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ASSESSING CLIMATE CHANGE EFFECTS ON AGRICULTURAL WATER DEMAND IN ABADAN USING LARS WG 8 (CMIP6 SSP SCENARIOS)

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Climate change in hot and arid regions like Abadan poses a serious threat to food security and water resources. Accurate projections of future conditions are essential for developing effective adaptation strategies. In this study, the LARS-WG 8 model was applied using meteorological data from Abadan station (Iran) under three climate scenarios, SSP1-2.6, SSP2-4.5, and SSP5-8.5, for the year 2040. Interpretation of the climate data for 2023 and 2024 compared to future scenarios for 2040 (SSP1-2.6, SSP2-4.5, SSP5-8.5) at Abadan station reveals a clear trend of warming and seasonal shifts in precipitation. In July, maximum temperature rises from 47.2°C (2024) to 48.7°C (SSP5-8.5), while evapotranspiration drops from 393.5 *mm* to around 291–294 *mm*, a 25% reduction. December precipitation increases dramatically from 0.8 *mm* to 25.7 *mm* in SSP5-8.5, over 30 times higher. In contrast, rainfall in June remains zero across all scenarios. March precipitation declines from 45.0 *mm* to 19.1 *mm* in SSP2-4.5 (a 58% drop), while minimum temperature rises from 13.9°C to 16.0–16.5°C (about 15% increase). These shifts indicate higher temperatures, reduced summer evapotranspiration, and a concentration of rainfall in cooler months, directly affecting crop water needs and irrigation scheduling. Based on the results obtained, it is recommended that agricultural planning in Abadan move towards climate change-resistant cropping patterns, improve irrigation efficiency, and revise water allocation plans to take into account the increasing temperature and increasing concentration of precipitation in the cold months of the year.

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Introduction. Climate change poses significant challenges to arid and semi-arid regions, where water scarcity and extreme temperatures already threaten agricultural productivity and human well-being [1]. Abadan, located in southwestern Iran, is particularly vulnerable to climatic shifts due to its hot climate, limited water

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resources, and strategic socio-economic importance. Anticipating future climate conditions in such regions is essential for informed planning and adaptation strategies. to continue throughout the 21st century, raising the risk of desertification and ecosystem degradation. Rising temperatures and variable rainfall have led to increased aridity, more frequent and severe droughts, and reduced soil moisture, which together threaten agricultural productivity, food security, and water resources [2]. These climatic shifts also reduce the carbon and nutrient storage capacity of soils, diminish biodiversity, and impair essential ecosystem services, further challenging the resilience of local communities [3]. Stochastic weather generators, such as the LARS-WG 8 model, offer a robust framework for simulating daily climate data under various future scenarios. By downscaling global climate projections to local scales, LARS-WG enables researchers to assess potential changes in key meteorological parameters, including temperature, precipitation, and solar radiation, with high temporal resolution [4]. The model is particularly effective in reproducing the statistical characteristics of observed weather data, filling gaps in historical records, and providing high-resolution projections for specific locations, even in regions with limited or missing data [5, 6].

The research background on the LARS-WG 8 model and climate change prediction indicates that this model has been widely used for simulating and forecasting temperature and precipitation across various regions, particularly in arid and semi-arid areas. Studies conducted in Iraq using the LARS-WG 8 model and General Circulation Model (GCM) data under various emission scenarios (such as RCP and SSP) have shown that annual temperatures will significantly increase by the end of the century, exceeding 5℃ in some regions, while precipitation trends may either increase or decrease depending on the region and scenario [7, 8]. This model demonstrated satisfactory performance in calibration and validation using historical datasets, successfully projecting future climate trends with reasonable accuracy [9]. Moreover, studies have shown that LARS-WG performs well in reproducing the statistical characteristics of climate data and identifying extreme events such as heavy rainfall or droughts. However, the uncertainty in precipitation projections is generally higher than that of temperature, and combining multiple climate models can yield more reliable results [10].

The study by Mohammadi et al. [11], aimed at predicting climate change in the Southern Zagros Region for the year 2038, utilized the LARS-WG weather generator model along with data from GCMs under two emission scenarios: RCP4.5 and RCP 8.5. The results indicated a significant upward trend in annual temperature across the examined stations, with some cases exceeding historical averages. Moreover, precipitation levels declined in most stations, although the intensity and pattern of this reduction varied depending on the climate scenario and the geographical location of each station. The results of Salahi et al. [12], who applied the LARS-WG model in the Urmia Lake watershed, showed that according to the projections for the 2050s, precipitation is expected to decrease by 1.12%, while temperature is projected to increase by 1.3℃. The study by Kamari et al. [13] evaluated the performance of the LARS-WG model in predicting meteorological parameters across cotton-growing climatic zones in Iran. In this research, data from GCMs for the future period of 2041–2060 were input into the LARS-WG model, and trends in temperature and precipitation were analyzed. The results indicated that the annual average of minimum and maximum temperatures in the studied regions will increase significantly, while precipitation levels in areas leading to the central arid plateau and southern Iran are expected to decline.

The study by Dastranj and Noohegar [14] examined climate change and its implications for natural resource governance in the Mahabad Region. In this research, daily data on temperature (minimum and maximum), precipitation, and sunshine hours from 1986 to 2014. Using the LARS-WG 8 downscaling model, the future climate conditions for the period 2021–2040 were simulated. The results showed that the average minimum and maximum temperatures are projected to increase by approximately 20% and 8%, respectively, while the annual average precipitation is expected to decrease by around 13%. This study aims to evaluate the projected climate conditions in Abadan for the year 2040 using the LARS-WG 8 model under selected emission scenarios. The results will provide insights into possible shifts in climatic patterns and support regional efforts in climate-resilient planning, particularly in agriculture and water resource management.

Materials and Methods. Abadan is located in the Southwest of Iran, within Khuzestan Province. Its geographical coordinates are 48°17' longitude and 30°20' latitude, with an elevation of 3 *m* above sea level and a total area of 2.796 km^2. Positioned near the shores of the Persian Gulf and adjacent to desert regions (Desert areas of Southwestern Iran and Iraq), the city experiences a hot and humid climate due to its geographical setting. This location also makes Abadan vulnerable to airborne dust and suspended particles that are carried from surrounding desert areas toward the city [15].

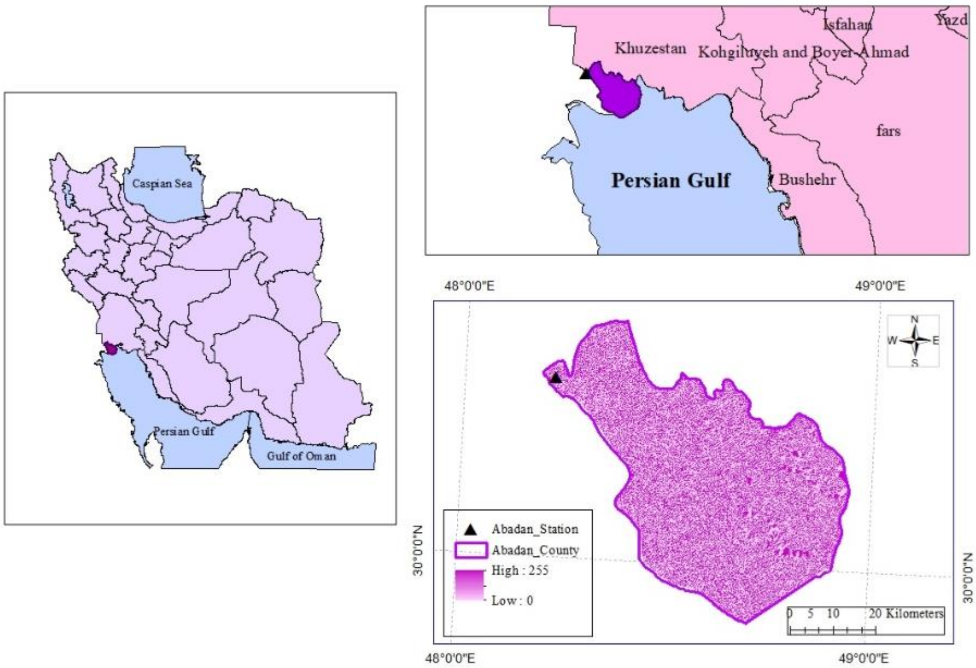

Fig. 1. Location of the study area.

Tab. 1 presents the characteristics of the Abadan weather station based on average data from the last decade.

Table 1

Specifications of the Abadan Meteorological Station (Recent Decade Average)

Parameter	Value
Latitude, °	30.37
Longitude, °	48.22
Station Elevation, *m*	6.60
Annual Precipitation, *mm*	250.93
Average Annual ET_0, *mm*	2940.23
Average Annual Temperature, ℃	27.64
Average Annual Wind Speed, *m/s*	3.36
Average Relative Humidity, %	43.17

LARS-WG Model. The LARS-WG 8 model is a stochastic weather simulation tool used to generate daily climate data such as precipitation, temperature, and solar radiation based on short-term historical records. It is widely applied in climate change studies and in assessing its impacts on agriculture and water resources [5]. The model can produce long-term synthetic time series with statistical characteristics similar to observed data. Statistical evaluations have shown that LARS-WG can reproduce the mean and frequency distribution of precipitation and temperature with acceptable accuracy, although it has limitations in replicating the variance of daily and monthly data [16].

This model is commonly employed through a three-step process, calibration, validation, and generation of synthetic climate data, and is well-suited for projecting future climate scenarios. In LARS-WG, depending on the version and research objectives, a range of GCMs can be utilized [6]. For instance, the fifth version of LARS-WG, based on the IPCC Fourth Assessment Report, includes 15 GCMs, six of which (GFCM21, HadCM3, INCM, IPCM4, MPEH, and NCCCSM) are run under 3 scenarios: SRA2, SRA1B, and SRB1. In more recent studies, models from CMIP3 and CMIP5 project such as HadCM3, GFDL-CM2.1, ECHAM5-OM, CCSM3, MRI-CGCM2.3.2, CSIRO-MK3, CanESM2, and others have also been employed in LARS-WG under various scenarios, including RCP4.5 and RCP8.5 [17].

GCMs from various projects such as CMIP5, and especially CMIP6, are widely used for simulating and projecting Iran's climate. Each model tends to perform better in a specific climatic region. For instance, CNRM-CM6-1 and MRI-ESM2-0, which showed good performance in humid areas, were less accurate in arid and hyper-arid zones. Conversely, models such as HadGEM3-GC31-LL, BCC-CSM2-MR, and CanESM5, which performed well in arid and hyper-arid regions, were less reliable in humid zones [18]. In the present study, the HadGEM3-GC31-LL general circulation model from the CMIP6 ensemble has been used to investigate climate change projections for the city of Abadan in the year 2040.

Tab. 1 presents the meteorological characteristics of the Abadan station.

Results and Discussion.

Scenario 1 (Comparison of 2023 and 2039). Based on the 2023 climate data from the Abadan station, the temperature and precipitation patterns reflect the region's hot and arid climate. The average minimum temperature ranges from 9.4°C in January to 30.6°C in August, while the maximum temperature rises from 16.5°C in winter to 48.5°C in summer. Monthly precipitation is concentrated in winter and early spring, especially January with 88.4 *mm*, whereas from May to September, rainfall is nearly absent. This pattern aligns with reference evapotranspiration (ET_0), which increases from 44.9 *mm* in January to over 390 *mm* in June, indicating a sharp rise in crop water demand during the hot, dry season (Fig. 2). The 2023 climate data from Abadan station fully aligns with the characteristics of the region's hot and arid climate. This pattern is also confirmed by the Consecutive Dry Days index (CDD), as Abadan recorded 193 consecutive dry days, one of the highest values in the country [19].

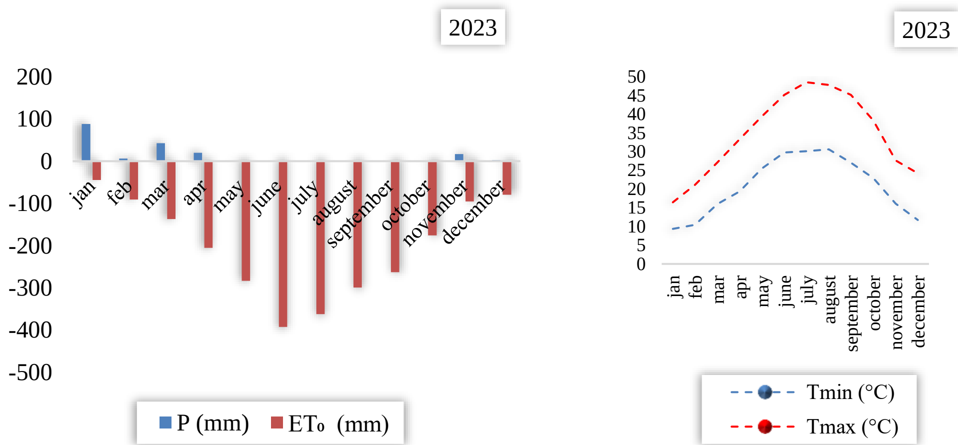

Fig. 2. Meteorological parameters in the baseline year 2023.

Comparison of the 2023 baseline with the SSP1-2.6 scenario for the year 2040 in Abadan reveals notable shifts in temperature, precipitation, and ET_0. In January, the maximum temperature rises from 16.5°C to 19.8°C, a 20% increase, while precipitation drops sharply from 88.4 *mm* to 20.1 *mm*, a 77% decrease. In July, the minimum temperature increases by 6.6% (from 30.1°C to 32.1°C), however ET_0 decreases by 25% (from 362.3 *mm* to 269.9 *mm*) (Fig. 3). The reason for the decrease in ET_0 is that this parameter is calculated using the Hargreaves-Samani equation. Since the range of minimum and maximum temperatures decreases, ET_0 decreases. Annual precipitation decreases significantly, reaching values close to zero in months such as February and December, while November shows a 144% increase in precipitation.

Comparison of the baseline climate data from 2023 with two future scenarios, SSP1-2.6 and SSP2-4.5, for the year 2040 at the Abadan station reveals a clear trend of warming and reduced precipitation in the region. In January, the maximum temperature rises from 16.5°C in the baseline to 19.8°C under SSP1-2.6 and 19°C under SSP2-4.5, representing increases of approximately 20% and 15%, respectively.

Precipitation in the same month drops from 88.4 *mm* to 20.1 *mm* (SSP1-2.6) and 22 *mm* (SSP2-4.5), indicating a decline of about 75%. In hot months like July, the minimum temperature increases from 30.1°C to 32.1°C (SSP1-2.6) and 32°C (SSP2-4.5), a rise of roughly 6.6%, while ET_0 decreases from 362.3 *mm* to 269.9 *mm* and 270 *mm*, a reduction of around 25%. Summer precipitation remains zero across all scenarios, but in November, rainfall increases from 17.1 *mm* to 41.8 *mm* (SSP1-2.6) and 43 *mm* (SSP2-4.5), marking a surge of over 150% (Fig. 3).

Analysis of climate data from Abadan station for the baseline year 2023 and three future scenarios for 2040 (SSP1-2.6, SSP2-4.5, SSP5-8.5) reveals a gradual trend of warming, reduced precipitation, and shifts in ET_0. In June, maximum temperature rises from 45.1°C in 2023 to 45.6°C (SSP1-2.6), 45.7°C (SSP2-4.5), and 45.9°C (SSP5-8.5), while ET_0 drops from 392.5 *mm* to 258.5 *mm*, 259.7 *mm*, and 261.8 *mm*, respectively, a reduction of about 33%. In March, rainfall decreases from 42.8 *mm* to 26.0 *mm* (SSP1-2.6), 23 *mm* (SSP2-4.5), and 29.3 *mm* (SSP5-8.5), indicating a decline of 31–46%. November shows a notable increase in precipitation from 17.1 *mm* to 41.8 *mm*, 43 *mm*, and 41.1 *mm*, over 140% growth. Minimum temperature in July rises from 30.1°C to 32.1°C, 32.1°C, and 32.3°C, reflecting a 7% increase (Fig. 3). According to the findings reported in the studies by Dehghani et al. [5, 6], it is observed that the three aforementioned scenarios lead to warming, changing rainfall patterns, and changing crop water demand with different intensities, highlighting the need for adaptive water and agricultural strategies.

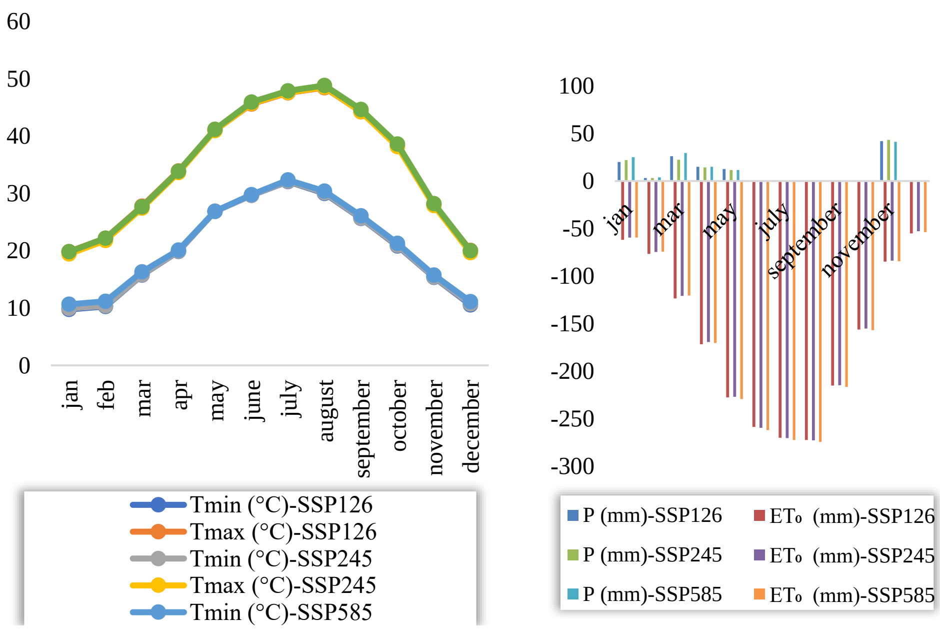

Fig. 3. Projected meteorological parameters for 2039 under SSP5-8.5, SSP2-4.5, SSP1-2.6.

The 2024 climate data from Abadan station reveals a typical hot and arid pattern. Minimum temperatures range from 8.1°C in December to 30.5°C in August, while maximum temperatures rise from 21.2°C in winter to 47.2°C in summer.

Rainfall is sparse and concentrated in winter and early spring, with the highest amount recorded in March (45.0 *mm*), and no precipitation observed from June to September. ET_0 increases sharply during the hot season, peaking at 393.5 *mm* in July, indicating high water demand.

Scenario 2 (Comparison of 2024 and 2040). The 2024 climate data from Abadan station reveals a distinctly hot and arid pattern with notable temperature and precipitation fluctuations. Minimum temperatures range from 8.1°C in December to 30.5°C in August, while maximum temperatures rise from 21.2°C in winter to 47.2°C in July. Annual precipitation is extremely limited, with significant rainfall only in March (45.0 *mm*) and February (25.1 *mm*), while no rainfall is recorded from June through September. ET_0 increases sharply during the hot season, rising from 96.9 *mm* in January to 393.5 *mm* in July, over four times higher, indicating intense crop water demand in summer (Fig. 4).

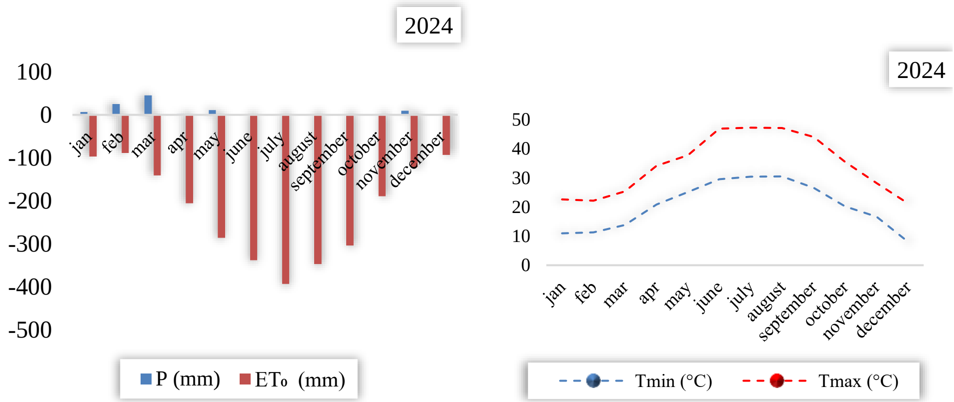

Fig. 4. Meteorological parameters in the baseline year 2024.

Comparison of the 2024 climate data with the SSP1-2.6 scenario for 2040 at Abadan station reveals notable shifts in temperature, precipitation, and ET_0. In January, the minimum temperature drops from 11.0°C to 8.1°C (26% decrease), and the maximum temperature falls from 22.7°C to 18.8°C (17% decrease), while precipitation slightly increases from 6.2 *mm* to 6.6 *mm*. In March, the maximum temperature rises from 25.4°C to 27.6°C (8.6% increase), but rainfall decreases by nearly 50%, from 45.0 *mm* to 22.3 *mm*. During hot months like July, the maximum temperature increases from 47.2°C to 48.3°C (2.3% rise), while ET_0 drops from 393.5 *mm* to 291.2 *mm* (a 26% reduction). Notably, December precipitation rises dramatically from 0.8 *mm* to 21.5 *mm* (Fig. 5).

Comparison of the 2024 baseline with two future scenarios, SSP1-2.6 and SSP2-4.5, for the year 2040 at Abadan station reveals significant shifts in climate indicators. In July, ET_0 drops from 393.5 *mm* in 2024 to 291.2 *mm* under SSP1-2.6 and 291.7 *mm* under SSP2-4.5, reflecting a reduction of about 26%, while maximum temperature rises from 47.2°C to 48.3°C and 48.4°C, respectively. December precipitation increases dramatically from 0.8 *mm* to 21.5 *mm* (SSP1-2.6) and 25.6 *mm* (SSP2-4.5), more than 25 times higher. In March, rainfall declines from

45.0 *mm* to 22.3 *mm* and 19.1 *mm*, nearly a 50% drop, while minimum temperature rises from 13.9℃ to 16.0℃ in both scenarios, a 15% increase (Fig. 5).

Comparison of the 2024 baseline with three future climate scenarios for 2040 (SSP1-2.6, SSP2-4.5, and SSP5-8.5) at Abadan station reveals concurrent trends of gradual warming, reduced ET_0, and a shift in rainfall toward cooler months. In January, minimum temperature drops from 11.0℃ to 8.1℃ (SSP1-2.6), 8.3℃ (SSP2-4.5), and 9.0℃ (SSP5-8.5), a decrease of up to 26%, while precipitation rises from 6.2 *mm* to 6.6 *mm*, 7.8 *mm*, and 8.2 *mm*, respectively. In hot months like July, maximum temperature increases from 47.2℃ to 48.3℃, 48.4℃, and 48.7℃ (about 3% rise), while ET_0 drops from 393.5 *mm* to 291.2 *mm*, 291.7 *mm*, and 293.7 *mm*, roughly a 25% reduction in crop water demand. December rainfall surges from 0.8 *mm* to 21.5 *mm*, 25.6 *mm*, and 25.7 *mm* (Fig. 5).

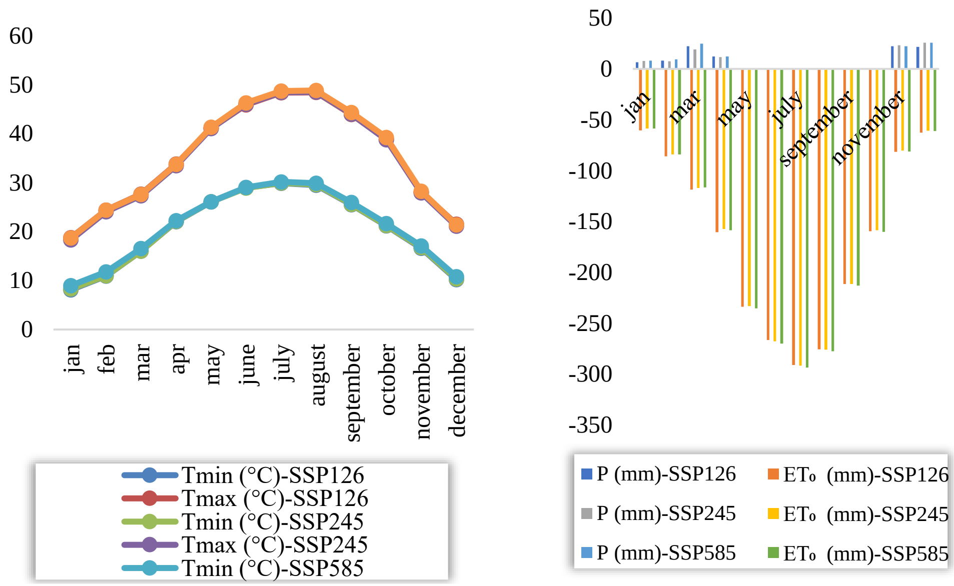

Fig. 5. Projected meteorological parameters for 2040 under SSP5-8.5, SSP2-4.5, SSP1-2.6.

The results of this study are consistent with regional analyses concerning Southwestern Iran and neighboring countries in terms of the warming trend, particularly in the near-term period up to 2040. According to CMIP6 multi-model studies, Iran's annual mean temperature during this period is likely to increase by approximately 1.26℃, and the intensity of warming is predicted to be greater in the Central, Southern, and Southwestern Regions than in other regions [20]. The results of the study by Abdulsahib et al. [7] using the LARS-WG model and the CMIP6 model suite showed that in Northern Iraq, both SSP2-4.5 and SSP5-8.5 climate scenarios will lead to significant temperature increases and changes in distribution patterns in the future period.

Also, the results of Hadi et al. [10] showed that in future periods, temperature increases are certain in both SSP2-4.5 and SSP5-8.5 scenarios, and the intensity of warming will be greater in the SSP5-8.5 scenario. Precipitation patterns also undergo significant changes; so that some months have seen a decrease in precipitation and some months have seen an increase, which indicates seasonal fluctuations and spatial-temporal changes in precipitation. According to the results reported in the study by Huang et al. [1], the area of semi-arid regions in the world has increased significantly over the past six decades, and this expansion has been mainly due to increasing temperatures, decreasing effective precipitation, and intensifying droughts.

Based on the outcomes reported by Dehghani et al. [5], future climate scenarios will cause an increase in temperature, a change in precipitation pattern, and a decrease in water productivity of irrigated wheat in Alborz province, highlighting the need to adopt adaptation strategies in irrigation management and select resistant cultivars.

This is also evidenced by other studies [21–23].

Conclusion. Based on the comparison of baseline years 2023 and 2024 with three future climate scenarios for 2040 (SSP1-2.6, SSP2-4.5, and SSP5-8.5) at Abadan station, it can be concluded that the region is facing significant climate shifts affecting temperature, precipitation, and ET_0. In all scenarios, maximum temperatures during hot months such as July and August exceed 48°C, while ET_0 drops by up to 25% compared to baseline years – likely due to changes in humidity, cloud cover, or solar radiation. Meanwhile, rainfall in cold months, especially November and December, increases dramatically, reaching more than 30 times the baseline in some cases, while summer precipitation remains zero. This seasonal shift in rainfall, combined with reduced evaporative stress in summer, indicates fundamental changes in crop water requirements, irrigation timing, and water resource management. Therefore, in response to future climate scenarios, it is essential to revise adaptation strategies, optimize agricultural calendars, and develop resilient infrastructure to maintain agricultural productivity and food security in the region.

It is suggested that the cropping pattern of the region be purposefully redesigned, given the intense summer heat and significant increase in precipitation in the cold months. In this regard, the development of solar-agricultural farms (Agro-PV) as an innovative solution can both reduce soil temperature and evaporation and provide sustainable energy for irrigation systems. It is also recommended that the cultivation of drought-resistant and heat-resistant crops such as sorghum, sesame, millet, heat-resistant cotton, cowpea, quinoa, and drought-loving medicinal plants be prioritized. In addition, developing rainwater harvesting infrastructure and water recycling systems is essential for dry-season resilience.

This study has some limitations. First, the analysis is based on data from only one weather station and one atmospheric general circulation model (HadGEM3-GC31-LL). Although this provides a consistent basis for scenario analysis, it does not capture the full range of uncertainty inherent in climate projections. Future studies could enhance the robustness of the results by employing a ensemble of multiple CMIP6 models. The Penman-Monteith method is widely regarded as the most accurate approach for estimating ET_0. However, applying it to future periods requires simultaneous projections of temperature, humidity, wind speed, and solar radiation. The LARS-WG model, like most stochastic weather generators, primarily provides reliable projections of temperature and precipitation, but does not generate other climate variables (i.e., humidity and wind speed) for future periods.

The projected decrease in ET_0 for the Abadan Region can be attributed mainly to the reduction in the daily temperature range (the difference between the maximum and minimum temperatures) in future scenarios. Since the Hargreaves-Samani equation is sensitive to temperature differences, a decrease in this range will lead to a decrease in ET_0, even if average temperatures increase. Although the decrease in ET_0 may indicate a decrease in agricultural water demand, the concomitant increase in heavy winter precipitation creates the risk of winter flooding, while a drier spring could lead to water shortages at critical stages of crop growth. However, these findings should be interpreted with caution given the inherent uncertainties of climate models, especially at the local scale.

Based on the findings, the following adaptation measures are recommended for the Abadan Region:

- adjusting planting times to avoid the coincidence of critical growth stages with spring dry periods;
- expanding the use of drip irrigation systems to improve water use efficiency;
- developing drainage and flood management infrastructure to address the increased risk of winter floods;
- integrating seasonal climate forecasts into water allocation planning.

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REFERENCES

1. Huang J., Ji M., et al. Global Semi-Arid Climate Change Over Last 60 Years. *Climate Dynamics* **46** (2016), 1131–1150.
https://doi.org/10.1007/s00382-015-2636-8
2. Sivakumar M.V., Das H.P., Brunini O. Impacts of Present and Future Climate Variability and Change on Agriculture and Forestry in the Arid and Semi-Arid Tropics. *Climatic Change* **70** (2005), 31–72.
https://doi.org/10.1007/s10584-005-5937-9
3. Tariq A., Sardans J., et al. Impact of Aridity Rise and Arid Lands Expansion on Carbon-Storing Capacity, Biodiversity Loss, and Ecosystem Services. *Global Change Biology* **30** (2024), e17292.
https://doi.org/10.1111/gcb.17292
4. Zubaidi S.L., Fadhel Z.A. Prediction of Precipitation in Western Iraq Using the LARS-WG 8.0 Model. *Wasit Journal of Engineering Sciences* **13** (2025), 14–21.
https://doi.org/10.31185/ejuow.vol12.iss4.567
5. Dehghani T., Liaghat A., Nazari B. Analysis of Climate Scenario Impacts on Irrigated Wheat Water Productivity in Alborz Province Using the AquaCrop Model. *Iranian Water Research Journal* (2025) (in press) (in Persian).
https://doi.org/10.22034/iwrj.2026.14896.2629
6. Dehghani T., Nazari B., Liaghat A. Future-oriented Agricultural Water Management with Scenario-Based Evaluation: Case Study of Maize in Khuzestan. *Modeling and Management of Water and Soil* (2025) (in Persian).
https://doi.org/10.22098/mmws.2025.18953.1740
7. Abdulsahib S.M., Zubaidi S.L., et al. Temperature and Precipitation Change Assessment in the North of Iraq Using LARS-WG and CMIP6 Models. *Water* **16** (2024), 2869.
https://doi.org/10.3390/w16192869

8. Mohammed Z.M., Hassan W.H. Climate Change and the Projection of Future Temperature and Precipitation in Southern Iraq Using a LARS-WG Model. *Modeling Earth Systems and Environment* **8** (2022), 4205–4218.
https://doi.org/10.1007/s40808-022-01358-x
9. Sabri N.Q., Khayyun T.S. Estimation of Future Climate Change in Low Folded Zone, Iraq with the LARS-WG and five GMS Models under CMIP5 Scenarios. *J. Ecohumanism* **3** (2024), 2207–2234.
https://doi.org/10.62754/joe.v3i8.4898
10. Hadi S.H., Alwan H.H., Al-Mohammed F.M. Analysis of Climate Change Scenarios Using the LARS-WG 8 Model Based on Precipitation and Temperature Trends. *Civil Engineering Journal* **10** (2024), 4019–4042.
https://doi.org/10.28991/cej-2024-010-12-0140
11. Mohammadi H., Khalili R., Mohammadi S. Future Temperature and Precipitation Prediction under Climate Change Impacts using the LARS-WG Weather Generator (Case Study: Southern Zagros Region of Iran). *Nivar.* **45** (2021), 137–153.
https://doi.org/10.30467/nivar.2022.319565.1209
12. Salahi B., Goudarzi M., Hosseini S. A. Predicting the Temperature and Precipitation Changes during the 2050s in Urmia Lake Basin. *Watershed Engineer. and Manag.* **8** (2017), 425–438.
13. Kamari H., Zeinali E., et al. Evaluation of the LARS-WG Model in Predicting Meteorological Parameters in Cotton-Growing Climatic Zones of Iran. *J. Crop Production* **13** (2021), 27–40.
https://doi.org/10.22069/ejcp.2021.17645.2300
14. Dastranj R., Noohagar A. Analysis of Climate Change and its Implications for Natural Resource Governance: An Integrated Approach Using LARS-WG and SWOT. *Natural Resource Governance* **2** (2025), 158–173.
https://doi.org/10.22059/jnrg.2025.401978.1053
15. Ahmady-Birgani H., Mirnejad H., et al. Mineralogy and Geochemistry of Atmospheric Particulates in Western Iran. *Atmospheric Environment* **119** (2015), 262–272.
https://doi.org/10.1016/j.atmosenv.2015.08.021
16. Kazemi Rad L., Mohammadi H. Climate Change Assessment by Using LARS-WG Model in Gilan Province (Iran). *Journal of Geography and Environmental Hazards* **4** (2016), 55–74.
https://doi.org/10.22067/geo.v4i4.38892
17. Saddique N., Bernhofer C., et al. Downscaling of CMIP5 Models Output by Using Statistical Models in a Data Scarce Mountain Environment (Mangla Dam Watershed), Northern Pakistan. *Asia-Pacific Journal of Atmospheric Sciences* **55 (**2019), 719–735.
https://doi.org/10.1007/s13143-019-00111-2
18. Yazdandoost F., Moradian S., et al. Evaluation of CMIP6 Precipitation Simulations across Different Climatic Zones: Uncertainty and Model Intercomparison. *Atmospheric Research* **250** (2021), 105369.
https://doi.org/10.1016/j.atmosres.2020.105369
19. Fattahi E., Kamali S., et al. Investigating the Spatiotemporal Variation in Extreme Precipitation Indices in Iran from 1990 to 2020. *Water* **17** (2025), 1227.
https://doi.org/10.3390/w17081227
20. Zarrin A., Dadashi-Roudbari A. Projected Changes in Temperature over Iran by 2040 Based on CMIP6 Multi-Model Ensemble. *Physical Geography Research* **53** (2021), 75–90.
https://doi.org/10.22059/jphgr.2021.308361.1007551
21. Margaryan V.G. Long-term Fluctuations in the Annual Runoff of Rivers Flowing into Lake Sevan under the Current Climate Change. *Ukrainian Geographical Journal* **4** (2021), 30–38.
https://doi.org/10.15407/ugz2021.04.030
22. Margaryan V.G., Ovcharuk V.A., et al. Comparative Analysis and Estimate of the Long-Term Fluctuations of the River Maximum Runoff of the Mountain Territories of Armenia and Ukraine under of Global Climate Change. *Sustainable Development of Mountain Territories* **12** (2020), 61–75 (in Russian).
https://doi.org/10.21177/1998-4502-2020-12-1-61-75
23. Margaryan V., Tsibul'skii G., Raevich K. Dynamics of Changes in Long-Term Average Annual River Runoff in the Lake Sevan Basin. Regional Problems of Earth Remote Sensing (RPERS 2019). *E3S Web of Conferences* **149** (2020), 03009.
https://doi.org/10.1051/e3sconf/202014903009

ԹԵՀՄԻՆԵ ԴԵՀԱՆԻ, ԲԻՋԱՆ ՆԱԶԱՐԻ, ԱԲԴՈՒԼՄԱՋԻԴ ԼԻԱՀԱՏ

ԿԼԻՄԱՅԻ ՓՈՓՈԽՈՒԹՅԱՆ ԱԶԴԵՑՈՒԹՅԱՆ ԳՆԱՀԱՏՈՒՄԸ ԱԲԱԴԱՆՈՒՄ ԳՅՈՒՂԱՏՆՏԵՍԱԿԱՆ ՋՐԻ ՊԱՀԱՆՋԱՐԿԻ ՎՐԱ LARS-WG 8-Ի (CMIP6 SSP SCENARIOS) ՕԳՏԱԳՈՐԾՄԱՄԲ

Ամփոփում

Աբադանի նման տաք և չորային շրջաններում կլիմայի փոփոխությունը լուրջ սպառնալիք է ներկայացնում սննդի անվտանգության և ջրային ռեսուրսների համար: Ապագա պայմանների ճշգրիտ կանխատեսումները կարևոր են արդյունավետ հարմարվողականության ռազմավարություններ մշակելու համար: Այս ուսումնասիրության մեջ LARS-WG 8 մոդելը կիրառվել է Աբադանի կայանից (Իրան) ստացված օդերևութաբանական տվյալների հիման վրա՝ 2040 թվականի համար երեք կլիմայական սցենարների՝ SSP1-2.6, SSP2-4.5 և SSP5-8.5, համաձայն: Աբադանի կայանում 2023 և 2024 թթ.-ի կլիմայական տվյալների մեկնաբանությունը, համեմատած 2040 թ.-ի ապագա սցենարների հետ (SSP1-2.6, SSP2-4.5, SSP5-8.5), բացահայտում է տաքացման և տեղումների սեզոնային փոփոխությունների հստակ միտում: Հուլիսին առավելագույն ջերմաստիճանը 47.2°C-ից (2024) բարձրանում է մինչև 48.7°C (SSP5-8.5), մինչդեռ ET_0-ն 393.5 *մմ*-ից նվազում է մինչև մոտ 291–294 *մմ*, ինչը կազմում է 25% նվազում: Դեկտեմբերին SSP5-8.5-ում տեղումների քանակը կտրուկ աճում է՝ 0.8 *մմ*-ից հասնելով 25.7 *մմ*-ի, ավելի քան 30 անգամ ավելի: Ի տարբերություն դրա, հունիսին տեղումների քանակը բոլոր սցենարներում մնում է զրոյական: Մարտ ամսվա տեղումները SSP2-4.5-ում նվազում են 45.0 *մմ*-ից մինչև 19.1 *մմ* (58% անկում), մինչդեռ նվազագույն ջերմաստիճանը բարձրանում է 13.9°C-ից մինչև 16.0–16.5°C (մոտ 15% աճ): Այս տեղաշարժերը վկայում են ավելի բարձր ջերմաստիճանների, ամառային գոլորշիացման նվազման և անձրևի կոնցենտրացիայի մասին ավելի զով ամիսներին, ինչը անմիջականորեն ազդում է մշակաբույսերի ջրի կարիքների և ոռոգման ժամանակացույցի վրա: Ստացված արդյունքների հիման վրա խորհուրդ է տրվում, որ Աբադանում գյուղատնտեսական պլանավորումը անցնի կլիմայի փոփոխությանը դիմացկուն մշակաբույսերի մոդելների, բարելավի ոռոգման արդյունավետությունը և վերանայի ջրի բաշխման պլանները՝ հաշվի առնելով տարվա ցուրտ ամիսներին ջերմաստիճանի աճը և տեղումների կոնցենտրացիայի աճը:

ТЕМИНЕ ДЕХАНИ, БИДЖАН НАЗАРИ, АБДУЛМАДЖИД ЛИАХАТ

ОЦЕНКА ВЛИЯНИЯ ИЗМЕНЕНИЯ КЛИМАТА НА ПОТРЕБНОСТЬ СЕЛЬСКОГО ХОЗЯЙСТВА В ВОДЕ В АБАДАНЕ С ИСПОЛЬЗОВАНИЕМ МОДЕЛИ LARS-WG 8 (СЦЕНАРИЙ CMIP6 SSP)

Резюме

Изменение климата в жарких и засушливых регионах, таких как Абадан, представляет серьезную угрозу продовольственной безопасности и водным

ресурсам. Точные прогнозы будущих климатических условий необходимы для разработки эффективных стратегий адаптации. В данном исследовании модель LARS-WG 8 была применена с использованием метеорологических данных со станции “Абадан” (Иран) в рамках трех климатических сценариев SSP1-2.6, SSP2-4.5 и SSP5-8.5 для 2040 г. Интерпретация климатических данных за 2023 и 2024 гг. в сравнении с будущими сценариями на 2040 г. (SSP1-2.6, SSP2-4.5, SSP5-8.5) на станции “Абадан” выявляет четкую тенденцию потепления и сезонных сдвигов в количестве осадков. В июле максимальная температура повышается с 47,2°C (2024 г.) до 48,7°C (SSP5-8.5), в то время как эвапотранспирация (ET_0) снижается с 393,5 *мм* до ≈ 291–294 *мм*, что ниже на 25%. Количество осадков в декабре резко увеличивается с 0,8 до 25,7 *мм* в SSP5-8.5, что более чем в 30 раз выше. В отличие от этого, количество осадков в июне остается нулевым во всех сценариях. Количество осадков в марте снижается с 45,0 до 19,1 *мм* в SSP2-4.5 (снижение на 58%), в то время как минимальная температура повышается с 13,9°C до 16,0–16,5°C (≈ на 15%). Эти изменения указывают на более высокие температуры, снижение летнего испарения и концентрацию осадков в более прохладные месяцы, что напрямую влияет на потребность сельскохозяйственных культур в воде и график орошения. На основании полученных результатов рекомендуется, чтобы сельскохозяйственное планирование в Абадане перешло к использованию устойчивых к изменению климата моделей севооборота, была повышена эффективность орошения и пересмотрены планы распределения воды с учетом повышения температуры и увеличения концентрации осадков в холодные месяцы года.