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THE EFFECTS OF CLIMATE CHANGE: AN OVERVIEW OF THE ECOLOGICAL AND ECONOMIC CONSEQUENCES

UČINCI KLIMATSKIH PROMJENA: PREGLED EKOLOŠKIH I GOSPODARSKIH POSLJEDICA

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SUMMARY

Climate change, a relentless force of nature, poses a significant threat to ecosystems and endangers livelihoods. This review examines the diverse impacts of climate change, ranging from shifting seasons and retreating glaciers to rapidly rising sea levels. These changes lead to identifiable risks such as rising temperatures, dwindling groundwater supplies, loss of biodiversity, reduced forestry and agricultural productivity, and increased health risks. The impacts go beyond the ecological sphere and permeate global economies. Particularly important is the disproportionate impact on countries with limited resources and lower socio-economic status. In addition, this report examines the complicated dynamics of international cooperation on climate policy, and underscores the urgent need for collective efforts to address the escalating environmental crisis. Carbon emissions are the main cause of global climate change. In response, the world's nations have come together under the Kyoto Protocol, which is based on the recognition of different national capacities to address climate-related challenges. The transition from the Kyoto Protocol to the Paris Agreement underscores the shift towards collective responsibility for climate change and emphasizes international cooperation and efforts to build resilience, particularly for the benefit of vulnerable nations. Therefore, this synthesis of systematic review procedures and bibliometric analysis methods underscores the need for coordinated action to mitigate the looming environmental crisis. Strategic planning and implementation are essential to proactively mitigate the negative effects of climate change. Efforts such as afforestation, reforestation and reducing dependence on fossil fuels, as well as the extensive use of renewable energy sources such as wind, solar and geothermal sources, offer significant potential to reduce greenhouse gas emissions.

KEY WORDS: climate change, environment, economy, low-income countries, Kyoto protocol

Abbreviations: CIRA: Climate Impact Risk Assessment; UHI: urban heat island**;** WHO: World Health Organisation; WBGT: Wet Bulb Globe Temperature; IAMs: Integrated Assessment Models; UNFCCC: United Nations Framework Convention on Climate Change; LDC: least developed countries; INDCs: Intended Nationally Determined Contribution

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INTRODUCTION
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Climate change is one of the most important factors that affect the environment and is crucial for the survival of living beings (Rawat et al. 2024). Due to the complex and ambiguous nature of human-Earth interactions, analyzing the effects of climate change is challenging (Kemp et al. 2022). The US environmental agencies Nodal and Climate Impact Risk Assessment (CIRA) have provided a comprehensive overview of six major sectors affected by temperature variability, impacting the overall economy (Kemp et al. 2022). These projects were primarily aimed at understanding the relationship between temperature rise and the country's economy. Various studies show that around 33% of the world's population is exposed to major heatwaves every five years, even though the global temperature is reduced by 2˚C on average (Johansen 2023). The human body is unable to automatically lower the temperature due to the wet bulb temperature limit (above 35 degrees); this limit causes the body temperature to skyrocket, leading to illness and death (Mora et al. 2017). From a medical point of view, a healthy human body would only survive six hours at 45°C and 50% humidity (Wolkoff 2018).

The phenomenon of climate change is an "impending catastrophe" that is expected to severely affect global agricultural yields over this century (Hannigan 2022). Given the severity of the deterioration in agricultural production, the African agricultural model represents a miniature view (Truelove et al. 2023). With a global average temperature increase of about 1.5˚C by the end of 2050, the average temperature of the African continent would rise disproportionately by a colossal 3 to 4 alarming degrees over the same period (Soeder 2022). This will have a direct impact on the total yield (8 to 22%) of staple crops in the region if not counteracted in time (Schlenker and Lobell 2010). The process of climate change is confusing in that some parts of the globe are becoming wetter while others are drying out severely, affecting the impact of the hydrological cycle. A shift in rainfall patterns from much to little rain has led to unusual changes in agricultural yields. (Upadhyay 2020). The warmer climate forces plant and animal species to move upwards and this transition leads to an increased risk for the survival of these species, which increases their extinction. Upadhyay (2020) confirmed the vulnerability of polar species to rising temperatures. Forestry is also severely affected, with increased wildfires, pest outbreaks, and diseases threatening forest ecosystems (Clark et al. 2016). Forests, which serve as important carbon sinks, are impaired in their ability to sequester carbon due to climate stressors. These stressors are changing the composition and productivity of forests and threatening biodiversity. This situation underlines the urgent need for integrated management strategies to mitigate the impacts of climate change on both agriculture and forestry. Against this background, this review summarizes scientific studies on the effects of climate change on populations at different levels.

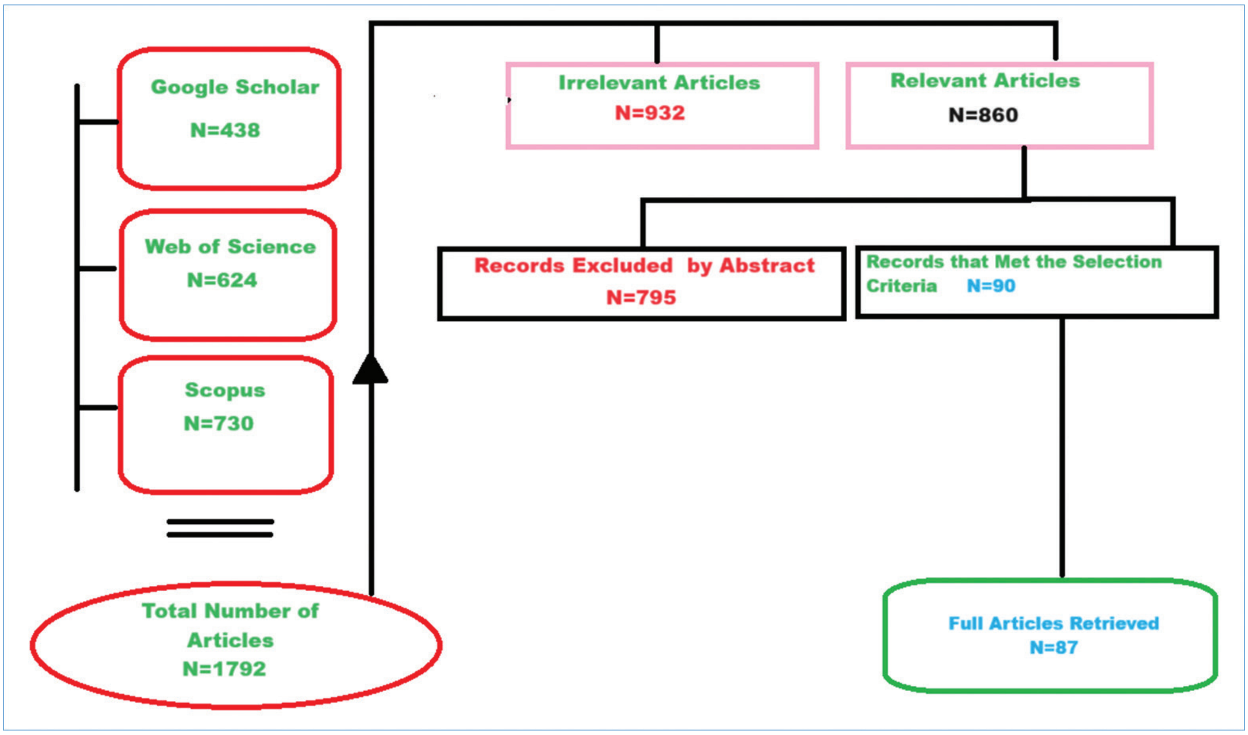

Figure 1. Flowchart showing the selection of articles
Slika 1. Dijagram toka koji prikazuje odabir članaka

METHODOLOGY
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A combination of systematic review procedures and bibliometric analysis methods were used to select and analyze the publications from various databases, including Web of Science, Scopus and Google Scholar. These methods included literature search, screening and selection, data extraction, data synthesis and analysis, and reporting (Anik et al. 2023). Keywords used in the search included "climate change mitigation", "climate adaptation", "environmental economics", "agroforestry and climate", "heat stress" and "international climate policy". In addition, terms such as "food security and climate change", "temperature" "human health and climate", "climate change and ecosystem" were included.

The inclusion criteria targeted studies published between 2000 and 2024 and focused on peer-reviewed journal articles, book chapters and reputable reports from international organizations that addressed the environmental, economic and international cooperation aspects of climate change. Exclusion criteria were preprints, opinion pieces, editorials, non-English language studies and articles that did not contain substantial empirical or theoretical contributions. The screening process included an initial review of titles and abstracts to determine relevance, followed by a full-text assessment of potentially relevant studies to ensure that they met the inclusion criteria. Data extraction was carefully conducted, with key information from each included study compiled in a structured data extraction form. This information included study details (author(s), publication year and source), research focus (objectives), methods (qualitative, quantitative or mixed) and relevance (importance to the aims of the review and contribution to understanding the dynamics of climate change).

The selection process is comprehensively illustrated in Figure 1.

An initial literature search in three databases yielded a total of 1,792 publications. In order to eliminate irrelevant entries, a cross-check of DOIs and titles was carried out, which narrowed the selection down to 860 unique publications. After a further review of the abstracts, 795 publications were excluded as they did not meet the specified selection criteria. Consequently, 90 articles were shortlisted, of which 87 full texts were successfully retrieved for further analysis.

A two-way clustering heat map analysis was used to examine the correlation between publications dealing with climate impacts and specific years. In addition, this analysis illustrated the distribution of publication frequency across the selected years in relation to the identified climate impacts.

RESULTS AND DISCUSSION
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Based on the literature review and our analysis, we have identified 10 likely impacts of climate change, including: Agriculture, Agroforestry, Drought, Economy, Ecosystem, Food Security, Health, Heat Stress, Policy, and Temperature (Table 1). These categories are explained in more detail in

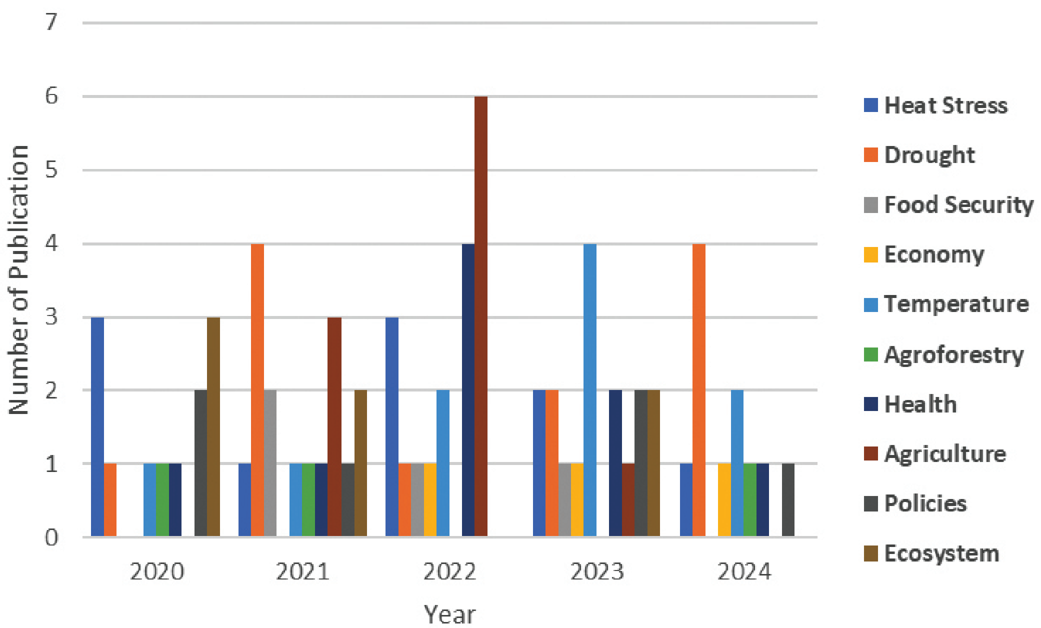

Figure 2. Bar chart showing the number of studies including topics per year of publication
Slika 2. Stupičasti dijagram koji prikazuje broj studija uključujući teme po godini objavljivanja

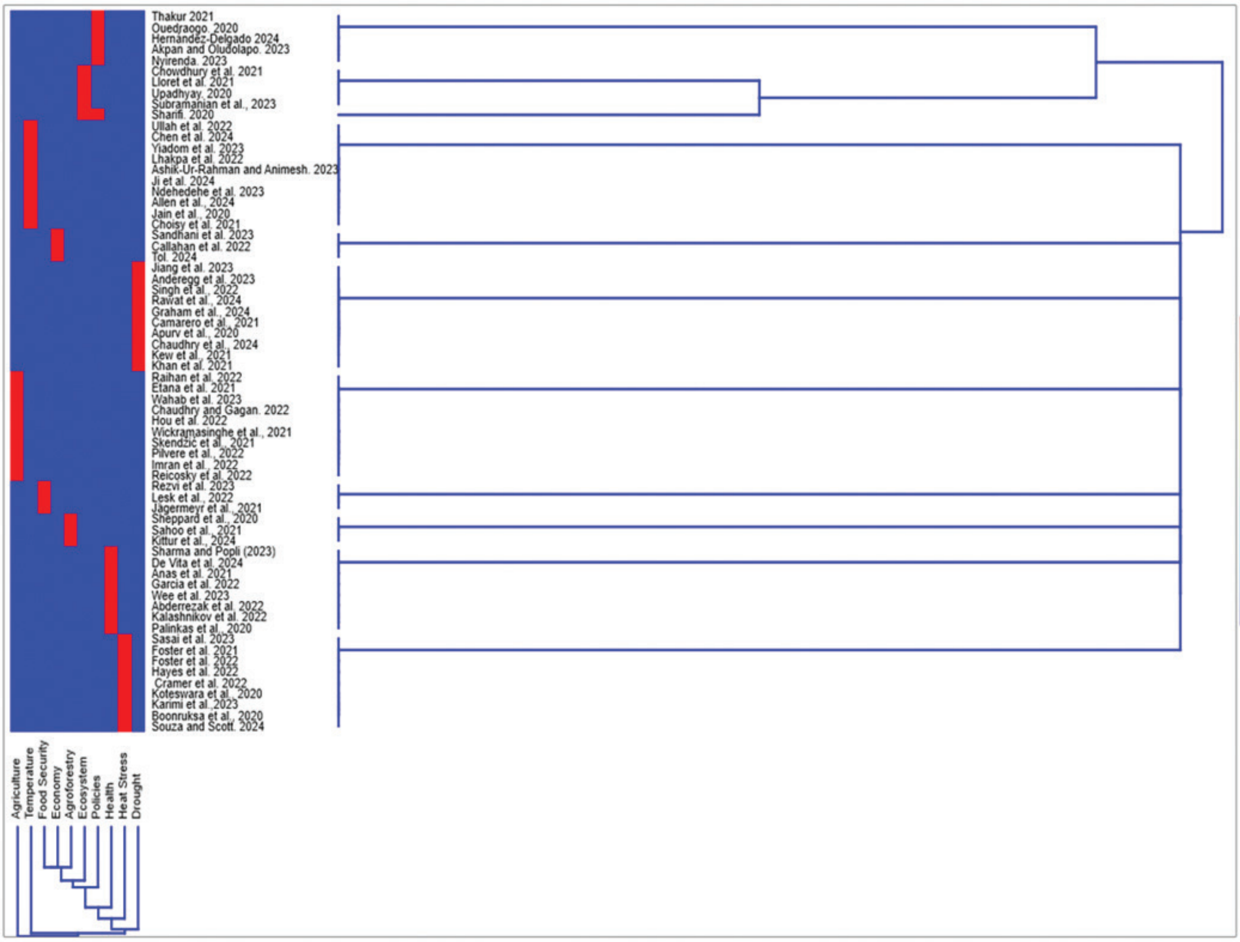

Figure 3. Two-way cluster heat map analysis revealing the association of publication on climatic impacts across the selected years (2021-2024)
Slika 3. Analiza dvosmjerne klasterske toplinske karte koja pridružuje publikacije o klimatskim utjecajima odabranim godinama (2021.-2024.)

the following text, and the specific findings of each publication are listed in Table 2.

We analysed the frequency of occurrence of the topics in the publications over the years, as shown in Figure 2. These trends are characterised by their relevance, a concept introduced by Velten et al. (2015). Persistence refers to the proportion of years in which a topic is mentioned in the literature over the entire years analysed, while relevance indicates the average proportion of studies dealing with a topic in relation to all studies in a given year. Among the topics analysed, "agriculture", "health", "drought" and "temperature" prove to be particularly persistent, as most publications belong to these topics (Figure 2). The two-way clustering analysis revealed two primary clusters regarding the impacts of climate change in the selected years (2020-2024) (Figure 3). Cluster I comprises the majority of impacts, including agroforestry, drought, economy, ecosystem, food security, health, heat stress, policy and temperature. The studies published in 2020, 2021, 2023 and 2024 correspond to this cluster. In contrast, Cluster II only includes agriculture, indicating a unique climate impact in 2022, the year with the highest number of publications. A complete overview of the publications on the selected topic can be found in Table 1, Figure 3.

Ecosystem, drought, forest and climate change – *Ekosustavi, suše, šume i klimatske promjene*

Climate has a considerable influence on ecosystems. It fundamentally controls the distribution of ecosystems, the range of species and process rates on Earth (Allen et al. 2024). Climate change affects ecosystems in different ways. For example, warming may force species to move to higher latitudes or altitudes where temperatures are more favorable for survival (Rawat et al. 2024). Frequently occurring biological events have a significant impact on ecological relationships and serve as a signal for climatic responses (Subramanian et al. 2023). Any change in climatic conditions, such as a rise in temperature or fluctuating precipitation patterns, is accurately registered by species. Phenological shifts in birds are associated with earlier migration and breeding. There is empirical evidence for a robust phenological shift in terrestrial organisms compared to their aquatic counterparts due to the laborious tracking mechanism of marine organisms.

Table 1. Predicted impacts of climate change according to the processed literature articles
Tablica 1. Predviđeni utjecaji klimatskih promjena prema obrađenim znanstvenim radovima

Projected impacts	Authors and publication year
Agriculture (10)	Hou et al. 2022 Reicosky et al. 2022 Skendžić et al. 2021 Etana et al. 2021 Wickramasinghe et al. 2021 Chaudhry and Gagan. 2022 Imran et al. 2022 Wahab et al. 2023 Pilvere et al. 2022 Raihan et al. 2022
Agroforestry (3)	Kittur et al. 2024 Sahoo et al. 2021 Sheppard et al. 2020
Drought (12)	Rawat et al. 2024 Graham et al. 2024 Camarero et al. 2021 Kew et al. 2021 Anderegg et al. 2023 Chaudhry et al. 2024 Apurv et al. 2020 Graham et al. 2024 Jiang et al. 2023 Singh et al. 2022 Khan et al. 2021 Kew et al. 2021
Economy (3)	Tol 2024 Callahan et al. 2022 Sandhani et al. 2023
Ecosystem (7)	Subramanian et al. 2023 Upadhyay 2020 Sharifi. 2020 Subramanian et al. 2023 Lloret et al. 2021 Chowdhury et al. 2021 Upadhyay 2020
Food Security (3)	Jägermeyr et al. 2021 Rezvi et al. 2023 Lesk et al. 2022
Health (9)	Kalashnikov et al. 2022 Abderrezak et al. 2022 Wee et al. 2023 Garcia et al. 2022 Palinkas et al. 2020 Anas et al. 2021 Garcia et al. 2022 De Vita et al. 2024 Ashik-Ur-Rahman and Animesh 2023
Heat Stress (10)	Al-Bouwarthan et al. 2020 Cramer et al. 2022 Karimi et al. 2023 Hayes et al. 2022 Boonruksa et al. 2020 Foster et al. 2022 Souza and Scott 2024 Foster et al. 2021 Koteswara et al. 2020 Sasai et al. 2023
Policies (6)	Sharifi. 2020 Nyirenda 2023 Akpan and Oludolapo 2023 Hernández-Delgado 2024 Ouedraogo. 2020 Thakur 2021
Temperature (9)	Allen et al. 2024 Ndehedehe et al. 2023 Ji et al. 2024 Lhakpa et al. 2022 Jain et al. 2020 Yiadom et al. 2023 Chen et al. 2023 Ullah et al. 2022 Choisy et al. 2021
Total impacts (10)	Articles 72

Photosynthetic organisms/primary producers form the basis of the large food webs that directly or indirectly provide food to all other life forms and also oxygenate the environment while reducing the overall carbon footprint. Upadhyay (2020) reports how weak primary production comes at the expense of other trophic levels and disrupts the balance of the entire ecosystem. In the last half of the 20th century and the first quarter of the 21st century, there was a net increase in terrestrial primary production, exacerbated by natural and anthropogenic activities such as an increased carbon balance, longer growing seasons, etc. (Hou et al. 2022).

While we have so far counted all contributions of climate components in the same direction, there are also studies on the opposite effect of climate components on total production. For example, an increase in temperature supplemented by an excess of carbon dioxide can affect below-ground processes by distorting the natural cycles (carbon and nitrogen cycles) (Reicosky et al. 2021). This distortion would have a huge impact on the soil as it limits the overall growth of primary producers regardless of the dynamics of the ecosystem (Hou et al. 2022).

Ecosystem patterns and processes, such as rates of primary productivity or the input-output balance of chemical elements, respond to climate change in complex ways due to numerous controlling factors (Sharifi 2020). Physical changes in ecosystems - e.g. changes in thermal stratification patterns in lakes and oceans, flooding and drying systems in streams and rivers, or the escalation of the hydrological cycle in large catchments - lead to changes in the structure and function of ecosystems that have economic and human impacts. Subramanian et al. (2023) reported a significant disruption of species interactions due to climate change by affecting the structural and functional aspects of marine food webs, which in turn affects human populations that are highly dependent on fisheries for their livelihoods, but also for recreation and culture, which are basic human needs. With the increase in greenhouse gas emissions, the problem of global warming will have an indelible impact on the living systems in the coming decade. The effects are manifold, ranging from a reduction in oxygen levels to the melting of the ice caps, causing sea levels to rise in the last years of the first half of the 21st century. These aberrations have cumulative effects on the marine food web (Graham et al., 2024). The rise in temperature in marine ecosystems due to global warming disrupts the interaction between species and distorts the food web, leading to a reduction in the number of basal species, which contributes to the overall decline in species populations. These complications result in marine habitats lacking basic ecosystem requirements (Jägermeyr et al., 2021). In addition to the temperature aspect, ocean acidification also poses a great threat to the tropical web as it impairs connectivity between the tropics. Increased carbon dioxide levels also disrupt the balance between the tropics and lead to a general imbalance in the ecosystem.

The temperature rise disrupts the balance in the food chain by altering the total number of secondary producers, leading to an increased number of predators due to increased metabolic demand. Meanwhile, Jägermeyr et al. (2021) reported that increased carbon dioxide impairs energy flow at the intertropical level, which leads to an imbalance between supply and demand, affecting the entire food web. In addition, any imbalance due to an external abiotic factor such as temperature or higher carbon dioxide levels can favour a strong occurrence of the upper trophic levels, leading to a threatening trophic cascade (Kew et al. 2021).

On the other hand, in connection to forest ecosystems, primary producers could use the increase in carbon dioxide and temperature to enhance their physiology, which in turn would channel and reinforce conventional bottom-up control of the food web. Any deviation whatsoever from conventional tropical levels would disrupt the food web (Subramanian et al. 2023) and destroy the nature of the ecosystem as a whole. The climate catastrophe has not only affected the stability of ecosystems by distorting the pattern of the food web, but has also altered the occurrence of extreme events, particularly droughts and heatwaves (Camarero et al. 2021). These impacts have a long-term effect on the overall "maintenance" of the ecosystem and make it vulnerable to weaknesses.

Anderegg et al. (2023) found that significant changes have been occurring in forests across the western United States due to the combined effects of drought, insects, and fire, emphasizing their interrelationships. These changes include declines, changes in forest composition and structure, and shifts in distribution boundaries.While the effects of increasing drought are becoming clearer at the individual tree level, in the eastern United States these findings are not yet sufficient to predict changes in forest structure and diversity. Across the continental United States, anticipated major shifts in suitable habitats due to climate change and the limited capacity for rapid migration of tree populations suggest that changes in tree and forest distribution may lag behind the habitat changes already occurring. Forestry practices can help mitigate the effects of drought by reducing stand density, selecting drought-tolerant species and genotypes, using artificial regeneration and promoting multi-structured stands. However, these practices can also exacerbate the effects of drought if they are not carefully tailored to specific site and stand conditions. Chaudhry et al. (2022) reported on the effects of inappropriate droughts on tree growth and mortality in forested areas too. In addition, recurrent droughts reduce the resistance of plants to pathogens and other invasive species and also increase wildfires Graham et al. 2024). Together with these factors, the severity and duration of droughts affect the structure and function of the forest ecosystem.

While agroforestry is a sustainable and adaptable approach to agriculture, it is not immune to the impacts of climate change. The vulnerability of the agroforestry sector to climate change can be understood in terms of various dimensions, including environmental, economic and social factors (Kittur et al. 2024). The increased frequency and intensity of heat waves can produce stress for trees and plants in agroforestry systems, which can lead to a decline in growth rates and yields (Sahoo et al. 2021). Trees that are not well adapted to higher temperatures may experience increased mortality rates, which can alter the composition and structure of agroforestry systems (Sheppard et al. 2020). Changing rainfall patterns, including more intense and erratic rainfall, can lead to soil erosion and waterlogging, negatively impacting tree and plant health. Prolonged droughts reduce water availability and affect tree growth and crop productivity, especially in regions that rely on rain-fed agroforestry systems. Climate change is altering the distribution and life cycle of pests and diseases, increasing their prevalence and impact on agroforestry systems. Warmer temperatures and changing moisture conditions create favorable conditions for pest outbreaks, which is devastating for both trees and crops (Skendžić et al. 2021). The productivity of agroforestry systems can fluctuate more strongly due to climate-related stress factors. These fluctuations affect the economic stability of farmers who depend on constant yields for their livelihoods. Lower yields lead to lower incomes and greater financial insecurity (Etana et al. 2021). Climate change affects global and local markets by disrupting supply chains and changing the availability of agroforestry products. This leads to price volatility and affects the economic viability of agroforestry systems (Kittur et al. 2024).

Drought is a multifaceted environmental condition that induces a plant response at two different levels: at the molecular level and at the forest stand level (Anderegg et al. 2023). According to Camarero (2021), drought has a negative impact on forests worldwide, including forest dieback. The negative effects of drought on plants can be observed in the form of reduced productivity, death of mature trees, susceptibility to pathogens, susceptibility to fire damage and seedling recruitment (Lloret et al. 2021).

A persistent deficit in water supply and a decline in rainfall is depleting groundwater globally, and the area in question is known to be in a severe condition known as "drought" (Apurv and Cai 2020). Climate scientists have been trying to define the term "drought" for decades and have categorized it into various categories, including meteorological, agricultural, forestry, hydrological and socio-economic.

Drought has a negative impact on the quality and quantity of water as it disrupts the water cycle, Graham et al. (2024) explain how drought affects water quantity. Drought is associated with the scarcity of rainfall in a particular region, which has a strong impact on rain-fed systems such as agriculture. Short-term drought can be managed by creating aquifers using drought buffers, but these buffers are not helpful during prolonged drought. Drought mainly affects the water table and lowered water table leads to the disruption of the aquatic ecosystem balance. The study by Ndehedehe et al. (2023) claims that there is a direct link between groundwater recharge and climatic anomalies, leading to an overall decline in groundwater. About 40% of the modern world depends on agriculture as its main economic source, and yet drought is a major disaster for farmers and communities that depend on agriculture. The largest droughts in recent years have been recorded in Central/Southwest Asia (1998-2003), Western North America (1999-2007), Australia (2002-2003), Europe (2003) and Amazonia (2005) (Jiang et al. 2023). In India, droughts are the main cause of major famines, including the Bengal famine of 1770, which killed a third of the population in the affected areas, the famine of 1876-1877, in which five million people lost their lives, and the famine of 1899, in which nearly 4.5 million people died. In 1972, the drought in the state of Maharashtra affected 2.5 million people (Singh et al. 2022). Geographically, droughts have increased at an alarming rate worldwide (Khan et al. 2021). Researchers such as Ji et al. (2024) reported that sporadic droughts cause an unusual increase in carbon dioxide (CO_2), so it is expected that the carbon cycle will be more affected in the near future.

To conclude this chapter on ecosystems, drought, forests and climate change: climate change has a profound impact on ecosystems by altering species distributions, ecological relationships and process rates. It displaces species, affects phenological events and disrupts primary production and food web dynamics. There is evidence of significant disturbance in terrestrial and aquatic systems, with forests experiencing changes in their composition and structure. Agroforestry systems are vulnerable to climate-related stressors that affect productivity, pest dynamics and economic stability. Drought exacerbates these impacts, affecting water quality, agriculture and the communities that depend on it. The cumulative impacts require comprehensive and adaptive management strategies to ensure ecosystem resilience.

Vulnerability of agriculture – *Ranjivost sektora poljoprivrede*

Agriculture is considered the most vulnerable of the many sectors affected by climate change (Wickramasinghe et al. 2021). Agriculture and climate change are closely linked as climate change is the main cause of biotic and abiotic stress that negatively impacts a region's agriculture (Chaudhry and Gagan 2022). Various aspects such as changes in annual rainfall, average temperature, heat waves, changes in weeds, pests or microbes, global changes in atmospheric CO_2, and sea level fluctuations are affected by climate change (Imran et al. 2022). Increasing food demand due to the ever-growing population has led to intensive agricultural practices, including unprecedented use of agrochemicals, livestock farming (for meat and other sources of income), exploitation of water resources, etc., which has further exacerbated the situation as the emission of greenhouse gasses (due to agricultural activities) leads to the pollution of natural resources. Agricultural yields in developing countries are mainly affected by unfavorable environmental conditions (Wahab et al. 2023). As a result of climate change, floods and droughts are expected to increase in the coming years, which may reduce crop productivity (Rezvi et al. 2023). Agricultural cultivation methods and the nature of a region are severely affected by prolonged climatic conditions. In general, the experience and infrastructure of local farmers are geared towards certain types of agriculture and a certain number of crops that are considered productive under the current climatic conditions. To maintain productivity, changes in mean climate may require adaptation of current practices to current conditions, and in some cases, the optimal way of farming may change (Pilvere et al. 2022).

Higher temperatures have an immediate detrimental effect in regions where the temperature is already close to the physiological limit of plants, e.g., crops in seasonally dry and tropical regions where heat stress increases along with water loss through evaporation (Lesk et al. 2022). Water is important for plant growth, so different precipitation patterns have a major impact on agriculture. Projections of potential precipitation changes also affect the magnitude and trajectory of climate impacts on crop production, since more than 80% of all agriculture depends on precipitation

(Jägermeyr et al. 2021). However, changes in seasonal precipitation may be more important for agriculture than changes in mean annual precipitation. Increased drought, frequent heavy precipitation, and temperature fluctuations will reduce crop production and lead to a higher risk of famine (Rezvi et al. 2023).

Climate change leads to enormous land loss, resulting in increased desertification and nutrient-poor soils; at the same time, flooding washes away topsoil and soil nutrients, which will lead to low productivity in the coming years**.** The acceleration of climate change will have a long-term impact on the productivity of agroecosystems. It is therefore high time that we prepare for the challenges ahead to combat the effects of climate change and ensure food security not only for humans but also for other living beings.

In conclusion, agriculture is highly vulnerable to multiple impacts of climate change, which include biotic and abiotic stressors, changing precipitation patterns and an increase in extreme weather events, all of which have a negative impact on crop productivity. The intensification of agricultural practices and the resulting greenhouse gas emissions further exacerbate these challenges. Therefore, adapting agricultural practices and infrastructure is crucial to maintaining agricultural productivity and ensuring food security. Proactive and comprehensive measures are essential to mitigate the effects of climate change and ensure the well-being of people and the environment.

Possible effects of heat stress on humans – *Mogući učinci toplinskog stresa na ljude*

The global rise in temperature due to climate change is causing growing concern regarding occupational heat stress among workers around the world, especially in areas with hot climates (Al-Bouwarthan et al. 2020). To facilitate the transfer of heat from the body to the atmosphere to maintain core body temperature, environmental and metabolic heat stress leads to physiological responses (Cramer et al. 2022). Higher temperature exposure may contribute to higher stress levels with more regular heat cycles, likely leading to more cases of heat-related illnesses such as heat stroke, heat exhaustion, increased susceptibility to chemical exposure, and fatigue. Increased temperature exposure can also lead to decreased alertness, resulting in an increased risk of injury or lack of protection. In addition, elevated temperatures can increase air pollution, such as ground-level ozone; workers who work outdoors are more susceptible to air pollutants, which have been linked to chronic health conditions such as respiratory diseases and allergic reactions (Kalashnikov et al. 2022). The urban heat island (UHI) is an area with higher temperatures than the surrounding rural or suburban climate. The UHI effect is due to various factors such as air pollution, anthropogenic heat, urban architecture, and changes in precipitation patterns (Karimi et al. 2023). Through exposure to elevated temperatures, UHI affects human health and can be particularly problematic during heatwaves. During the summer months with extremely high temperatures or heat waves, the health effects of UHI are more intense. Therefore, heat-related mortality is likely to increase in the future due to climate change. There is a close link between the UHI effect and urban planning. This is because the lack of trees and plants in urban areas impairs the transpiration process. The introduction of sufficient vegetation in urban areas contributes to the cooling of the climate, which increases transpiration and reduces the UHI effect (Hayes et al. 2022). The UHI effect is partly responsible for recent temperature fluctuations in different cities. Outdoor workers, such as traffic wardens, street sweepers, police officers, construction workers, and small landscapers, work during the hottest times, and an increase of 3 to 5°C makes physical labour much more difficult (Karimi et al. 2023). Another issue that has recently gained attention is the well-being of women working outdoors, especially during pregnancy, as this causes additional problems due to heat stress. The combination of heat exposure in the workplace (both from weather and artificial heat) and body heat from metabolic processes (related to workload) can lead to heat build-up in the body (Abderrezak et al. 2022). Heat-related illnesses are the acute adverse effects of prolonged exposure to high temperatures. These effects range from mild heat-related illnesses and symptoms such as heat exhaustion, heat rash, heat edema, heat cramps, and syncope, to severe heat injuries leading to death, such as exertional heat injury, exertional rhabdomyolysis, and heat stroke. The effects of climate change are expected to increase the vulnerability of people in equatorial climates to heat and heat-related illnesses and, in particular, lower the socioeconomic status of workers in non-automotive occupations (Boonruksa et al. 2020). According to Foster et al. (2022), there are six basic factors, which include air temperature, radiant temperature, humidity, air movement (wind speed), clothing, and metabolic heat, which are generated by human physical activity and determine the psychological activities and heat balance of the human body. In addition to regulating the work environment, work pace, and work limits, perceptual knowledge is a direct adaptation mechanism for individual workers to protect themselves from heat exposure. They are designed to help predict physiological stress in workers due to stressful environmental conditions (Souza and Scott 2024). According to the World Health Organisation (WHO), heat stress has direct and indirect effects (Figure 4).

Heat stress is measured using various methods, with the two most commonly used approaches being environmental/meteorological variables and multiple indices. Some matrices, such as the National Weather Service Heat Index and Humidex, use combinations of temperature and hu-

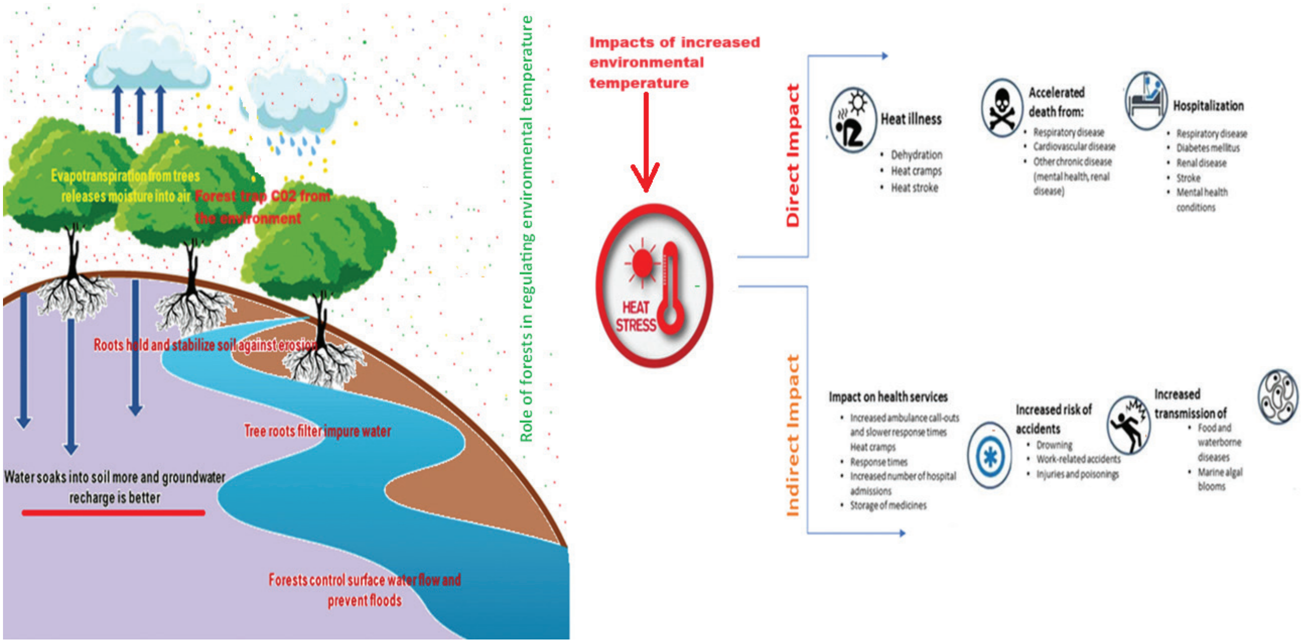

Figure 4. Impact of forest ecosystems on environmental temperature; health effects of heat stress according to the WHO (PC: Musheerul Hassan)
Slika 4. Utjecaj šumskih ekosustava na temperaturu okoliša; učinci toplinskog stresa na zdravlje prema WHO (Slika: Musheerul Hassan)

midity, while others use solar radiation. e.g. Wet Bulb Globe Temperature (WBGT) and Environmental Stress Index (Foster et al. 2021). The human core body temperature of 37°C is elevated during extreme heat exposure, leading to a heat stroke (severe hyperpyrexia), which impairs the physical ability to work. Increased heat exposure is associated with work-related health risks and impairs work efficiency (Koteswara et al. 2020). The most critical thermoregulation parameter is core body temperature; a difference of only 3 degrees in the core body temperature can lead to injury or even death. Healthy people's heart and skin temperature under neutral conditions is 36.8°C and 34.1°C, respectively. Clinical studies suggest that aging, obesity and cardiovascular disease can severely impair a person's ability to thermoregulate (Wee et al. 2023). In combination with dehydration, heat stress often leads to a range of heat-related symptoms such as fatigue, headache, muscle cramps, weakness, dizziness, nausea, vomiting, tachycardia, hyperventilation, ataxia, hypotension, and transient mental status changes (Garcia et al. 2022). Epidemiologic studies have shown that the occurrence and prevalence of kidney stones increase in populations exposed to prolonged dehydration, elevated ambient temperature, and intense physical activity (Sasai et al. 2023).

Climate change affects various aspects of our lives, such as the environment, health, security, natural resources, and agricultural and food production (Foster et al. 2022). However, among all these aspects, health is the most important, and we must be aware that health is not only the most important means of achieving progress. Health itself is the ultimate goal of development, as it aims to ensure healthy lives and promote well-being for all people at all ages (Palinkas et al. 2020). As one of the most important means of achieving development, health guarantees the quality of human resources needed in developing countries to achieve economic growth and reduce poverty and social inequalities (Palinkas et al. 2020). Climate change and other environmental stresses can directly and indirectly cause water-related diseases (Anas et al. 2021). Furthermore, there is clear evidence that the increased number and intensity of heatwaves can exacerbate hypertension problems leading to cardiovascular disease, particularly in older people, which in turn leads to increased mortality (De Vita et al. 2024). In addition, the increased salinity in the waters exacerbates blood pressure-related problems leading to hypertension and cardiovascular diseases. This can be considered a serious health issue, especially in Asian countries such as Bangladesh, as the existing coastal population receives water from sources that are highly susceptible to salt intrusion and therefore tend to consume higher amounts of sodium (Ashik-Ur-Rahman et al. 2023) An increasing trend of rising salinity in the Sundarbans has also been observed in India due to the difference between the lower freshwater inflow from the north during the monsoon season and the increase in saline water from the Bay of Bengal (Chowdhury et al. 2021).

Climate has been scientifically proven to directly and indirectly affect living organisms from the tropics to the poles by influencing social dynamics and health outcomes (Malakar et al. 2023; Upadhyay 2020). The world needs to be prepared to invest in and finance healthcare systems, overstretching both infrastructure and the economy (Sharma and Harvinder 2023). In most climate change scenarios, heavy rainfall events are expected to occur more regularly in large regions of the world in the future, which will have a direct or indirect negative impact on living things. In some South Asian countries such as India and Bangladesh, snowmelt in the Himalayas is an important determinant of river flow and crucial for maintaining the flow upstream. Changing precipitation patterns and warm temperatures are the factors that significantly affect the melting process and lead to a decline in ice masses, which can reduce water sources for human use (Lhakpa et al. 2022). As sea levels rise, water sources become more susceptible to salinity, which can exacerbate health problems that are not directly related to water-borne diseases but to hypertension and strokes (Garcia et al. 2022).

To conclude the potential impacts of heat stress on humans: the global temperature rise associated with climate change exacerbates occupational heat stress, which is particularly pronounced in regions with hot climates. This phenomenon leads to an increase in heat-related illnesses and an increased risk of injury. The exacerbation of these health impacts during heatwaves, compounded by the urban heat island effect, highlights the urgent need for proactive urban planning strategies that improve ecological resilience through measures such as increased greening. Addressing these challenges requires comprehensive approaches to protect health, optimize the work environment and mitigate the overall public health impacts resulting from rising temperatures due to climate change.

Temperature and economic performance – *Temperatura i ekonomska učinkovitost*

In the treatise "The Spirit of the Laws" it is claimed that an excess of heat makes people become sluggish and dissatisfied. It is estimated that the global average temperature will increase by 2°C – 8°C by 2100 compared to pre-industrial levels**.** Temperature has a significant impact on various economic and social outcomes, including agricultural yields, labor supply, mortality, energy consumption, conflict, health, poverty, labor productivity, and industrial productivity (Jain et al. 2020).

Conventionally, two approaches have been used to understand the relationship between temperature and macroeconomic activity. The first focused on growth and development and examined the relationship between macroeconomic variables and average temperature in cross-sections of countries. Recent data show that hot countries tend to be poor, with a national income of less than 8.5% per degree Celsius in the global cross-section (Tol et al. 2024), while several researchers have discussed that this correlation is due to a spurious relationship between temperature and national characteristics such as intuitional quality (Yiadom et al. 2023). The second approach to quantify the different climate effects and their net impact on national income is micro-evidence. This approach is included in the Integrated Assessment Models (IAMs) used in the climate change literature to model climate-economy interactions and in various policy recommendations on greenhouse gas emissions. At the micro level, climate research suggests a wide range of temperature effects, with large impacts on agricultural productivity, cognitive performance, crime, mortality, physical fitness, and land crisis.

Callahan et al. (2022) examined the relationship between economic growth and temperature variation. The results showed significant effects of temperature in poor (low-income) countries. In general, low- and middle-income countries are geographically located at low elevations and are likely to be most affected by heat shocks (Choisy et al. 2021). It was found that a 1°C rise in temperature reduces economic growth by 1.3% on average. The report shows that climate change can have a negative impact on economic growth. Agricultural yields are severely affected by higher temperatures, while industrial production and political stability are also reduced. Sandhani et al. (2023) examined the impact of temperature on economic activity in India from 1980 to 2015 and found that the economic growth rate declined by 2.5 percentage points with a 1°C rise in temperature. The impact was the lowest in poor states and in primary sectors such as agriculture, forestry, fishing, and mining. Similar results were reported by Chen et al. (2024) in China, Raihan et al. (2022) in Bangladesh, and Ullah et al. (2022) in Nepal.

In conclusion, the predicted temperature rise of 2°C to 8°C by 2100 will have a significant impact on global socio-economic dynamics. Studies show that the rise in temperature will affect economic growth, especially in low-income countries which are heavily dependent on agriculture and natural resources. These findings underscore the urgent need for robust climate policies and adaptation strategies to mitigate the negative impacts of heat shocks on productivity, health and stability worldwide.

Climate change and damage limitation – *Klimatske promjene i ograničavanje štete*

Due to global climate change, most disasters pose a threat to people's livelihoods. The main strategies to address climate change and its costs focus on mitigation and adaptation measures (Sharifi 2020). Following the conclusion of the Kyoto Protocol's first commitment cycle in 2012, the UNFCCC discussed how to share the reduction of carbon emissions (Nyirenda et al. 2023). In the 1990s, during the Kyoto Protocol era, the UNFCCC recognized and applied the position of common but differentiated responsibility so that no country that was in the development phase in 1990 received compensation for emission reductions at that time. But in the post-Kyoto Protocol phase, underpinned by the

Paris Agreement, shared responsibility for all is a hot topic in climate negotiations and is being defended ever more vehemently by industrialized countries. Although the post-2020 agreement remains non-binding and voluntary, it was created in response to international pressure from developed countries to encourage developing countries to reduce their emissions based on their capacities as parties to the UNFCCC.

The inequality between rich and poor countries in terms of carbon emissions over time has led the UNFCCC to use the previous time factors as a benchmark to describe the principle of common but differentiated responsibility (Akpan and Oludolapo 2023). On this basis, developing countries by no means had compliance targets to reduce emissions (Hernández-Delgado 2024). However, the fact that developing countries have not met the targets set for the first (2005-2012) and second (2005-2012) commitment periods of the Kyoto Protocol has shown the need for greater cooperation between countries (Ouedraogo 2020), including countries considered to be the 'least developed countries' (LDCs). For the success of the signing of the Paris Agreement in 2015, all UNFCCC Parties submitted their strengthened targets for the next decade, from 2020 to 2030, as announced in the "Intended Nationally Determined Contribution" (INDCs) (Ouedraogo 2020), among other official procedures. The enormous involvement of UNFCCC Parties in upholding the mitigation initiatives, or at least the target, gives the Paris Agreement an original attribute in the climate debate (Thakur 2021). The 47 LDC are located in different regions of the world, with Africa and Asia being particularly well represented with 33 and 9 countries respectively. Bangladesh is one of these Asian countries in the LDC group and has chronologically low carbon emissions since 1971, the year of its sovereignty.

To conclude, the transition from the Kyoto Protocol to the Paris Agreement underscores the shift towards collective climate responsibility that balances global equity with differentiated national capacities. Despite the challenges associated with emissions reduction and compliance, the Agreement's voluntary framework promotes international cooperation and resilience, benefiting the least developed countries in particular. This strategic development represents an important milestone in global climate policy and underscores the ongoing commitment to sustainability and equitable climate action.

CONCLUSION
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Climate change has a profound impact on ecosystems, leading to changes in species distribution, disrupted ecological relationships and altered dynamics of primary production. These changes manifest themselves in the displacement of species, phenological changes and structural changes in forest ecosystems. Agricultural systems are increasingly vulnerable to climate-related stressors, including changing precipitation patterns and more frequent extreme weather events, which negatively impact crop productivity and economic stability. Adaptation strategies that focus on agricultural practices and infrastructure are essential to maintain productivity and ensure food security in the face of climate impacts. Occupational health risks increase as global temperatures rise, especially in hot climates, exacerbating heat stress-related illnesses. Urban heat islands exacerbate these effects during heatwaves and require proactive urban planning measures such as the expansion of green spaces. The socio-economic impacts of the projected temperature rise pose a significant risk to global economic growth, particularly for agricultural and resource-dependent economies. The transition from the Kyoto Protocol to the Paris Agreement underscores a shift towards collective climate responsibility that emphasizes international cooperation and resilience-building efforts, benefiting vulnerable nations in particular. These findings underscore the need for robust climate policies and adaptation measures to mitigate impacts and promote sustainable global development.

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SAŽETAK

Klimatske promjene, kao nemilosrdna sila prirode, predstavljaju značajnu prijetnju ekosustavima i ugrožavaju preživljavanje. Ovaj sveobuhvatni pregled znanstvenih istraživanja ispituje različite utjecaje klimatskih promjena, u rasponu od promjene godišnjih doba i povlačenja ledenjaka do rapidnog porasta razine mora. Navedene promjene dovode do prepoznatljivih rizika kao što su porast temperature, smanjenje zaliha podzemne vode, gubitak bioraznolikosti, smanjena poljoprivredna produktivnost i povećani zdravstveni rizici. Utjecaji nadilaze ekološku sferu i prožimaju gospodarstva na globalnoj razini. Posebno treba istaknuti nerazmjeran utjecaj na zemlje s ograničenim resursima i nižim socioekonomskim statusom. Osim toga, u ovom radu istražuje se kompleksna dinamika međunarodne suradnje u klimatskoj politici te se naglašava hitna potreba za zajedničkim naporima za rješavanjem eskalirajuće ekološke krize. Emisije ugljika glavni su uzrok globalnih klimatskih promjena. Kao odgovor na njih, države svijeta okupile su se u okviru Protokola iz Kyota koji se temelji na priznavanju različitih nacionalnih kapaciteta za rješavanje izazova povezanih s klimom. Prijelaz s Protokola iz Kyota na Pariški sporazum naglašava pomak prema kolektivnoj odgovornosti za klimatske promjene te naglašava međunarodnu suradnju i napore za izgradnju otpornosti, posebno za dobrobit ugroženih nacija. Stoga ova sinteza postupaka sustavnog pregleda i metoda bibliometrijske analize naglašava potrebu za koordiniranom akcijom za ublažavanje prijeteće ekološke krize. Strateško planiranje i provedba ključni su za proaktivno ublažavanje negativnih učinaka klimatskih promjena. Akcije kao što su pošumljavanje i smanjenje ovisnosti o fosilnim gorivima, kao i opsežna upotreba obnovljivih izvora energije poput vjetra, sunca i geotermalne energije, nude značajan potencijal za smanjenje emisija stakleničkih plinova.

KLJUČNE RIJEČI: klimatske promjene, okoliš, ekonomija, zemlje s niskim dohotkom, Protokol iz Kyota

APPENDIX

Table 2. Projected impacts of climate change on people at different levels of global warming
Tablica 2. Predviđeni utjecaji klimatskih promjena na ljude na različitim razinama globalnog zatopljenja

Projected impacts and Remarks	Title	Authors and publication Year
ECOSYSTEM, DROUGHT, FOREST AND CLIMATE CHANGE – *EKOSUSTAV, SUŠA, ŠUME I KLIMATSKE PROMJENE*		
Agriculture		
The study concludes that future land use and land cover changes will significantly and potentially dominate global gross primary productivity (GPP). These changes, driven by human activities like deforestation and urbanization, could influence the global carbon cycle as much as or more than direct climate change effects. Therefore, managing LULC changes is crucial for mitigating their impact on GPP and the global climate	Future land use/land cover change has nontrivial and potentially dominant impact on global gross primary productivity	Hou et al. 2022
The study concludes that conservation agriculture (CA) significantly enhances soil organic carbon, improves soil health, and boosts agricultural productivity. CA practices, like minimal soil disturbance and crop rotation, are essential for sustainable production and carbon sequestration. This approach contributes greatly to climate change mitigation and adaptation	Carbon and conservation centered foundation for sustainable production	Reicosky et al. 2022
The authors conclude that climate change, through rising temperatures, altered precipitation patterns, and increased frequency of extreme weather events, is likely to exacerbate the challenges posed by insect pests to agriculture.	The Impact of Climate Change on Agricultural Insect Pests	Skendžić et al. 2021
The research underscores the importance of supporting adaptive capacity and providing targeted interventions to sustain the livelihoods of smallholder farmers in the face of climate variability and change.	The impact of adaptation to climate change and variability on the livelihood of smallholder farmers in central Ethiopia	Etana et al. 2021
The study emphasizes the significant benefits of agroforestry practices for sustainable development. The authors highlight that agroforestry systems enhance biodiversity, improve soil health, and contribute to carbon sequestration, making them an effective strategy for climate change mitigation and adaptation.	Agroforestry for Resource Diversification and Sustainable Development	Kittur et al. 2024
Agroforestry		
The conclusion of the study reveals the Impacts and Mitigation Through Sustainable Agroforestry Practices emphasizes the critical role of agroforestry in mitigating climate change impacts.	Climate Change Impacts and Mitigation Through Sustainable Agroforestry Practices	Sahoo et al. 2021
The conclusion of the study indicates that agroforestry is a highly appropriate and sustainable response to the challenges posed by climate change in Southern Africa.	Agroforestry: An Appropriate and Sustainable Response to a Changing Climate in Southern Africa	Sheppard et al. 2020
Drought		
The authors summarize that climate change poses significant challenges to water resources, agriculture, ecosystems, and human health globally.	A Review on Climate Change Impacts, Models, and Its Consequences on Different Sectors: A Systematic Approach	Rawat et al. 2024
The study concludes that droughts and heatwaves cause significant increases in river water temperature and salinity, and a decrease in dissolved oxygen levels. The study also found that the severity of these impacts varies depending on factors such as climate zone, land use, and the level of wastewater treatment.	Impacts of Droughts and Heatwaves on River Water Quality Worldwide	Graham et al. 2024
This research underscores the need for integrated water resource management strategies to enhance drought resilience and agricultural sustainability in the face of evolving climate conditions in Central Asia	Agricultural drought over water-scarce Central Asia aggravated by internal climate variability	Jiang et al. 2023
The authors conclude that droughts in Maharashtra are becoming more frequent and severe due to climate change. The study indicates that increasing temperatures and changing precipitation patterns are significant contributors to this trend.	Drought Frequency Assessment and Implications of Climate Change for Maharashtra, India	Singh et al. 2022
It demonstrates the application of remote sensing and geospatial analysis techniques to assess and monitor drought conditions worldwide	Global drought monitoring with big geospatial datasets using Google Earth Engine	Khan et al. 2021
The study concludes that integrating the use of renewable surface and groundwater resources can significantly mitigate water supply deficits during droughts in U.S. watersheds.	Impact of Droughts on Water Supply in U.S. Watersheds: The Role of Renewable Surface and Groundwater Resources	Apurv et al. 2020

The conclusion indicates that increasing temperatures and changes in precipitation patterns are contributing to more frequent and severe droughts in Eastern Africa	Impact of Precipitation and Increasing Temperatures on Drought Trends in Eastern Africa	Kew et al. 2021
The study concludes that drought-induced dieback and mortality in trees are significant concerns that currently lack forecasting tools with sufficient predictive power. The study suggests using surrogates of tree vigor, growth, and functioning to build more accurate models to predict tree death in response to extreme climate events linked to drought.	The Drought‐dieback‐death Conundrum in Trees and Forests	Camarero et al. 2021
The study concludes that climate change will significantly increase the risk to U.S. property values from forest disturbances such as wildfires, tree mortality, and insect infestations, especially in high-risk western regions.	Climate change greatly escalates forest disturbance risks to US property values.	Anderegg et al. 2023
The study concludes that environmental adversities like Heat and drought has adverse effects on crop production	Climate Change Regulated Abiotic Stress Mechanisms in Plants: A Comprehensive Review	Chaudhry et al. 2024
The study concludes that droughts and heatwaves cause significant increases in river water temperature and salinity, and a decrease in dissolved oxygen levels. The study also found that the severity of these impacts varies depending on factors such as climate zone, land use, and the level of wastewater treatment.	Impacts of Droughts and Heatwaves on River Water Quality Worldwide	Graham et al. 2024
The conclusion is that rising temperatures and changing rainfall patterns are contributing to more frequent and more severe droughts in East Africa	Impact of Precipitation and Increasing Temperatures on Drought Trends in Eastern Africa;	Kew et al. 2021
Ecosystem		
It underscores how these extreme weather events disrupt ecosystem dynamics, leading to forest collapse and biodiversity loss	Climate-induced global forest shifts due to heatwave-drought	Lloret et al. 2021
The conclusion of the study emphasizes the significant long-term impacts of climate change on coastal and transitional ecosystems in India.	Long-Term Impacts of Climate Change on Coastal and Transitional Eco-Systems in India	Subramanian et al. 2023
The conclusion of the reveals the markers and impacts of global climate change on social, biological, and ecological systems.	Markers for Global Climate Change and Its Impact on Social, Biological and Ecological Systems: A Review	Upadhyay 2020
The author highlights patterns and processes in ecosystems, such as rates of primary productivity or the input-output balance of chemical elements, which respond to climate change in complex ways due to numerous controlling factors.	Trade-Offs and Conflicts between Urban Climate Change Mitigation and Adaptation Measures	Sharifi 2020
Food Security		
The study underscores the importance of early and robust adaptation strategies to mitigate the adverse effects of climate change on global food security. The findings call for urgent action in developing more resilient agricultural practices to cope with the anticipated changes in climate	Climate Impacts on Global Agriculture Emerge Earlier in New Generation of Climate and Crop Models	Jägermeyr et al. 2021
Temperature		
It highlights the complex relationships between climate variables such as precipitation patterns, temperature changes, and groundwater availability, emphasizing the critical role of hydrological modeling and monitoring in managing water resources under changing climatic conditions	Understanding global groundwater-climate interactions	Ndehedehe et al. 2023
The study concludes that significant changes in temperature and precipitation regimes over the next 500 years will drastically affect global vegetation distribution.	Projected Future Climatic Forcing on the Global Distribution of Vegetation Type	Allen et al. 2024
The study investigates whether limiting global temperature rise to below 2°C can prevent the emergence of unprecedented drought events	Can limiting global temperature rise to below 2° C warming prevent the emergence of unprecedented drought	Ji et al. 2024
VULNERABILITY OF AGRICULTURE - *RANJIVOST SEKTORA POLJOPRIVREDE*		
Agriculture		
This study focuses on developing a conceptual framework to assess and map the vulnerability of the agriculture sector in Sri Lanka to climate change at the Divisional Secretariat (DS), an administrative level. Vulnerability indices were formulated based on the definition of vulnerability by the Intergovernmental Panel on Climate Change (IPCC)	An Assessment and Mapping at Divisional Secretariat Level in Sri Lanka.	Wickramasinghe et al. 2021

This research synthesizes current understanding to elucidate the complex interactions between climate change and plant adaptation strategies, offering insights crucial for enhancing agricultural resilience and sustainable crop production in a changing climate.	Climate change regulated abiotic stress mechanisms in plants	Chaudhry and Gagan. 2022
The research emphasizes the need for adaptive agricultural practices, including the development of climate resilient crops, improved irrigation techniques and sustainable land management practices.	Climate Change and Agriculture	Imran et al. 2022
It highlights how climate variability and extreme weather events negatively impact crop yields, leading to financial challenges for farmers and difficulties in repaying loans.	The impact of climate change on agricultural productivity and agricultural loan recovery; evidence from a developing economy.	Wahab et al. 2023
The authors conclude that while the European Green Deal presents significant opportunities for enhancing sustainability in agriculture, it also poses challenges for farmers due to potential changes in subsidy structures and increased environmental requirements.	Evaluation of the European Green Deal Policy in the Context of Agricultural Support Payments in Latvia	Pilvere et al. 2022
Food Security		
It discusses how climate variability, including temperature changes and altered precipitation patterns, affects rice yield and quality, posing significant risks to food security.	Rice and food security: Climate change implications and the future prospects for nutritional security	Rezvi et al. 2023
The conclusion emphasizes that compound heat and moisture extremes, exacerbated by climate change, pose a significant threat to global crop yields. The authors emphasize that the simultaneous occurrence of extreme heat and drought can lead to significant losses in agricultural productivity, with potentially devastating impacts on food security.	Compound Heat and Moisture Extreme Impacts on Global Crop Yields under Climate Change	Lesk et al., 2022
The study underscores the importance of early and robust adaptation strategies to mitigate the adverse effects of climate change on global food security. The findings call for urgent action in developing more resilient agricultural practices to cope with the anticipated changes in climate	Climate Impacts on Global Agriculture Emerge Earlier in New Generation of Climate and Crop Models	Jägermeyr et al. 2021
POSSIBLE EFFECTS OF HEAT STRESS ON HUMANS - *MOGUĆI UČINCI TOPLINSKOG STRESA NA LJUDE*		
Health		
The study highlights current knowledge on pathophysiology, clinical manifestations, and management strategies, emphasizing the distinct characteristics and risk factors associated with each type of heatstroke	Classic and exertional heatstroke (Primer)	Abderrezak et al. 2022
This finding underscores the compounding effects of air pollution on human health and the environment, emphasizing the urgent need for targeted mitigation strategies and policy interventions to address these dual air quality challenges.	Increasing co-occurrence of fine particulate matter and ground-level ozone extremes in the western United States	Kalashnikov et al. 2022
This research highlights the importance of considering pharmacological influences on thermal physiology when managing chronic diseases in a warming climate, informing strategies to mitigate heat-related health risks in vulnerable populations	Effects of medications on heat loss capacity in chronic disease patients: health implications amidst global warming	Wee et al. 2023
This comprehensive analysis provides insights crucial for improving prevention, early recognition, and management strategies to mitigate the morbidity and mortality associated with exertional heat stroke in both athletic and occupational settings	Exertional heat stroke: pathophysiology and risk factors	Garcia et al. 2022
The article discusses the challenges faced by lower-middle-income countries, particularly India, in achieving universal healthcare.	Challenges for lower-middle-income countries in achieving universal healthcare: An Indian perspective	Sharma and Popli 2023
The conclusion of the study underlines the significant impact of global climate change on mental health. The authors highlight that climate change-related events such as extreme weather and prolonged environmental change are associated with a range of mental health problems such as anxiety, depression, post-traumatic stress disorder (PTSD) and increased stress levels	Global Climate Change and Mental Health	Palinkas et al. 2020
The research emphasizes the need for enhanced public health measures and adaptive strategies to mitigate the risks posed by climate change to food and water safety.	Impact of climate change on the incidence and transfer of food-and water-borne diseases	Anas et al. 2021
The findings underscore the importance of developing public health strategies and interventions to protect vulnerable populations from the adverse cardiovascular effects associated with climate change and extreme weather conditions.	The Impact of Climate Change and Extreme Weather Conditions on Cardiovascular Health and Acute Cardiovascular Diseases.	De Vita et al. 2024
The authors highlight the worsening impacts of climate change on water availability, salinity intrusion and the overall vulnerability of local communities.	Water Security in the Coastal Region of Bangladesh.	Ashik-Ur-Rahman and Animesh 2023

Heat Stress		
The study finds that exposure to summer heat may lead to dehydration, short sleep, and obesity	Risk of Kidney Injury among Construction Workers Exposed to Heat Stress: A Longitudinal Study from Saudi Arabia	Al-Bouwarthan et al. 2020
The study concludes that human temperature regulation under heat stress is influenced by multiple factors, including morphology, intrinsic characteristics, diseases, and injuries. These factors can significantly affect the body's ability to manage heat, highlighting the complexity of thermoregulation. Understanding these interactions is essential for improving health outcomes during heat stress	Human temperature regulation under heat stress in health, disease, and injury	Cramer et al. 2022
The study emphasizes the importance of integrated urban planning and the need for interdisciplinary approaches to address the complex nature of urban heat islands	New Developments and Future Challenges in Reducing and Controlling Heat Island Effect in Urban Areas	Karimi et al. 2023
Findings underscore the potential of nature-based solutions (NBS) such as green roofs and urban forests to enhance urban resilience, reduce heat stress, and improve overall urban microclimate conditions	Nature-based solutions (nbss) to mitigate urban heat island (UHI) effects in Canadian cities	Hayes et al. 2022
The study concludes that sugarcane cutters are at high risk for heat stress and strain due to working in extremely hot environments with high workloads. This is associated with acute health effects, emphasizing the need for preventive and control measures to reduce the risk of heat strain.	Heat Stress, Physiological Response, and Heat-Related Symptoms among Thai Sugarcane Workers	Boonruksa et al. 2020
Their findings underscore the complex interactions between environmental factors and heat stress, highlighting the importance of considering multiple variables in assessing the effects of heat on human performance	Quantifying the impact of heat on human physical work capacity; part III: the impact of solar radiation varies with air temperature, humidity, and clothing coverage	Foster et al. 2022
The authors conclude that rising global temperatures, changing precipitation patterns, and increased frequency of extreme weather events, combined with human-induced changes such as urbanization, deforestation, and global travel, are driving the expansion of habitats suitable for vectors (such as mosquitoes and ticks).	Effects of Climate Change and Human Activities on Vector-Borne Diseases	Souza and Scott 2024
The study presents an advanced empirical model for quantifying the impact of heat and climate change on human physical work capacity. Their model integrates various environmental variables to predict how rising temperatures due to climate change will affect human performance, emphasizing the critical need for adaptive strategies in occupational and environmental health planning	An advanced empirical model for quantifying the impact of heat and climate change on human physical work capacity	Foster et al. 2021
The conclusion highlights that projected increases in global temperatures due to climate change will significantly elevate heat stress levels across India. This increased heat stress is expected to adversely affect work performance, particularly in outdoor and labor-intensive occupations. The study quantifies these impacts, indicating substantial reductions in labor capacity and productivity, with severe implications for economic performance and public health	Projections of Heat Stress and Associated Work Performance over India in Response to Global Warming	Koteswara et al. 2020
The article discusses the intersection of climate change and nephrology. It examines the evolving impact of climate change on kidney health, emphasizing factors such as heat stress, dehydration, and environmental pollutants that contribute to renal disease burden	Climate change and nephrology.	Sasai et al. 2023
Ecosystem		
The research highlights the significant environmental and socio-economic impacts of salinity intrusion and emphasizes the need for comprehensive management and mitigation strategies to protect the fragile ecosystem and livelihoods of local communities.	Dynamics of salinity intrusion in the surface and ground water of Sundarban Biosphere Reserve, India."	Chowdhury et al. 2021
The conclusion of the study highlights the markers and impacts of global climate change on social, biological and ecological systems.	Markers for Global Climate Change and Its Impact on Social, Biological and Ecological Systems: A Review	Upadhyay 2020
Temperature		
The research uses remote sensing data to analyze glacier dynamics and provides valuable insights into the complex interactions between climate fluctuations and glacier behavior in the Karakoram region.	Continuous Karakoram glacier anomaly and its response to climate change during 2000–2021	Lhakpa et al. 2022
TEMPERATURE AND ECONOMIC PERFORMANCE- *TEMPERATURA I EKONOMSKO IZVOĐENJE*		
Agriculture		
The research underscores the complex relationships among these variables and highlights the need for integrated policies and strategies to promote sustainable development, enhance agricultural productivity, and mitigate carbon emissions in Bangladesh's evolving socio-economic landscape.	Nexus between economic growth, energy use, urbanization, agricultural productivity, and carbon dioxide emissions: New insights from Bangladesh	Raihan et al. 2022

Economy		
The findings indicate that extreme heat disproportionately affects low-income countries, exacerbating existing economic vulnerabilities and hindering development.	Globally unequal effect of extreme heat on economic growth	Callahan et al. 2022
The study provides insights into economic resilience and vulnerability to climate variability and emphasizes the need for adaptation strategies and policy measures to mitigate the negative impact of weather shocks on India's economic development.	Weather shocks and economic growth in India	Sandhani et al. 2023
The study provides insights into the overall costs associated with climate impacts, including damage to infrastructure, health impacts, agricultural losses, and adaptation expenses.	A meta-analysis of the total economic impact of climate change.	Tol 2024
Temperature		
The study finds that higher temperatures have a detrimental impact on agricultural productivity and labor productivity, leading to reduced economic output	Temperature and Economic Activity: Evidence from India	Jain et al. 2020
In conclusion, this study underscores the complex interplay between extreme weather events, due to temperature increase, urbanization, and food insecurity, highlighting the critical role of institutional quality.	Exploring the relationship between extreme weather events, urbanization, and food insecurity: Institutional quality perspective	Yiadom et al. 2023
The results showed significant effects of temperature in poor (low-income) countries. In general, low- and middle-income countries are geographically located at low elevations and are likely to be most affected by heat shocks	Climate change and health in Southeast Asia–defining research priorities and the role of the Welcome Trust Africa Asia Programs	Choisy et al. 2021
The study concludes that global warming increases global flood risk and that current flood protection standards may be inadequate. It emphasizes the need to update these standards to better address the increasing frequency and severity of flooding due to rising global temperatures.	Impacts of Climate Warming on Global Floods and Their Implication to Current Flood Defense Standards	Chen et al. 2023
It assesses how rising temperatures and changing climate patterns will impact vulnerable populations in the region, considering factors such as urbanization, population growth, and socio-economic disparities.	Projected changes in socioeconomic exposure to heatwaves in South Asia under changing climate	Ullah et al. 2022
CLIMATE CHANGE AND DAMAGE LIMITATION- *KLIMATSKE PROMJENE I OGRANIČENJE ŠTETE*		
Policies		
The author highlights the importance of integrated planning and policy-making that considers these trade-offs and promotes co-benefits to achieve a balanced approach in urban climate strategies	Trade-Offs and Conflicts between Urban Climate Change Mitigation and Adaptation Measures	Sharifi. 2020
The study may also discuss the evolution of international climate agreements, the role of different stakeholders, and the ongoing efforts to achieve meaningful climate action and sustainability goals worldwide.	Peeping into the highs and lows of the post-Kyoto climate change conferences: a review on contexts, decisions and implementation highlights	Nyirenda 2023
The study seeks to examine key issues concerning the efficacy of current Nationally Determined Contributions (NDCs) in mitigating global temperature increase to levels significantly below 2°C, in accordance with the objectives outlined in the Paris Agreement.	Towards the 1.5° C Climate Scenario: Global Emissions Reduction Commitment Simulation and the Way Forward	Akpan and Oludolapo 2023
The study emphasizes the need for integrated strategies that include enhanced green infrastructure restoration, sustainable development practices, and the adoption of ecological restoration policies.	Coastal Restoration Challenges and Strategies for Small Island Developing States in the Face of Sea Level Rise and Climate Change	Hernández-Delgado 2024
The conclusion provides a model-based assessment of the transition pathways for North Africa to meet its (Intended) Nationally Determined Contributions ((I)NDCs) under the Paris Agreement. The study also emphasizes the need for robust policy frameworks and strategic planning to ensure that the transition pathways are sustainable, economically viable, and socially inclusive. The authors call for continuous monitoring and adaptation of policies to meet evolving climate goals effectively.	Transition Pathways for North Africa to Meet Its (Intended) Nationally Determined Contributions ((I)NDCs) under the Paris Agreement: A Model-Based Assessment.	Ouedraogo. 2020
The conclusion of the study reflects on the evolving dynamics and politics of climate change governance from the Kyoto Protocol to the Paris Agreement and beyond.	The Emerging Politics of Climate Change	Thakur 2021