

CLIMATE CHANGE AND ITS IMPACT ON AGRICULTURE, HEALTH, PSYCHOLOGY, HUMAN RESOURCE MANAGEMENT, AND FISHERY PRODUCT TECHNOLOGY: A MULTIDISCIPLINARY REVIEW

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Abstract

Climate change is one of the greatest global challenges of the 21st century, impacting various aspects of human life. Rising global temperatures, shifting rainfall patterns, increasing extreme weather events, and rising sea levels have significantly impacted public health, psychological well-being, human resource management, and the fisheries industry. This article aims to examine the impacts of climate change in a multidisciplinary manner by integrating the latest research findings. The method used is a literature review through a review of scientific articles, international reports, and policy documents published in recent years. In the health sector, climate change increases the incidence of infectious diseases, heat-related illnesses, malnutrition, and environmental health disorders. From a psychological perspective, people experience increased stress, anxiety, depression, and eco-anxiety due to environmental uncertainty and loss of livelihoods. In human resource management, organizations are required to develop adaptation strategies through capacity building, occupational safety, organizational flexibility, and the development of green competencies. In the fisheries technology sector, climate change affects the quality of raw materials, increases the risk of post-harvest damage, and encourages innovation in processing, packaging, and more efficient cold chain technologies. A multidisciplinary approach is an important strategy in increasing community resilience to climate change.

Keywords: climate change, health, psychology, human resource management, fishery product technology.

Introduction

Climate change has become a strategic issue affecting global development. Increased greenhouse gas concentrations due to human activities have led to an increase in the average temperature of the Earth's surface, changes in seasonal patterns, and an increase in the frequency and intensity of floods, droughts, storms, and other extreme weather events. These phenomena not only alter the global climate system but also have multidimensional impacts on economic stability, social well-being, public health, food security, and sustainable development in various countries (Intergovernmental Panel on Climate Change [IPCC], 2023; United Nations, 2023). The latest IPCC report confirms that the increasing rate of global warming has increased risks to human life systems and ecosystems, making adaptation and mitigation efforts a key agenda for sustainable development (IPCC, 2023).

Indonesia, as an archipelagic nation with tropical characteristics, is highly vulnerable to the impacts of climate change. Increasing climate variability, rising air temperatures, changing rainfall patterns, and the increasing incidence of hydrometeorological disasters have put pressure on various development sectors (Meteorology, Climatology, and Geophysics Agency, 2024). In addition to impacting environmental conditions, climate change also increases the risk of environmentally-related diseases, vector-borne diseases, air quality disturbances, and increases the burden on public health care systems (World Health Organization, 2023). The organization estimates that climate change will be a major cause of increased global morbidity and mortality in the coming decades due to increased exposure to extreme heat, infectious diseases, malnutrition, and environmental health problems.

In addition to its impact on physical health, climate change also has psychological consequences that are receiving increasing attention in various studies. The increasing frequency of natural disasters, environmental uncertainty, loss of livelihoods, and threats to the future have contributed to increased stress, anxiety, depression, post-traumatic stress disorder, and eco-anxiety in various groups (American Psychological Association, 2021; Clayton et al., 2021). These psychological impacts are experienced not only by disaster victims but also by communities with a strong concern for environmental sustainability.

Climate change is also driving transformation in human resource management. Organizations are required to develop an adaptive, healthy, resilient workforce that is competent in addressing various climate risks. Rising workplace temperatures, operational disruptions due to disasters, and changing work patterns require the implementation of *Green Human Resource Management* (Green HRM) strategies, improvements in occupational safety and health, and the development of sustainability-oriented organizational capacity (Renwick et al., 2022; Jabbour & de Sousa Jabbour, 2023). In the fisheries technology sector, changes in ocean temperature, ocean acidification, and degradation of aquatic environments impact raw material availability, catch quality, and food safety. These conditions have driven the development of various technological innovations, such as cold chain systems, active and intelligent packaging, environmentally friendly preservation technologies, and the utilization of fishery waste as value-added products to improve the efficiency and sustainability of the fisheries industry (Food and Agriculture Organization of the United Nations, 2024; Naylor et al., 2021). Based on these conditions, climate change can no longer be viewed solely as an environmental issue, but rather as a multidisciplinary challenge that requires collaboration between health, psychology, human resource management, and fisheries technology. An interdisciplinary approach is crucial for developing comprehensive adaptation strategies to support sustainable development, enhance community resilience, and strengthen institutional capacity to address future climate change risks.

Impact of Climate Change on Health

Climate change has been recognized as one of the greatest threats to public health in the 21st century. Rising global temperatures, changing rainfall patterns, the increasing frequency of extreme weather events, and environmental degradation directly and indirectly impact the determinants of health. These impacts include increased morbidity and mortality, malnutrition, and increased burden on healthcare systems in various countries (World Health Organization, 2023; Romanello et al., 2024). Exposure to extreme temperatures due to heat waves increases the risk of health problems such as heat stroke, dehydration, heat exhaustion, impaired kidney function, and an increased incidence of cardiovascular and respiratory diseases. The elderly, children, outdoor workers, and individuals with chronic illnesses are among the populations most vulnerable to these impacts. Several studies have shown that increasing environmental temperatures are also associated with increased hospitalizations and mortality due to ischemic heart disease, stroke, and chronic lung disorders (World Health Organization, 2023; Romanello et al., 2024). Changing rainfall patterns and increased flooding increase the risk of water-borne diseases. Contamination of clean water sources due to flooding increases the incidence of diarrhea, leptospirosis, cholera, hepatitis A, and various other gastrointestinal infections. Conversely, prolonged periods of drought can reduce the quality and availability of clean water, thereby worsening environmental sanitation and increasing the risk of infectious diseases in the community (Levy et al., 2022).

Furthermore, climate change affects the geographic distribution and population dynamics of various disease vectors. Increased air temperature and humidity expand the habitats of *Aedes aegypti* and *Anopheles mosquitoes*, increasing the risk of transmission of dengue fever, malaria, chikungunya, and other vector-borne diseases. Seasonal changes can also extend the reproductive period of vectors, increasing the intensity of disease transmission in previously relatively safe areas (Ryan et al., 2021; World Health Organization, 2023). Disruptions to food systems due to climate change also have consequences for the nutritional status of communities. Decreased fisheries productivity, disruptions to food supply chains, and rising food prices can increase the prevalence of malnutrition, stunting, micronutrient deficiencies, and food insecurity, particularly among children, pregnant women, the elderly, and low-income groups. These conditions have the potential to worsen public health in the long term (Food and Agriculture Organization of the United Nations, 2023). To address these challenges, strengthening health systems that are adaptive to climate change is essential. Possible strategies include increasing the capacity of health care facilities, strengthening climate-based disease surveillance systems, developing early warning systems, providing clean water and adequate sanitation, improving public health education, and integrating climate information into national health policies. A cross-sectoral approach involving governments, health institutions, academics, and communities is key to increasing health system resilience to the impacts of climate change (World Health Organization, 2023; Romanello et al., 2024).

The Impact of Climate Change on Psychology

In addition to impacting physical health, climate change also impacts people's mental health and psychological well-being. In recent years, the psychological impacts of climate change have received increasing attention because the increasing frequency of hydrometeorological disasters, such as floods, droughts, storms, wildfires, and heat waves, has caused significant emotional distress for individuals and communities. These conditions increase the prevalence of mental health disorders, such as anxiety, depression, post-traumatic stress disorder, sleep disturbances, and even reduced quality of life (American Psychological Association, 2021; Cunsolo & Ellis, 2018).

Communities that depend on natural resources for their livelihoods, such as fishers, coastal communities, and communities living in disaster-prone areas, are among the most vulnerable to psychological stress caused by climate change. Loss of income, economic uncertainty, housing damage, and disruption to social activities increase the risk of chronic stress and mental health disorders. These stresses not only affect individuals but also impact family relationships, social cohesion, and the overall well-being of communities (Berry et al., 2018; Hayes et al., 2018). One psychological phenomenon that has developed in the last decade is *eco-anxiety*, a persistent feeling of anxiety, fear, and worry about the threat of environmental damage and climate change. Unlike clinical anxiety disorders, *eco-anxiety* is an emotional response to real threats to environmental sustainability. This phenomenon is commonly found among young people, academics, healthcare workers, and individuals with a strong concern for environmental issues. If not managed properly, *eco-anxiety* can reduce motivation, productivity, decision-making ability, and psychological well-being (Clayton et al., 2021; Hickman et al., 2021).

Climate change also impacts social dynamics. Competition for increasingly limited resources, migration due to disasters, and increasing social inequality have the potential to trigger intergroup conflict, reduce social trust, and weaken a community's social capital. These conditions indirectly worsen mental health as individuals lose a sense of security, social support, and certainty about the future (Berry et al., 2018). Facing these various impacts, adaptation strategies are needed that focus not only on physical aspects but also address community mental health. Community-based psychosocial approaches, providing easily accessible counseling services, strengthening social capital, disaster mitigation and preparedness education, and developing programs to increase individual and community resilience are essential components in building psychological resilience to climate change. Integrating mental health services into climate change adaptation policies is also necessary to improve communities' capacity to cope with various environmental risks in the future (World Health Organization, 2023; Clayton et al., 2021).

The Impact of Climate Change on Human Resource Management

Climate change has shifted the paradigm of human resource (HR) management across various organizational sectors. Climate risk is no longer viewed solely as an environmental issue, but also as a factor impacting worker health, organizational productivity, operational continuity, and company competitiveness. The increasing frequency of heat waves, floods, storms, and extreme weather events disrupts work activities, increases operational costs, and requires organizations to develop more adaptive and sustainability-oriented HR management systems (International Labour Organization, 2024). Exposure to high ambient temperatures directly impacts workers' physical and cognitive work capacity. Workers working outdoors, such as in the construction, transportation, fisheries, agriculture, and manufacturing sectors, are at higher risk of heat exhaustion (*heat stress*), dehydration, decreased concentration, and increased workplace accidents. These conditions lead to decreased productivity, increased absenteeism, increased healthcare costs, and reduced overall organizational effectiveness (International Labour Organization, 2024; Kjellstrom et al., 2021).

To address these challenges, organizations need to develop a **Green Human Resource Management (Green HRM) approach** as part of their climate change adaptation strategy. Green HRM is a human resource management approach that integrates sustainability principles into all management functions, from recruitment and training to competency development, performance appraisals, and rewards, to the development of an environmentally friendly organizational culture. Through this approach, organizations not only increase employee environmental awareness but also build adaptive capacity to address climate change risks (Jennifer Renwick et al., 2022; Charbel José Chiappetta Jabbour & Ana Beatriz Lopes de Sousa Jabbour, 2023). Improving human resource capacity through education and training is a crucial element in supporting organizations that are resilient to climate change. Training programs on climate change mitigation and adaptation, climate-risk-based occupational safety and health, energy efficiency, waste management, and the use of low-carbon technologies can enhance employee competency while strengthening a sustainable work culture. Furthermore, organizations need to develop workplace safety policies that take extreme weather conditions into account, including scheduling working hours, providing heat protection, and

early warning systems for workers in high-risk locations (International Labour Organization, 2024). Digital transformation is also a crucial strategy for increasing organizational resilience to the impacts of climate change. The use of digital technology, artificial intelligence, data analytics, remote working systems, and flexible work models enables organizations to maintain productivity during disruptions caused by disasters or extreme weather conditions. Digitalization not only improves operational efficiency but also contributes to carbon emissions reductions through reduced mobility and more efficient resource use (OECD, 2023). Beyond technological aspects, adaptive leadership is a key factor in navigating the uncertainty caused by climate change. Organizational leaders are required to possess the ability to manage risk, make data-driven decisions, build effective communication, and encourage innovation and cross-sector collaboration. Adaptive leadership can increase employee engagement, strengthen organizational resilience, and create a work culture that is responsive to dynamic environmental changes (Jabbour & Jabbour, 2023). Overall, climate change demands a comprehensive transformation in human resource management. The integration of Green HRM, strengthening occupational safety and health, developing green competencies, organizational digitalization, and adaptive leadership are complementary strategies to enhance organizational competitiveness and sustainability in facing future climate change challenges.

Impact of Climate Change on Fishery Product Technology

Climate change has a significant impact on both the capture fisheries sector and the fishery processing industry. Rising sea surface temperatures, ocean acidification, changes in salinity, decreased dissolved oxygen levels, and the increasing frequency of extreme weather events have altered the productivity of aquatic ecosystems and the distribution of various fish species. Shifts in fishing grounds (*fish stock redistribution*) have caused fluctuations in the availability of raw materials for the processing industry, thus affecting production continuity, supply chain efficiency, and the economic stability of the fisheries sector (Food and Agriculture Organization of the United Nations, 2024; Barange et al., 2023).

Changes in aquatic environmental conditions also impact the quality of the catch. Higher temperatures accelerate enzyme activity and the growth of spoilage and pathogenic microorganisms, thus accelerating the decline in fish freshness after capture. Furthermore, changes in water quality have the potential to increase the accumulation of biological and chemical contaminants, which can impact food safety and reduce the competitiveness of fishery products in the global market (Love et al., 2021; Food and Agriculture Organization of the United Nations, 2024). To address these challenges, innovation in fishery technology is a key factor in maintaining product quality during handling, storage, and distribution. Developing an efficient cold chain system, *from the fishing process to marketing*, can slow the growth of microorganisms, reduce product damage, and extend the shelf life of fish. Furthermore, the application of *individual* quick freezing, energy-efficient drying, *high-pressure processing*, and other non-thermal technologies is increasingly emerging as alternatives to maintain product quality while reducing energy consumption (Ashie & Simpson, 2022).

Developments in packaging technology also play a crucial role in maintaining the quality of fishery products. Active packaging *containing* natural antimicrobial or antioxidant compounds, as well as intelligent packaging *equipped* with freshness indicators, temperature sensors, and Internet of Things (IoT) technology, enable real-time product quality monitoring during the distribution process. The integration of digital sensors, artificial intelligence, and data analytics supports more accurate quality control systems, thereby minimizing post-harvest losses and increasing consumer confidence in food safety (Ahmed et al., 2022). In addition to maintaining product quality, climate change is also driving the implementation of the circular economy concept *in the fisheries industry*. Processing waste, previously considered a byproduct, is now being utilized to create various value-added products, such as collagen, gelatin, bioactive peptides, fish oil, chitosan, animal feed, organic fertilizer, biomaterials, and even raw materials for the pharmaceutical and cosmetics industries.

This approach not only reduces environmental pollution but also increases resource efficiency, strengthens industrial resilience, and supports the achievement of the Sustainable Development Goals *through the application of* responsible production and consumption principles (Naylor et al., 2021; Food and Agriculture Organization of the United Nations, 2024). Going forward, the transformation of fisheries technology needs to be directed at developing production systems that are more adaptive to climate change through the integration of digital technology, energy efficiency, renewable energy utilization, and the implementation of international food safety standards. Synergy between the government, universities, research institutions, and industry is crucial in accelerating technological innovation that can increase the competitiveness of fisheries products while strengthening the fisheries sector's resilience to the impacts of climate change.

An Integrated Approach to Climate Change

Multidisciplinary Approach to Climate Change Adaptation

The complexity of climate change impacts demonstrates that solutions cannot be achieved through a sectoral approach alone. Climate change is a multidimensional problem that impacts physical health, mental health, labor productivity, and food production and security systems. Therefore, adaptation strategies require a multidisciplinary approach that integrates health sciences, psychology, human resource management, fisheries technology, and evidence-based public policy support. This integrated approach enables the development of more comprehensive, effective, and sustainable policies to increase community resilience to various climate change risks (Intergovernmental Panel on Climate Change, 2023).

In the health sector, strengthening climate *-resilient health systems* is a top priority. This includes increasing the capacity of health care facilities, strengthening climate-based disease surveillance, developing early warning systems, integrating climate data with health data, and improving the preparedness of health workers to respond to extreme weather events and climate-related diseases. This approach is expected to reduce morbidity and mortality due to health risks associated with climate change (World Health Organization, 2023).

From a psychological perspective, adaptation strategies need to pay greater attention to community mental health. Developing community-based psychosocial services, providing accessible counseling, disaster preparedness education, and programs to increase individual and community resilience are essential components in mitigating the psychological impacts of climate change. Integrating mental health services into national adaptation policies is also necessary to ensure communities are better equipped to cope with environmental uncertainty and the various socio-economic pressures posed by climate change (Clayton et al., 2021; World Health Organization, 2023). In an organizational context, implementing **Green Human Resource Management (Green HRM)** is a crucial strategy for enhancing the adaptive capacity of the workforce. Organizations need to integrate sustainability aspects into recruitment, training, competency development, performance appraisals, and reward systems. Furthermore, strengthening a sustainability-oriented work culture, implementing climate-risk-based occupational health and safety policies, digitizing business processes, and developing adaptive leadership will enhance organizational resilience in the face of disruptions caused by climate change (International Labour Organization, 2024; Jabbour & Jabbour, 2023).

In the fisheries technology sector, adaptation focuses on developing technologies capable of maintaining product quality, safety, and sustainability amidst changing environmental conditions. Strengthening the cold chain system, utilizing active and intelligent packaging, implementing digital sensors and the Internet of Things (IoT) for real-time quality monitoring, and developing energy-efficient processing technologies are important strategies for reducing post-harvest losses and increasing industrial competitiveness. Furthermore, implementing a circular economy concept through the utilization of fisheries waste into value-added products supports resource efficiency while reducing environmental impacts (Food and Agriculture Organization of the United Nations, 2024). The success of adaptation strategies depends heavily on cross-sector collaboration. The government plays a role in developing evidence-based regulations and policies, universities contribute through research and innovation, businesses implement sustainable technologies and practices, and communities play a key role in implementing various adaptation strategies at the local level. This synergy between stakeholders will accelerate knowledge transfer, enhance institutional capacity, and strengthen social, economic, and environmental resilience in the face of climate change impacts.

Thus, a multidisciplinary approach that integrates adaptive health systems, comprehensive mental health services, the application of Green Human Resource Management, and innovation in fisheries technology is an important foundation in building communities and organizations that are resilient to climate change. The integration of these four areas is expected to support the achievement of **the Sustainable Development Goals (SDGs)**, especially the goals regarding good health and well-being (SDG 3), decent work and economic growth (SDG 8), industry, innovation, and infrastructure (SDG 9), responsible consumption and production (SDG 12), and climate change management (SDG 13).

Conclusion

Climate change has become a multidimensional challenge with significant impacts on public health, psychological well-being, human resource management, and the sustainability of the fisheries industry. Rising global temperatures, changing rainfall patterns, and increasingly frequent extreme weather events contribute to the rise in climate-related diseases, the spread of vector-borne diseases, heat-related health problems, and the increased burden on the healthcare system. At the same time, climate change also triggers various psychological problems, such as stress, depression, post- *traumatic stress disorder*, and *eco-anxiety*, which have the potential to reduce the quality

of life, productivity, and social resilience of communities. In an organizational context, climate change demands a transformation in human resource management strategies through the implementation of **Green Human Resource Management (Green HRM)**, strengthening climate-risk-based occupational safety and health, enhancing green competencies, digitizing work processes, and developing adaptive leadership. This transformation is a crucial prerequisite for organizations to increase resilience, maintain workforce productivity, and maintain operational sustainability amidst increasing uncertainty caused by climate change. In the fisheries technology sector, climate change is driving the need for continuous innovation to maintain product quality, safety, and competitiveness. The development of cold chain systems, *active and intelligent packaging* technology, the use of digital sensors and the Internet of Things (IoT), energy-efficient processing technology, and the application of circular economy principles through the utilization of fisheries byproducts into value-added products are important strategies for increasing resource efficiency and strengthening the resilience of the fisheries industry to changing environmental conditions. Based on the results of this study, it can be concluded that a sectoral approach is no longer adequate to address the complex impacts of climate change. A multidisciplinary approach is needed that integrates *climate-resilient health systems*, comprehensive mental health services, sustainability-oriented human resource management, and adaptive, low-carbon fisheries technology innovation. Collaboration between the government, universities, research institutions, the business world, and the community is a key factor in generating evidence-based policies, accelerating innovation, and increasing adaptive capacity across various sectors. This article also emphasizes that future research needs to be directed at developing adaptation models that integrate aspects of health, psychology, Green HRM, and fishery product technology within a comprehensive conceptual framework. This approach is expected to produce more effective adaptation strategies in strengthening community resilience, supporting sustainable economic development, and contributing to the achievement of **the Sustainable Development Goals (SDGs)**, particularly SDG 3 (Health and Well-Being), SDG 8 (Decent Work and Economic Growth), SDG 9 (Industry, Innovation, and Infrastructure), SDG 12 (Responsible Consumption and Production), and SDG 13 (Addressing Climate Change).

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