundheit von Mensch, Tier, und Umwelt durch die Berliner Prinzipien. Verabschiedet von den Vereinten Nationen für die Verringerung des Katastrophenrisikos und ratifiziert von 187 Mitgliedsstaaten, stellt das Sendai Rahmenwerk für Katastrophenvorsorge 2015–2030 das globale Werkzeug zur Katastrophenrisikoreduzierung dar.

Ziel dieser Masterarbeit war eine Übersicht über die Vernetzung zwischen Pandemien, globalem Wandel, und Klimawandel zu erstellen und die Bewertung des Potentials der Integration des One Health Ansatzes mit dem Sendai Rahmenwerk damit diese das Risiko Management für Pandemien bereichern. Die qualitative Forschung basiert auf der Analyse der Berliner Prinzipien des One Health Ansatzes, der gesundheitsrelevanten Paragraphen der Prioritäten und der Bangkok Prinzipien des Sendai Rahmenwerkes.

Die Ergebnisse weisen auf eine starke Korrelation zwischen dem One Health Ansatz und dem Sendai Rahmenwerk hin und sind ein nennenswertes Potential zur Bereicherung des Risiko Managements für Pandemien.