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Impact of Climate Change on Water Availability: Systematic Literature Review

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Abstract

Climate change has caused shifts in the distribution of rainfall and drought. This research aims to analyze the impact of climate change on water availability based on several research results that have been carried out. This research uses the PRISMA (Preferred Reporting Items for Systematic Review and Meta-Analysis) method and VosViewer for bibliometric analysis. Data was sourced from Publish or Perish and Google Scholar in 2015–2024, totaling 500 journals. Data was reduced using inclusion and exclusion criteria so that 40 journals were obtained to be reviewed and 10 journals with the highest citations to be discussed. Climate change has a significant impact on the availability of air on Earth. Rising earth temperatures can cause river water to become less abundant and air quality to become worse, which in turn can affect human life and biota that depend on the air. This research will have implications for efforts to deal with climate change as part of the influence on the availability of clean water.

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Abstrak

Perubahan iklim telah menyebabkan pergeseran distribusi hujan dan kekeringan. Tujuan dari penelitian ini adalah untuk menganalisis dampak perubahan iklim terhadap ketersediaan air terhadap beberapa hasil penelitian yang telah dilakukan. Penelitian ini menggunakan metode PRISMA (Preferred Reporting Items for Systematic Review and Meta-Analysis) bersama dengan VosViewer untuk analisis bibliometrik. Data bersumber dari Publish or Perish dan Google Scholar tahun 2015–2024 berjumlah 500 jurnal. Data direduksi menggunakan kriteria inklusi dan eksklusi sehingga diperoleh 40 jurnal akan direview dan 10 jurnal dengan sitasi tertinggi akan dibahas. Perubahan iklim memiliki dampak yang signifikan terhadap ketersediaan air di Bumi. Kenaikan suhu bumi dapat menyebabkan air sungai menjadi lebih sedikit dan kualitas air menjadi lebih buruk, yang pada gilirannya dapat mempengaruhi kehidupan manusia dan biota yang bergantung pada air. Penelitian ini berimplikasi pada upaya penanganan perubahan iklim sebagai bagian yang berpengaruh terhadap ketersediaan air bersih.

INTRODUCTION

Climate change caused by increases in greenhouse gases and human activities is the primary cause of most climate change, which includes changes in nature and variability of climate that occur over long periods (Nur et al., 2024; Amdah et al., 2024). Climate change can be identified by conducting statistical tests on climate parameters (Prasetiawan, 2015). Climate change has affected hydrological processes and water resources (Utami et al., 2024; Maru et al., 2024; Nuryadin et al., 2024). As a result, it is very difficult to manage water resources sustainably. Climate change has been shown in recent decades that tropical and subtropical regions of the Northern Hemisphere are becoming drier and mid-latitude regions are becoming wetter (Sipayung et al., 2019). It is hoped that rising global temperatures will increase the intensity of extreme weather phenomena and change the amount and pattern of rain. This will lead to more rain, a shorter wet season, and a longer dry season. Reducing the amount of rain and increasing the length of the dry season can cause a reduction in water supplies for drinking water, industry, the environment, and other needs (Rahmawati & Noerhayati, 2015). This is a concrete example that can be seen in several regions in Indonesia. As a result of the El-Nino event which caused a prolonged dry season, it caused drought in several areas such as Pangkep Regency, Barru Regency, and Soppeng which felt the impact of this phenomenon due to the lack of limited air availability (Nuryadin et al., 2024).

One of the most important natural resources for the survival of living things is water. Because water availability may vary depending on land characteristics, open water on Earth is quantitatively and temporally limited (Serang, 2012). Time-limited is a term used to describe changes in the amount of water that occur over time. Source of water supply on the earth's surface, which will be distributed according to the water cycle, precipitation is very important for the survival of water on the earth's surface. However, climate change has affected the amount and path of rainwater throughout the world (Wijayanti et al., 2015). Water is important for life because it is used for daily activities such as drinking, bathing, cooking, and washing. Therefore, having sufficient amounts of water is important, both in cities and in villages. Water scarcity and crisis will occur if the amount of water available is less than needed, which of course will make it difficult for people to meet their daily needs.

Based on the information provided, the aim of writing this journal is to conduct further research on how climate change impacts water availability. To determine co-occurrence and co-authorship of large literature mapping results, we used the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) method and bibliometric analysis. Bibliometric analysis collects data from various literature, such as articles and journals. To extract enhanced information from publications, journals, or academics, the use of VOSviewer software is also necessary to describe the relationship between bibliometric sources and sources of top writers (Lange, 2023).

METHOD

This type of research is a systematic literature review (SLR) which aims to find literature sources for research results that are relevant to the object of study under study. In this research, two analyses were carried out, namely Bibliometric Analysis and PRISMA analysis (Preferred Reporting Items for Systematic Review and Meta-Analysis).

Bibliometric Analysis

Journals obtained from Publish or Perish and Google Scholar. The keywords used are Climate Change and water availability. The results obtained were 500 journals. Then the 500 journals were downloaded in RIS (Research Information System) format. The RIS format is entered into the Mendeley Reference Manager Application. After that, select journals that are closely related to the research topic, resulting in 159 journals. After being entered into the application, the RIS format of each journal is changed (exported) to one RIS format for the entire journal. In the next step, the RIS of the entire journal is entered into the VOSviewer software to produce a graphical representation of the bibliometric map. Citation analysis supports research findings written in the form of articles, the term "citation" refers to the activity of referring to other articles that have been published or are in the process of being published (Gunawan, 2021).

Preferred Reporting Items for Systematic Review and Meta-Analysis

This research uses the PRISMA (method (O'Dea et al., 2021). Journals obtained from Publish or Perish and Google Scholar. The keywords used are climate change and water availability. The results obtained were 500 journals. Then, by filtering journal publication years from 2015 to 2024, 200 journals were obtained. Of the 200 journals, 65 journals can be accessed, while 25 journals are irrelevant. The PRISMA analysis flow is presented in Figure 1.

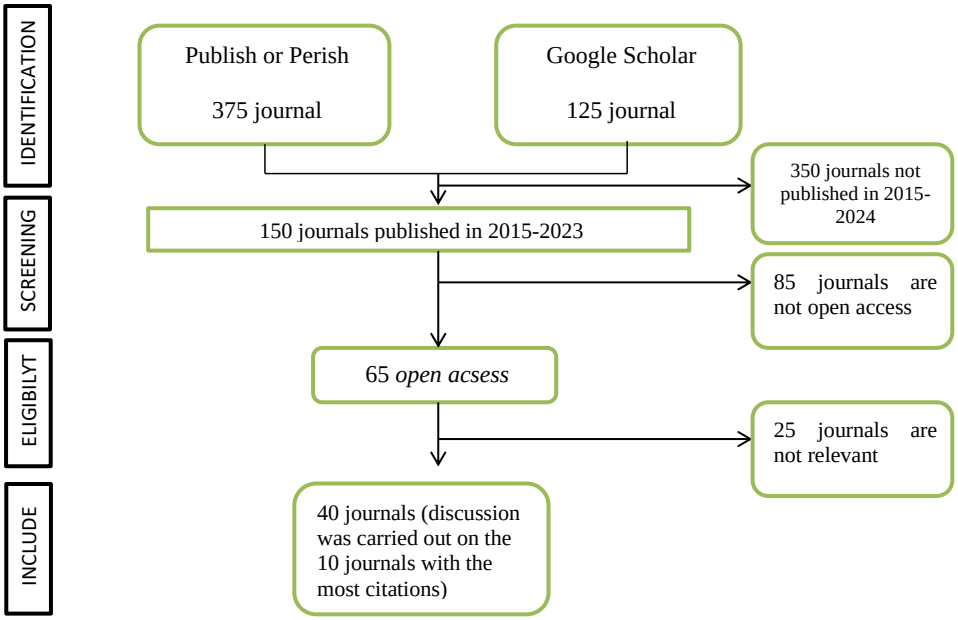

Figure 1. PRISMA Diagram

RESULT AND DISCUSSION

Bibliometric Analisys

Co-authorship

This analysis is used to see the results of scientific research published in journals in the status of interconnected or related and unrelated or unrelated. This is done to see the correlation between one study and another according to the object of study being studied.

Interconnected

In the context of a bibliography, the term interconnected refers to the relationship between various works or references. An interconnected bibliography reflects the connections among sources used in the research, including how one source may support, critique, or complement another. The following Figure 2 presents the relationship between one study and another.

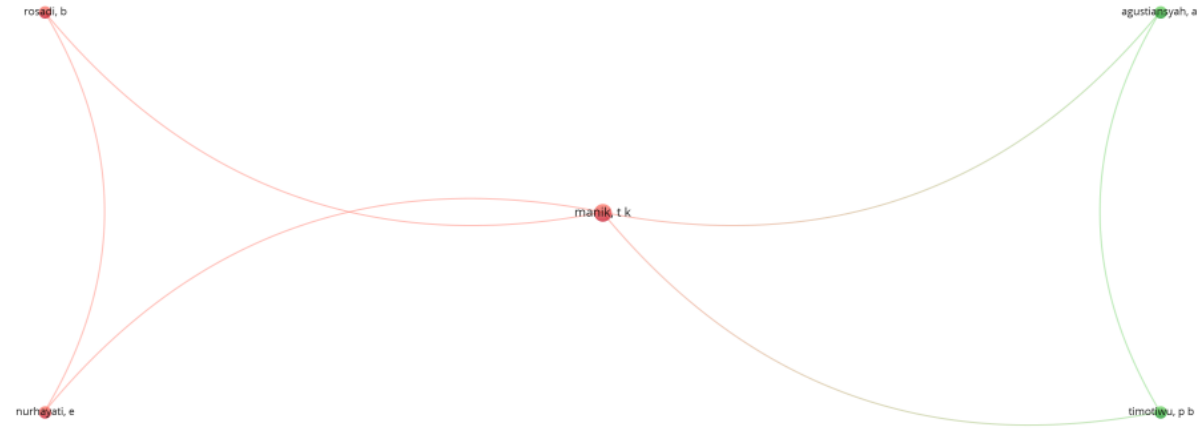

Figure 2. Co-Authorship Research

Based on the information in Figure 2 regarding Co-Authorship, it can be seen that in each study that has been identified, there is a relationship between research results and other research results with mutually harmful relationships. In this case, there are two clusters of authors in each study which are interconnected, namely there are eighty links in each cluster who write about research topics regarding the impact of climate change on the availability of clean water.

Not Connected/Related to Each Other

Based on the identification results of several existing research results by several scientific writers in reputable journals, several authors present scientific work but are not related as in the following Figure 3.

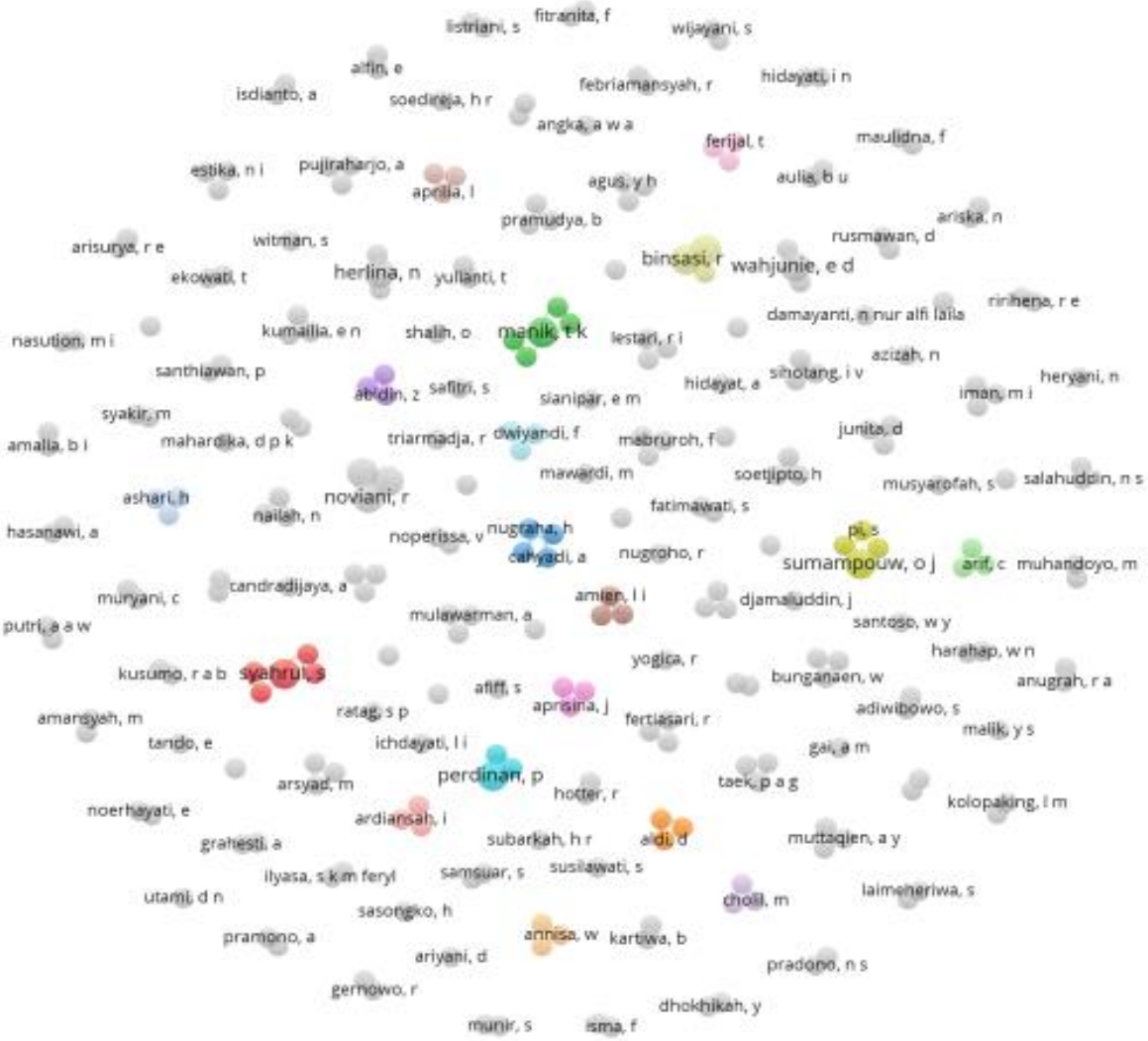

Figure 3. Co-Authorship Research

Based on Figure 3 above, there are 290 researchers spread across 272 clusters with a total of 1450 links. This cluster has no connections with other clusters. This is related to the results of research that has been carried out regarding the influence of climate change on water availability.

Co-Occurrence

Co-occurrence in SLR aims to determine the frequency of co-occurrence of two or more words, terms, or concepts. In this study, an analysis was carried out to identify the relationship between climate change studies and water availability (Figure 4).

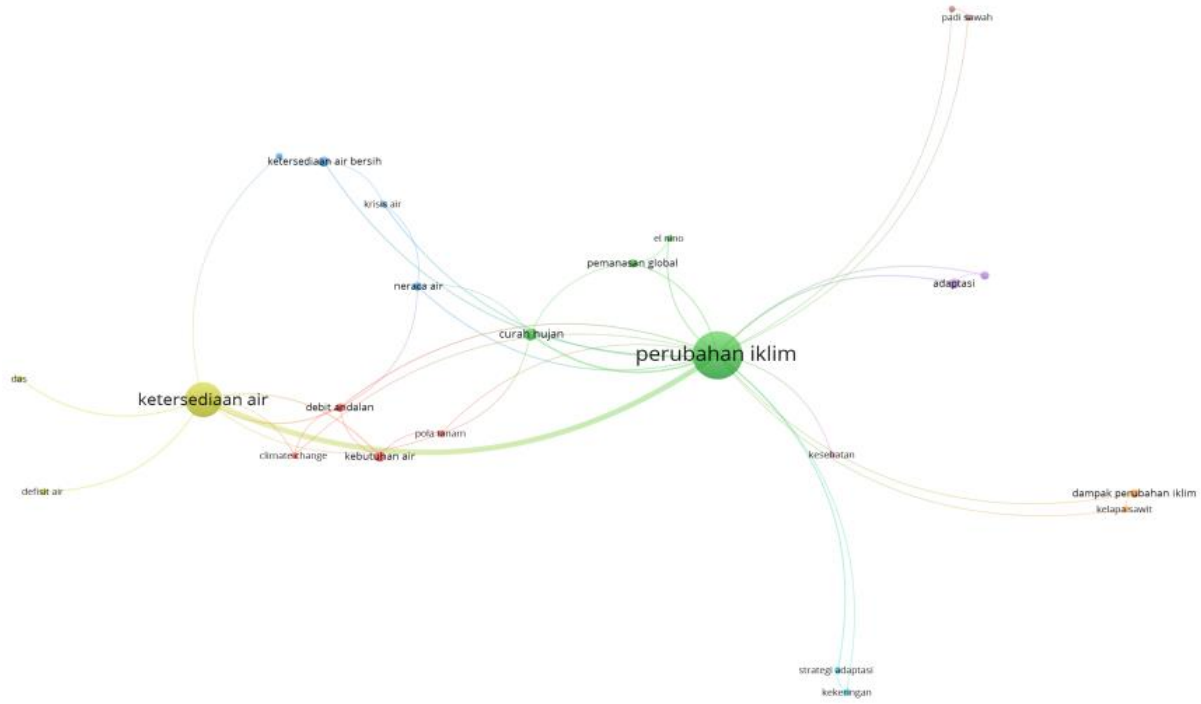

Figure 4. Co-Occurrence Research

Based on the known figure 4 above, it can be seen that several research results have been identified. Most stated that climate change is closely related/has a large correlation to air availability.

Citation

Based on 40 articles that have been obtained using SLR analysis, about 10 journals will be selected that have the highest number of citations. Citation analysis is used to determine how many people's work has been cited by other people (Aulianto & Nashihuddin, 2020).

Preferred Reporting Items for Systematic Review and Meta-Analysis

Based on the identification results of 40 published articles, there were 10 scientific articles with the highest number of citations to be discussed. The article is presented in Table 1.

Table 1. Results of PRISMA

Author	Research Title	Citation	Years	Publisher
Laimeheriwa et al.	Analysis of the El-Nino Phenomenon and Its Impact on Land Water Balance on Ambon Island	22	2019	Jurnal Budidaya Pertanian
Lestari et al.	Water and the Impact of Its Scarcity on the Economy of Urban Communities: A Literature Study of Java Island	21	2021	OECONOMICUS Journal of Economics
Latifa	The Impact of Climate Change (the Survival Strategies of Women in Facing the Impacts of Climate Change)	17	2015	Jurnal Kependudukan Indonesia
Hidayati & Suryanto	The Impact of Climate Change on Agricultural Production and Adaptation Strategies on Drought-Prone Lands	16	2015	Jurnal Ekonomi dan Studi Pembangunan
Martha	The Issue of Water Scarcity and Its Threat to Global Security	15	2017	Jurnal Ilmu Politik dan Komunikasi
Iman et al.	Groundwater for Climate Change Adaptation in Malang, East Java: Risk Assessment of Water Availability Decline	13	2017	RISET Geologi dan Pertambangan

Author	Research Title	Citation	Years	Publisher
Nugroho	Popularization of Wastewater Recycling to Anticipate Water Scarcity Due to Global Climate Change.	13	2015	Jurnal Indonesia
Nurhayati et al.	Perceptions and Strategies for Community Adaptation to Climate Change in the Southeast Asian Region	12	2020	Jurnal Proteksi: Jurnal Lingkungan Berkelanjutan
Ferijal et al.	Impact of Climate Change on the Main Flow of the Krueng Aceh River	8	2016	Jurnal Rona Teknik Pertanian
Nasution & Nuh	Climate Study Based on Oldeman Classification in Langkat Regency	7	2018	JISTech (Journal of Islamic Science and Technology)

Source: Data Analysis, 2024.

The first place with 22 (twenty-two) citations is the journal written by Laimeheriwa et al. (2019). Among the negative effects of extreme climate events and climate change are a decrease in potential agricultural production due to rising temperatures, a decrease in water availability in regions due to drought, an increase in areas vulnerable to floods and landslides, a rise in sea levels, and an increase in the number of people exposed to infectious diseases. Increasing the amount of rainfall during the dry season will have a positive effect on climate change, such as increasing planting intensity and harvest area for several food crops (Laimeheriwa et al., 2019).

In second place is a journal written by Indah Lestari et al. (2021) with a total of 21 citations which aims to determine and analyze the influence of water resources on the economy of urban communities on the island of Java and answer the question of whether clean water will be scarce in 2040 Research shows that there will be water scarcity on the island of Java in 2040 (Lestari et al., 2021). Apart from demographic factors, there are natural factors, namely climate change, which influence water availability. Even though rainfall is high in Indonesia because of its tropical climate, the process of groundwater travel takes a long time because of its particular geology. As a result, if water is taken excessively, it will cause water scarcity. In Indonesia, rain does not fall evenly like on the island of Java. However, several areas on the island of Java are still experiencing drought (Lestari et al., 2021).

The third place is an article written by Latifa (2015). The article explains that the effects of climate change are not felt much by poor households or communities. However, climate change truly threatens women's survival. In an article, it is explained that environmental damage caused by climate change has affected the daily lives of women and children. The food and clean water crisis was a real threat that is now starting to be felt by many people, especially women and children. In countries belonging to the third world group, the clean water crisis also contributes to child mortality and maternal and child malnutrition. The disease causes the deaths of around 5 million children every year (Latifa, 2015).

Fourth place is an article written by Hidayati & Suryanto (2015). In this article, it is stated that the main cause of the decline in farmers' crop yields in the dry land of Dharmaputri, India, is due to a decrease in rain intensity. The decline in farmer income was caused by a decrease in crop yields. The decline in farmer income is a short-term consequence; however, the long-term consequence is the end of dryland farmers' jobs. One of the main causes of decreased crop yields is a decrease in rain intensity. Dryland crop yields are strongly influenced by climate variations such as long dry periods (Hidayati & Suryanto, 2015)

In fifth place is an article written by Martha (2017). This article has 15 (fifteen) citations. The Earth's climate is changing more and more every day. One symptom of increasing temperature on the earth's surface which can cause global warming is climate change. This increase in temperature is caused by increasing levels of greenhouse gases in the atmosphere, and human activity is one of the main causes of this increase. The main cause of the water crisis on Earth is increasingly unnatural climate change. Climate change is causing droughts to become more frequent and more common in many places. Finally, prolonged drought causes erratic changes in seasons. On the other hand, some areas will flood continuously. Additionally, snow and glaciers will disappear.

As a result, water availability for agriculture, energy generation, ecosystems, and various other purposes will be threatened (Martha, 2017).

In sixth place is an article written by Iman et al. (2017). This article has 13 (thirteen) citations. Both climatic and non-climatic factors influence the risk of decreasing water availability. Influenced by climate, water distribution reaches its equilibrium. With the tendency for the temperature to rise and rainfall to decrease, the rising temperature will increase the evapotranspiration value, and rainfall which tends to fall will reduce the amount of water flowing on the earth (Iman et al., 2017).

In seventh place is an article written by Nugroho (2014). This article has 13 (thirteen) citations. The poor, who are the group most vulnerable to climate change, will be the most vulnerable. This population group will be more vulnerable when they live in urban areas with high population density. Urban residents face clean water problems due to industrialization, increasing population, and pressure on land, including the use of clean water that exceeds capacity. When climate change occurs, clean water problems increase. Two extreme conditions have emerged as a result of changes in the water cycle. The first is increased drought conditions, which reduce the natural availability of groundwater. Another effect of climate change is sea level rise, which results in increased seawater intrusion, which results in a decrease in the quality of clean water in land areas (Nugroho, 2014).

In eighth place is an article written by Nurhayati et al. (2020). The number of citations in this article is 12 (twelve). Rising temperatures and heat waves are the main changes farmers are feeling. This can increase the number of dry spells in the summer, increase the variability of rainfall in the wet season, and shorten the growing period. For years, society has been thought to lack understanding of climate change. However, people who depend on nature, such as farmers, feel the impact of climate change the most. According to the results of research conducted in Cambodia, the majority of people have experienced changes in rainfall patterns, following the rainy season, decreasing rainfall every year, increasing the frequency of droughts and droughts, and increasing temperatures. (Nurhayati et al., 2020)

In ninth place is an article written by Ferijal et al. (2016). This article has a total of 8 (eight) citations. People see changes in water availability as a result of climate change. However, these changes are very different and require different understandings in each place. To find out how climate change affects water availability at the surface, in the soil profile, and underground, various studies have been carried out. The study was conducted on a lake in Austria to examine the lake's hydrological response to climate change. The results show that lake volume is very sensitive to changes in rainfall levels. Increasing temperatures cause increased evaporation from lakes. Based on simulation results for the period 2040–2060, the lake will experience significant changes in its storage (Ferijal et al., 2016).

Tenth Place is an article written by Nasution & Nuh (2018). The world today is very uncertain, and many industries will experience change. One of those most affected by these changes is agriculture, where extreme weather can cause crop failure or delays in planting because the weather often does not match expectations. (Nasution & Nuh, 2018). Most studies on the relationship between weather and crop production discuss rainfall, or the availability of water or rain, with crop production. This is because rain is the main weather component that greatly influences the diversity of crop production in tropical areas. After all, the diversity is very large both in terms of time and location. (Nasution & Nuh, 2018)

Based on the identification results of the ten literature sources that have been reviewed, it can be seen that the impact of climate change is very significant on air availability. Several studies explain that climate change affects increasing surface temperatures which will continuously influence the amount of air intensity at certain time trends each year. So, several research results state the importance of strategic efforts/steps in maintaining air availability by implementing life poles which do not have a major influence on climate change because this has a very significant impact on air availability.

CONCLUSION

Climate change has a profound impact on the availability of water on Earth by altering the hydrological cycle, affecting groundwater, rivers, seawater, and glaciers. Rising global

temperatures increase evaporation rates and disrupt rainfall and flood patterns, leading to more frequent droughts and poorer water quality in many areas. These changes also prevent optimal groundwater recharge, exacerbating drought conditions. River and seawater patterns are similarly affected, with higher temperatures reducing river flow and causing ocean acidification, which harms marine ecosystems. The melting of glaciers further contributes to sea-level rise, affecting water supplies in coastal regions. As climate change intensifies, the risks of droughts, floods, and degraded water quality are expected to grow. To mitigate these effects, it is crucial to reduce greenhouse gas emissions, improve water management technologies, and promote more efficient water use, ensuring that water resources remain stable and sustainable for both human and environmental health.

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