Int. J. Hum. Capital Urban Manage., 7(1): 1-16, Winter 2022

International Journal of Human Capital in Urban Management
(IJHCUM)

Homepage: http://www.ijhcum.net/

ORIGINAL RESEARCH PAPER

Environmental management for human communities around wetlands adjacent urban region by ecological risk approach

N. Mohebbi[1], **J. Nouri**[2,*], **N. Khorasani**[3], **B. Riazi**[1]

[1] *Department of Natural Resources and Environment, Science and Research Branch, Islamic Azad University, Tehran, Iran*

[2] *Department of Environmental Health Engineering, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran*

[3] *Faculty of Natural Resources, Tehran University, Karaj, Iran*

ARTICLE INFO

Article History:
Received 11 March 2021
Revised 24 April 2021
Accepted 22 June 2021

Keywords:
Boujagh Wetland
Ecological Risk Assessment
Hazard Quotient (HQ)
Human Communities Activities
Environmental Management

ABSTRACT

BACKGROUND AND OBJECTIVES: Human communities encompass significant population proportion via various strategies of livelihood around the wetlands, including urban development, municipal wastewater discharge or solid disposal, construction growth, agriculture, and fishery piers. Wetlands essentially prepare precious biodiversity and are excellently approved as valuable ecosystems; however, have been exposed to destruction and ruin. The most impressive objectives of the research are briefly to improve the wetland ecosystem by highlighting biodiversity protection approaches. In this paper, the whole socio-economic activities, besides the environmental concerns have been probed on the Boujagh Wetland to better figure out the trade-offs with this management practice.
METHODS: Overall, a conceptual integrated management model has been utilized as the framework of the study, afterward identifying hazardous factors, vulnerability, and indicator species threshold, Ecological Risk Assessment has been implemented by Tiered-ERA model; MIKE 21 simulated contaminants in the widespread aquatic area. SWOT and Quantitative Strategic Planning Matrix have been selected for strategy identification and classification, respectively. In order to illustrate sensitive habitats and other features, Geographic Information System and Remote Sensing instruments have been applied.
FINDINGS: Results demonstrated "chemical fertilizers and pesticides of upstream farmlands" and "toxic metals of industrial wastes and boating" led to ecological hazards for organisms; in addition, nitrogen and phosphor parameters affected eutrophication, influenced due to residential effluents. Furthermore, the most sensitive ecosystems are situated on the surrounding Boujagh Wetland and Sefidrud River margin. Conservation and tourism are prioritized as key strategies and wise uses by scores 10.19 and 9.79 on the QSPM respectively.
CONCLUSION: Finally, conservation, extensive tourism, urban wastewater treatment establishment, elimination of chemical fertilizers and pesticide consumption, prevention of boating, especially military maneuvers, and landfill removal have been suggested to restore the Boujagh Wetland instead of countless unaccustomed land uses.

DOI: 10.22034/IJHCUM.2022.01.01

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
41	9	4

*Corresponding Author:
Email: *jnouri@tums.ac.ir*
Phone: +9821-26105110
ORCID: 0000-0002-9982-3546

Note: Discussion period for this manuscript open until April 1, 2022 on IJHCUM website at the "Show Article.

INTRODUCTION

Wetlands are acknowledged as multifunction ecosystems with significant and valuable potentials to store, purify, and gradually distribute water, which can proscribe floods and provide water for life (Land *et al*., 2016). Most of the wetland functions are related to dominant plant species on it (Saeidi Moshaver *et al*., 2016). Since 1990 an overwhelming deprivation has occurred. Until at present time, more than half of wetlands worldwide have been converted to farmlands and urban areas (Isunju and Kemp, 2016; Sadreazam Nouri *et al.,* 2021). According to previous studies results, wetlands adjacent to urban have faced excessive pressure due to competitive land requests for urban development and population growth, infrastructure expansion, aquaculture, and urban farming (Kingsford *et al.*, 2016). The concept of "wise utilization" has been adhered to in the Ramsar Convention originally, which is regarded as the main purpose of preserving the ecological features of the wetlands, attained via an ecosystem approach in the perspective of sustainable development (Ostrovskaya *et al.*, 2013). Thus, a comprehensive and accurate management method is required to estimate determinations caused by the human community's activities, as well as urban, agricultural and industrial development around wetlands, which can solve environmental multifaceted problems of wetland (Eagles-Smith *et al.*, 2016). In this paper, analyzing and integrating management, a conceptual framework has been thoroughly developed through an ecological risk approach, and Boujagh Wetland has been probed as a case study. The framework was elaborated on two main fundamental perceptions. The first was related to the explanation of effective and sufficient management practice, which is certainly inferred from the Ramsar guidelines. The second is debated in superior details of management capacity and the numerous scopes (Ostrovskaya *et al.*, 2013), which are covered by ecological risk assessment (ERA). This special exclusivity is to provide a synthesis of researches on environmental deviations and human impacts on wetlands (Cui *et al.*, 2016). The convention has additional offered a Geographical Information System (GIS)-based manner as a theoretically convenient performance for localizing risks in the wetlands (Sarkar *et al*., 2016). An ERA is a multi-dimension process that depends on all-inclusive data accumulation, integration, and probing of miscellaneous ecological, spatial, socio-cultural, economical, and managerial variables (Malekmohammadi and Blouchi, 2014). Its data should incorporate spatial information, the incidence likelihood, frequency, and intensity of risk related to proximity to human communities and urban (Chaves *et al.*, 2020). Therefore ERA has been known as a proper tool for detailed wetland management. Especially, the ERA is an evaluation of risks related to an ecological hazard and has advocated for the production of meticulous and accurate scientific information. This information can assist planners in reducing environmental pollutions and other damages to the minimum (Sievers *et al*., 2017). ERA argues the probability of loss occurrence of the ecosystem due to exposure to the stressors (Cesen *et al*., 2018). The stressors and chemical substances entered into the wetland and river through effluents and polluted runoffs discharge in the upstreams and expose vital organisms to the risk (Shifflett and Schubauer-Berigan, 2019). ERA inherently involves three important objects "intensity" and "likelihood" of occurrence plus "threshold of receptors", ERA process can analyze the problem formulation and ecological vulnerabilities, in addition, estimate the probability of irrecoverable detriment to the environment (Jin *et al.*, 2016). Furthermost of the former literature concentrated on a particular characteristic of Boujagh Wetland, for instant wastewater pollution in sensitive areas (Mahdi *et al.*, 2021), effects of Caspian Sea Level (Khoshravan *et al*., 2021), ecotourism (Gourabi and Rad, 2013), geomorphology (Khoshraftar, 2015), vegetation (Maghsoudi *et al.,* 2015), bird species (Ashoori, 2018). Haghani and Leroy (2020) have examined the Sefidrud Delta evolution based on Caspian Sea Level (CSL) fluctuations and stated as a result the consequences of the human are tangible in the delta transmission. However, the effects were concluded for an explicit type of revival performance (e.g., formation of a barrier, harbor, path, or dam) during an explicit time. Spearman *et al*. (2014) demonstrated the probable impact of the port on a coastal habitat and realized that the deposit recycling prevented habitat loss enlargement, and decreased the consequent reactions of the aquatic ecosystem to this interference. Mammides *et al*. (2015) concluded that roads had adverse impacts on four of the five bird groups they considered in Cyprus sites. Madu *et al.* (2018) applied the fish-bone model as a diagnostic analytics tool to categorize the multi-depot spreading and the root causes and effects of lacked oil in the Niger River Delta. Alemi Safaval *et al.* (2018) used GIS and Remote Sensing (RS) as means to clarify the impact of ports and coastal structures built in the Boujagh Wetland region on beach and shoreline morphological changes of shoreline modification recognition using satellite pictures and recommended an innovative method. Kapourchal *et al.* (2014) studied the portion of ecological and socio-economical land uses in Boujagh national park by using GIS and RS; they specified the rigid nature, threatened, extensive, intensive, reclamation, managerial, scientific, and manifold use sectors are included of the total area, respectively. In this regard, GIS and RS can facilitate data analysis and management and illustrate risk levels. Besides, ERA is flexible and simplifies the complicated data of ecosystems and hazards via computational formulas (Liang *et al.*, 2015). In this research, investigating stressors, and forecasting contaminants distribution, the simulation model of MIKE 21 has been undertaken in a combination with the Tier Ecological Risk assessment (TIER) model. Recently, the database of spatial response to natural changes and human impacts in Boujagh National park has been conducted by Karimi et al. (2021). Nevertheless, in this study, MIKE 21 has been applied to pollution simulation and the results have been used in ERA. The most significant porpuses of this research are briefly to improve the wetland ecosystem, and to present a set of sufficient and effective mitigation measures and a management model to solve human-made problems by highlighting biodiversity conservation approaches (Endter-Wada *et al.*, 2020). So, ecological approach has been chosen, not only presents an integrated framework of management, but also regards to details. Reihanian *et al.* (2012) explored the use of altering of tourism in the Boujagh National Park via Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis method. The case study provided a subjective experience of the management method. Boujagh wetland located on Kiashahr city downstream, the north of Iran and Sothern of Caspian Sea shoreline and Sefidrud Delta, within 500 hectares area, is known as the first marine coastal national park protected by Iranian Department of Environment (DOE). Kiashahr is the nearest city to this wetland (Hakimi Abed *et al.*, 2011). The satellite map of Boujagh Wetland and National Park location has been illustrated in fig 1. Boujagh Wetland is one of the first wetlands of the Ramsar Convention (Noroozi, *et al*., 2009). The study area includes the

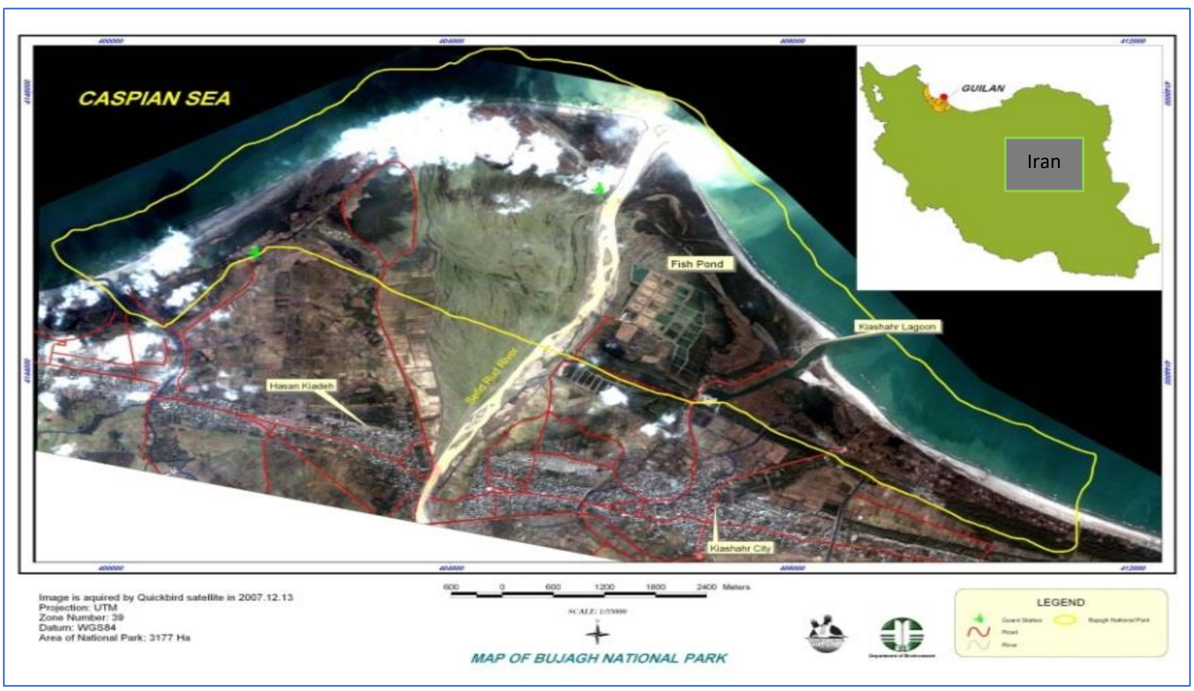

Fig. 1: Geographic location of the study area in Bujagh Wetland and National Park (Alemi safaval *et al*., 2018)

Boujagh National Park and Wetland.

Individual habitats of Boujagh Wetland have attracted precious biodiversity of fauna and flora especially migrated birds during winters (Khoshraftar, 2015). Sefidrud Estuary is a significant habitat for Caspian kutum (*Rutilus frisii kutum*) and sturgeon (*Acipenser spp*.) breeding in the spring (Khara and Nezami Balouchi, 2005), which have played an important role in residents livelihood on the wetland surrounding (Khara *et al.*, 2007). The remarkable variety and population of migrated birds, fishes, marine animals, and mammals are representing the ecological capability and efficiency of the region (Esmaeili *et al.*, 2014). Unfortunately in recent decades, municipal wastewater pollution, residential solid wastes disposal, chemical fertilizer and pesticides of agriculture, industrial effluents, contaminated run-offs, aquaculture, land use changing, and water taking of Sefidrud on the catchment have threatened the ecosystem (Alemi Safaval *et al.*, 2018). The most important stressors have consisted of chemical substances related to agriculture pesticides and fertilizers (eg., nitrogen and phosphor), heavy metals and toxic elements of the residential, hospital, and industrial effluents from the nearby cities and urban areas especially Kiashahr city and other settlements, organic ingredients, and exotic species from aquacultural pounds, fishery, hunting, fuel leakage of boat and military maneuvers, which have faced Boujagh Wetland and its protected animals to the dangers, for example, Caspian seal (*Phoca caspica*), brown trout (Salmo trutta), starry sturgeon (*Acipenser stellatus*) (Khara and Nezami Balouchi, 2005), dalmatian pelican (*Pelecanus crispus*), pygmy cormorant (*Phalacrocorax pygmeus*), white-fronted goose (*Anser albifrons*), red-breasted goose (*Branta ruficollis*), white-tailed eagle (*Haliaeetus albicilla*), swans, ducks, cran, flamingoes, etc. (Ashoori, 2018), amphibians and reptiles. Some of the species are listed by the International Union for Conservation of Nature (IUCN) red list as endangered and vulnerable. Tourism attractions due to the natural features regularly absorb humans to visit the area (Gourabi and Rad, 2013). Even if the biosphere of the wetland was altered, the efforts of wetland conservation should enhance to attain the highest alterations and sustainable development; else overwhelming utilization of natural resources would lead to biodiversity degradation and declining ecosystem balance (Jafari, 2009). It is necessary to mention, the factors of migration to metropolitans, converting farm fields to protected and tourism land use could decline the pressure of population on the study area (Reihanian *et al.*, 2012), but then again residential complex development, aquaculture, sand taking, overplant of rice and overusing pesticides are existing (Nasrolahi *et al.*, 2017), therefore the comprehensive management framework can play a significant role in wetland restoration and alteration (Grygoruk and Rannow, 2017).

MATERIALS AND METHODS

Overall, a conceptual management model was utilized as a framework of the study, that indeed integrates unique and hybrid methods and potentially categorizes the whole functions of procedures and regards to relations and consequences amongst the different sections (Bratley and Ghoneim, 2018). Consideration of environmental existing conditions was established based on previous studies (Chaves *et al.*, 2020). ERA was carried out with the TIER model. In the first step, reviewing the literature of the wetland studies, environmental hazards, threats, and ecological sensitivities are considered and then are categorized through the fish-bone model (Madu *et al.*, 2018). To quantify and estimate ecological risks the formulas including Eq. 1 (Liang *et al.*, 2016), and Eq. 2 (Cesen *et al.*, 2018) are used; TIER is known as a conceptual model which can quantify risks within aquatic ecosystems (Riva *et al.*, 2019).

$$HQ= \frac{PEC}{Threshold} \times sensitivity \quad (1)$$

Where; HQ= Hazard Quotients

The threshold is accounted by NOEC or NOEL or LC50 or LD50 it depends on the available amount which has been already examined by valid scientific references) NOEC= No Observed Effect Concentration; NOEL= No Observed Effect Level; LC50= Median Lethal Concentration; or LD50= Median Lethal Dose; amounts of the threshold have been extracted from the United States Environmental Protection Agency agendas (US EPA). LC50 and LD50 scales are the concentration of chemical material that lead to the death of 50% of a group of laboratory test animals at once. These are the manner to measure the short-term poisoning ability (acute toxicity) of a substance

(Riva *et al*., 2019). PEC = Predicted Environmental Concentrations; or the estimated amounts might be available so it is replaced by EEC = Estimated Environmental Concentrations. In this study, the sensitivity of species was likewise considered as the third parameter; so in terms of the IUCN red list, characters involving critical, endangered, and vulnerable species have been assessed in HQ corresponding to Eq. 1. If HQ was less than one it is classified as a very high-risk level (VHL), between 1 and 4 as high (HL), 4 to 7 medium (ML), 7 to 14 low level (LL), and upper than 14 is negligible (NL). To ensure HQ results and reduce uncertainties, Risk Quotient (RQ) was applied to probe the ecological risks posed by the object elements, and RQ was computed using Eq.1 (Cesen *et al*., 2018).

$$RQ = MEC / PNEC \quad (2)$$

MEC corresponds to the maximum perceived concentrations; PNEC or the Predicted No-Effect Concentration was tallied by EC50/LC50, which examined risks in acute and chronic toxicity.

Acute Effects RQ (fish and invertebrates):

1-in-10 Year Peak Water Concentration = RQ most sensitive organism LC50 or EC50

Chronic Exposure RQ (invertebrate):

1-in-10 Year 21-day Average Water Concentration = RQ aquatic invertebrate chronic toxicity NOEC

Chronic exposure RQ (fish):

1-in-10 Year 56-day or 60-day Average Concentration =RQ fish early life stage or full life cycle toxicity NOEC

An RQ that is less than 0.1 (RQ < 0.1) is potentially classified as a “Negligible Level” (NL). The value between 0.1 and 0.4 is called “Low Level” (LL), among 0.4 to 0.7 “Medium Level” (ML), about 0.7 to 1 “High Level” (HL), and an RQ that is upper than 1 (RQ≥1) is entitled as “Very High-risk Level” (VHL) (Cesen *et al*., 2018). Extraction the number of indicators species of the wetland, the sensitivity of organisms has been determined (Chaves *et al*., 2020); by reviewing the ecosystem food chain, some the aquatic organisms have been examined including invertebrates, plants, and fishes (Sattari *et al*., 2019). ERA has been improved through combination with a computational simulation model MIKE 21 FM-ECOLAB which can illustrate how pollutants are released on the wetland and surface waters (Karimi *et al*., 2021). The combination and application of MIKE to show pollutants dispersion are the innovation of this study. MIKE 21 model is a computerized model to evaluate hydrological changes and water flows in Boujagh Wetland (Nasrolahi *et al*., 2017) as well as can consider contamination defusion. Additional sampling information is used as a database in a simulation that the DOE has already done. To assess seasonal variations in Boujagh basin pollution loading, samples of water were collected in spring, summer, autumn, and winter and 12 sample points, from Sefidrud Dam to the downstream. Simulation has been conducted for 4 seasons separately. Extraction results from GIS and RS have adequately been implemented to elucidate MIKE simulation and sensitive areas (risk levels sites) through maps (Malekmohammadi and Blouchi, 2014). Finally, analyzing data, SWOT and Quantitative Strategic Planning Matrix (QSPM) have carried out and the scores were normalized from zero to one. In the first step of SWOT, internal (strengths and threats) and external (opportunities and threats) environmental factors have been estimated in two matrices separately (Pazouki *et al*., 2017). Perusing the factors is a key section of a strategic planning process that is a part of sustainable development (Endter-Wada *et al*., 2020). The internal factors of the wetland were categorized as strengths (S) or weaknesses (W) and those external were summarized as opportunities (O) or threats (T). Accordingly, a set of Ss and Ws and a set of Os and Ts were summed up. The prior was arranged in the Internal Factor Evaluation Matrix (IFEM) and the latter was arranged in the External Factor Evaluation Matrix (EFEM). Following, the factors were scored by a board of specialists and the final weight was counted (Reihanian *et al*., 2012). Subsequently, base on the wetland ecological capability and restoration evolution, prioritized strategies, and management scenarios were suggested (Endter-Wada *et al*., 2020).

RESULTS AND DISCUSSION

According to probe the Boujagh Wetland area, the human activities often weren’t compatible with ecological capability. Municipal wastewater discharges, unexpected land use exchanges (for example urban development, land encroachment, construction, agriculture, and aquaculture), improper exploitation (e.g hunting, fishery, sand mining, and harvesting), non-systematic recreation, pier establishment, canoe, military maneuvers, fuel leakage, entering exotic species, and solid waste disposal have been subtracted as significant reasons for ecological risks in the area. Using the fish-bone model is categorized main causes and effects of risks in the Boujagh wetland area, which has illustrated in Fig 2.

Assessing dispersion scope and effects of water pollutants, has been conducted by MIKE 21, the inputs of the model are sampling results, bathymetry, and water flow, and also the outputs are maps of two-dimensional distribution simulation of pollutants on the wetland surface and river on the basin. Nitrogen and phosphor parameters are index stressor factors of eutrophication and Dissolved Oxygen (DO) decrease meant which is directly related to effluents and causes stress to the ecosystem, benthos, and terrestrial and aquatic animals and plants. A drawing of pollutants simulation of DO, Biological Oxygen Demand (BOD), Nitrate (NO_3^{-2}), and Phosphate (PO_4^{3-}) on Boujagh Wetland and Sefidrud River has been shown in Figs. 3 to 6 respectively, during winter with a report of peak presence of immigrant birds and endangered species. Heavy metals concentrations haven't regularly been stated on the sampling report hence the simulation wasn't provided. However, coliforms Escherichia coli (E.coli) and Total coliforms (T.coli) have been stated which demonstrates residential sewages could influence the wetland.

According to the ERA framework, some individual species have been judiciously chosen, and then HQ has been precisely estimated for each indicator separately. Amongst bird species, the mallard has approximately existed in the whole sections of

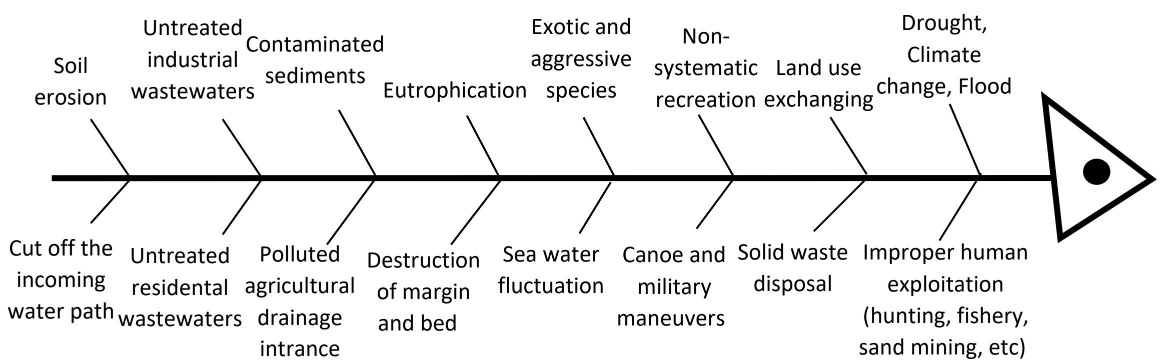

Fig. 2: The fish-bone model of anthropoid hazards causes and effects of Boujagh Wetland

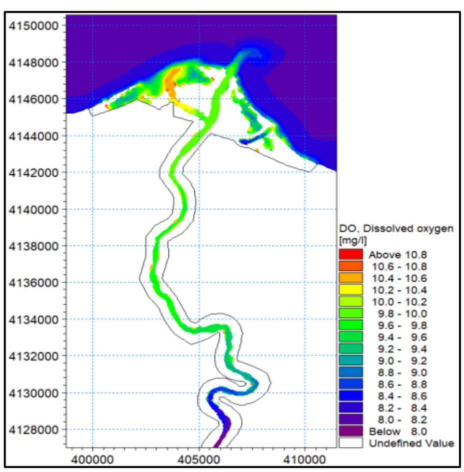

Fig. 3: DO fluctuations tendency

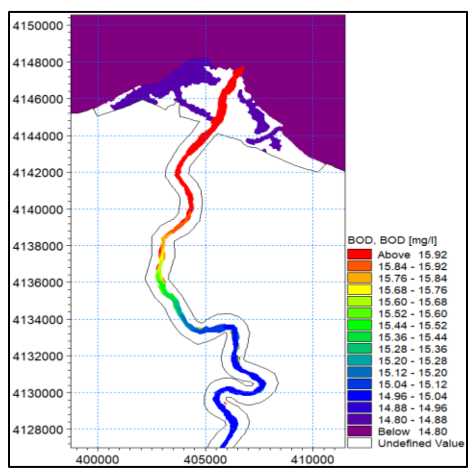

Fig. 4: BOD fluctuations tendency

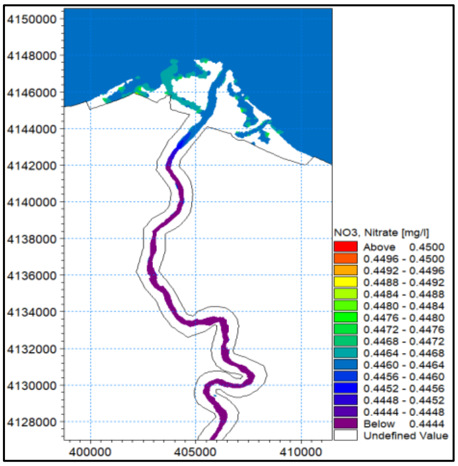

Fig. 5: Nitrate (NO_3^{2-}) fluctuations tendency

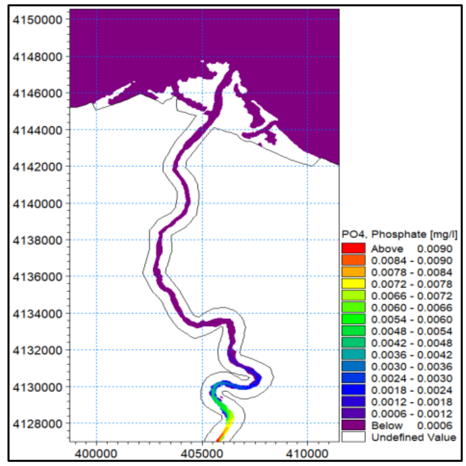

Fig. 6: Phosphate fluctuations tendency

Table 1: ecological risk characterization and receptors sensivities by using TIER

Species	LC50	LD50	HQ	RQ	Risk level	Risk magement is required
Caspian hydrothermal fish (Carp, Kora vobla, and Southern Caspian kutum)	8000 mg/L (in 96 hours exposure)	50 mg/L	2.3	0.87	HL	Manage to prevent mortality and natural population reduction
Caspian cold fish (trout and salmon)	5300 mg/L (in 96 hours exposure)	0.5, 5, and 50 mg/L	0.94	1.32	VHL	For high ecological sensitivity, especially red-spotted trout, manage to prevent mortality and natural population reduction
Starry sturgeon	6000 mg/L (in 96 hours exposure)	0.5, 5, and 50 mg/L	0.94	1.67	VHL	High ecological sensitivity, manage to prevent mortality
Kilka fish	5300 mg/L (in 96 hours exposure)	5 mg/L	2.3	0.75	HL	manage to prevent mortality and population reduction
Aquatic benthoses and macroinvertebrates	3.8 mg/L (in 48 hours exposure)	48 mg/L	6.2	0.79	ML	Manage by reducing the concentration of phosphor and carbon in sediments during time
Aquatic plants	4.6	67-93% 1hlorophyll production reduction in 1 mg/L	5.2	0.82	ML	Manage carbon and phosphor concentration in sediments and dissolved nitrogen, by preventing the loss of sediments

the wetland area, were prioritized on ML; still, the sensitive species such as chlorophyll pelican with a less population density, larger physique, and vulnerable (near threatened) status in IUCN red list, were categorized on HL. Birds, mammals, and reptile species due to aquatics nourishing were exposed to oral risks; depending on ecotoxic effects and a degree in the body tissue of organisms, risk characterized to acute and chronic. Thus, HQ was calculated for pioneer species of former levels of the food chain in the aquatic ecosystem (Table 1).

Eventually, overlapping and integrating environmentally sensitive areas in the study area and the hazards and threats in the area and land use and human activities that have exposed the wetland, the environmental risk zoning map was drawn as shown in Fig. 7.

To improve the condition of the Boujagh Wetland, management strategies were determined and proposed through the SWOT method. For this purpose, at first, the Strengths (S) and Weaknesses (W) of the wetland (internal factors) and also the Opportunities

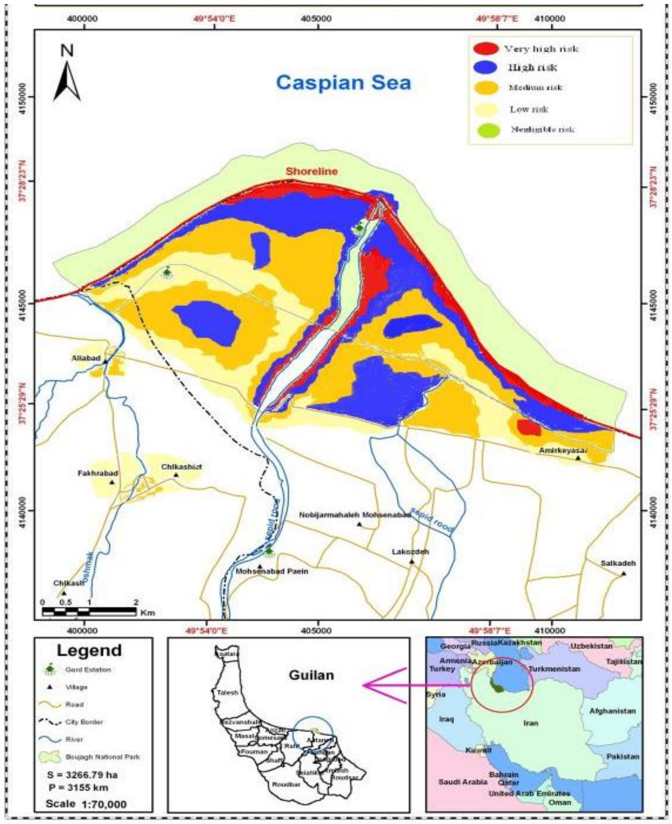

Fig. 7: The performed environmental risk zoning for Boujagh Wetland area

(O) and Threats (T) caused by human activities in the wetland (external factors) as well as the risks arising from externals on the structure and function of the wetland were determined and prioritized. Tables 2 and 3 summarized the outcome of internal and external factors prioritization, respectively. Regarding the obtained results, the value of IFEM equaled 2.37 (less than 2.5), which meant the strengths were less than weaknesses; and also the final score of EFEM was 2.43 (less than 2.5), so the opportunities were less than threats. It can be concluded the current state of management is suffering and the wetland has gone ahead to a hardship situation and might be recorded to the Montreux blacklist.

According to the results of the strategy analysis by SWOT, sustainable conservation, recreation, and restoration are the substantial pivot of the wetland environmental management. To acquire those, by pair conforming S, W, O, and T, forty-two crucial strategies were determined for the wetland. SO strategies offered opportunities that apt well with the wetland area strengths. Plus, WO strategies suggest opportunities to overcome weaknesses. ST strategies distinguish the solution that can be used to decrease susceptibility to threats. WT strategies were determined a defensive plan avoiding the wetland weaknesses for creating it extremely vulnerable relative to threats (Fig. 8).

Based on the scoring results in the QSPM matrix, management strategies are prioritized and quantified as described in Table 4.

Regarding the results, identifying where Boujagh Wetland management can support risk reduction is essential for assisting decisions, integrated management, and conservation. The risk analysis can provide decision-making tools for the prioritization of conservation strategies which are categorized in the first grade; it means the Boujagh Wetland was exposed to urban development, hazardous human activities, and illogical utilization, which caused the wetland degradation. Furthermore, spatial urban development has resulted in the intake of more agricultural lands and forest depletion of numerous circumstances. The concerns are particularly more apparent in the urban areas adjacent to the coastal area and river margin. Inappropriate schemes of land exploitation, wood smuggling, and pastures overgrazing in height above sea level have led to numerous risks in recent decades. The disturbances of natural habitats, over fishery, and excess hunting are other main environmental hazards in Boujagh Wetland. Additional meaningful hazardous of urban

Table 2: IFEM of environmental management of Boujagh Wetland area

Internal environmental factors	Code	Score	Weight	Total Score
Strengths				
Individual ecosystems, breeding habitats, and desirable bio-geography	S_1	4	0.035	0.14
Conservation of valuable endemic and individual species	S_2	2	0.029	0.05
Significant diversity of plant species, aquatic animals, birds, marine mammals, existence of endangered and threatened species	S_3	3	0.024	0.07
Suitable and fertilized soil with little erosion in some parts	S_4	3	0.031	0.09
Significant capabilities to attract tourism	S_5	3	0.023	0.07
Primary infrastructures such as power network	S_6	3	0.025	0.08
Sand dunes and grasslands in the wetland area, flood controlling and diversity of landscape	S_7	2	0.025	0.05
The economic value of wetland habitats (estuary, beach, …)	S_8	3	0.033	0.09
Distribution of wetland habitats in the study area	S_9	2	0.030	0.06
Attractive and natural landscapes with natural aesthetics, recreational space, and bird watching	S_{10}	3	0.022	0.07
Active and educated inhabitants to participate in conservation and tourism plans	S_{11}	3	0.023	0.07
Striking capability of research, training, and study inherently	S_{12}	3	0.022	0.06
Natural resources affecting the livelihood of the locals and inhabitants	S_{13}	4	0.032	0.12
Active Environmental NGOs presence	S_{14}	4	0.032	0.13
DOE inspection, Park rangers presence, and Ramsar convention limitation	S_{15}	2	0.030	0.06
Weakness				
Sedimentation and settlement on Sefidrud River estuary	W_1	3	0.023	0.07
The loss of plant species and destruction of some parts of grasslands by overgrazing	W_2	4	0.025	0.10
Lack of belonging sense among stakeholders towards protection and sustainable productivity	W_3	4	0.021	0.08
Lack of improper planning and infrastructure for tourism	W_4	4	0.022	0.09
Soil erosion due to torrential rain especially on spring and river margin	W_5	3	0.010	0.03
Occupational attraction shortage for locals and lack of long-term planning	W_6	3	0.021	0.06
land encroachment and inconsiderate exploitation	W_7	3	0.012	0.04
Local organized group absence on Boujagh Wetland margin	W_8	3	0.015	0.04
Lack of proper relation between non-governmental organizations, stakeholders, and managers	W_9	3	0.018	0.06
Lack of proper system for solid waste management and disposal	W_{10}	4	0.020	0.08
Extraordinary destruction in some parts of the wetland area due to reed and plant harvesting	W_{11}	4	0.020	0.08
Polluted sediments and water entrance to the wetland	W_{12}	3	0.016	0.05
Absence of executive warranty for preventing illegal hunting and fishing	W_{13}	2	0.014	0.03
Disorganized areas and unknown potentials of recreation	W_{14}	3	0.006	0.02
The shortage of public awareness locally to protect natural resources	W_{15}	2	0.012	0.02
Incompatibility of land uses and ecological capability	W_{16}	3	0.013	0.04
Absence of training and research use	W_{17}	3	0.014	0.04
Absence of acquaintance of experts, planners, and managers about participation techniques	W_{18}	3	0.022	0.07
Livelihood problems for locals and handcraft manufacturers	W_{19}	3	0.018	0.05
The weakness of management about conservation of sensitive areas and enhancement	W_{20}	3	0.014	0.04
Lack of wastewater treatment network and system	W_{21}	3	0.014	0.04
Sum	-	-		2.37

Table 3: EFEM of environmental management of Boujagh Wetland area

Enternal environmental factors	Code	Score	Weight	Total Score
Opportunities				
Annual birds migration route	O_1	4	0.023	0.10
Villages around the wetland with attractive traditional culture for tourism	O_2	3	0.027	0.08
Abundant precipitation in the region	O_3	3	0.025	0.07
Alignment of Sefidrud River and Boujagh Wetland	O_4	3	0.026	0.07
Seashore proximity	O_5	3	0.021	0.06
Environmental NGOs undertakings in the area	O_6	3	0.019	0.06
A guesthouse in the eastern part of the national park	O_7	3	0.018	0.05
Kiashahr port improvement plan in 40-50 hectares area in the eastern during 20 years	O_8	3	0.028	0.08
Strict laws of the national park and international wetlands for criminal land use exchanging	O_9	3	0.021	0.06
Iranian wetland conservation project and ongoing management agenda	O_{10}	3	0.024	0.07
The shortage of access road and ways	O_{11}	3	0.020	0.06
Soil fertility by bird's residues or excrement in surrounding areas and farmlands	O_{12}	3	0.025	0.07
Restrictive laws about the illogical exploration of the wetland and feasible wise use establishment	O_{13}	3	0.028	0.09
Possibility of renewable energy using	O_{14}	3	0.021	0.06
Aquaculture pounds for economic improvement and employment	O_{15}	3	0.022	0.06
Universities studies on Boujagh Wetland	O_{16}	3	0.024	0.07
Individual landscape and widespread perspective of the area	O_{17}	3	0.021	0.06
Register the wetland on Ramsar Site	O_{18}	3	0.029	0.09
Fundamental investing in training and researching about the wetland concerns and issues	O_{19}	3	0.024	0.07
Threat				
Polluting Sefidrud River at the upstream through effluents and wastewater and discharge into the wetland	T_1	4	0.019	0.08
Soil erosion at the wetland coast and river margin in addition transfer massive sediments into the wetland	T_2	3	0.010	0.03
Overgrazing around the wetland grasslands	T_3	3	0.008	0.02
An urban landfill in the eastern of the study area	T_4	3	0.012	0.04
Boating and fishing performances in the wetland	T_5	3	0.012	0.04
Exotic species entrance into the wetland	T_6	3	0.012	0.04
Urban development, land encroachment and residential complex construction around the wetland	T_7	3	0.015	0.05
Destruction of individual habitats and natural ecosystems	T_8	4	0.014	0.06
Aquaculture ponds in the wetland and Sefidrud River	T_9	3	0.016	0.05
Garrison and military maneuvers direction in the wetland area	T_{10}	4	0.017	0.07
Vicinity to the fishery pier	T_{11}	2	0.007	0.01
Unmatchable financial resources with the wetland conservation and restoration requirements	T_{12}	3	0.017	0.05
Motorcycle track in the area	T_{13}	3	0.014	0.04
Incompatibility of land use development without legal and conservation considerations	T_{14}	4	0.016	0.06
Soil compaction and flora dissipation	T_{15}	3	0.019	0.06
Overexploitation related to economic operations and Incompatible with the ecological capability	T_{16}	4	0.020	0.08
Continuing to the various restrictions and probability to recording the wetland on the Montreux's Blacklist	T_{17}	3	0.012	0.04
Visual disturbance and unmatchable landscape with the nature for changing the old texture of buildings	T_{18}	3	0.018	0.05
Illegal hunting and fishing, out of the wildlife resistance power	T_{19}	3	0.015	0.05
Agriculture Development in the upstream and the wetland margin	T_{20}	3	0.014	0.04
Public participation obstacles, lack of appropriate relation between governmental organizations, stakeholders, and private sectors	T_{21}	3	0.011	0.03
The economic poverty of the local communities	T_{22}	3	0.019	0.06
Plain and facile accessibility to the wetland region	T_{23}	4	0.007	0.03
Sum	-	-		2.43

Table 4: Strategies prioritization and quantification on QSPM matrix

Rank	Strategy description	Final Score	Rank	Strategy description	Final Score
1	Using the applied conservation of the wetland and hazardous factors elimination gradually	10.19	2	Implementing conservation management plan for Boujagh Wetland according to the national wetlands conservation plan	9.79
3	Financially supporting for wetland restoration	9.56	4	Planning for the wetland exploitation by ecotourism approach and biodiversity conservation	9.51
5	Developing compatible activities with the wetland ecological capability to protect the area	9.22	6	Allocation of the wetland environmental water right	9.12
7	Ecotourism development in the site in accordance with ecological capabilities	8.85	8	Planning for a thorough and continuous inspection for the wetland and biodiversity conservation	8.81
9	Developing sustainable tourism and following international wetland standards	8.66	10	Protecting the wetland hydrological and ecological boundaries and preventing land encroachment	8.56
11	Preventing land use development and all the activities incompatible with ecological capabilities through regulations	8.46	12	Defining economical activities based on long term planning for wise use	8.20
13	Controlling entered polluted water and sediments mass to the wetland upstream and margin	8.04	14	Encouraging researching and training endeavors and using the results on management	7.96
15	Determining the conversational wetland policies and targeting for long term	7.87	16	Providing satisfactory habitats for migrated birds and preventing site destruction	7.85
17	Strengthening infrastructure relevant to sustainable tourism in the wetland area	7.63	18	Watershed management and soil conservation in the catchment area	7.59
19	Providing financial resources through tourism for the wetland restoration	7.57	20	Using biocontrol in agriculture and aquaculture rather than chemical pesticides in the basin	7.55
21	Planing wastewater treatment system and coordinating between Kiashahr municipality and local government water authorities	7.50	22	Creating job opportunities for locals especially young people by the ecological values and protection objectives and public awareness	7.43
23	Manipulating public participation programs and holding training workshops in Boujagh site	7.42	24	Providing solid waste management plan and separation at the source in the site of the national park and wetland	7.36
25	Improving the ranger station of the park in the wetland and organizing a work structure by a conservation approach and avoiding destruction	7.25	26	Prevention of military maneuver and unnecessary boating with strict laws about international wetland and national park	7.14
27	Persuading and creating a sense of belonging to the wetland for all the stakeholders and users through the principal planning such as tourism, holding sport and leisure tournaments on permitted seasons, training, and public declaration	7.13	28	Forbidding solid wastes disposal in environmentally sensitive areas, and finding new sites for Kiashahr landfill	7.11
29	Getting an opportunity to rehabilitate the wetland by using protective management method such as habitats treatment and stopping operation	7.08	30	Training and awareness to local experts and stakeholders about the wetland values and wise use	7.04
31	Controlling entered flood and sediments mass to the wetland from upstream and Sefidrud River catchment and dam	6.95	32	Appealing environmentalists, actors, famous persons, and athletes to supporting Boujagh Wetland and preventing the destruction	6.92
33	Determining sustainable incomes for locals in terms of the wetland ecological capabilities and renovating current occupations with sustainable livelihood manners eg. Handcraft, participation, tourism, etc.	6.78	34	Using public participation, young workforce, and women for conservation, restoration, and ecotourism development in the wetland	6.68
35	Training and announcing inhabitants, expert, NGOs, and tourism for the wetland protection and biodiversity	6.64	36	Developing scientific research in the wetland site	62.6
37	Studying the wetland benthos and updating biodiversity database in the area	6.58	38	Advertising ecotourism and providing financial sources on the wetland conservation	6.42
39	Public participation and determining the role of young people and women in management, conservation, and recreation of the wetland	6.39	40	Using NGOs abilities to public and stakeholders awareness	6.35
41	Planning for handcraft and traditional arts development	6.11	42	Creating the tools for tourism and using natural attractions eg. Bird watching station, the wetland museum in the park ranger building	5.59

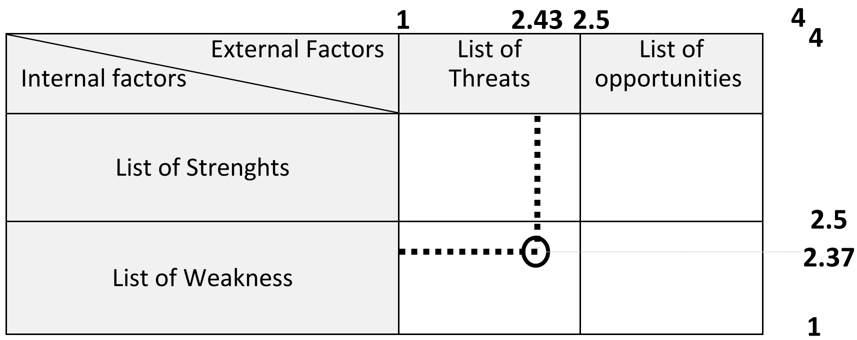

Fig. 8: Strategy characterization of Boujagh Wetland

near Boujagh Wetland has been the municipal wastewater and solid wastes coming to the basin area. The water quality degradation in the natural breeding areas for sturgeon and trout species, eutrophication, and threats to the benthos or other aquatics are significant risks. Causes of the problems have been associated with human activities increased such as the Sefidrud Dam, pollution of the Sefidrud River, vehicle traffic around the wetland, boating, fossil fuel leakage (to the water or margin), construction, and sand mining. So, restoration and conservation of the wetland are necessary to survive the wetland. In terms of ecological capabilities evaluation of Boujagh Wetland, management strategies have been described in three axles containing conservation, restoration, and sustainable recreation. Conservation strategies such as "Using the applied conservation of the wetland and hazardous factors elimination gradually" with a 10.19 score and "implementing a conservation management plan for Boujagh Wetland according to the national wetlands conservation plan" with 9.79 scores are the most important suggested strategies. In the next grade, "financially supporting for the wetland restoration" and "planning for the wetland exploitation by ecotourism approach and biodiversity conservation" with 9.56 and 9.51 scores are ranked respectively. In addition, unexpected land uses around the wetland were known at a high-risk level. Therefore, the strategy "developing compatible activities with the wetland ecological capability to protect the area" (with a 9.22 score) is prioritized in 5th grade. "Allocation of the wetland environmental water right" is a significant strategy that is rated on the 6th rank with a 9.12 score. "Sustainable ecotourism development in the site in accordance with ecological capabilities" (with an 8.85 score) is the 7th prioritized strategy for wetland wise use. Whereas, eliminating incompatible environmental factors and hazardous land uses are accounted urgent requirements, most probably; it will be quickly tabloid the suggested strategies and procedures of wise utilization, for instant stabilizing effective sewage treatment system for residential areas specially Kiashahr, prohibiting the straight discharge of the residential effluents and untreated industrial runoff into Sefidrud River, improving the current wastes collection in Kiashahr, villages, and tourist spots, recycling of persistent wastes and launching compost installations for carbon-based and disposable ingredients, modification of urban expansion and construction policies, control land encroachment, preventing navy maneuvers, effective measures to be taken versus the proscribed fishing, criminal hunting, overgrazing and forest destruction, eliminating chemical pesticides and using biocontrol methods, and watershed management in the upstream. Sustainable tourist activity is assessed as appropriate use, which is close to the ecological potential evaluation and wetland conservation programs. One of the most important techniques of the wetland wisdom use is sustainable recreation; therefore the managerial strategies have been defined such as financial resource providing, training, public awareness, using local workforce, and stakeholder participation, introducing traditional culture, and Strengthening tourist infrastructures and tools. Concluding the results, the three main groups of strategies have been localized on the Boujagh national park and wetland area (Fig. 9). A protection strategy has been suggested on the areas, as shown by orange color and required to strick conservation.

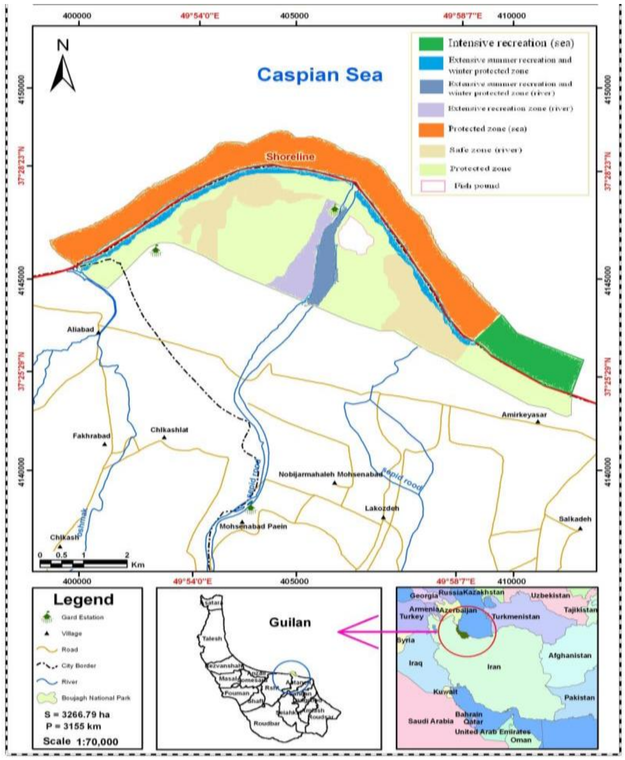

Fig. 9: Zoning of key environmental management strategies of Boujagh Wetland

According to the wetland and river margins classes as the most sensitive area, conservation and extensive ecotourism have been suggested for those areas. The areas with pale green color indicate that the conservation strategy is dominant.

CONCLUSION

In the present study, has been shown, Boujagh Wetland is one of the most valuable ecosystems, which requires an enhanced management framework and sustainable conservation, restoration, ecotourism, and adopted socio-economic activities, which are called "wise use". It displayed wise exploitation neither preserves and sustains the area nor benefits the communities around the wetland especially Kiashahr City. Thus, Boujagh Wetland is in despairing requirement of an integrated environmental management plan to produce profits for inhabitants and mitigate the adverse effects of utilizations. Therefore, all the aspects of environmental management have been considered, in this paper. For this purpose, deductive and inductive approaches have been taken in the management method. The framework encompasses five basic steps the problem formulation, identification of hazardous activities, risk estimation, management and reducing risks, and improve the wetland condition. Using TIER, MIKE 21, and HQ quantitative formula, ecological risk assessment has been conducted. Determining indicator species threshold, the value of LC50 and LD50 have been extracted EPA documents. Applying GIS and RS have been localized risk levels in the wetland area. In the end, IFEM, EFEM, and SWOT have been used to analyzing data and presenting strategies; in addition, the QSPM has been used to prioritize the key strategies. In conclusion, the management strategies have been recommended to alter the wetland and wise uses. Furthermore, public and stakeholder participation and awareness have been suggested to enhance environmental management. Also, preventing incompatible land uses has been offered coordination between Kiashahr municipality and Gilan province DOE.

AUTHOR CONTRIBUTIONS

N. Mohebbi performed the literature review, experimental design, analyzed and interpreted the data. J. Nouri prepared the manuscript text and manuscript edition. N. Khorasani revised the wetland data and literature review, B. Riazi helped in the literature review and wetland subject revision.

ACKNOWLEDGMENTS

The authors would like to thank the Graduate School of Environment and Natural Resources for the support in the implementation and completion of the study. Also, appreciate Behrouz Dehzad and Ebrahim Jafari and the anonymous reviewers for the promotion of the study with their valuable and essential technical comments.

CONFLICT OF INTEREST

The authors declare no potential conflict of interest regarding the publication of this work. In addition, ethical issues including plagiarism, informed consent, misconduct, data fabrication and, or falsification, double publication and, or submission, and redundancy have been completely witnessed by the authors.

PUBLISHER'S NOTE

Tehran Urban Planning and Research Center remains neutral with regard to jurisdictional claims in published maps and institutional afflictions.

ABBREVIATIONS

%	Percent
AHP	Analytical Hierarchy Process
BOD	Biological Oxygen Demand
COD	Chemical Oxygen Demand (BOD)
CSL	Caspian Sea Level
DEM	Digital Elevation Map
DO	Dissolved Oxygen
DOE	Iranian Deparment of Environment
EC	Expert Choice
E.coli	Escherichia coli
EEC	Estimated Environmental Concentrations
EFEM	External Factor Evaluation Matrix
EI	Environmental Indicators
Eq	Equation
ERA	Ecological Risk Assessment
GIS	Geographic Information System
HL	High Level of risk
HQ	Hazard Quotient
IFEM	Internal Factor Evaluation Matrix
IMM	Integrated Management Model
IUCN	The International Union for Conservation of Nature
LC50	Median Lethal Concentration
LD50	Median Lethal Dose
LL	Low level of risk
MCDM	Multi-criteria decision Making
ML	Medium Level of risk
NGOs	Non-Governmental Organizations
NL	Negligible level of risk
O	Opportunities
PEC	Predicted Environmental Concentrations
QSPM	Quantitative Strategic Planning Matrix
RS	Remote sensing
RQ	Risk Quotient
S	Strengths
SO	Strengths and Opportunities strategies

ST	Strengths and Threats strategies
SWOT	Strengths, Weaknesses, Opportunities, Threats (Strategic Environmental Management)
T	Threats
T.coli	Total coliforms
TIER	Tiered Ecological Risk assessment model
US EPA	United States Environmental Protection Agency
VHL	Very High Level of risk
W	Weaknesses
WO	Weaknesses and Opportunities strategies
WT	Weaknesses and Threats strategies

REFERENCES

Alemi Safaval, P.; Kheirkhah Zarkesh, M.; Neshaei, S.A.; Ejlali, F., (2018). Morphological changes in the southern coasts of the Caspian Sea using remote sensing and GIS, Caspian J. Environ. Sci. 16(3): 271-285 (**15 pages**).

Ashoori, A., (2018). The birds of Bujagh national park, Iran, 2004–2016. Sandgrouse. 40: 144-156 (**13 pages**).

Bratley, K.; Ghoneim, E., (2018). Modeling urban encroachment on the agricultural land of the eastern Nile Delta using remote sensing and a GIS-Based Markov Chain model. Land. 7(4): 114-134 (**21 pages**).

Cesen, M.; Heath, D.; Krivec, M.; Kosmrlj, J.; Kosjek, T.; Heath, E., (2018). Seasonal and spatial variations in the occurrence, mass loadings and removal of compounds of emerging concern in the Slovene aqueous environment and environmental risk assessment. Environ. Pollut., 242: 143-154 (**12 pages**).

Chaves, M.J.S.; Barbosa, S.C.; Malinowski, M.M.; Volpato, D.; Castro, I.B.; Santos Franco, T. C.R.; Primel, E.G., (2020). Pharmaceuticals and personal care products in a Brazilian wetland of international importance: Occurrence and environmental risk assessment. Sci. Total Environ., 734(139374): 1-11 (**11 pages**).

Cui, B.; He, Q.; Gu, B.; Bai, J.; Liu, X., (2016). China's Coastal Wetlands: Understanding Environmental Changes and Human Impacts for Management and Conservation. Wetlands. 36(Suppl 1): 1-9 (**9 pages**).

Shifflett, S.D.; Schubauer-Berigan, J., (2019). Assessing the risk of utilizing tidal coastal wetlands for wastewater Management. J. Environ. Manage., 236: 269-279 (**11 pages**).

Eagles-Smith, C.A.; Wiener, J.G.; Eckley, C.S.; Willacker, J.J.; Evers, D.C.; Marvin-DiPasquale, M.; Obrist, D.; Fleck, J.A.; Aiken, G.R.; Lepak, J.M.; Jackson, A.K.; Webster, J.P.; Stewart, A.R.; Davis, J.A.; Alpers, C.N.; Ackerman,J.T., (2016). Mercury in western North America: A synthesis of environmental contamination, fluxes, bioaccumulation, and risk to fish and wildlife. Sci. Total Environ., 5(094): 1-14 (**14 pages**).

Endter-Wada, J.; Kettenring, K.M.; Sutton-Grier, A., (2020). Protecting wetlands for people: Strategic policy action can help wetlands mitigate risks and enhance resilience. Environ. Sci. Policy., 108: 37-44 (**8 pages**).

Esmaeili, H.R.; Coad, B.W.; Mehraban, H.R.; Masoudi, M.; Khaefi, R.; Abbasi, K.; Mostafavi, H.; Vatandoust, S., (2014). An updated checklist of fishes of the Caspian Sea basin of Iran with a note on their zoogeography. Iranian. J. Ichthyol., 1(3): 152-184 (**33 Pages**).

Grygoruk, M.; Rannow, S., (2017). Mind the gap! Lessons from science-based stakeholder dialogue in climate-adapted management of wetlands. J. Environ. Manage., 186: 108-119 (**12 pages**).

Gourabi, B.R.; Rad, T.G., (2013). The analysis of ecotourism potential in Boujagh wetland with AHP method. Life Sci. J., 10(2s): 251-258 (**8 pages**).

Haghani, S.; Leroy, S.A.G., (2020). Recent avulsion history of Sefidrud, south west of the Caspian Sea. Quaternary Int., 540: 97–110 (**14 pages**).

Hakimi Abed, M.; Monavari, M.; Karbasi, A.; Farshchi, P.; Abedi, Z., (2011). Site selection using analytical hierarchy process by Geographical Information System for sustainable coastal tourism. International conference on environmental and agriculture engineering IPCBEE, LACSIT press, Singapour, 15(): 120-124 (**5 pages**).

Isunju, J.B.; Kemp, J., (2016). Spatiotemporal analysis of encroachment on wetlands: a case of Nakivubo wetland in Kampala, Uganda. Environ. Monit. Assess. 188(203): 1-17 (**17 pages**).

Jafari, N., (2009). Ecological integrity of wetland, their functions and sustainable use. J. Ecol. Nat. Environ., 1(13): 045-054 (**10 pages**).

Jin, Y.; Yang, W.; Sun, T.; Yang, Z.; Li, M., (2016). Effects of seashore reclamation activities on the health of wetland ecosystems: A case study in the Yellow River Delta, China. Oce Coa Man., 123: 44-52 (**9 pages**).

Karimi, M.; Samani, J.M.V.; Mazaheri, M., (2021). Shoreline spatial and temporal response to natural and human effects in Boujagh National Park, Iran. Int. J. Sediment. Res., Available online.

Kapourchal, S.A.; Dargahi, M.D.; Karimzadegan, H., (2014). Zoning Coastal Marine Boujagh National Park and Sustainable Management by Geographic Information System. Indian. J. Sci. Tech., 7(12): 1933–1938 (**6 pages**).

Khara, H.; Nezami Balouchi, Sh.A. (2005). Studying fish biodiversity and abundance in Boujagh Wetland of Kiashahr, South western Caspian Sea. Iranian. Sci. Fish. J., 13(4): 41-54 (**14 pages**). (In Persian)

Khara, H.; Nezami Sh.A.; Sattari, M.; Mirhasheminasab, S.F.; Mousavi, S.A., (2007). An investigation on fish infection with Diplostumum spathaceum (Rudolphi, 1891) in Boojagh Wetland. Iranian. J. Biol., 20(4): 418-429 (**12 pages**). (In Persian).

Khoshraftar, R., (2015). Geomorphological Evolution Kiashahr lagoon using aearial photographs and satellite images and GPS, Proceeding of the 9th international Conference on Environmental science and Technology, Rhodes island, Greece. Srcosmos., 381-387 (**8 pages**).

Khoshravan, H.; Naqinezhad, A.; Alinejad-Tabrizi, T.; Yanina, T., (2020). Effects of the Caspian Sea water level change on

Boujagh National Park, southwest the Caspian Sea. Caspian J. Environ. Sci., 19(1): 127-138 (**12 pages**).

Kingsford, R.T.; Basset, A.; Jackson, L., (2016). Wetlands: conservation's poor cousins. Aquatic Conserv. Mar. Freshw. Ecosyst., 26: 892-916 (**25 pages**).

Land, M.; Granéli, W.; Grimvall, A.; Hoffmann, C.C.; Mitsch, W.J.; Tonderski, K.S.; Verhoeven, J.T.A., (2016). How effective are created or restored freshwater wetlands for nitrogen and phosphorus removal? A systematic review. Environ. Evid., 5(9): 1-26 (**26 pages**).

Liang, J.; Liu, J.; Yuan, X.; Zeng, G.; Yuan, Y.; Wu, H.; Li, F., (2016). A method for heavy metal exposure risk assessment to migratory herbivorous birds and identification of priority pollutants/ areas in wetlands. Environ. Sci. Pollut Res., Online published: 1-8 (**8 pages**).

Maghsoudi, M.; Mehrvarz, S.S; Naqinezhad, A.; Ravanbakhsh, M., (2015). The study of factors affecting the vegetation in aquatic and wet habitats of Boujagh National Park, Kiashahr, Guilan Province, Iran. Nova. Biologica. Reperta., 2: 176-185 (**10 pages**).

Mahdi, A.; Karimi, D.; Farshchi, P,; Panahi, M., (2021). Waste Water Pollution zoning of sensitive coastal-marine areas with an environmental protection approach (Study area: Boujagh International Park and International Wetland). Anthropogenic. Pollut. J., 5(1): 16-30 (**15 pages**).

Malekmohammadi, B.; Blouchi, L.R., (2014). Ecological risk assessment of wetland ecosystems using Multi Criteria Decision Making and Geographic Information System. Ecolo. Indicators. 41: 133-144 (**12 pages**).

Mammides, C.; Chen, J.; Goodale, U.M.; Kotagama, S.W.; Sidhu, S.; Goodale, E., (2015). Does mixed-species flocking influence how birds respond to a gradient of land-use intensity? Proc. R. Soc. B 282: 1-9 (**9 pages**).

Nasrolahi, A.; Smith B.D.; Ehsanpour M.; Afkhami M.; Rainbow P.S., (2017). Biomonitoring of trace metal bioavailability in the barnacle Amphibalanus improvisus along the Iranian coast of the Caspian Sea. Iranian J. Fish. Sci., 16(1): 1-25 (**25 pages**).

Noroozi, M.; Nequnezhad, A.; Mehrvarz, Sh.S., (2009). Algal fora in first Iranian land-marine the Boujagh National Park. Int. J. Alegae., 11(3): 276-288 (**13 pages**).

Ostrovskaya, E.; Douven, W.; Schwartz, K.; Pataki, B.; Mukuyu, P.; Kaggwa, R.C., (2013). Capacity for sustainable management of wetlands: Lessons from the WETwin project. Environ. Sci. Policy., 34: 128-137 (**10 pages**).

Pazouki, M.; Jozi, S.A.; Ziari, Y.A., (2017), Strategic management in urban environment using SWOT and QSPM model. Global J. Environ. Sci. Manage., 3(2): 207-216 (**11 pages**).

Reihanian, A.; Zalina Binti Mahmood, N.; Kahrom, E.; Wan Hin, T., (2012). Sustainable tourism development strategy by SWOT analysis: Boujagh National Park, Iran. Tourism Manage. Prespectives. 4: 223-228 (**6 pages**).

Riva, F.; Zuccato, E.; Davoli, E.; Fattore, E.; Castiglioni, S., (2019). Risk assessment of amixture of emerging contaminants in surface water in a highly urbanized area in Italy. J. Hazard. Mater., 361: 103-110 (**8 pages**).

Sadreazam Nouri, Z.; Nouri, J.; Habib, F.; Rafian, M., (2021). Environmental management for urban development around river valleys via a conceptual model. Int. J. Hum. Capital Urban Manage. 6(4): 351-364 **(14 pages).**

Saeidi Moshaver, Sh.; Naqinezhad, A.; Ravanbakhsh, M.; Maghsoudi, M., (2016). The survey of macrophytes diversity in wetlanl zone of Boujagh National Park, Guilan, Iran. Asian J. Conser. Biol., 5(2): 75-80 (**6 Pages**).

Sarkar, S.; Parihar, S.M.; Dutta, A., (2016). Fuzzy risk assessment modelling of East Kolkata Wetland Area: A remote sensing and GIS based approach. Environ. Model. Soft., 75: 105-118 (**14 pages**).

Sattari, M.; Namin, J.I.; Bibak, M.; Vajargah, M.F.; Bakhshalizadeh, S.; Faggio, C., (2019). Determination of Trace Element Accumulation in Gonads of Rutilus kutum (Kamensky, 1901) from the South Caspian Sea Trace Element Contaminations in Gonads. Proc. Natl. Acad. Sci., India, Sect. B Biol. Sci., Online publication: 1-8 (**8 pages**).

Sievers, M.; Hale, R.; Parris, K.M.; Swearer, S.E., (2017), Impacts of human-induced environmental change in wetlands on aquatic animals. Biol. Rev., 1-26 (**26 pages**).

Spearman, J.; Baugh, J; Feates, N.; Dearnaley, M.; Eccles, D., (2014). Small estuary, big port–progress in the management of the Stour-Orwell Estuary system. Estuarine Coastal Shelf Sci., 150: 299-311 (**13 pages**).

HOW TO CITE THIS ARTICLE

Mohebbi, N.; Nouri, J.; Khorasani, N.; Riazi, B., (2021). Environmental management for human communities around wetlands adjacent urban region by ecological risk approach. Int. J. Hum. Capital Urban Manage., 7(1): 1-16.

DOI: 10.22034/IJHCUM.2022.01.01

url: http://www.ijhcum.net/article_244572.html