COMMUNICATION ECONOMICS ORGANIZATION

7-8 December 2024 - Rajasthan, India

10th PROCEEDINGS BOOK

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EDITORS

Prof.Dr.Sumer Singh YADAV

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International CEO

(Communication, Economics, Organization)

Social Sciences Congress

PROCEEDINGS E-BOOK

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CEOSSC 2024 - Rajasthan, India

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International CEO

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Presentation

We are delighted to introduce **Career Point University (Host University for 10th CEO Congress), Esil University, Polytechnic Institute of Portalegre, Acacia University, IPMI International Business School, Mohanlal Sukhadia University, Samarkand Branch of Tashkent University of Economics, International Vision University, Alfred Nobel University, Nişantaşı University, University of Prizren, Cyprus West University, Ciputra University, Knowledge Laboratory, ACMIT, Insec, NCM Publishing, CEO Tekmer, Jakarta Global University, Universitas Bhayangkara, Ostim Technical University and Mardin Artuklu University** served as the vehicle of dissemination for a showpiece of articles at the **International CEO** (**C**ommunication, **E**conomics, **O**rganization) **Social Sciences Congress** (**CEO SSC 2024, Rajasthan, India**) that was held online and offline on **7-8 December 2024**. CEO Congress aims to provide a platform for discussing the issues, challenges, opportunities and findings of **Communication, Economics, Organization and Social Science** research. The organizing committee with feedback from the division chairs and the members of the **scientific committee** foresaw an opportunity and research gap in the conference theme, that pitches for pressing issues in the business world. Presentations are in Turkish & English.

2024 Int. CEO Congress takes place with the participation and contributions of **401 academics from 33 countries*: Afghanistan, Argentina, Australia, Azerbaijan, Belarus, Canada, China, Cuba, Ethiopia, India, Indonesia, Iran, Iraq, Japan, Kazakhistan, Kosovo, Malaysia, Nctr, New Zeland, Nigeria, North Macedonia, Pakistan, Poland, Portugal, Singapore, Slovakia,South Korea, Spain, Thailand, Ukraine, United Kingdom, Uzbekistan, Vietnam.***

It is a great privilege for us to present the Abstract Book of **CEO SSC 2024** to the authors and delegates of the conference.

Several manuscripts from prestigious institutions could not be accepted due to the reviewing outcomes and our capacity constraints. Participation from **115 different institutions or universities**. The 2 days long conference gathered close to **401 national and international attendees** to enliven a constellation of contributions. **205** papers of the **234** papers approved to present at the congress are outside of Türkiye. **76% of the papers presented at the congress are from outside Türkiye.** Best paper awards were issued to distinguished papers.

On the day of completion of this journey, we are delighted with **a high level of satisfaction** and **aspiration.** It is important to offer our sincere thanks and gratitude to a range of organizations and individuals, without whom this year's conference would not take place. This conference would have not materialized without the efforts of the contributing **authors for sharing the fruit of their research and the reviewers for scrutinizing**, despite their busy schedules. We also thank **our members and colleagues who accepted the duty to participate in the Scientific Committee** and for their valuable help in the screening, selecting, and recommending best contributions.

All presentations made during the congress were published on the social media accounts of the CEO Congress.

Uluslararası CEO
(İletişim, Ekonomi, Organizasyon)
Sosyal Bilimler Kongresi

Sunuş

7-8 Aralık 2024 tarihlerinde "**10. Uluslararası CEO İletişim, Ekonomi ve Organizasyon Sosyal Bilimler Kongresi**" **Career Point University** ev sahipliğinde Rajasthan, Hindistan'da Esil Üniversitesi, Polytechnic Institute of Portalegre, Acacia University, IPMI International Business School, Mohanlal Sukhadia University, Samarkand Branch of Tashkent University of Economics, International Vision University, Alfred Nobel University, Nişantaşı Üniversitesi, University of Prizren, Cyprus West University, Ciputra University, Knowledge Laboratory, ACMIT, Insec, NCM Publishing, CEO Tekmer, Universitas Bhayangkara, Jakarta Global University, Ostim Teknik Üniversitesi ve Mardin Artuklu Üniversitesi iş birliği ile **online ve fiziki katılımlar ile** düzenlenmiştir.

Kongremizde ***Afghanistan, Argentina, Australia, Azerbaijan, Belarus, Canada, China, Cuba, Ethiopia, India, Indonesia, Iran, Iraq, Japan, Kazakhistan, Kosovo, Malaysia, Nctr, New Zeland, Nigeria, North Macedonia, Pakistan, Poland, Portugal, Singapore, Slovakia,South Korea, Spain, Thailand, Ukraine, United Kingdom, Uzbekistan, Vietnam*** gibi **33 ülkeden ve 115** kurum/üniversiteden **401 akademisyen** tarafından hazırlanan **205 bildiri** sunulmuştur.

Kongremize **276** bildiri özeti gönderilmiş, editör ve hakem süreçlerinden sonra bunlardan **221** tanesi sözlü sunuma kabul edilmiş, ancak **34 oturumda 205 bildirinin sunumu** gerçekleşmiştir. Sunulan bildiriler, **978-625-98075-2-1** ISBN'li bu e kitapta yayımlanmaktadır.

Kongrede sunulan **205 bilidirinin 40'ı Türkiye ve 165'i yurt dışındandır**. Yayınlanan **bildirilerin %80'i Türkiye dışındandır. Önceki Uluslararası CEO Kongre'lerde olduğu gibi 10. Uluslararası CEO Kongre'de de hem bildiri özet kitabında hem de tam metin kitabında yabancı oranı %50'den fazladır. Okumakta olduğunuz tam metin kitabında yayınlanan tam metinlerin ise %50'den fazlası Türkiye dışındandır (36 yabancı (Türkiye dışından), 26 Türkiye'den).**

Onaylı ve yayınlanan **205 bildiriden biri Türkiye'den ve biri yurt dışından olmak üzere ikisine en iyi bildiri ödülü duyurulmuştur.**

Kongre esnasında gerçekleşen tüm sunumlar kongrenin sosyal medya hesaplarında yayımlanmıştır. Tekrar yararlanmak istendiği durumlarda **CEO Congress** sosyal medya hesaplarından izlenebilir.

Kongrenin bilim insanlarına, kamu ve özel sektör ile STK'ların yönetiminin etkinliğine katkı bulunmasını temenni eder, bildirileriyle katkıda bulunan akademisyenler ile düzenleme kurulu, danışma kurulu, bilim ve hakem kurulundaki meslektaşlarımıza ziyadesiyle teşekkür ederiz.

A Special Thanks To…

Below is a list of individuals who have supported **CEO Congress 2024 India** by donating some of their time. It is these people who make our work possible and have been a great help. We would like to say a special THANK YOU for all those listed below.

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SUSTAINABILITY, TECHNOLOGY, INNOVATION, ECONOMY AND GOVERNANCE: MULTIDISCIPLINARY PERSPECTIVES ON CONTEMPORARY CHALLENGES

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PREFACE

In the ever-evolving landscape of global challenges, interdisciplinary research has become essential to address the complex issues we face in urban planning, sustainability, technology, economics, and social governance. This book brings together a diverse collection of scholarly articles that explore these interconnected fields, with a particular focus on their implications for Indonesia. Drawing on rigorous research and practical case studies, the chapters within this volume provide valuable insights into the ways in which we can approach problems ranging from urban development and climate change to financial performance and green marketing.

The contributors to this book represent a cross-section of experts from various disciplines, each offering their unique perspective on contemporary issues. From the implementation of Transit Oriented Development (TOD) in urban spaces to the evaluation of financial strategies during the Covid-19 era, the chapters reflect both the local challenges and global trends shaping our world. The studies also delve into emerging fields such as the management of hazardous waste in onshore oil fields, the use of interpretive structural modeling in educational institutions, and the integration of green marketing strategies in corporate governance.

One of the key themes that runs through this book is the idea of sustainability—whether through environmental protection, economic resilience, or technological innovation. Many of the chapters explore how industries, governments, and organizations can adapt and thrive in a world marked by uncertainty and rapid change. The contributions are not only theoretical but also practical, offering strategies and methodologies that can be applied to real-world challenges.

We hope that this book will serve as both a reference and a source of inspiration for scholars, practitioners, and policymakers. It aims to foster greater collaboration and knowledge exchange across disciplines, as the solutions to our most pressing issues require a holistic approach. By combining the insights from urban planning, climate science, business analysis, and social studies, we believe this volume can contribute to the advancement of sustainable practices and innovative solutions in Indonesia and beyond.

We would like to express our sincere gratitude to all the authors, whose work forms the foundation of this book, and to the readers for their interest in this critical area of research. It is our hope that this collection of studies will spark new conversations and drive meaningful change in the fields explored.

Dr. Teena Singh
Bursa – December 2024

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CHAPTER 3

The Impacts of Climate Change on the Hydrological Cycle at Semarang

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ABSTRACT

Climate change affects the hydrological cycle in the form of changes in the intensity and frequency of extreme rainfall. The causes of the increase in extreme rainfall consist of several environmental indicators. The purpose of this study was to determine the conditions of rainfall due to climate change based on land cover conditions. The analytical method in this study is related to hydrology characteristic. The results obtained was based on the analysis of climate characteristics in the Semarang area for 30 years (1990-2023). There is a shift in the rainy and dry months for 1 month, a change in rainfall intensity of ±13%. There is an increase in rainfall during the rainy season, ranging from 12% to 13.3%, and a decrease in rainfall during the dry season of 7% to 9%. This illustrates that in the 2050s, there will be a change in rainfall distribution, where the rainy season will be wetter and the dry season will be drier and last longer as an impact of climate change. Jragung Watershed 73% of the rainwater that falls each year evaporates into the air (evapotranspiration), 6.31% flows on the surface (surface run-off), and 8.01% seeps into groundwater reserves (infiltration).
Keywords: Land Cover, Hydrology Cycle, Water Security, Climate Change.

1. Introduction

The scientific community around the world has given climatic variability and climate change a great deal of attention. The reason for the global concern about climate change is its impact on every region and all living things. The potential disruptions to the environment, including the delicate balance between biotic and abiotic elements in any ecosystem, highlight the global nature of this issue.

Glaciers are receding (Dyurgerov & Meier 2000), ice is melting more quickly (Gregory et al. 2004; Overpeck et al. 2006; Stroeve et al. 2007), sea levels are increasing (Ramachandran et al. 2017), natural disasters like floods, storms, and cyclones are occurring, and surface temperatures are rising (Kurniyaningrum et al. 2024). Rainfall patterns are changing (Kurniyaningrum et al., 2022). Climate change has an impact on nearly every ecosystem on the planet. Among the world's most fragile ecosystems are rivers. Furthermore, rivers are considered the ecosystems most vulnerable to climate change's direct and indirect effects due to a confluence of other stresses (Durance & Ormerod 2007, 2009). The hydrology and dynamics of rivers will be impacted by impacts on river ecosystems, which also present severe risks to the survival and existence of various aquatic plant and animal species, animals, human populations, etc. Besides sustaining life and offering several ecosystem services, rivers control flooding, sedimentation, erosion, water quality, pollution release, and other factors.

Water resources management (Kundzewicz et al. 2008), water quality (Whitehead et al. 2009), hydro morphological changes (Boon & Raven 2012), changes in catchment land use (Oliver & Morecroft 2014; Kadri et al. 2021), and surface temperature (Putra et al. 2024) are just a few of the many effects of climate change on rivers that have an impact on the dynamics of the entire river. There has also been research on how river systems are affected by climate change (Verghese & Iyer 1993; Gosain et al. 2006, 2011; Boon & Raven 2012; Hosterman et al. 2012). Rivers are essential to Indonesia and are sometimes called the nation's lifeblood. More than 70% of people in rural areas depend on agriculture for their livelihood, and rivers are the primary source of irrigation for this industry. Rivers are also the primary source of electricity, drinking water, transportation, aquaculture, leisure activities, etc. The state of the hydrological cycle is impacted by the growing human activity in the river basin. Therefore, this essay has looked into how climate change affects various aspects of the dynamics of the Jragung River.

2. Literature Review

Hydrological Cycle

The hydrological or water cycle is a continuous water cycle from the atmosphere to the earth and back to the atmosphere. Water circulation occurs through several processes: Evaporation, condensation, precipitation, infiltration, runoff, sublimation, interception, advection, and reservoir storage. The hydrological cycle begins with evaporation, where Water from the sea, lakes, rivers, and soil evaporates into the atmosphere due to sunlight, including evaporation from plants through transpiration. Water vapor then condenses as it cools in the atmosphere, forming clouds of water droplets or ice crystals. When the water droplets in the clouds enlarge, precipitation occurs, where Water falls back to earth as rain, snow, or hail. Some water seeps into the ground through infiltration, while others flow deeper into groundwater through

percolation. Water that is not absorbed flows on the surface as runoff towards rivers and seas. Ice or snow water can turn directly into vapor in cold conditions through sublimation. Rainwater can also be temporarily retained in vegetation during interception before evaporating or falling to the ground. In the atmosphere, water vapor can move horizontally through advection. Before returning to the cycle, Water is stored in various natural reservoirs such as oceans, lakes, rivers, soil, ice, and groundwater.

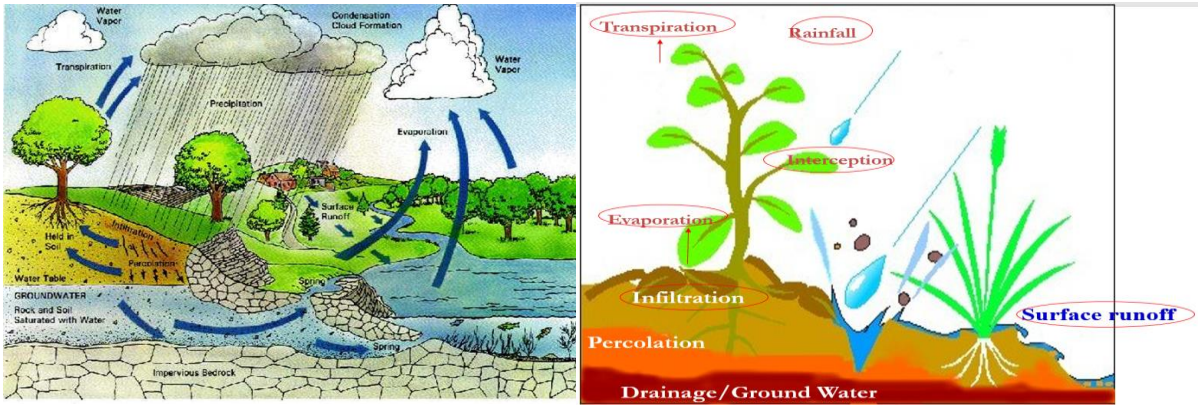

Figure 1. Hydrological Cycle

Global Climate Change

According to the United Nations, Climate change refers to changes in long-term weather and temperature patterns. When climate change occurs, atmospheric conditions experience increased temperatures, increased greenhouse gases, changes in weather patterns, and more frequent extreme weather phenomena. All of these changes interact with each other, exacerbating the impacts of global warming. Based on BMKG analysis and observations from 116 stations, the average air temperature in September 2023 was 27.0°C, which is 0.4°C higher than the climatological temperature in 1991-2020. This increase shows the difference between the observed and normal temperatures, which is hotter than the long-term average (positive anomaly). Therefore, September 2023 is included in the hottest period. This anomaly is the 4th highest in air temperature observations since 1981.

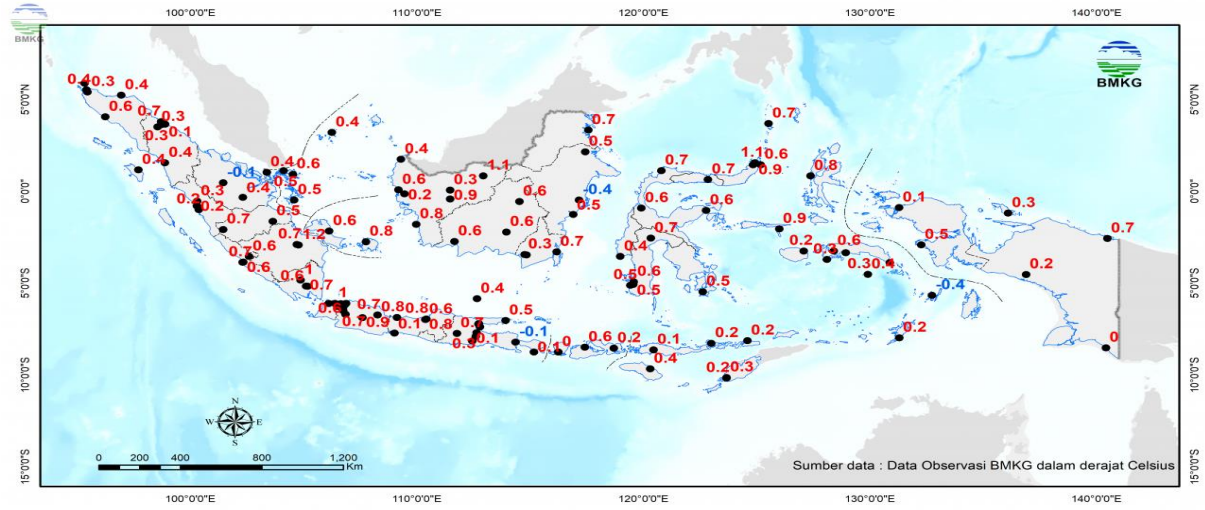

Figure 2. Annual average temperature anomaly 2023 compared to the period 1991-2020 (BMKG, 2023)

Positive air temperature anomalies can have adverse impacts on water resources, including increased evaporation, drought, decreased water quality, changes in rainfall patterns, ecosystem

disruption, and challenges in water management for agriculture. Adaptation in water resource management is essential to mitigate these impacts.

3. Material and Method

Based on various climatological correlations and radiation assumptions, this study presents a climate prediction for the future. Models of mathematical representations of interactions between the atmosphere, land surface, oceans, and sea ice are produced using global climate models (GCMs) and regional climate models (RCMs). The state of the research area is impacted by climate change. Below is a description of the methodology.

3.1. Study Area

Geographical Location of Jragung Watershed is located in the northern part of Central Java which crosses 4 (four) districts, namely from Demak Regency (65,145.98 ha), Semarang (25,932.55 ha), Grobogan (25,654.64 ha) and Semarang City (1,304.48 ha) with an area of 118,036.64 ha and has a watershed circumference of 135.22 km and a main river length of 72.44 km. The coordinate position of Jragung Watershed is between 1100 21 '57" - 1100 39' 58 " East Longitude and between 60 50' 55 " - 70 13 '59 " South Latitude.

Figure 3. Jragung Watershed

Figure 4. Jragung river condition

3.2. Climate Scenario

Rainfall condition prediction is modeled by Coupled Model Intercomparison Project 5 (CMIP). This study uses CMIP 5 models from GFDL and IPSL to project the next 50 years. The model requires fairly long baseline data, namely 30-year baseline data obtained from BMKG data combined with National Oceanic Atmospheric Administration (NOAA) data for the period 1990–2020.

In analyzing annual data, this study uses Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS) from the Climate Hazards Group from 2010 to 2020 as comparative data. In analyzing the effects of climate change on rainfall data, two scenarios were used, namely the Representative Concentration Pathway (RCP) Scenario 4.5 and 8.5 obtained from the Chelsa-Climate website in the form of raster maps. The RCP 4.5 scenario is a scenario that stabilizes radiative forcing at 4.5 Watts per square meter by 2100 without ever exceeding that value, while RCP 8.5 is a scenario that describes a possible future with high risks due to climate change. This scenario is generally used as a basis for worst-case climate change scenarios.

The climate change model describes a watershed's climatological conditions and how they will impact water availability.

4. Result and Discussion

4.1. Annual rainfall conditions

Rainfall and climate data used are sourced from BBWS Pemali Juana. Around the watershed area are 5 (five) rainfall-observing stations: Ngobo Station, Jatirunggo Station, Bawen Station, Ambarawa Station, and Jragung Station. These rainfall stations have observational data for 1o years (2010-2020). The rainfall data figure 3., shows that the average monthly rainfall reaches the highest value in January at 288 mm and the lowest in August at 22 mm. The highest monthly rainfall in November is 518 mm, and the lowest in August is 116 mm. The lowest monthly rain starts in June and continues until September, with 1 mm of monthly rainfall (Figure 3).

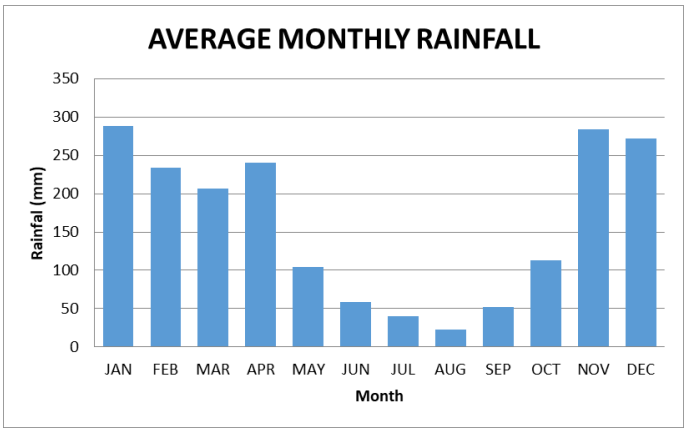

Figure 3. Average monthly rainfall

4.2. Climate change impact

Climate Change to Temperature used data by Badan Meteorologi, Klimatologi, Geofisika (BMKG) and Global Historical Climatological Nerwork (GHCN). Used historical data collection from 1990-2020. The projection of rainfall changes is based on climate change data that occurred in the last 10 years, 2010-2020, using the GCM (General Circulation Model) model with the RCP scenario. The projection of rainfall changes is based on climate change data that occurred in the last 10 years, 2010-2020, using the GCM (General Circulation Model) model with the RCP (Representative Concentration Pathway) scenario with a downscaling process. The projection of changes is divided into three stages (representative concentration pathway) with a downscaling process. The projection of changes is divided into three stages, namely short-term (stage 1), medium-term (stage 2), and long-term (stage 3).

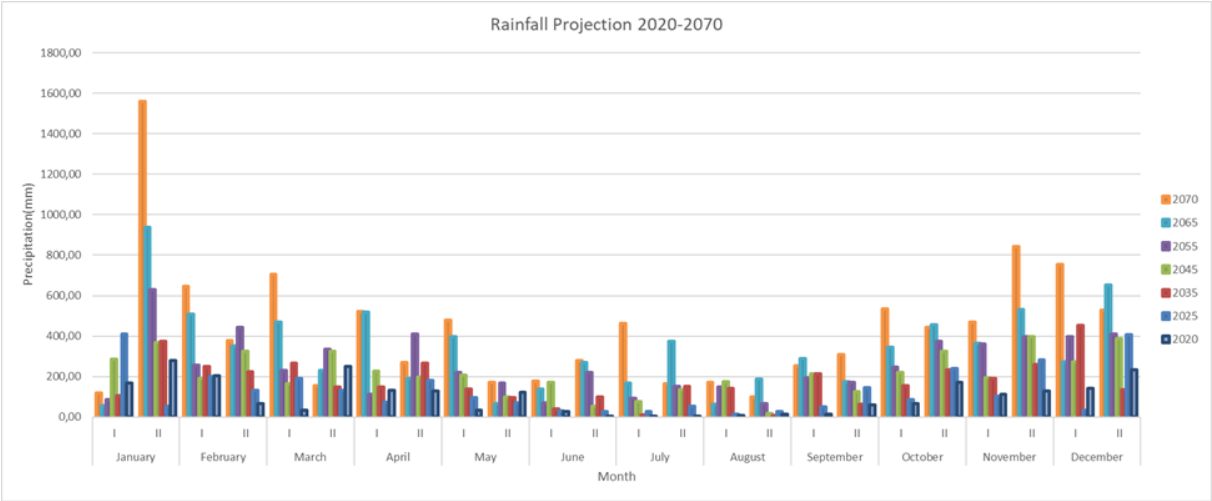

Figure 4 . Rainfall Projection 2020-2070 at Jragung Watershed

Table 1. Precent change of temperature

Years	1990-2000	2001-2020	Percentage
Average Temperature (^{0}C)	27.5	27.8	1.08 %

The results of the analysis of temperature trends from 1990 to 2020 show a temperature increase of 1.08% (Table 1). The temperature change is then predicted for the next 40 years in predicting the rainfall patterns that are likely to occur (Table 2).

Table 2. Precent change projection of temperature

Years	2021-2040	2041-2060	2061-2080
Average Temperature (^{0}C)	1.08%	2.16%	3.21%

Table 3. Precent Change of Rainfall Data

	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Ave. RR	246.6	138.5	106.0	99.0	107.6	69.4	157.5	76.0	74.0	76.0	91.2	188.6
Total RR	119.2	119.2	119.2	119.2	119.2	119.2	119.2	119.2	119.2	119.2	119.2	119.2
Condition	WET	WET	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	WET
% Change	51.7	13.9	-12.5	-20.4	-10.8	-71.8	24.3	-56.8	-61.1	-56.8	-30.7	36.8
SOI (2023)	11.8	10.5	−2.0	0.3	−18.5	0,2	−4.3	−12.7	−13.6	−6.8	−8.6	−2.4

The analysis of rainfall change trends in Semarang from 1990 to 2020 shows that the rainfall patterns that occur experience positive and negative trends. A positive trend indicates an increase in rainfall, while a negative trend indicates a decrease in rainfall. This shows that in the period 1990 to 2020, the rainfall data used as a baseline, which was then compared with the rainfall data in 2023, tended to decrease in intensity and degree of wetness, meaning that Semarang experienced drought conditions caused by heat waves from the effects of increasing surface temperatures. Climate change in Indonesia globally affects local conditions, causing changes in the frequency, area, duration, and time of extreme weather and climate events.

In the study area, there was an anomaly in rainfall. Namely, the impact of the global climate on the study area was seen in April and June. The global conditions experienced increasing rainfall intensity, but in the study area, there was a significant decrease in rainfall intensity; in December, there was an increase in rainfall globally, but the conditions of the study area experienced a reduction in rainfall intensity.

In developing water resources, mitigation is carried out in stages by considering the impact of climate change. Based on the results of this study, the mitigation of water resource conditions is divided into three phases: the short term for 2035, the medium term for 2050, and the long term for 2070. Rainfall predictions for the short term 2035 include shifts in seasonal patterns: rainy season in November, December, January, February, March, and April; dry season in May, June, July, August, September, and October. The maximum rainfall intensity is in December, while the minimum is in July. Increase the average temperature from 0.5°C to 1°C.

The medium-term 2050 includes a rainy season in December, January, February, March, April, and May and a dry season in June, July, August, September, October, and November. The maximum rainfall intensity is in January, while the minimum is in June. The average temperature will increase from 0.8°C to 1.2°C.

The long term 2070 includes rainy seasons in December, January, February, March, April, May, and June and dry seasons in July, August, September, October, and November. The maximum rainfall intensity is in January, while the minimum is in August. The average temperature will increase from 10°C to 1.50°C.

5. Conclusion and Recommendation

There is a shift in the rainy and dry months for 1 month, a change in rainfall intensity of ±13%. There is an increase in rainfall during the rainy season, ranging from 12% to 13.3%, and a decrease in rainfall during the dry season of 7% to 9%. This illustrates that in the 2050s, there will be a change in rainfall distribution, where the rainy season will be wetter and the dry season will be drier and last longer as an impact of climate change. Jragung Watershed 73% of the rainwater that falls each year evaporates into the air (evapotranspiration), 6.31% flows on the surface (surface run-off), and 8.01% seeps into groundwater reserves (infiltration).

Recommendation: Establish a map of disaster-prone water-related areas as a reference in preparing regional spatial planning and control of spatial utilization.

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EDITOR'S BIOGRAPY

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The Impacts of Climate Change on the Hydrological Cycle at Semarang

by Cahaya Rosyidan

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The Impacts of Climate Change on the Hydrological Cycle at Semarang

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ABSTRACT

Climate change affects the hydrological cycle in the form of changes in the intensity and frequency of extreme rainfall. The causes of the increase in extreme rainfall consist of several environmental indicators. The purpose of this study was to determine the conditions of rainfall due to climate change based on land cover conditions. The analytical method in this study is related to hydrology characteristic. The results obtained was based on the analysis of climate characteristics in the Semarang area for 30 years (1990-2023). There is a shift in the rainy and dry months for 1 month, a change in rainfall intensity of ±13%. There is an increase in rainfall during the rainy season, ranging from 12% to 13.3%, and a decrease in rainfall during the dry season of 7% to 9%. This illustrates that in the 2050s, there will be a change in rainfall distribution, where the rainy season will be wetter and the dry season will be drier and last longer as an impact of climate change. Jragung Watershed 73% of the rainwater that falls each year evaporates into the air (evapotranspiration), 6.31% flows on the surface (surface run-off), and 8.01% seeps into groundwater reserves (infiltration).

Keywords: Land Cover, Hydrology cycle, Water security, Climate Change

1. Introduction

The scientific community around the world has given climatic variability and climate change a great deal of attention. The reason for the global concern about climate change is its impact on every region and all living things. The potential disruptions to the environment, including the delicate balance between biotic and abiotic elements in any ecosystem, highlight the global nature of this issue.

Glaciers are receding (Dyurgerov & Meier 2000), ice is melting more quickly (Gregory et al. 2004; Overpeck et al. 2006; Stroeve et al. 2007), sea levels are increasing (Ramachandran et al. 2017), natural disasters like floods, storms, and cyclones are occurring, and surface temperatures are rising (Kurniyaningrum et al. 2024). Rainfall patterns are changing (Kurniyaningrum et al., 2022). Climate change has an impact on nearly every ecosystem on the planet. Among the world's most fragile ecosystems are rivers. Furthermore, rivers are considered the ecosystems most vulnerable to climate change's direct and indirect effects due to a confluence of other stresses (Durance & Ormerod 2007, 2009). The hydrology and dynamics of rivers will be impacted by impacts on river ecosystems, which also present severe risks to the survival and existence of various aquatic plant and animal species, animals, human populations, etc. Besides sustaining life and offering several ecosystem services, rivers control flooding, sedimentation, erosion, water quality, pollution release, and other factors.

Water resources management (Kundzewicz et al. 2008), water quality (Whitehead et al. 2009), hydro morphological changes (Boon & Raven 2012), changes in catchment land use (Oliver & Morecroft 2014; Kadri et al. 2021), and surface temperature (Putra et al. 2024) are just a few of the many effects of climate change on rivers that have an impact on the dynamics of the entire river. There has also been research on how river systems are affected by climate change (Verghese & Iyer 1993; Gosain et al. 2006, 2011; Boon & Raven 2012; Hosterman et al. 2012). Rivers are essential to Indonesia and are sometimes called the nation's lifeblood. More than 70% of people in rural areas depend on agriculture for their livelihood, and rivers are the primary source of irrigation for this industry. Rivers are also the primary source of electricity, drinking water, transportation, aquaculture, leisure activities, etc. The state of the hydrological cycle is impacted by the growing human activity in the river basin. Therefore, this essay has looked into how climate change affects various aspects of the dynamics of the Jragung River.

2. Literature Review

Hydrological Cycle

The hydrological or water cycle is a continuous water cycle from the atmosphere to the earth and back to the atmosphere. Water circulation occurs through several processes: Evaporation, condensation, precipitation, infiltration, runoff, sublimation, interception, advection, and reservoir storage. The hydrological cycle begins with evaporation, where Water from the sea, lakes, rivers, and soil evaporates into the atmosphere due to sunlight, including evaporation from plants through transpiration. Water vapor then condenses as it cools in the atmosphere, forming clouds of water droplets or ice crystals. When the water droplets in the clouds enlarge, precipitation occurs, where Water falls back to earth as rain, snow, or hail. Some water seeps into the ground through infiltration, while others flow deeper into groundwater through percolation. Water that is not absorbed flows on the surface as runoff towards rivers and seas. Ice or snow water can turn directly into vapor in cold conditions through sublimation. Rainwater can also be temporarily retained in vegetation during interception before evaporating or falling to the ground. In the atmosphere, water vapor can move horizontally through advection. Before returning to the cycle, Water is stored in various natural reservoirs such as oceans, lakes, rivers, soil, ice, and groundwater.

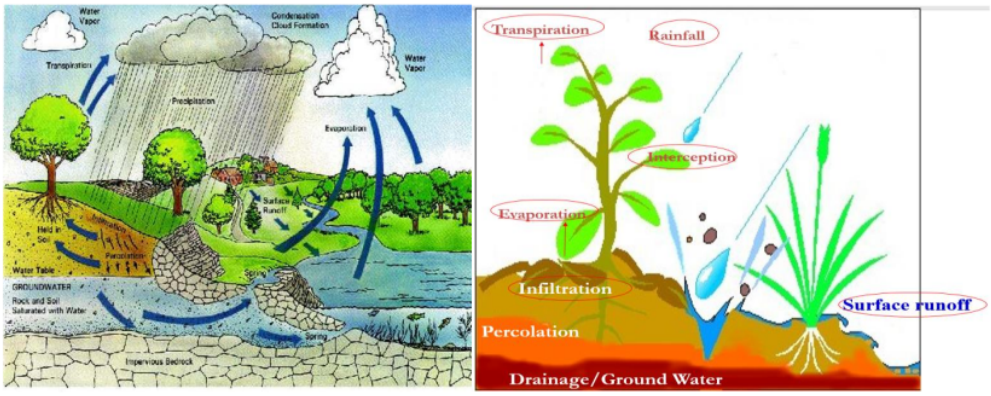

Figure 1. Hydrological Cycle

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According to the United Nations, Climate change refers to changes in long-term weather and temperature patterns. When climate change occurs, atmospheric conditions experience increased temperatures, increased greenhouse gases, changes in weather patterns, and more frequent extreme weather phenomena. All of these changes interact with each other,

exacerbating the impacts of global warming. Based on BMKG analysis and observations from 116 stations, the average air temperature in September 2023 was 27.0°C, which is 0.4°C higher than the climatological temperature in 1991-2020. This increase shows the difference between the observed and normal temperatures, which is hotter than the long-term average (positive anomaly). Therefore, September 2023 is included in the hottest period. This anomaly is the 4th highest in air temperature observations since 1981.

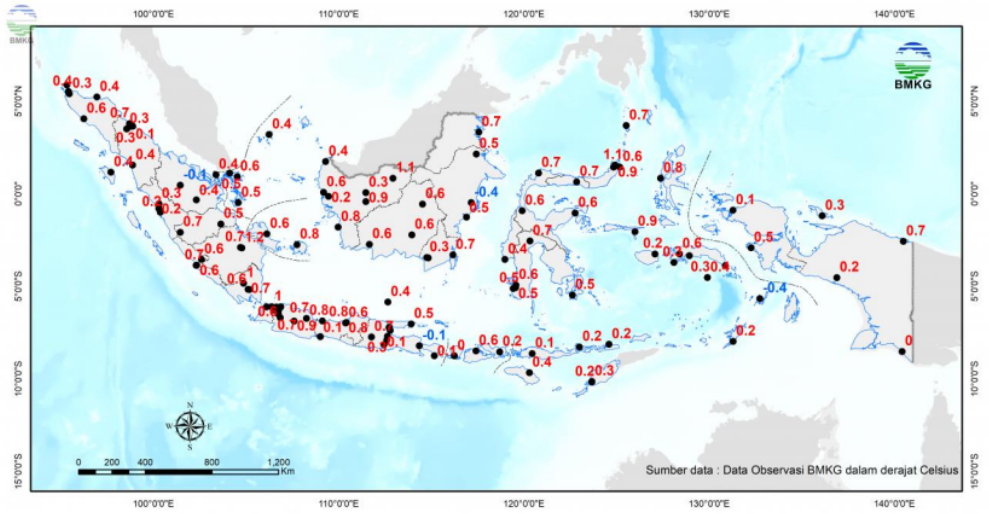

Figure 2. Annual average temperature anomaly 2023 compared to the period 1991-2020 (BMKG, 2023)

Positive air temperature anomalies can have adverse impacts on water resources, including increased evaporation, drought, decreased water quality, changes in rainfall patterns, ecosystem disruption, and challenges in water management for agriculture. Adaptation in water resource management is essential to mitigate these impacts.

3. Material and Method

This study depicts a climate scenario of the future climate based on a range of climatological relationships and assumptions of radioactive forcing. Global climate models (GCMs) and regional climate models (RCMs) are used to create models of three-dimensional mathematical representations that show interactions between the atmosphere, land surface, oceans, and sea ice. Climate change affects the study area's condition, where the water flow changes affect water availability. The methodology is described below

3.1. Study Area

Geographical Location of Jragung Watershed is located in the northern part of Central Java which crosses 4 (four) districts, namely from Demak Regency (65,145.98 ha), Semarang (25,932.55 ha), Grobogan (25,654.64 ha) and Semarang City (1,304.48 ha) with an area of 118,036.64 ha and has a watershed circumference of 135.22 km and a main river length of 72.44 km. The coordinate position of Jragung Watershed is between 1100 21 '57" - 1100 39' 58 " East Longitude and between 60 50' 55 " - 70 13 '59 " South Latitude.

Figure 3. Jragung Watershed

Figure 4. Jragung river condition

3.2. Climate Scenario

Future rainfall conditions are modeled by the Coupled Model Intercomparison Project 5 (CMIP). Several nations have used CMIP 5 to construct several rain models. The GFDL model from America and the IPSL model from Japan were employed in this investigation. To compute

the projection for the years 2021–2080, the temperature conditions are processed using historical Meteorology, Climatology, and Geophysics Agency (BMKG) data elaborated with National Oceanic Atmospheric Administration (NOAA) data for the period 1990–2020. The FJ fake calculation method is utilized to calculate the rainfall-runoff data, and the flow duration curve (FDC) is used for validation.

The Climate Hazards Group's InfraRed Precipitation with Station Data (CHIRPS) from 2010 to 2020 provided rain data modeling. Representative Concentration Pathway (RCP) 4.5 is used in this investigation, and The Climate Hazards Group's InfraRed Precipitation with Station Data (CHIRPS) from 2010 to 2020 provided the rain data modeling. Representative Concentration Pathway (RCP) 4.5 and 8.5 scenarios are used in this study to examine predictions. The Chelsa-Climate website provided the CMIP 5 model. The average monthly data, which included 12 data raster maps, was employed in this study. Data from 1990 to 2020 is downloaded to create the rainfall baseline, and data from the GFDL-ESM2M-RCP85 (2021–2070) and IPSL models -CM5A-RCP85 (2021–2070) are downloaded to make the rainfall projection data under extreme climate change conditions, RCP.85, with no climate change prevention. In ArcGIS, GCM data is utilized as a raster for processing. The information is GFDL-rcp45 data from 2081–2070 and rain baseline data from 1990–2020. After that, processing is done to show variations in rainfall.

4. Result and Discussion

4.1. Annual rainfall conditions

Rainfall and climate data used are sourced from BBWS Pemali Juana. Around the watershed area are 5 (five) rainfall-observing stations: Ngobo Station, Jatirunggo Station, Bawen Station, Ambarawa Station, and Jragung Station. These rainfall stations have observational data for 1o years (2010-2020). The rainfall data figure 3., shows that the average monthly rainfall reaches the highest value in January at 288 mm and the lowest in August at 22 mm. The highest monthly rainfall in November is 518 mm, and the lowest in August is 116 mm. The lowest monthly rain starts in June and continues until September, with 1 mm of monthly rainfall (Figure 3).

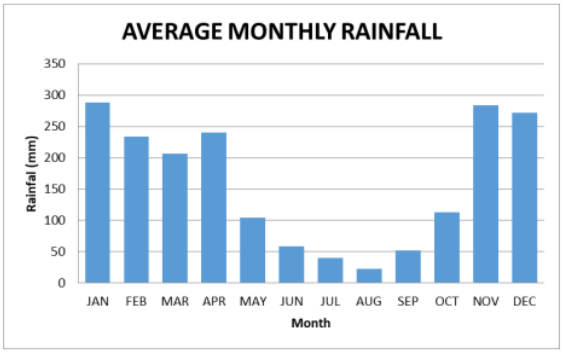

Figure 3. Average monthly rainfall

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Climate Change to Temperature used data by Badan Meteorologi, Klimatologi, Geofisika (BMKG) and Global Historical Climatological Nerwork (GHCN). Used historical data collection from 1990-2020. The projection of rainfall changes is based on climate change data that occurred in the last 10 years, 2010-2020, using the GCM (General Circulation Model) model with the RCP scenario. The projection of rainfall changes is based on climate change data that occurred in the last 10 years, 2010-2020, using the GCM (General Circulation Model) model with the RCP (Representative Concentration Pathway) scenario with a downscaling process. The projection of changes is divided into three stages (representative concentration pathway) with a downscaling process. The projection of changes is divided into three stages, namely short-term (stage 1), medium-term (stage 2), and long-term (stage 3).

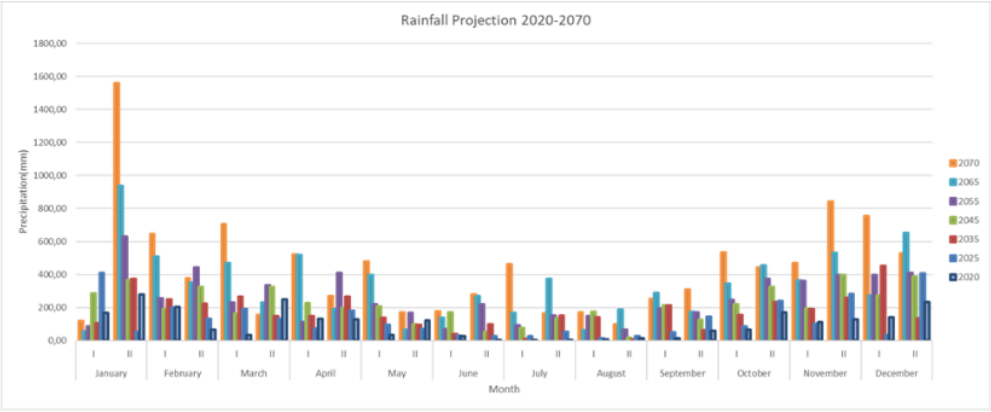

Figure 4 . Rainfall Projection 2020-2070 at Jragung Watershed

Table 1. Precent change of temperature

Years	1990-2000	2001-2020	Percentage
Average Temperature (^{0}C)	27.5	27.8	1.08 %

The results of the analysis of temperature trends from 1990 to 2020 show a temperature increase of 1.08% (Table 1). The temperature change is then predicted for the next 40 years in predicting the rainfall patterns that are likely to occur (Table 2).

Table 2. Precent change projection of temperature

Years	2021-2040	2041-2060	2061-2080
Average Temperature (^{0}C)	1.08%	2.16%	3.21%

Table 3. Precent Change of Rainfall Data

	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Ave. RR	246.6	138.5	106.0	99.0	107.6	69.4	157.5	76.0	74.0	76.0	91.2	188.6
Total RR	119.2	119.2	119.2	119.2	119.2	119.2	119.2	119.2	119.2	119.2	119.2	119.2
Condition	WET	WET	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	WET
% Change	51.7	13.9	-12.5	-20.4	-10.8	-71.8	24.3	-56.8	-61.1	-56.8	-30.7	36.8
SOI (2023)	11.8	10.5	−2.0	0.3	−18.5	0,2	−4.3	−12.7	−13.6	−6.8	−8.6	−2.4

The analysis of rainfall change trends in Semarang from 1990 to 2020 shows that the rainfall patterns that occur experience positive and negative trends. A positive trend indicates an increase in rainfall, while a negative trend indicates a decrease in rainfall. This shows that in the period 1990 to 2020, the rainfall data used as a baseline, which was then compared with the rainfall data in 2023, tended to decrease in intensity and degree of wetness, meaning that Semarang experienced drought conditions caused by heat waves from the effects of increasing surface temperatures. Climate change in Indonesia globally affects local conditions, causing changes in the frequency, area, duration, and time of extreme weather and climate events.

In the study area, there was an anomaly in rainfall. Namely, the impact of the global climate on the study area was seen in April and June. The international conditions experienced increasing rainfall intensity, but in the study area, there was a significant decrease in rainfall intensity; in December, there was an increase in rainfall globally, but the conditions of the study area experienced a reduction in rainfall intensity.

5. Conclusion and Recommendation

There is a shift in the rainy and dry months for 1 month, a change in rainfall intensity of ±13%. There is an increase in rainfall during the rainy season, ranging from 12% to 13.3%, and a decrease in rainfall during the dry season of 7% to 9%. This illustrates that in the 2050s, there will be a change in rainfall distribution, where the rainy season will be wetter and the dry season

will be drier and last longer as an impact of climate change. Jragung Watershed 73% of the rainwater that falls each year evaporates into the air (evapotranspiration), 6.31% flows on the surface (surface run-off), and 8.01% seeps into groundwater reserves (infiltration).

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