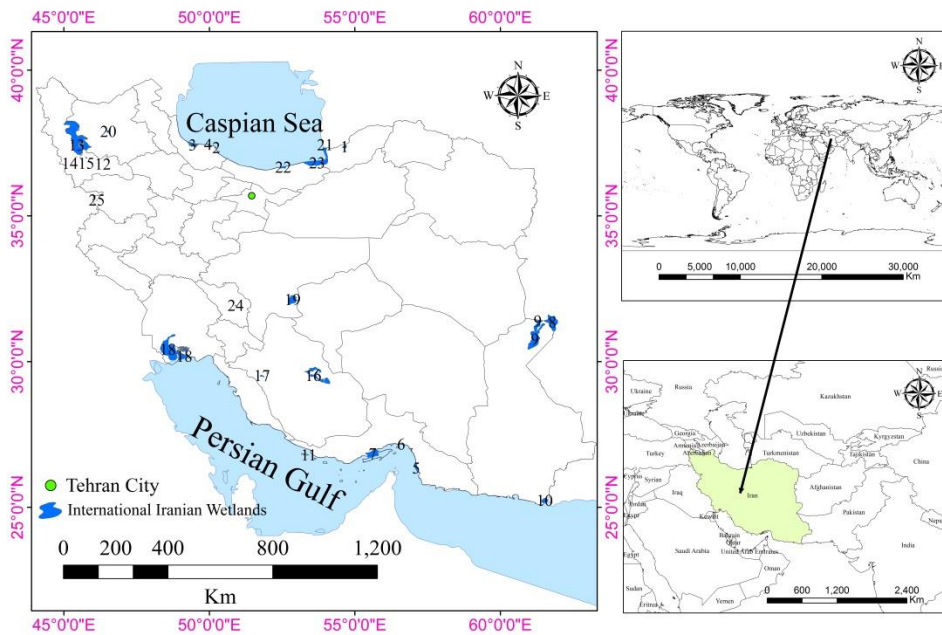# Update data of the Iranian wetlands (2023)

Jaber Aazami[1,*] iD , Sharif Joorabian Shooshtari[2] iD

[1]Department of Environmental Sciences, Faculty of Science, University of Zanjan, Zanjan, Iran.
[2]Department of Nature Engineering, Faculty of Agriculture, Agricultural Sciences and Natural Resources University of Khuzestan, Mollasani, Iran.

GRAPHICAL ABSTRACT

ARTICLE INFO

ABSTRACT

Wetlands, as temporary or permanent water reservoirs, provide various benefits for the ecosystem, such as water supply, waste water treatment, and dust control. By the end of 2023, the Iranian government and the Ramsar Convention have registered 25 international and 226 national wetlands. West Azerbaijan and Mazandaran provinces have more wetland ecosystems than any other provinces. Semnan, Yazd, and Zanjan provinces have no wetlands. According to the Ramsar Convention of 1971, Iran has 32 aquatic ecosystems that have the potential to become wetland. In addition, according to the available data and the WHO standard, eight wetlands have the highest probability of producing dust and should be given more attention and care. We recommend the wetland management plan, which ensures their water requirements, protects them from degradation and pollution, and promotes their ecological restoration. Satellite image analysis can help explore how climate change affects dust intensity, considering the role of wetlands in dust control.

1. Introduction

Based on Ramsar International convention, wetland is defined as "areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters". The Ramsar Strategic Plan 2016–2024 aims to address the drivers of wetland loss and degradation, conserve and manage the Ramsar Site Network effectively, and wisely use all ecosystem services of wetlands (Kingsford *et al.*, 2021). The objectives are to expand the area,

*Corresponding author Email: j.aazami@znu.ac.ir

numbers, and ecological connectivity of Ramsar Sites, emphasizing under-represented regions or types, and ensure efficient management.

Many studies have demonstrated that wetlands are crucial natural ecosystems that aid biodiversity and provide a wide range of ecosystem services, such as groundwater recharge, climate change mitigation, and flood control (Foroughi, Aazami, and Khosravi, 2021). To develop a country, it is crucial to identify and classify wetlands with more details, as has already been documented (Verhoeven and Setter, 2010). According to Hemati *et al.* (2023), wetland classes and water bodies covered 22,384.591 km^2 of Iranian area. Based on previous Ramsar maps and national land cover, the estimated area was agreed, with the added benefit of including various wetland classes and local wetland sites. The geographical distribution, status, and extent of well-documented wetland classes (Hemati *et al.*, 2023) were given unparalleled information on the map of Iran's wetland inventory (Hemati *et al.*, 2022).

There are generally two kinds of wetlands, including natural and constructed wetlands as defined in the Ramsar Convention. To identify key wetland habitats at each site in a timely manner, the Ramsar Convention defines wetland types. Iran has listed all wetland types under the Ramsar Convention, except for tundra wetlands, according to some expert advice. Nonetheless, there is no scientific study that has examined the types of wetlands in Iran and compared them to the classification of the Ramsar Convention. Thus, a comprehensive investigation is required to determine which kinds of wetlands are covered by the Ramsar Convention.

Environmental problems such as dust have caused the identification of wetland ecosystem services (Jiangyi, Shiquan, and Hmeimar, 2020) to be given more attention in recent days. To take advantage of their important services, it is important to identify and update the list of wetlands in each country as the first step. The goal of this article was to give a comprehensive list of Iranian wetlands that have been registered with the Department of Environment (DoE). Furthermore, we have made significant efforts to introduce aquatic ecosystems that may be affected by dust from wetlands.

2. Materials and methods

Iran is home to over 20 million hectares of wetlands, which play a crucial role in maintaining biodiversity and providing essential ecosystem services such as water purification and flood control. However, these wetlands are under threat from activities such as agriculture, urban development, and water diversion, leading to habitat loss and degradation. The Ramsar Convention, an international treaty for the conservation and sustainable use of wetlands, has designated several Iranian wetlands as Wetlands of International Importance. Despite this recognition, the degradation of these wetlands continues, highlighting the need for better conservation efforts. By gathering data through field surveys and expert questionnaires, the study aims to provide a comprehensive understanding of the current state of Iranian wetlands. This information will be valuable for policymakers and conservationists in formulating effective strategies for the protection and restoration of these important ecosystems. Overall, the study's findings will contribute to the global effort to conserve wetlands and ensure their sustainable use for future generations.

3. Results and discussion

In accordance with the Council of Ministers' approval, the list of wetlands is consistent. 157408 / T55096, and currently the provinces of Semnan, Yazd, and Zanjan do not have wetlands (Table 1). In terms of wetland ecosystems, West Azerbaijan and Mazandaran provinces are the most dense among other provinces.

Table 1. The number of Iranian wetlands registered in the Department of Environment (2023).

Provinces	N	Provinces	N	Provinces	N
Kerman	1	Western Azerbaijan	43	Hamedan	3
Sistan and Baluchestan	7	Kurdestan	1	Ardabil	5
Southern Khorasan	1	Markazi	1	Chaharmahal-Bakhtiari	7
Fars	13	Lorestan	8	Qazvin	4
Khorasan Razavi	4	Kermanshah	6	Kohgiloyeh and Boyer-Ahmad	4
Isfahan	2	Mazandaran	22	Guilan	9
Hormozgan	19	Bushehr	9	Tehran	3
Khuzestan	13	Golestan	8	Qom	5
East Azerbaijan	9	Ilam	18	Alborz	1
North Khorasan	1				

N: Number of Wetlands

The complete list of wetlands in Iran was produced by provincial experts after reviewing available documents and studies, monitoring satellite images, and completing a questionnaire.

There are currently 25 sites in Iran that are designated as Wetlands of International Importance (Ramsar Sites) and have a surface area of 1,488,624 hectares (Table 3, Fig. 1).

Table 2. The Iranian wetlands with their watershed and province names (updated in 2023).

Watershed	Province	Registered wetlands	Suggested wetlands
Urmia	West Azerbaijan	1- Orumieh Lake, 2- Hasanlu 3- Siran Goli, 4- Yadegarloo, 5- Qapi BabaAli, 6- Kani Barazan, 7- Qara Gol, 8- Aq Ziarat, 9- Gopi Ghazan and Gross, 10- Taleghan, 11- Jamal Abad (Shirin Su), 12- Chengiz Goli, 13- Gardeh Gheit and Mamind, 14- Qara Gheshlagh, 15- Lake Marmisho, 16- Qara Dagh, 17- Eshghabad, 18- Konikor, 19- Navar, 20- Soldoz , 21- Pirahmad Kandi, 22- Qarabolagh Goli, 23- Yousef Kennedy, 24- Islamabad, 25- BandNoruzlu, 26- Aq Qala (Shurgol), 27- Shibloo, 28- Chaman Goli, 29- Golmarz, 30- Nowruzloo, 31- Zaviyeh-ye Sofla, 32- Dalamper, 33- Hassan Batan, 34- Gardezarin, 35- Talebabad, 36- Shah Goli, 37- Arab Goli, 38- Qaris, 39- Qorough, 40- Qazalche	1- Chichek, 2- Khedr Haji, 3- Suleiman Goli, 4- Aghgol, 5- Shirinabad , 6- Talkhab.
	East Azerbaijan	1- Qara Gheshlagh, 2- Guri Gol, 3- Yanigh, 4-Almaloo, 5- Sakh Selu, 6- Ghusha Goli, 7- Iqergol	
Caspian sea	Ardabil	1- Neor, 2- Aras, 3- At Goli, 4- Mil and Moghan, 5- Tavus Goli	1- Taprak Kennedy, 2- Shahrak Lake, 3- Ghorigel Ghezel Bareh, 4- Qaragol Kasram, 5- Gilarloo, 6- Shurgol
	East Azerbaijan	1- Zolbin, 2- Bezojiq	1- Khorshid Goli
	Guilan	1- Anzali, 2- Amirkalayeh, 3- Lundville (Aq), 4- Steel Astara, 5- Bojagh National Park, 6- Aynak, 7- Kurd Mahalla, 8- Kiakalayeh, 9- Jokandan Talesh,	1- Chaf and Chamkhaleh, 2- Sostan, 3- Karfestan, 4- Ajdehbloch, 5- Zaribijar, 6- Painposht, 7- KohnehSol

2	Mazandaran	1- Miankaleh Peninsula, Gorgan Bay and Lapoo-Zaghmarz Ab-bandan, 2- Fereydoon Kenar, Ezbaran & Sorkh Ruds Ab-Bandans, 3- Velesht lake, 4- StakhrPosht, 5- Shurmast, 6- Abbasabad, 7- Lasem, 8- Marzanabad, 9- Haidarkola, 10- Shir Khan Lepo, 11- Palangan, 12- Dasht-e-Mormoz, 13- Neshtarood, 14- Hasel, 15- Alandan, 16- Casey, 17- Seyed Mahalla, 18- Kordkola, 19- Oja, 20- Ziar Kola, 21- Drivak, 22- Mola Dodangeh	
	Golestan	1- Alagol, 2- Ulmagol, 3- Ajigol, 4- Gomishan, 5- Incheh, 6- Shoor Lake, 7- Estil, 8- Bojaq	
	Qazvin	1- Evan	
	West Azerbaijan	1- Boralan, 2- Yarim Ghiyeh, 3- Agh Gol	
	Zanjan		1- Kordabad, 2- Kuhsar
		All the estuaries of the Caspian Sea basin	
Persian plateau	Qazvin	1- Darbabig, 2- Allah-Abad, 3- Alvin Alamut	1- Yaghobabad
	Alborz	1- Salehie	
	Tehran	1- Band Ali Khan, 2- Tar, 3- Hovyer	
	Kerman	1- Jazmourian	
	Hamedan	1- Aq Gol	
	Markazi	1- Mighan	
	Isfahan	1- Gavkhoni, 2- Shoorgolpayegan	
	Fars	1- Bakhtegan (Tashk, Neyriz, Kamjan), 2- Kaftar, 3- Hiram, 4- Boram Shoor, 5- Boram Firooz, 6- Dasht-e Kenar, 7- Shadkam	
	Qom	1- Hoz Sultan, 2- Salt Lake, 3- Marah, 4- Ghadir-e Asb, 5- Behesht-e Masoumeh	
	Yazd		1- Sheikhha, 2- Ali Gholi, 3- Banoo, 4- Masih, 5- Shahidieh
Persian Gulf and the sea of Oman	Kurdestan	1- Zarivar	
	Ilam	1- Chagar, 2- SiahGav-Zamzam, 3- Siab Darvish, 4- Doirej Dam, 5- Ilam Dam Lake, 6- Kangir Dam Lake, 7- Seimare Dam Lake, 8- Siag Avo (Dogholo Lake), 9- Sivan, 10- Golhi 1, 11- Golhi 2, 12- Abdanan, 13- Kalan, 14- Darrehshahr, 15- Sikan, 16- Kalam, 17- Mishkhas, 18- Mort Meime	1- Zamzam,
	Fars	1- Parishan, 2- Arjan, 3- Haft Boram, 4- Maharloo, 5- Heram and Kavian, 6- Paqalat	
	Hamedan	1- Cham Shoor, 2- Pirsalman	1- Shirin Su, 2- Wasj
	Kermanshah	1- Heshilan, 2- Niloufar, 3- Yavari, 4- Ravansar, 5- Sharafabad, 6- Sarab-e Jaberi	
	Lorestan	1- Bishedallan, 2- Gohar, 3- Poldakhtar, 4- Tanordar, 5- Gori Belmak, 6- Ghar-e Mahi Kour, 7- Vejenab, 8- Khorusan Ab-Bandan	
	Khuzestan	1- Khormousi, Jafari, and Zangi, 2- Shadegan, 3- Bamadj, 4- Horalazim, 5- Bandoon and Miangaran Izeh, 6- Shimbar Lake, 7- Dez, 8- Karkheh, 9- Dasht Shoaib, 10- Om-al-Debs, 11- Sagvar, 12- Shushtar Shuaibiyah wetland, 13- Dara Sea coastal wetlands	
	Chaharmahal va Bakhtiari	1- Choghakhor, 2- Gandoman, 3- Aliabad, 4- Sulqan, 5- Ghezel Gol, 6- Chal Tar, 7- Chal Khoshk	
	Kohgiloyeh and Boyerahmad	1- Boram Alvan, 2- Boram Shir, 3- Kooh Gol, 4- Mozard Zilabi	
	Sistan and Baluchestan	1- Govater Bay and Hur-e-Bahu, 2- Tis, 3- Tang, 4- Goordim, 5- Galak, 6- Pazm Khor	1- Lipar
	Hormozgan	1- Jagin and Gabrik, 2- Khorkhalasi, 3- Jask, 4- Deltas of Rud-e-Gaz and Rud-e-Hara, 5- Tiab, 6- Deltas of Rud-e-Shur, Rud-e-Shirin and Rud-e-Minab, 7- Khuran Straits, 8- All islands of the province (with Coral reefs, seagrasses, bird breeding habitats and sea turtle spawning area), 9- Shidvar, 10- Khor Azini, 11- Dayrestan Bay, 12- Holor, 13- Lark island, 14- Tunbe Bozorg island, 15-Bikoral Area, 16, Padideh Area, 17- Lavan Area and other coral reeds, 18- Hendorabi Island, 19- Kish Island- spawning of sea turtle	
	Bushehr	1- Naiband, 2- Haleh, 3- Dair and Nakhilo, 4- All the islands of the province (with coral reefs, seagrasses, bird breeding habitats and sea turtle spawning area), 5- Kharh, 6- Kharko, 7- Mond, 8- Shokri and Soltani Khor, 9- Bardestan	
Shargh	Southern Khorasan	Kajinamakzar	
	Sistan and Baluchestan	Hamoon of Sistan	
GhareGhom	Khorasan Razavi	1- Bazangan (Gol Bibi), 2- Cheshmehsabz, 3- Tajan, 4- Sirkhoon	
	North Khorasan	1- Agh Gheshlagh	

All coral reefs, sea grasses, estuaries, mud flats, rocky beaches, mangrove forests and river estuaries of the Persian Gulf and Oman Sea.

Table 3. The international Iranian wetlands documented in Ramsar Convention (2023).

N	Wetland	Area	Province
1	Alagol, Ulmagol and Ajigol Lakes	1400	Golestan
2	Amirkelayeh	1230	
3	Anzali Complex	15000	Guilan
4	Bujagh National Park	500	
5	Deltas of Rud-e-Gaz and Rud-e-Hara	15000	Hormozgan
6	Deltas of Rud-e-Shur, Rud-e-Shirin and Rud-e-Minab	45000	

158

| 7 | Khuran Straits | 100000 | |
8	Hamun-e-Puzak, south end	10000	Sistan and Baluchestan
9	Hamun-e-Saberi & Hamun-e-Helmand	50,000	
10	Govater Bay and Hur-e-Bahu	10000	
11	Sheedvar Island	10000	
12	Kobi	1200	
13	Orumieh	483000	Western Azerbaijan
14	Shurgol, Yadegarlu & Dorgeh Sangi Lakes	2500	
15	Kanibarazan	600	
16	Neiriz Lakes & Kamjan Marshes	108000	Fars
17	Lake Parishan and Dasht-e-Arjan	6200	
18	Shadegan Marshes & mudflats of Khor-al Amaya & Khor Musa	400000	Khuzestan
19	Gavkhouni Lake and marshes of the lower Zaindeh Rud	43000	Isfahan
20	Gori	120	East Azerbaijan
21	Gomishan	17700	Golestan
22	Fereydoon Kenar, Ezbaran & Sorkh Ruds Ab-Bandans	5427	Mazandaran
23	Miankaleh Peninsula, Gorgan Bay and Lapoo-Zaghmarz Ab-bandan	100000	
24	Choghakhor	1500	ChaharMahal and Bakhtiari
25	Zarivar	2185	Kurdestan
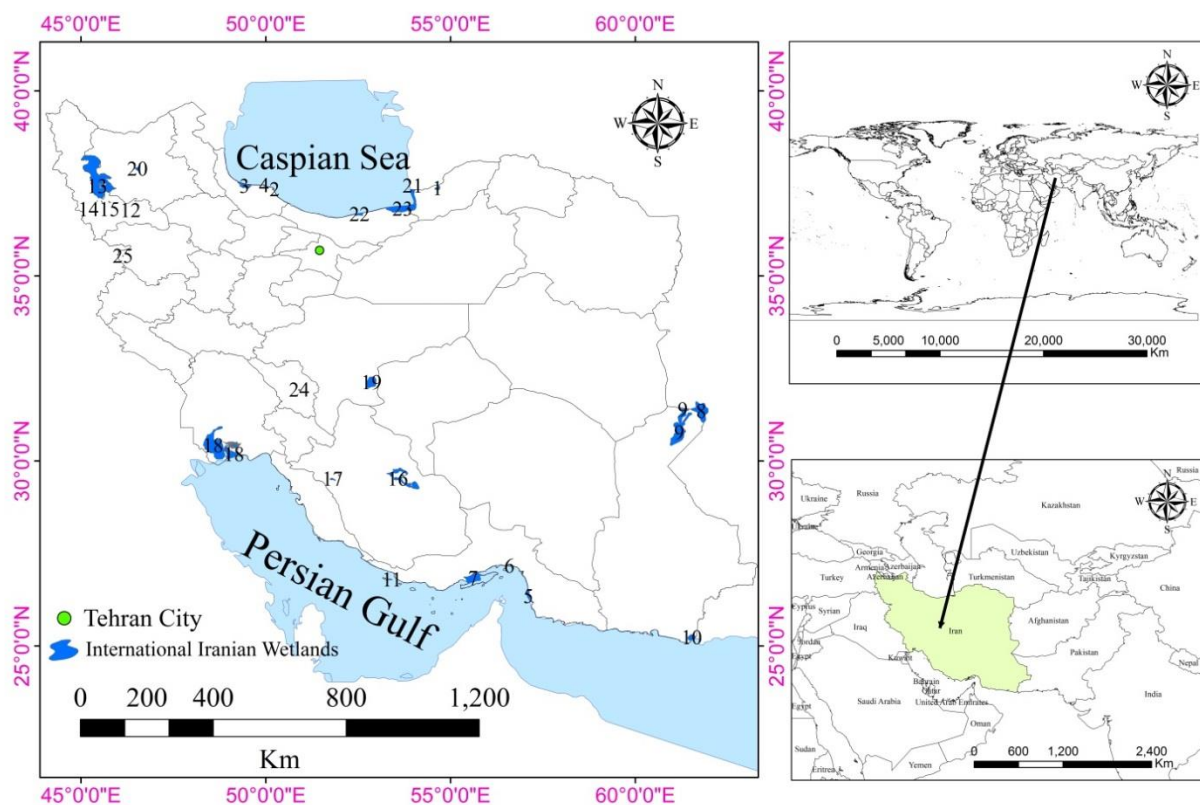
Fig. 1. The location of 25 Iranian International Wetlands (Updated 2023).

The National Dust Control Headquarters of the Department of Environmental has determined that eight of the 226 wetlands have a high potential for producing dust (Table 4).

The survival and valuable services of the wetland are dependent on the availability of water with the appropriate quantity and quality, as the name suggests. The first step in managing any wetland ecosystem and benefiting from their special services is to determine or estimate their water needs. This water requirement is determined according to the required ecosystem services and in accordance with chapter 2 of the Law on Protection, Rehabilitation and Management of Wetlands of the country (No. 146887/92 dated 30/02/2017), the Department of the Environment is required to comply with environmental water requirements. The Ministry of Energy has an obligation to develop and implement a written plan to allocate and supply wetlands that have been designated. However, the water requirements of Iranian wetlands have not yet been fully studied. It is highly recommended that they determine their water needs for the environment.

Table 4. The Iranian wetland with high intensity of dust (2023- reported by Department of Environment, Iran).

N	Wetland	Province
1	KajiNamakzar	Southern Khorasan
2	KhorKhalasi	
3	Khuran Straits	Hormozgan
4	Hara-e Gabrik	
5	Karkheh	Khuzestan
6	Shadegan Marshes & mudflats of Khor-al Amaya & Khor Musa	
7	Hamoon Saberi	Sistan and Balochestan
8	Jazmourian	Kerman

Wastewater treatment is one of the most important services provided by wetlands, but they also collect fine particles in the sediments since they are located at the end of the catchment. As long as they have enough moisture, these particles retain their original structure and offer services for plant growth, erosion control, and air softening. When the moisture level is too low, they lose their structure and emit dust particles (Bao et al., 2022). Consequently, wetlands that have been destroyed will be the origins of dust generation. The

159

majorities of the wetlands in Iran, which are used by the locals, have deteriorated due to drought and have lost their essential ecosystem services. This was caused by various well-known reasons, such as water resource crisis, water pollution (Jahantigh, 2021), land use change, etc. It seems that paying attention to wetlands in these areas can be crucial in terms of dust production, and in the future, other ecosystem services like wastewater treatment will be important. Dust in central Iran is largely attributed to the major sources of dust found in the Meighan Wetlands in Markazi Province. Local managers endeavored to provide the water requirements of the wastewater treatment plant that is situated near the wetland. According to scientific sources, wetlands have significantly improved water quality and purified potential contaminants by retaining water and providing activated micro-organisms through chemical interactions (Sonu, Sogani, and Syed, 2021). Various plants help wetlands enhance their water quality. Natural wastewater treatment systems can be classified into two broad categories: terrestrial and aquatic. Aquatic systems are becoming more widely used to provide effective and economical wastewater treatment. However, the performance, type, benefits, and drawbacks of wetlands used for sewage treatment are already well documented (Omondi and Navalia, 2020).

Before considering their ecosystem services such as wastewater treatment, aquatic ecosystems should be valued as dust regulators that prevent dust storms rather than sources of dust pollution, especially in Iran. This is because, as Fakhroueian et al. 2018 have shown, fine dust can have harmful effects on human health and well-being, such as causing respiratory, eye, and digestive problems, as well as social and economic losses. For instance, it can increase the migration of local people to other regions and cause issues such as unemployment, income reduction, tourism reduction, hospital overcrowding with sick children and other individuals, the exodus of migratory birds, and the establishment of salt hurricane centers.

4. Conclusions

Wetlands play a vital role in the well-being of any society today. Wetlands, as temporary/permanent water reservoirs, support many ecosystem services such as wastewater treatment, improve the global warming process, carbon dioxide balance and carbon stabilization, improve rainfall and humidity, soil erosion protection, effect on water quality, eliminate nutrients, biodegradation of toxic compounds, removal and accumulation of heavy metals, local and environmental effects, biodiversity protection, wildlife preserve and habitation. Identifying areas with potential for wetland, preparing a checklist of wetlands, updating data, and determining their current status are crucial, particularly given the specific conditions of these ecosystems in terms of dust production. Thirty-two aquatic ecosystems in Iran have wetland potential, and according to the results, eight wetlands have a high potential to produce dust. Our recommendation is the wetland management plan, which provides their water requirements, prevents their degradation and pollution, and ultimately implements their ecological restoration. In view of the importance of wetlands in dust control, it is suggested that the relationship between climate change and dust intensity should be investigated using satellite image analysis. Additionally, the water needs of wetlands are determined and given priority for water supply. It is crucial for researchers to establish indigenous criteria for identifying wetlands. To protect the soil and prevent dust, new methods like biomechanical methods and algae-based coatings can be utilized.

Authors' Contributions

Jaber Aazami: Conceptualization, collected, sorted the data and writing the manuscript
Sharif Joorabian Shooshtari: Visualization, investigation, contributed to analysis of the results, writing-review & editing.
All authors have read and approved the final manuscript.

Conflicts of Interest

The authors declare that they have no known competing financial interests.

Acknowledgements

Data Availability Statement

Data produced from this study are provided in this manuscript. Some data are also openly available from the Department of Environment, Iran. https://en.doe.ir/portal/home/.

References

Bao, C. *et al.* (2022) 'Analyses of the dust storm sources, affected areas, and moving paths in Mongolia and China in early spring', *Remote Sensing,* 14 (15), pp. 3661. doi: https://doi.org/10.3390/rs14153661

Fakhroueian, Z. *et al.* (2018) 'Transfer of technical knowledge from dust control in Khuzestan province for elimination of Hamoon Jazmoorian wetland challenges', *Asian Journal of Water, Environment and Pollution*, 15(2), pp. 89-98. doi: https://doi.org/10.3233/AJW-180021

Foroughi, M., Aazami, J., and Khosravi, Y. (2021) 'Predicting future changes in temperature and precipitation using hadcm2 model (case study): Golpayegan Shoor Wetland, Iran', *Arabian Journal of Geoscience*, 14 (8), pp. 1-9. doi: https://doi.org/10.1007/s12517-021-06883-0

Hemati, M, *et al.* (2023) 'Iranian wetland inventory map at a spatial resolution of 10 m using Sentinel-1 and Sentinel-2 data on the Google Earth Engine cloud computing platform', *Environmental Monitoring and Assessment*, 195 (5), pp. 1-21. doi: https://doi.org/10.1007/s10661-023-11202-z

Hemati M, *et al.* (2022) 'Iranian wetland hydroperiod change detection using an unsupervised method on 20 years of Landsat data within the Google Earth Engine', *International Geoscience and Remote Sensing Symposium*. Kuala Lumpur, Malaysia, 17-22 July. USA: IEEE, pp. 6209-6212.

Jahantigh, M. (2021) 'Effects of irrigation methods of subsurface, clay pot and drop on Mulberry growth in dry land region (Case study: Sistan area)', *Water and Soil Management and Modeling*, 1 (2), pp. 25-35. doi: https://doi.org/10.22098/mmws.2021.8691

Jiangyi, L., Shiquan, D., and Hmeimar, A. (2020) 'Cost-effectiveness analysis of different types of payments for ecosystem services: A case in the urban wetland ecosystem', *Journal of Cleaner Production*, 249, p. 119325. doi: https://doi.org/10.1016/j.jclepro.2019.119325

Kingsford, R. *et al.* (2021) 'Ramsar wetlands of international importance–improving conservation outcomes', *Frontiers in Environmental Science*, 9, pp. 1-6. doi: https://doi.org/10.3389/fenvs.2021.643367

Omondi, D.O., and Navalia, A.C. (2020) 'Constructed wetlands in wastewater treatment and challenges of emerging resistant genes filtration and reloading', in Devlin, A., Pen, J., Shah, M.M. (ed.) *Inland Waters-Dynamics and Ecology*. London: IntechOpen, pp. 1-16.

Sonu, K., Sogani, M., and Syed, Z. (2021) 'Integrated constructed wetland-microbial fuel cell using biochar as wetland matrix: Influence on power generation and textile wastewater treatment', *Energy Technology & Environmental Science*, 6 (32), pp. 8323-8328. doi: https://doi.org/10.1002/slct.202102033

Verhoeven, J.T, and Setter, T.L. (2010) 'Agricultural use of wetlands: opportunities and limitations', *Annals of Botany*, 105 (1), pp. 155-63. doi: https://doi.org/10.1093/aob/mcp172