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A Promising Vegetation Type to Sustain Development in Drylands

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Abstract: Due to the increasing harsh climate, only few species of halophytic plants were able to survive in such a harsh environment and high salinity of soil and water which all prevail in the study area of the research. The area is a warm costal desert where drylands and wetlands sit side by side. Mangrove (*Avicennia marina*), showed potential indicators for having useful functions for both costal and arid regions environment in parallel. Therefore, this paper addressed the potential impacts of the correlative functions of *A. marina* that contribute to the sustainability of drayland development compared to the other abundant plants species. The study implemented GIS analysis; field visits, literature, and group discussion with the local inhibitions of the region. The study demonstrated that the vegetation in the study area consisted of 3 main types; *A. marina* was mostly the most prevailing. In some sites, it has been adapted to becoming completely terrestrial, and an efficient instrument in biologic dune fixation against sand encroachment and wind erosion. It was also shown to be a valuable promoter to other associated economic activities like eco-truism and indigenous activities to emerge. In conclusion, *A. marina* might be an alternative and /or additional species of vegetation in coastal drylands where other species are difficult to grow, they can provide a number of environmental and economical benefits; of which, is to control sand encroachment and biodiversity depletion and to promote living standards of Bedouins. It is therefore, recommended to consider embracing *A. marina* vegetation in dryland management strategies where it is applicable.

Keywords: *Avicennia marina*, Biodiversity, Dryland development and economic values, Dune fixation

1. Introduction

There are 238 million ha of dryland forests in the world and Africa alone has 64% of these forests. These ecosystems provide shelter to nearly 1 billion people and half of the world's domestic livestock and a large variety of wildlife (FAO, 1999). A total of 124 countries and areas were identified as containing one or more true mangrove species. In Egypt, the most abundant species are *Avicennia marina* and *Rhizophora mucronata* (FAO, 2007; Saenger, 2002). Mangroves are intertidal plants that occur in the interface between land and sea. The depletion or destruction of mangrove is one of the important factors leading to land degradation and soil erosion. The mangrove forests consist of trees and bushes growing below the water level of spring tides, they are the most typical forest found on the coastlines in the tropics and subtropics (Singh and Odaki, 2004) and the areas where they exist are rich in biological diversity of flora and fauna (EEAA, 2005). It is a highly specialized habitat with many species that do not occur anywhere else; such as characteristic fauna and microbial species of the soil (Bennett and Reynolds, 1993; UNESCO, 2008).

The objective of this study was to characterize the land cover in this region to emphasis the role of mangroves ecosystem in controlling soil erosion and promoting vegetation cover, as a supporting tool to sustain development. Socioeconomic investigation was highlighted to show the potential impacts of mangroves management strategies on the direct and indirect benefits.

2. Materials and Methods

GIS mapping, filed visits, previous recorded data, group discussion and literature were all implemented GIS analysis was used to map mangrove vegetation distribution in Egypt and recent satellite images were processed by the ERDAS 9.1 and ARCGIS 9.2 programs for this reason. Frequent field

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visits to the study area were made precisely identify the vegetation type. Group discussion and individual conversation with the local inhabitants of the regions was used to show an overview of the socioeconomic condition. Previously reported data by the BioMAP and EEAA were also employed.

The work was carried out in 9 months in 2007-2008 and additional data previously reported on the same study area by EEAA and BioMAP was also used. However, the study area is an arid desert in East-South Sinai the Egyptian Red Sea coast where mangrove forests occur as a "warm coastal desert".

3. Results and Discussion

3.1. GIS scanning

Mangroves forests were detected in twelve regions along the costal desert of Egypt. The study area visually showed the highest density of vegetation cover by the mangrove habitats. Therefore the site was used as model to examine the study hypothesis. GIS calculations indicated that the study area was 183.782 km^2; total coast line is 26.8697 km, and that the area was categorized as in **Figures 1** and **2**:

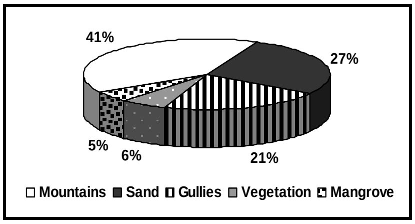

Fig. 1. the categories of the study area.

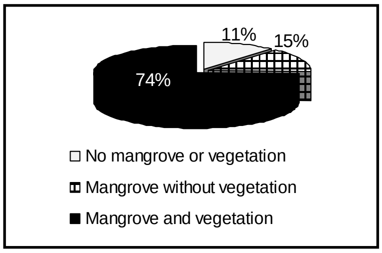

Fig. 2. Vegetations distribution in the area by GIS the study area categories.

3.2. The vegetation cover

Site visits showed that the vegetation cover of the area consisted of three types; (1) hyper saline tolerant plants represented in mangroves (*Avicennia marina*) which extended along the intertidal zone of the study area (2) saltwater-tolerant plants (halophytes plants) in low lying areas, three species were identified; *Zygophylhum album*, *Limonium axilare*, *Nitraria retusa* and (3) freshwater-dependent plants, *Salvadora persica*, *Acasia raddiana* and *Phoenix dactylifera*. Mangrove habitats were identified in 4 sites in the study area region, (N: 27.72913˚ and E: 38.24699˚), (N: 28.13156˚ and E: 34.44109˚), (N: 28.14770˚ and E: 34.44374˚), and (N: 28.18218˚ and E: 34.43951˚). Variation in mangrove trees height between sites was recorded. These mangroves grow under extreme conditions of high salinity that reaches 50.000 ppm and low winter temperatures that reaches 4 ˚C (Zahran, 1993). They are marine trees are normally living in lagoons, and they normally have aerial dark brown roots which grow apparently on the land level (**Fig. 3**), forming an intrinsic network which work as desalinator of the sea water so that enough moisture is available for growth (EEAA, 2000). However, in the study area, mangroves were found at location (N: 28.14770˚ E: 34.44374˚) forming part of the coastal marsh and high terrestrial dune vegetation (Sabkha), and totally lost their aerial roots (**Fig. 4**). Mostly, they have adapted to this harsh environment by becoming completely terrestrial by a natural alteration. This clarified the high density of terrestrial vegetation identified by GIS, as it is actually consisted of terrestrial mangroves. However, this natural alternation may bring up a new definition of mangroves varies from the common one.

Fig. 3. Aerial roots in *A. Marina.*

Fig. 4. Vanished aerial roots in *A. Marina*.

3.3. Soil and landscape

Sand dunes accumulation was formed around mangroves 1- 1.5 m high. apparently, these dunes were mostly caused by the deep roots (pneumatophores) of mangroves which trap terrestrial sand blown by wind as the direction of the dunes parallels the direction of the north-west winds, and/or caused by seasonal rain floods waters, as wadis bring down sediments to lowland and coastal areas, causing much of the sediment to run-off into the sea. In either cases, the two functions may have resulted in accumulation of land in the coastal plain, leading to extending the land slowly out to sea, and reduces the risk of losing the surface nutrients sediment of the soil by water erosion into the sea, the loss can reach up to $>100 \times 10^3$ m^3 of sediments into the sea at a high risk level, and 50×10^3 in a low risk level (Hefny, 1997).

3.4. Water resources

The prevailing ground water salinity is influenced by the high salinity of sea water (41.8 ± 0.2 ppt) due to the high rate of evaporation and the slow rate of water exchange between the Gulf and the main body of the Red Sea (Al-Mufti, 2000). In the study area, salinity at 2 m deep ranged between 15-38 ppt which reflects the leaching of fresh ground water into the coastal zone, and /or might be rated to the mountain catchments area behind the two sites where rain and flooding occur in the inland wadi. In addition, mangroves are believed to supply aquifers via releasing water from aquifers as well.

3.5. The socioeconomic impact of mangroves

Mangroves have direct and indirect values as follow; (1) the direct use pattern value is derived from the direct and traditional use or interaction with a mangrove's resources and services by local communities in the area as shown in **Figure 5**; the main traditional activities undertaken by Bedouin are livestock raising and minor seasonal agriculture. Bedouin men look after camels whilst women herd goats. Fishing is an additional activity raised in drylands near shorelines (El Bastawisi, 1995). Bedouin men undertake fishing activities, whilst women collect shellfish along reef flats. In many countries, introducing bees to mangrove areas for apiculture was possible using *Apis mellifera* which is a common species in Africa and the Middle East (FAO, 1994). Introducing a native bee species in the mangrove areas in Egypt might be valuable. (2) the indirect value of mangrove are the benefits derived from its functional services to support current production and consumption, and protection provided to economic activity and property by the mangrove's regulatory environmental services are considerable (EEAA, 2005). The damage mangroves are exposed to by strong wind is significantly limited (Galal 1999) therefore it functions as a strong and effectively tolerant wind breaker. The total of avoided damaged area and damaged economic activities, caused by storms, provided by mangroves are also a valuable cost. In addition, the avoided costs of building alternative wind breaks or sea walls other than mangroves are also high. For instance, as reported by WRM (2005), studies of the 2004 Asian tsunami showed that areas near healthy mangroves suffered less damage and fewer loss of life. In Myanmar, mangrove forests could have reduced damages resulting from the waves caused by cyclone Nargis[redacted].

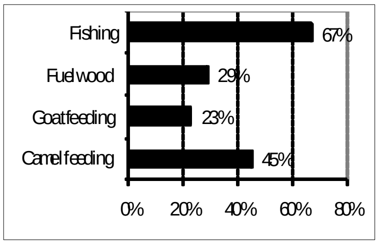

Fig. 5. Common mangrove based activities carried out by Bedouins

In the same time, frequent flash floods were reported to cause significant damage in the study area (Hefney, 1997). The avoided damage costs, or the flood prevention expenditures or the replacement cost technique were reported as significant (EEAA, 2005). These sediments in most cases contain high contents of organic nutrients, including those from animal waste which add the value of nutrient retention to mangrove.

Groundwater recharge made by mangroves was reported to be a possible aquifer refill supplier which for domestic agricultural and industrial purposes in other regions (EEAA, 2005) which is an additional value of mangrove. Moreover, The nutrient and energy flows of mangroves is believed to be able to stabilize local climatic conditions, particularly humidity and temperatures which has a valuable influence on any agricultural or resource-based, besides its ability to maintain water quality and retaining water toxins (EEAA, 2005).

Furthermore, mangroves act as nursery area for juvenile stages and as feeding areas for adults, and for reptiles and birds might be a strong support to biodiversity since over 470 wild birds species live in Egypt, over two thirds of which are migrant (Baha El Din, 1999) and many of them were recorded in mangrove areas (GEF, 1997). Also the landscape afforded by mangroves to tourists in national parks and reserves is valuable to Bedouins who are increasingly getting involved in tourism (EEAA, 2005).

4. Conclusions

Mangrove forests may be a vital tool to sustain the development process in drylands, as it provides highly economic direct and indirect use pattern values, and a number of environmental services to the ecosystem of the region. Mangroves can be a potential alternative and/or additional type of vegetation in costal drylands.

Genetic investigations are recommended to recognize if any genetic mutation in the aerial roots of mangroves has occurred, in order to explore genetic engineering possibilities to develop terrestrial mangroves vegetation applicable in appropriate saline soils.

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Annotation

A) FAO (2008b): Intact Mangroves Could Have Reduced Nargis Damage. http://www.fao.org/newsroom/en/news/2008/1000839/index.html

References

Al-Mufti M. (2000): *Flora of Nabq protected area*. EEAA Egyptian Environmental Affairs Agency (EEAA), Cairo, Egypt, 3-4**.**

Baha El Din S. (1999): Directory of important bird areas in Egypt, Birdlife International. cited in Socio-economic assessment and economic valuation of Egypt's mangroves, *FAO Final Report Consultancy Report*, TCP/EGY/0168 (A) 2002

Bennett E.L ., Reynolds C.J. (1993): The value of a mangrove area in Sarawak. *Biodiversity Conservatio*n, **2**: 359-375

EEAA (2000): *Flora of Nabq Protected Area*. Egyptian Environmental Affairs Agency,

EEAA (2005): *EEAA/ ITTO / MALR / MSEA Project's Progress Report Number 4,* (March 2005 – August 2005)

EEAA/ ITTO/MALR/MSEA (2006) *Project's Report No. 6. Assessment and Management of Mangrove Forest in Egypt for Sustainable Utilization and Development*. Ministry states of Environment affairs

El Bastawisi I.Y. (1995): *Anthropological survey of Ras Mohammed National Park Sector (South Sinai),* Development Project (5EM/03/220//025/A) for the National Parks of Egypt

FAO (1994): *Tree and Land Tenure Rapid Appraisal Tools*. Forests, Trees and People Programme Manual 4. FAO, Rome.

FAO (1999): *Tropical forest management techniques: a review of the sustainability of forest management practices in tropical countries.* Working Paper: FAO/FPIRS/04 prepared for the World Bank Forest Policy Implementation Review and Strategy

FAO (2007): *The World's Mangroves Forestry paper 153*. 1980–2005. ISSN: 0258-6150

Galal N. (1999): *Studies on the coastal ecology and management of the Nabq protected area, South Sinai, Egypt*. Ph.D. Thesis, York University.

GEF/CMPA (1997): *Red Sea coastal and Marine Protected area Strategy. Report 5, Part 2, Ecosystem Guidance and CMPA action plans*. TDA/Red Sea Governorate/EEAA.

Hefny K. (1997): *Study of Wadi Hydrology and Flash Flood Hazards*. GEF Egyptian Red Sea Coastal & Marine Resource Management Project.

Saenger P. (2002): *Rehabilitation, Conservation and Sustainable Utilization of Mangroves In Egypt: Ecological Assessment of Mangrove in Egypt*. Ministry of Agriculture & Land Reclamation, Ministry of State for Environmental Affairs, FAO, Cairo.

Singh V., Odaki P. (2004): *Mangrove Ecosystem: Structure and Function*. Scientific Publishers (India), Jodhpur, pp. 297.

UNESCO (2008): *Island and Coastal Areas, Targeting Sustainable Use of Environmental Resources and Human Development. Natural Sciences, People, Biodiversity and Ecology*.

WRM (2005): *Asia: The Ecological, Social and Political Dimension of December 26th Tsunamis*. World Rainforest Movement WRM's Bulletin Nº 90, January.

Zahran M.A. (1993): Mangroves and Shoreline Development in Egypt. *Journal of Environmental Sciences*, **5**: 119-140.