

ARTICLE

CAUSES AND EFFECTS OF COASTAL WETLANDS DEGRADATION IN YEMEN

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ABSTRACT

Wetlands have considerable importance as biodiversity holders (habitats, animals and plants), while they provide several resources and benefits to local communities in different parts of the world. In addition, wetlands can buffer pollutions, absorb floods and recharge aquifers. Yemen has been identified as hosting globally important biodiversity, thanks to its situation at the crossroads between the Afrotropical, Oriental and Palearctic regions. This biodiversity is particularly rich in coastal wetlands, given that the coastline of Yemen is over 2500 km long and overlapping three different seas with different characteristics that is: The Red Sea, Gulf of Aden and Arabian Sea. Coastal wetlands are continuously lost under pressure of several problems such as human activities, lack of data and climate change. This means that urgent description of these causes is needed to conserve wetland biodiversity. The main objective of this research is to give to the Yemeni government and other stakeholders baseline information to initiate a process of protection coastal wetlands. The work started by reviewing recent literature on the wetland degradation and interviewing various Yemen's experts in water, environmental issues. Finally, recommendations to guide decision-makers for protection coastal wetlands are given. Further research could focus on investigating how achieve the sustainable management for different wetlands.

INTRODUCTION

Situation review

WETLANDS have considerable importance as biodiversity holders (habitats, animals and plants) and they provide several resources and benefits for local communities in different parts of the world such as cultivation, recreation, education, timber production, etc. [10]. [18] Clarified that wetlands are important natural, economic and aesthetic resources and should be conserved. In addition, wetlands can buffer pollutants, absorb floods and recharge aquifers [26]. [16] Mentioned that wetlands of all sizes are very important, for example small wetlands in East Africa are important because they absorb carbon and provide clean water and fuel wood to the communities who live around them [10]. However, since 1980, more than 80% of the wetlands have been lost. It is important to protect wetlands by identifying the different causes and their interrelationships before taking any restoration actions and understanding problems in order to find solutions [17]. [8] mentioned that coastal wetlands in Yemen are diverse and include saltwater wetlands that occur along the coastal shorelines have important role because they play in buffering coastlines against storm and wave damage and in stabilizing shorelines in the face of climate change impacts. on the other hand. [2] Indicated that there is wetlands degradation on the red sea coast. For example, in the northern part of The Red Sea, there has been extensive coral mortality in the past 10 years with major reductions in living coral cover. This article describes the main causes of Yemen's coastal wetlands degradation. It also provides a brief overview of the literature, background of current situation of coastal wetlands, and a discussion of some of the proposed solutions. Finally recommendations to guide decision-makers for protecting and improving wetlands are given.

Background of wetlands in Yemen

The Republic of Yemen is located in the South-west part of Asia (the Arabian Peninsula); the total surface area is about 527,970 sq. km²; has been identified as a hosting globally important biodiversity, because it is situated at crossroads between the Afrotropical, Oriental and Palearctic regions [12] ; has undergone a number of rapid social and economic issues since 1970s.; has the highest rates of population growth in the world, about 27,477,600 million in 2016; the population is equivalent to 0.37% of the total world population [22]. The largest part of the population lives in the Mountain area in the western part, near the coastal of the country, where rainfall is still significant. Thus, Yemen is the largest development challenge in the Middle East.

Yemen has a predominantly semi-arid to arid climate, with rainy seasons during spring and summer and with high temperatures prevailing throughout the year in low-altitude zones [14]. Rainfall varies from less than 50 mm in the coastal plains region and desert plateau region, to more than 1,200 mm in the western mountainous highland region. The highest and most consistent rainfall occurs in the southern highlands near Ibb/Taiz area. The spatial pattern of annual rainfall varies from year to year [12]. Yemen has over 2500 km of coastline long and includes three different coastal regions, namely the Red Sea, Gulf of Aden and Arabian Sea. These coastal areas represent a complex and unique tropical marine ecosystem with extraordinary biological diversity and a remarkably high degree of endemism [13]. Moreover, it is considered one of the richest countries in biological diversity. It hosts about 2,500 species of plants, about 85 species of mammals 370 species of birds and more than 115 species of amphibians and reptiles. More than 250 species of plants and 25 bird species are considered endemic to Yemen. In Socotra Island

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alone, more than 30% of the plants are endemic. Twenty percent of spidermite species and 10 % of insect species on the island bear the name of the island as a genus or species [23]. However, Yemen was faced with the big problem of biodiversity degradation and the environment continues to deteriorate. According to [3], there are 17 wetlands scattering inland and along the coastlines such as (Al Luhaya, Ras Isa/Kamaran Island, Groups of Hannish and Zugar Islands, Aden Coastal Wetlands and Socotra Archipelago). See the [Table 1] below.

Table 1: Location of current wetlands in Yemen [5] & [34]

No	Name of Wetland	Name of Gov.	Area/Ha	Latitude	longitude	Type
1	Midi to Al-Luhayyah	Al-Hudaidah	30,000	42.7833	16.35	Coast/ Marine
2	Islands off the Northwest Coast	Al-Hudaidah	5,000	42.2833	15.4667	Coast/ Marine
3	Bahr Ibn Abbas, Ra's Isa and Kamaran Island	Al-Hudaidah	35,000	42.5333	15.1833	Coast/ Mangrove
4	Wadi Surdud	Al-Hudaidah	Un known	43.3333	15.2157	Coast/ Vally
5	Red Sea Coast: Al-'Urj to Al-Hudaydah	Al-Hudaidah	Un known	42.9167	14.9167	Coast/ Marine
6	Al-Hudaidah Sewage Lagoons	Al-Hudaidah	50	42.95	14.8167	Sewage/ Lagoons
7	Nukhaylah to Wadi Nakhlah	Al-Hudaidah	12,500	42.9667	14.6333	Coast/ Vally
8	Al-Khawkhah to Al-Mukha	Al-Hudaidah	7,000	43.2333	13.8	Coast/ Marine
9	Dhubab Flats	Taizz	100-200	43.4167	12.9167	Coast/ Marine
10	Taizz Sewage Lagoons and Marsh	Taizz	250	44	13.65	Sewage/ Lagoons
11	Wadi Warazan	Taizz	90	44.25	13.4167	Vally / Marsh
12	Aden Mudflats and Marsh	Aden	10,000	45.0333	12.75	Coast/ Sewage
13	Wadi Jahr	Abyan	500	46.3833	13.9667	Vally/ Marsh
14	Wadi Hajar	Shabwa	50-100	48.7	14.1	Vally/ Marsh
15	Qishn Beach	Al-Ghayda	100	51.75	15.4333	Coast/ Marine
16	Abdullah Gharib Lagoons	Al-Ghayda	50	52.3333	16.35	Coast/ Lagoon
17	Qalansiya Lagoon	Socotra Island	100	53.5	12.7	Coast/ Lagoon

In brief, many researches and studies in the world have investigated the causes of wetlands degradation and loss, such as [24] reported that the degradation and loss of coastal wetlands is more rapid than other ecosystems due to major changes in land use and water diversions; wetlands are degraded because of absence of the reliable information [9]; increased urbanization and industrialization[25] noticed that the diverse uses like crop cultivation, grazing, and harvest are resulting in the loss of ecosystem functions and land degradation. The degradation of coastal wetlands is high because local people depend on them for their livelihood. Moreover, wetlands conservation should be considered for improving biodiversity; the good way is to protect wetlands is to describe the different problems for finding good solutions [10]. On the other hand, there is a few literature research mentioned on wetlands in Yemen which we describe them deeply;

The most comprehensive general information on wetlands has been provided by The Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA). PERSGA introduced the topic in many years such as 2005 by describing the use and development of natural resources and provide also detailed information on coastal areas in Yemen and discusses Yemen's environmental strategies, policies and legislations. They propose some solutions to the coastal areas, including good management and raise awareness.

Also, Al-Saghier, 2000 wrote information on wetlands in general and for Seabirds in specific. He provides detailed information on the background of currents wetlands and legislations. He gives a general overview of the situation on wetlands and particularly seventeen coastal wetlands (location, altitude, physical and ecological features, land use, etc.)

Few researchers studied specific areas of wadis and wetlands in long time ago, such as Barratt et al. in 1987, who have surveyed some wetlands in the coastal Red Sea and studies one of wadis in western Yemen.

Al-Najar (2008) provides in his Master research about Geological and Tourism Study for Coastal Areas in Taiz. He explains how could be achieved good management for coastal areas for tourism and raising the economic as a result of improved wetlands management.

The government agency, which is responsible on wetlands management, is The Environmental Protection Authority (EPA). EPA has many reports which indicated in general about wetlands situation especially in EPA' reports 2004b and 2009.

The National Biodiversity Strategy and Action Plan for Yemen (NBSAPP) in 2012 indicated about wetlands in Yemen in small part.

METHODS

Data collection

The Academic articles and books from Internet websites is the first source of the data collection such as Science Direct and Springer Link as well as from international documents which give an overview of wetlands in general and in different aspects which linked with wetlands management, classification, inventory, assessment,, etc. For example, "climate-vegetation: "Wetlands Market and Intervention Failures" [26], "The US fish and wildlife service's national wetlands inventory project" [29], "Geological and Tourism Study for Coastal Areas in Yemen" [2] , "Marine Biodiversity of Aden Wetlands Protected Areas" [7] , "Ecosystem Services and Human Well-being: Water and Wetlands Synthesis" [15] , "The Conservation and Management of Temperate Marshes, Bogs and Other Wetlands" [18], "Wetland Conservation: A Review of Current Issues and Required Action"[10], "Sedimentation Initiatives in Developing Countries" [19], "Tropical Freshwater Wetlands: A Guide to Current Knowledge and Sustainable Management" [25], "Stedman S. 2013. Status and trends of wetlands in the coastal watersheds of the Conterminous United States 2004 to 2009" [8] and "Sedimentation in magroves and coral reefs in a wet tropical islands"[27]. The second source of the data collection comes from the international reports of RAMSAR, FAO, GNF, WB and PERSGA and national reports from EPA. These reports will be used to provide insight into how wetlands degradation is taken into account by the international and national sectors. The third source of the data collection is the opinion of Yemeni's Water and Environmental management experts, in order to investigate their point of view as a specialized group. For more information about the different types of experts, see the interview part below.

Interviews

First, interviews were conducted with government officials from the water sector, donors, and academic people involved in environmental and water issues, in order to investigate their opinions on the reasons why the wetlands degradation. Furthermore, collect their opinion of the consequences and analysis their ideas to have recommendations.

Six interviewees will be selected from different agencies which include sample of the major responsibilities parties in government, donors, researches, academic, and university. Thus, four types of interviews were taken. The first type of interview is intended for the Environment Protection Authority (EPA) under the Ministry of Water and Environment and General Directorate of Irrigation and Dams (GDI) under the Ministry of Agricultural and Irrigation. These interviews were focus on the makers-decision from government agencies. The second type of interview is intended for head of the Environment and Water in SFD which is worked with donors. Many questions focus on the information of coastal wetlands management issues. The last two types of interviews are intended for Academic parties; Research Authority (AREA) under the government agencies and Water and Environmental Department in Faculty of Agriculture. These questions are related to the characteristics of wetlands management, reasons, affects and what kind of solutions they suggest. Finally, their opinions and suggestions will be analyzed and then the recommendations are written.

RESULTS AND DISCUSSION

Causes of wetlands degradation

As the analysis from literature and interviews, there are 5 main causes of Yemen's wetlands degradation:

Climate change

Climate change is a critical issue and the impact on wetlands and water. Climate change will decrease the frequency and amount of rainfall [28]. [19] Reported that the climate in the Middle East and North African region will become even hotter and drier. Thus, Yemen will face many challenges such as flooding especially in coastal regions. Furthermore, Yemen faced years of drought, even when it does rain, because of heavy flooding and the ground inability to absorb the mass quantity of water. Many of the coastal wetlands, mangroves are being destroyed. This is affecting the livelihood of the people in these areas.

Limited water resources

Availability of water is the most often mentioned constraint to the development of the coastal wetlands management. Highland basins that rely on groundwater are experiencing rapid declines in the water table and competition for this dwindling resource is fierce. Coastal wetlands are dependent on rainfall levels that can vary from year to year. A few years ago, many regions were green and lush. Now they are dry and

barren, because of droughts and the decline in rainfall. Many researchers reported that about 80 percent of all rural conflicts in Yemen because of water [13].

Unsustainable human activities (Population growth, industrial, agricultural, urbanization)

Yemen's annual population growth is amongst the highest in the world, for example, the population was 12.3 million in 1990 and became 27,477,600 million in 2016. In addition, the coast of the mainland is suffering from pollution and prone to oil spills from ships and oil terminals. Thus, marine critical habitats such as mangrove, sea grass, and important coastal sites for bird feeding and breeding, are increasingly threatened by coastal development. Moreover, the pollution from oil waste in the coastal and Islands destroyed many coastal wetlands [11]. The agricultural technology is developed rapidly and chemical inputs and tube well technology were introduced. This is steered Yemen away from traditional farming practices which these technologies are lead no balance with the natural resources [2].

Many experts in Yemen indicated that the most challenges which destroys wetlands in unsustainable human pressures. [25] reported that increased urbanization and industrialization is degraded the wetlands. The degradation and loss of wetlands is more rapid than other ecosystems due to major changes in land use and water diversions [24]. [11] mentioned that the rapid development of the Agriculture and using a lot of pesticide since ten years ago have been affecting the environment and lost different biodiversity especially in coastal areas. Many wetlands have been drained and converted into agricultural use in the past. Now, some wetlands are protected as conservation sites, and others still are not conserved, but both are often close to farmland. [3] and [20] indicated that most local people in Yemen think that wetland is a wasteland and need to fill for building houses or hotel or resort. Thus, the coastal wetlands areas are urgent need for management to conserve their biological and natural resources. In addition, industries' areas raise the soil erosion and transports of higher amounts of pollutants and sediments into wetlands. Urbanization increases the amount of impervious surfaces in the watershed and causing floods. Moreover, the development of tourism, such as building hotels in the coastal areas, has a strong influence in the degradation and loss of many wetlands [4] and [5].

Insufficient availability of data and researches for wetlands

Wetlands are degraded because of absence of the reliable information [9]. Many experts in water, environment and ecology indicated that although wetlands in Yemen have great potentials for a multitude of uses, a lot of them are not even documented. Also, lack of official recognition has done little in preventing their over utilization. Few large Yemen's wetlands are typically having protection but there are still a large number of smaller wetlands which are not recorded [3], [1], [21], [20], [4] and [5]. Therefore, it is important to raise the awareness and knowledge. Local people need to be informed of wetlands and how to protect [3]. The source of recent information on the marine environment is old, such as the IUCN report by [6] which is the major source for much of the information on the coastal zone. Additional information is from the FAO Fisheries Development Project 1972-1977.

Lack of Policy, law enforcement and conflict

There is a lack of wetlands conservation laws. Also, the current law enforcement to protect areas' protection, which some of them are coastal wetlands, is absent. The lack of law enforcement and flawed policies has contributed to the wetlands degradation [22]. There is currently no legislation to protect any species which are already on the international list of threatened species. Furthermore, The funding absent to properly identify causes of wetland degradation and their interrelationships, for which further research is often needed. Moreover, the lack of involvement of all parties (local communities and stakeholders) in wetland management is decreased the wetlands degradation [1]. The conflicts are made the cooperation among all parties and stakeholders even more difficult to achieve. In addition, warfare has occurred in the region for several years, but the conflict has recently intensified. This conflict is restraining the government from focusing on the wetlands degradation.

In summary, wetlands of Yemen's coastal regions are being degraded rapidly due to; rapid development and population pressure; withdrawal of water for irrigation; Large scale habitat conversion; unsustainable harvesting policies; lack of environmental consideration; recreation and tourism and awareness and natural causes.

Effects

A lot of consequences and effects due to the wetlands degradation which the major effects are:

Hunger, loss of livelihood options, water scarcity, loss of plant and animal species and degradation of soil [20], [21], [5], [3] and [24].

Conflicts between communities over the use of resources may escalate as well and cause insecurity in the region [20], [21], [5], [3] and [24].

Degradation and loss of wetlands make climate change worse and leave people more vulnerable to climate change impacts such as floods, droughts and famine [17] and [24].

Some issues such as, steep topography, intense precipitation, and extensive land-use changes in watersheds could be led to high sediment loads that appear to have exceeded the sediment retention capacity of the coastal wetlands. This sediment deposition within estuarine and reef zones may be killed the habitate like adult and juvenile corals [27]. For example of rich wetlands' habitats in Res Sea coastal areas, is Bab Al Mandab area which includes coral reefs; sea grass beds; intertidal mud; and mangrove. All these habitats are highly benefited for local people [13].

Solution

Good base of data

The part of the Millennium Ecosystem Assessment is the achievements of global wetland inventory. Therefore, the need to improve information base of wetlands is important [15]. There is a need for information to support wetlands management from global, regional and national assessment to guide policy-making. Making good base of data about causes of wetlands degradation could be used to manage and protect wetlands [25]. Moreover, the wetland inventory is important to understand the various types of wetlands [9].

Raising awareness among various parties

[3], [20] reported that most local people in Yemen think that wetland is a wasteland and need to fill for building houses or hotel or resort. Thus, raising awareness is the key to understand the current situation to protect them. The Coastal Wetlands Areas are urgently needed for management to conserve their biological and natural resources. The priorities of conservation in Yemen are needs to raise conservation awareness among different stakeholders; and need for reassessment of a development and environment policy [3].

CONCLUSION AND RECOMMENDATIONS

The wetlands' degradation had negative implications on biodiversity and Yemen's economy. Thus, the causes need to be managed and organized. Moreover, new research and studies are urgently needed. The coastal wetlands degradation in Yemen has the potential to cause the destruction of the variety of environment. Thus, to establish any human activities such as Industries near to the coastal region should be stopped because many coastal wetlands are being illegally used as dump sites. Furthermore, different tourism agencies should be considered to make good studies before established any activities. Also, approach "Sustainable Wetlands Management" should be taken in account in the future. Finally, this research is tried to make some changes and we hope these attempts will be sufficient to improve coastal wetlands situation. Further research could focus on investigating how achieve the "Sustainable Wetlands Management".

CONFLICT OF INTEREST

There is no conflict of interest.

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None

REFERENCES

- [1] Al-Mujahed, Abdulwahab. [2014] Social Fund and Development (SFD). Head of water and Environment Unit.
- [2] Al-Najar A, Aldeeb A, Ahmed A. [2008] Geological and Tourism Study for Coastal Areas in Yemen. Tai'z University, Yemen and Aswan University, Egypt
- [3] Al-Saghier O. [2014] National Coordinator in GEF Small Grant Program. United Nations Development Programme (UNDP). The Republic of Yemen.
- [4] Al-Wadaey A. [2014] Assistant Professor. Soil and Water Department. Faculty of Agriculture. Sana'a University, Yemen.
- [5] Bamatraf A. [2014] Ex-Chairman of Agricultural Research Authority (AREA) - Ministry of Agricultural and Irrigation (MAI).
- [6] Barratt L, Dawson-Shepherd A, Ormand R, McDowell R. [1987] Yemen Arab Republic Marine Conservation Survey, Volume 1, Distribution of habitats and species along the YAR coastline, IUCN, Red Sea and Gulf of Aden Environmental Programme/TMRU, UK.
- [7] Bawazir G. [2009] Marine Biodiversity of Aden Wetlands Protected Areas. Republic of Yemen. Yemen Society for the Protection of Wildlife. Environmental Protection Authority. Aden Wetlands Conservation Project.
- [8] Dahl T, Stedman S. [2013] Status and trends of wetlands in the coastal watersheds of the Conterminous United States 2004 to 2009. U.S. Department of the Interior, Fish and Wildlife Service and National Oceanic and Atmospheric Administration, National Marine Fisheries Service. 46.
- [9] Davidson NC, Finlayson CM. [2007] Earth Observation for wetland inventory, assessment and monitoring. Aquatic Conservation: Marine and Freshwater Ecosystems.

- [10] Dugan J. (Ed.). [1990] Wetland Conservation: A Review of Current Issues and Required Action. IUCN, Gland. 96.
- [11] EPA (Environmental Protection Authority). [2004] Wetlands Overview. Office of Water. Ministry of Water and Environment. Yemen. Available: <http://water.epa.gov/lawsregs/guidance/wetlands/definitions.cfm> at 11th February, 2013.
- [12] EPA (Environmental Protection Authority). [2004] First National Report to the Convention on Biological Diversity. Ministry of Water and Environment, Yemen. 33:13-15.
- [13] EPA (Environmental Protection Authority). [2009] 4th National Report. Ministry of Water and Environment. Yemen.
- [14] FAO (Food Agricultural Organization). [2008] Irrigation in the Near East Region in Figures, Rome, FAO, Available: <ftp://ftp.fao.org/docrep/fao/012/i0936e/i0936e00.pdf> at: 21st March, 2015.
- [15] Finlayson CM, D'Cruz R, Davidson NJ. [2005] Ecosystem Services and Human Well-being: Water and Wetlands Synthesis. World Resources Institute, Washington DC, USA.
- [16] Franke J, Becker M, Menz G, Misana S, Mwita E, Nienkemper P. [2009] Aerial imagery for monitoring land use in East African wetland ecosystems. In: Geoscience and Remote Sensing Symposium, 2009 IEEE International, IGARSS. 5:288-290.
- [17] GNF. [2002] Wetlands Restoration and Degradation. Global Nature Fund, International Stiftung für Umwelt und Natur, Fritz-Reichle-Ring 4, D-78315 Radolfzell. Available: http://www.globalnature.org/34235/Wetland-Restoration/Degradation/02_vorlage.asp at: 10th August, 2016.
- [18] Hoffmann L. [1964] Project MAR, Vol. 1. The Conservation and Management of Temperate Marshes, Bogs and Other Wetlands. Proc. MARS Conf., Les Saintes Maries de la Mer, 1962, IUCN Publ. No. N.S.
- [19] Julien P, Shah S. [2005] Sedimentation Initiatives in Developing Countries. UNESCO. Colorado State University.
- [20] Mukred, Abdul Wahed. [2014] Agricultural Research Authority (AREA) - Ministry of Agricultural and Irrigation (MAI). Vice Chairman AREA/ Expert on water sector in Yemen.
- [21] Mutahar. [2014] General Directorate of Irrigation (GDI) – Ministry of Agricultural and Irrigation (MAI). General Director of Irrigation (GDI) – Director of Dam's Structure Project (DDSP).
- [22] NBSAPP (National Biodiversity Strategy and Action Plan Project). [2012] Ministry of Agricultural and Irrigation. Yemen
- [23] PERSGA (The Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden). [2005] Protocol concerning the Protection of the Marine Environment from Land-Based Activities in the Red Sea and Gulf of Aden. PERSGA. Jeddah, Saudi Arabia
- [24] RAMSAR, Handbooks 4th edition. Handbook 1. [2010] Wise use of wetlands. Available: <http://www.ramsar.org/pdf/lib/hbk4-01.pdf> at: 2014.
- [25] Rebelo LM, Finlayson CM, Nagabhatla N. [2009] remote sensing and GIS for wetland inventory, mapping and change analysis. Journal of Environmental Management. 2144-2151.
- [26] Roggeri H. [1995] Tropical Freshwater Wetlands: A Guide to Current Knowledge and Sustainable Management. Kluwer Publishers, Dordrecht. 364.
- [27] [Victor S, Neth L, Golbuu Y, Wolanski E, Richmond RH. [2006] Sedimentation in mangroves and coral reefs in a wet tropical islands, Pohnpei, Micronesia. Estuarine, Coastal & Shelf Science. 409-416.
- [28] WB (World Bank). [2010] World Bank : Yemen Assessing the Impacts of Climate Change and Variability on the Water and Agricultural Sectors and the Policy Implications, Sustainable Development Sector Department Middle East and North Africa Region, Report No. 54196-YE, World Bank, Washington DC.
- [29] Wilen BO, Bates MK. [1995] The US fish and wildlife service's national wetlands inventory project. Vegetatio. 154-168.