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The effects of Sinop province's relative humidity values on bioclimatic comfort and urban and landscape planning

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Abstract

This study examines the monthly average relative humidity values in different districts of Sinop province and evaluates the impact of these data on urban and landscape planning. The relative humidity rates from January to December showed significant differences between districts. The highest relative humidity values were mostly observed in the Erfelek district, while the lowest values were recorded in the Türkeli and Boyabat districts. Seasonal changes caused fluctuations in relative humidity rates, with higher humidity levels detected particularly during the winter months. These data are crucial for understanding the climatic conditions of Sinop province and for making strategic decisions in areas such as agriculture, water management, and urban planning. The study specifically recommends the development of landscape planning and water conservation strategies in areas with high relative humidity. Additionally, it emphasizes the need to study the long-term effects of climate change and the necessity of continuous monitoring. Finally, this study provides an important data source for local governments and future research.

Keywords: climate data, humidity and environmental effects, relative humidity, seasonal relative humidity changes

1. Introduction

Climate plays a decisive role in vegetation, water resources, and human health. In this context, relative humidity refers to the ratio of water vapor in the atmosphere to the maximum capacity of water vapor the air can hold, playing an important role in determining climatic conditions. Relative humidity, which has a direct impact on agricultural activities, water management, and urban life quality, is a critical parameter for the health of both natural ecosystems and the sustainability of human settlements. Relative humidity is crucial for the health of natural ecosystems and the sustainability of human settlements (Allen et al., 2011).

Sinop province, under the influence of the Black Sea climate, experiences fluctuating relative humidity values throughout the year, shaping the dynamics of local ecosystems. The climate of the Black Sea region is characterized by high humidity levels, particularly in the summer months, which directly affect agriculture and natural vegetation (Güven et al., 2016). Specifically, relative humidity is critically important in terms of agricultural productivity and biodiversity. High humidity promotes plant growth, while low humidity levels can lead to water stress and plant diseases (Pereira et al., 2002).

The aim of this study is to examine the monthly average relative humidity values in Sinop province and to evaluate the impact of these data on urban and landscape planning. The relative humidity levels observed in different districts of Sinop provide important information regarding local climate conditions and biodiversity. Relative humidity is a factor that directly affects agricultural activities, water management, and urban life quality (Kumar & Singh, 2014).

Sinop province, which is under the influence of the Black Sea climate, experiences fluctuating relative humidity values throughout the year, shaping the dynamics of local ecosystems. This study aims to examine the monthly average relative humidity values in Sinop province and to evaluate the impact of these data on urban and landscape planning. The relative humidity levels observed in

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different districts of Sinop provide important information regarding local climate conditions and biodiversity. In this context, high relative humidity values show the positive effects on plant growth and agricultural productivity, while low relative humidity rates highlight the need to reconsider water management and agricultural strategies.

The purpose of this study is to analyze the seasonal variability of relative humidity and its impact on ecosystems, agriculture, and urban planning, as well as to propose how these data can be used for sustainable development. Ultimately, the findings related to relative humidity will provide an important basis for addressing climate change at the local level and for the efficient use of natural resources.

In conclusion, this study aims to analyze the seasonal variability of relative humidity and its impact on ecosystems, agriculture, and urban planning. The findings will provide an important foundation for addressing climate change at the local level and for the efficient use of natural resources.

2. Material and Method

The study was conducted within the borders of Sinop province. Sinop province is located in the Black Sea Region and has a total area of 5,862 km². As of 2023, the total population of the province is recorded as 218,408 (Sinop Provincial Directorate of Culture and Tourism, 2024). The study area and relevant geographical location information are presented in Figure 1.

Figure 1 Geographical location of Sinop

In this study, relative humidity data for Sinop province were used. The data were obtained from meteorological stations in different districts of Sinop. The districts covered in the study are Merkez, Boyabat, Türkeli, Erfelek, Ayancık, and Durağan. The monthly average relative humidity data were obtained from the Turkish State Meteorological Service (MGM, 2024) database and cover a 12-month period as of 2023.

The relative humidity data were obtained from meteorological stations in the designated districts of Sinop province. These stations regularly measure and record various meteorological parameters. Monthly relative humidity values were calculated based on the daily measurements from the stations, with averages taken for each month.

The analysis of the obtained data was carried out following the steps below:

Descriptive Statistics: Descriptive statistics (mean, median, minimum, maximum, standard deviation) were calculated for the monthly average relative humidity values. This allowed for a general evaluation of the variability of humidity in each district.

Comparative Analysis: Relative humidity rates between the relevant districts were compared through graphs and tables. This comparison was made to observe the seasonal variations in relative humidity values.

Bioclimatic Comfort Map Production: Using the obtained relative humidity data, a bioclimatic comfort map of Sinop province was created. This map provides a visual representation of the relative humidity levels in different regions, offering insights into the area's climatic characteristics.

During the data analysis process, Geographic Information Systems (GIS) software (such as ArcGIS) was used to analyze the spatial data. These tools were employed to examine the spatial distribution of relative humidity values and to conduct mapping processes.

The accuracy of the obtained data was ensured by comparing the meteorological station data with the relative humidity values from the existing literature. This helped increase the reliability of the dataset.

The findings obtained through this method aim to contribute to a more comprehensive understanding of the climate characteristics of Sinop province. The results will provide valuable information for addressing climate change and managing resources sustainably at the local level.

3. Results

The monthly average relative humidity values of Sinop province are closely related to climate change and local microclimatic conditions (Figure 2). In general, the variability of relative humidity throughout the year affects the dynamics of local ecosystems and agricultural activities.

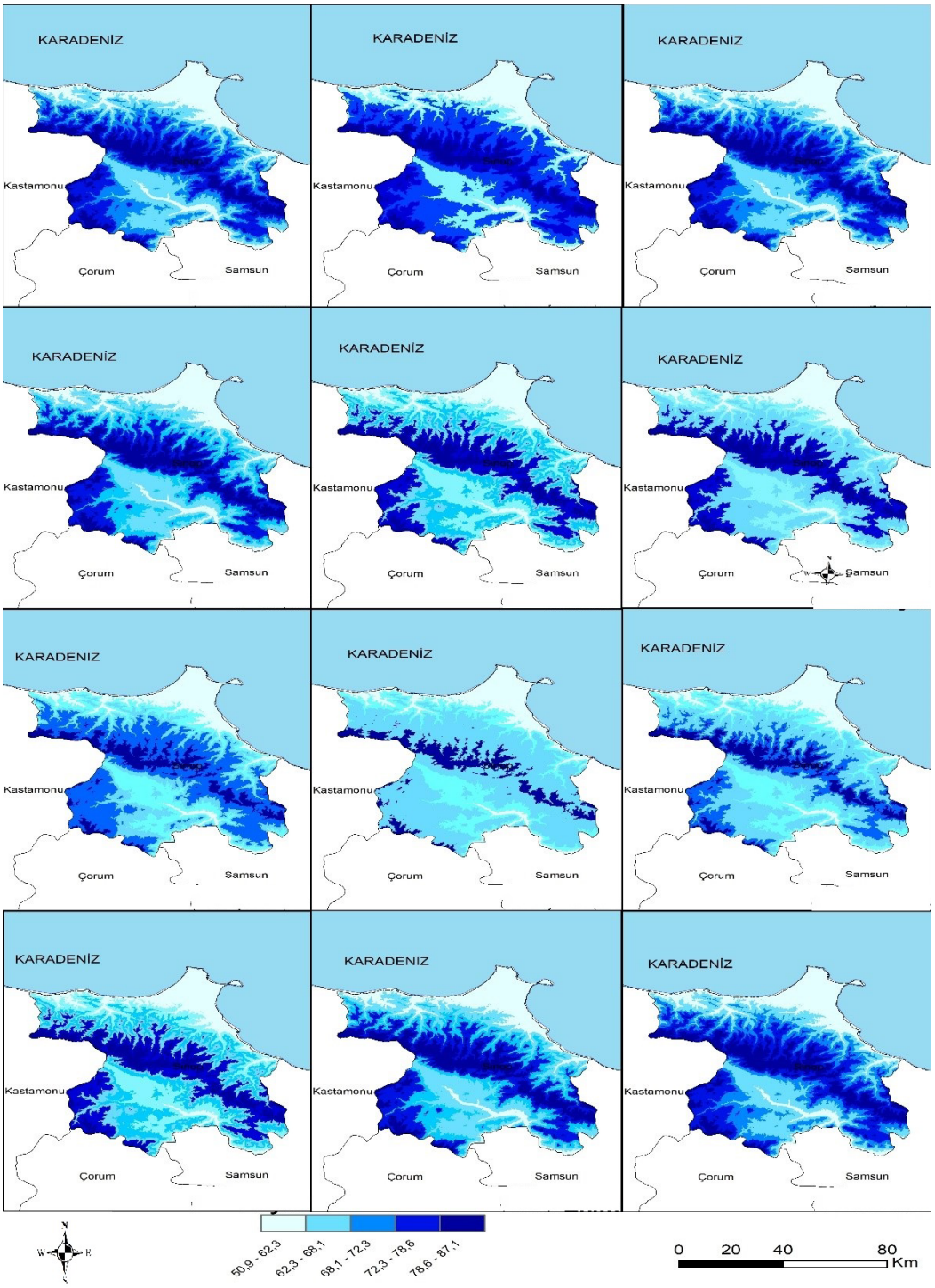

Figure 2 Relative humidity bioclimatic comfort map of Sinop province

Relative Humidity Variability: In January, relative humidity rates ranged between 66.8% and 81.2%, showing higher values during the winter months. This situation can directly affect agricultural production and water resource management. In particular, the high relative humidity values in the Erfelek district provide an advantage for irrigation and agricultural activities, while the lower values in the Türkeli district may increase irrigation needs.

Decrease in Summer Months: Relative humidity values observed in July and August, ranging from 51.9% to 78.1%, create a risk of agricultural drought with the increase in temperatures. This period should be considered a risky time for agricultural planning. It is necessary to implement water-saving techniques in agriculture and develop alternative irrigation methods.

Microclimate Effects: Differences in relative humidity between the various districts of Sinop reflect microclimate effects. This is an important criterion for landscape planning. For example, it is recommended to preserve areas with high humidity values as more green space and agricultural land to maintain the ecosystem balance.

4. Discussion

The relative humidity status of Sinop province is a crucial factor to consider in urban and landscape planning. While relative humidity determines the effects of climatic conditions on ecosystems, it plays a critical role in areas such as agriculture, water management, and green space design. Below is a more in-depth discussion of these topics.

The seasonal variability of relative humidity values in Sinop province can directly affect agricultural productivity. Studies have shown that high relative humidity levels have positive effects on plant growth and productivity (Danneberger, 2000). However, it should not be forgotten that excessive moisture conditions can also have negative effects on diseases and pests (Sinha et al., 2020). Particularly, the lower relative humidity values in the Türkeli district may make drought conditions more apparent, increasing the need for irrigation.

The differences in relative humidity observed between the various districts of Sinop reflect local microclimate conditions. These microclimate differences should be considered in landscape planning. Studies have shown that increasing green areas can help raise relative humidity levels and reduce temperature fluctuations (Tzoulas et al., 2007). Therefore, it is recommended to preserve and develop green areas in regions with high relative humidity levels.

Climate change is a significant factor that affects relative humidity values. The increase in temperature can change the amount of water vapor in the atmosphere, leading to changes in relative humidity. Various studies have examined the impacts of climate change scenarios on relative humidity, revealing that these effects may have long-term consequences for agricultural productivity (Lobell et al., 2011). Therefore, monitoring the relative humidity status in Sinop is crucial for developing climate change adaptation strategies.

The variability of relative humidity throughout the year is another factor that should be considered in water management. An increase in irrigation requirements during periods of low relative humidity can put pressure on water resources. Studies have shown that the integration of water-saving techniques and rainwater harvesting can enhance water management strategies (Allen et al., 1998; Abbaspour et al., 2009; Viviroli et al., 2011; Bhaduri et al., 2010). Therefore, developing water management plans based on relative humidity values in Sinop is of great importance.

5. Conclusion

In this study, the monthly average relative humidity values of Sinop province were thoroughly examined, and a comprehensive evaluation was made regarding the variations in different districts. The results obtained provide important findings for both the region's climatic characteristics and urban and landscape planning.

The monthly relative humidity values in Sinop province generally fluctuate throughout the year. Erfelek district, in particular, reached the highest relative humidity rates during many months of the year, while the Türkeli district recorded the lowest relative humidity values. This situation is considered an important indicator of the region's climatic differences and local characteristics.

Relative humidity rates vary depending on seasonal changes. During the winter months, especially in January and February, relative humidity rates are generally high. In the summer months, it is observed that relative humidity rates decrease. This is of critical importance for agricultural activities, water resource management, and overall climate adaptation. The positive

effects of high relative humidity on health and the potential for drought conditions due to low relative humidity should be considered.

The relative humidity map of Sinop province provides essential information for urban and landscape planning. The relative humidity levels in different regions contribute to decision-making processes in areas such as green space design, water resource management, and the positioning of structures. Particularly in regions with high relative humidity rates, strategies such as water-saving measures and plant selection should be developed.

The data obtained also highlight the region's risk of exposure to climatic changes. The impacts of climate change may lead to significant changes in relative humidity. In this context, continuous monitoring and analysis of current data are of vital importance for local governments. The effects of changes in relative humidity on agriculture, health, and water resource management should be examined, and strategies should be developed accordingly.

The results of this study provide a foundational dataset for future research. Long-term studies on relative humidity are important for better understanding the effects of climate change and developing local adaptation strategies. Additionally, evaluating the data obtained from these studies from a broader perspective will contribute to local communities' efforts to combat climate change.

The relative humidity status of Sinop province is a critical factor that should be considered in urban planning and landscape design. The analysis of monthly average relative humidity values provides important data for developing strategies that will enhance agricultural productivity, manage water resources, and promote sustainable urbanization. Protecting and managing areas with high relative humidity will play a significant role in ensuring the sustainability of natural resources.

The monthly average relative humidity values in Sinop province provide valuable data for understanding local climatic conditions and urban and landscape planning. This study revealed significant findings regarding the seasonal variability of relative humidity, which should be considered in various areas.

Seasonal Variability and Ecosystem Impacts: The relative humidity values observed throughout the year in Sinop play a decisive role in agricultural productivity and ecosystem health. Particularly, the high relative humidity rates in the Erfelek district contribute to the growth of vegetation and the increase in biodiversity. However, in regions with lower relative humidity, such as Türkeli and Boyabat, water management strategies are more important.

Urban Planning and Sustainability: Relative humidity values should also be considered in the planning of urban areas. Increasing green spaces and integrating climate-friendly designs in Sinop can help raise relative humidity levels and improve the microclimate. Green infrastructure applications are vital for enhancing the quality of urban life and efficiently using natural resources.

Connection to Climate Change: Climate change affects the dynamics of relative humidity. The changes in relative humidity observed in Sinop may have long-term effects on agriculture, water management, and ecosystem health when evaluated with future climate scenarios. In this context, proactive strategies need to be developed to address climate change.

6. Recommendations

This Water Management: Irrigation systems in agricultural areas need to be optimized, and water-saving methods should be adopted. The low relative humidity values observed during the summer months should be considered, providing flexibility in irrigation planning.

Increasing Green Spaces: In regions with high relative humidity rates, more green space and afforestation projects should be encouraged. This is important for both combating climate change and preserving biodiversity.

Education and Awareness: Agricultural producers and urban residents should be educated about the effects of relative humidity, raising awareness of climate change and local microclimate conditions.

Supporting Research: More academic research should be conducted on the relative humidity situation in Sinop, which will help in developing climate change adaptation strategies. This will ensure that planning is based on scientific data.

In this context, the relative humidity status of Sinop province is an important factor for maintaining climatic and ecological balance, and the use of this data plays a critical role in urban planning and landscape design processes.

Data Monitoring: Continuous monitoring of relative humidity values and collecting updated data is crucial for responding to local climate changes.

Green Infrastructure Applications: Integrating natural design elements such as green roofs, parks, and water pools into urban planning can help balance relative humidity.

Education and Awareness: Educating farmers and local people about the importance of relative humidity can promote the adoption of water-saving and sustainable agricultural practices.

Green Space Management: Careful selection of plant species and landscape arrangements should be made in regions with high relative humidity.

Climate Monitoring Systems: Continuous monitoring and analysis of meteorological data in Sinop province will assist in developing effective strategies to cope with climate change.

Public Education: Raising public awareness about climate change and the importance of relative humidity can contribute to environmental sustainability.

In conclusion, the relative humidity status of Sinop province is a critical factor to consider in terms of local ecosystem health, agricultural productivity, and urban planning. This study aims to promote the more effective use of relative humidity data and encourage the development of sustainable development strategies.

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Resume

Assistant Prof. Dr. Ilknur Zeren Cetin, from Ondokuz Mayıs University's Faculty of Architecture, Depertment of City and Regional Planning, Samsun, Türkiye, specializes in urban and regional planning with a focus on climate dynamics, land use changes, urban ecology, and plant-environment interactions. Her research spans two key areas: ***Climate Space Perception and Bioclimatic Comfort****, exploring environmental comfort through diverse methods, and* ***Sustainable Urban Development and Climate Impacts****, examining climate effects on land use and sustainable strategies. Dr. Cetin's expertise includes bioclimatic comfort, sustainable urban design, landscape ecology, GIS, and air quality analysis. Her recent work emphasizes the role of green campuses in enhancing sustainability and well-being, integrating socio-cultural and ecological perspectives. She investigates urban climate interactions to promote livable and environmentally aligned communities, addressing urbanization and climate change challenges through innovative approaches.*