

## **Reduction of Wind Erosion Impairments in Dried Lakes During Drought Periods: A Case Study in Hamun Lake, Iran.**

**Ajorlo Majid, Nohtani Mohammad, Ebrahimian Mahboubbeh**

*Natural Resources College, Zabol University, P.O. Box 98615-538, Zabol, Iran.*

*Email: [Ajorlo\\_m54@yahoo.com](mailto:Ajorlo_m54@yahoo.com)*

### **Abstract**

This study has been conducted in Sistan plain, eastern Iran. Sistan is very arid region with rainfall below 60 mm/year and potential evaporation rates over 4500 mm. Wind blowing for 120 days is another climatic factor of the regions. It consists of three freshwater, inland and permanent lakes. The last drought had been occurring in the region for seven years from 1998-2004. During the drought period, the water of Hirmand was stopped and the lakes were completely dried. Local and national authorities implemented different kind of operations. These operation, however, were not applicable and useful on the dried bed of Hamun because of vastness, lack of water, strong wind blowing, ecological and environmental problems. After doing exact and complete study on the local conditions by numerous researchers, inert wind break establishment on the Hamun bed was approved.

**Keyword:** Wind erosion, Drought, Hamun Lake, Sistan.

### **Resume**

Cette étude a été entreprise dans Sistan plat, Iran oriental. Sistan est région très aride avec des précipitations en-dessous de 60 mm/year et des taux potentiels d'évaporation plus de 4500 millimètres. Le vent soufflant pendant 120 jours est un autre facteur climatique des régions. Il se compose de trois d'eau douce, intérieurs et permanents lacs. La dernière sécheresse s'était produite dans la région pendant sept années de 1998-2004. Pendant la période de sécheresse, l'eau de Hirmand a été arrêtée et les lacs ont été complètement séchés. Les autorités locales et nationales ont mis en application le genre différent d'opération d'operations. These, cependant, n'étaient pas applicable et utile sur le lit sec de Hamun en raison de l'immensité, du manque de l'eau, des problèmes le soufflement, écologiques et écologiques de vent fort. Après avoir fait l'étude exacte et complète sur les conditions de gens du pays par de nombreux chercheurs, l'établissement inerte de coupure de vent sur le lit de Hamun était approuvé.

**Mot-clé :** Enroulez l'érosion, sécheresse, lac Hamun, Sistan

### **Introduction**

Sistan and Baluchestan province as one of the hyper-arid areas of Iran had been envisaged with very severe drought during last 7 years (1998-2004). The crisis was very deep and vast in northern part of province, Sistan, due to existence of Hamun Lake. It had very deep impacts on ecological, social and economic features in the region. A combination of drought, unmanaged water abstraction and political instability have caused the Hamun lake to go to dry. The precise extent of this desiccation is not fully known. But it is thought to possibly cover almost all of the

lake and to have lasted for over ten years. To this end, the Iranian authorities along with people's participation considered different kind of techniques to decline impairments of drought and wind erosion on the lake. This paper will discuss about implemented techniques for erosion control in Hamun and about their benefits and problem.

### **Area of study**

The Sistan plain stretches across the border of Iran and Afghanistan. The Sistan plain is located in the northern part of Sistan and Baluchestan province, eastern Iran. The plain is very arid with annual average rainfall below 60 mm and potential evapo-transpiration rates over 4500 mm. It consists of tree interconnected fresh water, inland and permanent lakes. The deltas of several major and permanent rivers feeding in to the lakes. Generally, the lakes are called Hamun Lake. Under normal circumstance, the tree lakes cover approximately 216000 hectares. The lakes are very shallow (on average 2-3 m deep) and, as the lie in a flat area, their surface area varies greatly as a function of the incoming water. The lakes are surrounded by permanent and seasonal wetlands, including vast and rich marshes, reed-beds and salt marshes. Hamun the only fresh water lake in Asia feeds mainly by Hirmand (Helmand) river. The Hirmand rises in the Hindu-Kush Mts., NE Afghanistan and flows generally to Sistan plain, where it forms the Hamun Lake. Therefore, Hirmand river and lake are vital water source for local people and a dynamic ecosystem. The dominant flora species in the lake are *Phragmites australis*, *Typha sp.*, *Carex sp.*, and *Tamarix sp.*.

### **Importance of Hamun lake**

The Sistan plain is a unique example of a complex wetland ecosystem within a desert area. The lake plays a substantial hydrological and ecological role in the natural functioning of a major river. The lake is also an extremely important staging and wintering area for migratory waterfowl, and is important breeding area for many water birds, and is home to a large diversity of mammals, aquatic species and flora. In terms of wintering birds, in 1976 over 500,000 wild fowl were counted on the lake, in what was considered to be a very poor year. Bird Life International (1994), list 20 wintering and breeding bird species for which over 1% of the global population has been recorded in Hamun. The lake is also considered very rich in aquatic species, with over 150 species of fish have been recorded. The vast *phragmites australis* reed-beds are considered particularly unique. The population dependent in the Sistan plain is estimated 350000. The vast majority of these people depend on the Hamun lake resources.

### **Problem statement**

Environmental degradation and desertification is underway across the Sistan plain. The intensity, scope and length of dry periods and drought have increased. The environmental degradation takes many forms including loss of biomass and vegetative cover, loss of biodiversity, declining soil productivity, and declining availability and quality of both surface and ground water. In general, the degradation is very severe at most sites and some environmental functions are in danger of being lost permanently. The status of tree lakes is of particular concern. Drought and climate variations have disastrous environmental consequence for the Hamun lake in the last decade. Due to low precipitation and recent drought, as the severest in current century, and more control of Afghanistan government on Hirmand flow; the lakes were completely drying during the period 1998-2004. The effects of recent drought have been more severe in Sistan plain than in the upper reach of the river. Due to the recent drought, there presently no fish and livestock

numbers have been decimated. Traditional practices have been abandoned and traditional skills are being lost. This could lead to a permanent damaging of the social and cultural fabric in the region. Likewise, all water dependent economic activities have stopped in the absence of water. As a result, the recent drought has caused an easily movement of fine-grained sand by a powerful local storm that is called "Sistan 120 Days Storm" (from 20<sup>th</sup> May to 20<sup>th</sup> September) and increased significantly airborne dust in the area. This sandy storm has damaged many villages, farmlands, and so on.

### **Implemented operations for wind erosion control**

After commencement of recent drought in 1998, about 650,000 ha sensitive lands (150,000 ha farmlands and 450,000 ha dried Hamun and river beds) have been added to the region. Actually, they are new critical foci for wind erosion. The most important operations which have been implemented during drought period to decline disastrous effects of wind erosion are as follows:

#### *1. Mulching*

This project has been done in area of 2216 ha by using of chemical mulches in order to stabilize moving sands and provide proper conditions for plant establishment. Because of harmful effects of chemical materials on the environment, this project has been implemented only on moving sands out of lake.

#### *2. plant sowing*

The aims of this project were establishment of wind break in order to reduce wind velocity and impairments. This project has been conducted in area of 1103 hectares. Species, such as *Tamarix Sp* and *Haloxylon Sp* which are drought resistance have been used.

#### *3. shelterbelts*

During drought period fallow lands and abandoned farmlands are suitable areas for soil particles detachment and sand dunes formation by wind. Shelterbelts by using of *Tamarix Sp*. have been established around farmlands by governmental authorities and people's participation. The shelterbelts are 1200 KM long.

#### *4. Inert wind break ( sand trap)*

The most important and huge project that has been implemented for control of drought damages and moving sand stabilization is establishment of inert wind break on Hamun dried bed. This project has been done in 40,000 ha areas. Total length of inert wind break is 250 KM long. About 90 KM of them have been established round of rural villages which are located in Hamun suburb. Dry twigs of *Tamarix sp* have been used in establishment of inert wind break. Actually, the supply source of them is on Hamun bed. Because of drying of Hamun, large numbers of *Tamarix sp* stems have been dried. Therefore, they could be very useful source to providing material for establishment of wind break. The wind breaks have established in six strips with three rows in each strip. The distances of rows in strip are 3 meters and distance of strips from each others is 250 meters. The lengths of strips are 7-30 KM that all of them are established perpendicular to prevailing wind. This project has been done in six months.

### **Results and outcomes of project**

Interim employment opportunity for 130,000 person/day local inhabitants.

Increasing of life expectancy and confidence to local authorities.

Declining of poverty by means of people's participation in project implementation.

Sequestration huge amount of moving sand on Hamun bed and suburb; total volume of stabilized sand by implemented projects are 5 million cubic meters in 300

hectares. Likewise, established sand traps are able to sequester about 6.5 million cubic meters moving sand in themselves.

Prevention of burring villages by moving sands and rural inhabitant's movement to the cities.

Increasing green space area in the region.

### **Conclusion and discussion**

As discussed in previous sections, most of the problems and impairments on Sistan arise from natural harsh conditions and soil & water limitations. They along with anthropogenic factors increase impairments of crisis in Sistan. Apart from above factors, there are other problems in Sistan which limit management strategies and planning. Some of these problems are as follows:

- Underdevelopment and high poverty in the region comparing with national indices.
- Neighborhood with underdeveloped country, Afghanistan, and existence of special social problems as smuggling and insecurity.
- Lack of crisis management strategies during normal years and forgetting drought during these years.
- Overshadowed of water erosion by wind erosion. As, large amount of alluvial deposition carry to Sistan by Hirmand water.
- Most of the detachment areas (critical foci) are located in Afghanistan and there is no information about them.
- Non-execution of Iran-Afghanistan bilateral agreement in 1973 concerning Iran's water right (26 m<sup>3</sup>/ S) by Afghani government.
- There is no facilities and advanced equipments for wind erosion monitoring and lack of "drought early warning system" in the region.

By consideration to the above problems, there are some new opportunity and capacity in Sistan because of drought conditions:

- Special considerations and auspices of Iran's high level authorities as supreme leader and president to the crisis in Sistan.
- Existence of very rich indigenous knowledge, patriot people, and people's participation potential in Sistan.
- International importance of Hamun; as, it is sixteen international importance wetland in RAMSAR Convention.

Finally, it should be noted that solution of wind erosion and drought problems in Sistan are out of local and regional authorities' capabilities. They should be solved by cooperation of local, regional, national and international (Afghanistan and UN) authorities. Likewise, preparation sustainable and knowledge based plan is very necessary in order to control impairments of next coming droughts. The plan should be prepared in short-time, mid-time and long-time. All plans should be prepared in collaboration with Afghanistan government.

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