

The Egyptian Experience of Sand Dunes Stabilization

**Prof. Dr. Naim Moselhy
President of Desert Research Center
UNCCD Focal Point of Egypt**

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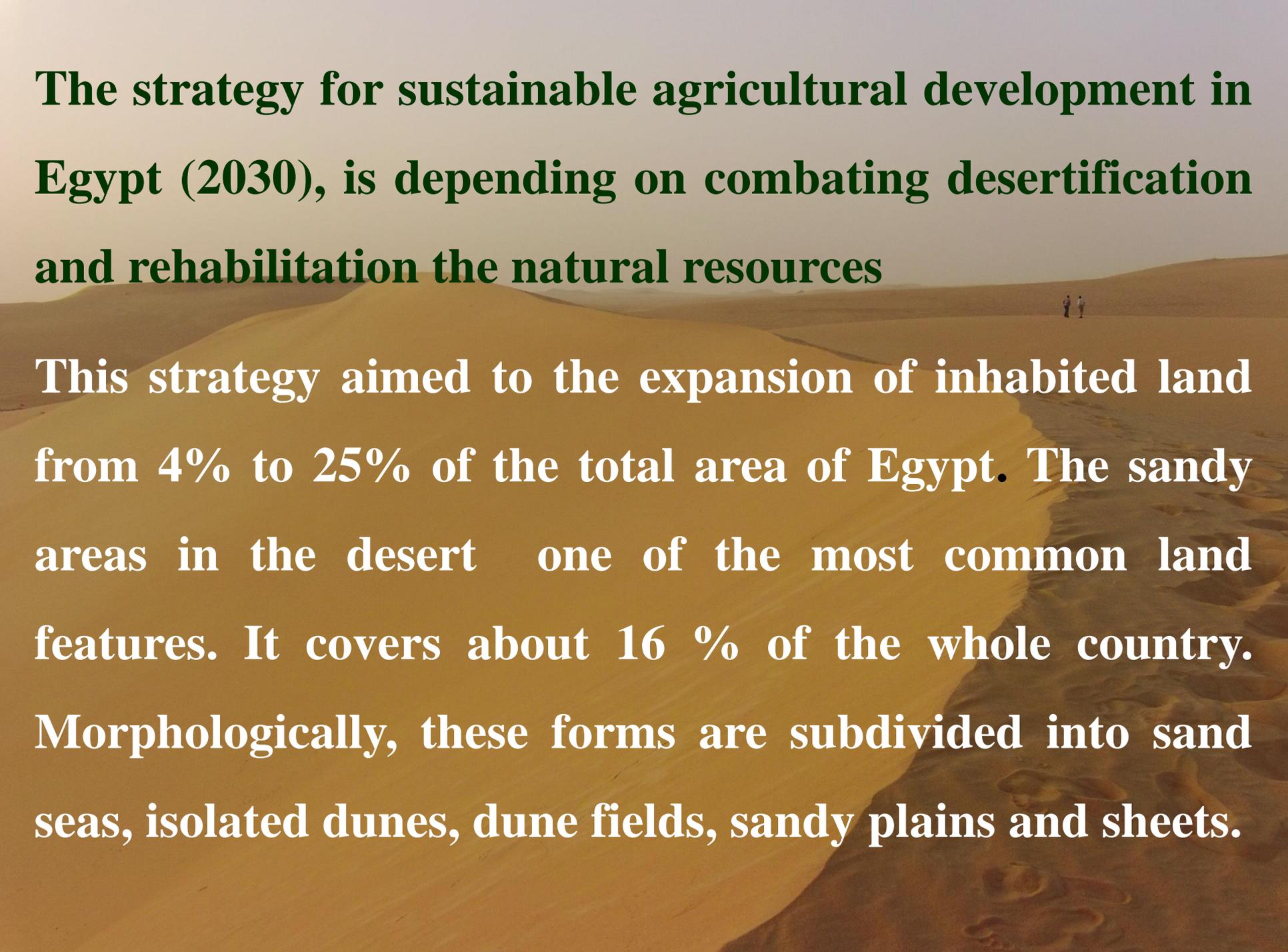
Introduction

Egypt considered a part of arid zones with area about One million Km², about 4% of the total area is arable land but, the rest 96 % is desert, the population is 90 million. The shortage of water and scanty rainfall magnifies the problem. The average of precipitation is 150 mm./year, along the northern costal Zone. This rate gradually decreases in the southward direction (30 mm/year) . Accordingly, Egypt facing more challenges to cover food gap and food security which considered as impacts of climate change, land degradation, drought, and sand and dust storms.

Major challenges facing Egypt

- ❖ Population, urban expansion, rural-urban migration
- ❖ Climate change
- ❖ Water shortages and limited water resources
- ❖ Wastewater hazards
- ❖ Land Degradation / Desertification
- ❖ Soil erosion by wind and flashflood water.
- ❖ Sand encroachments / sand and dust storms

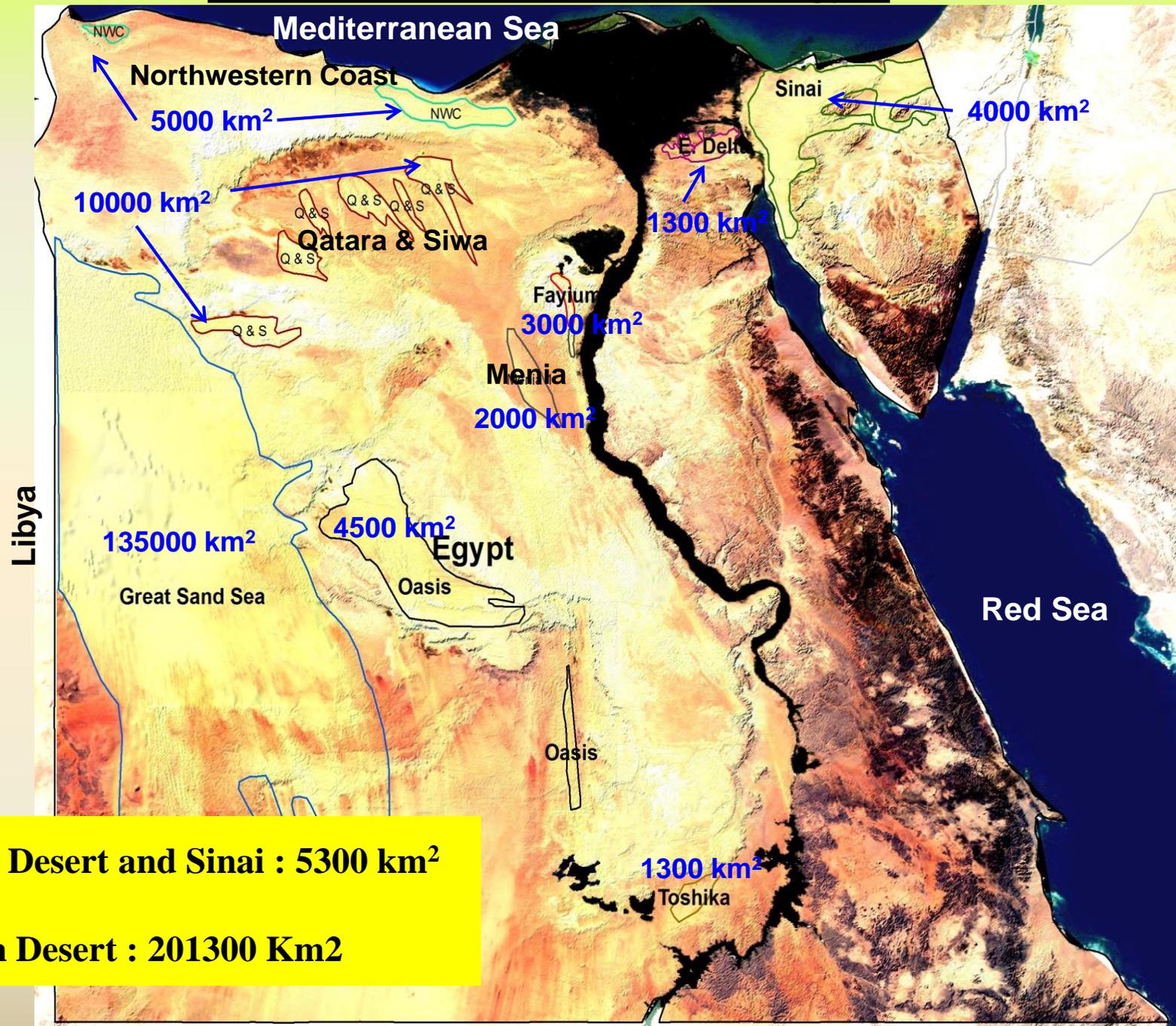




The strategy for sustainable agricultural development in Egypt (2030), is depending on combating desertification and rehabilitation the natural resources

This strategy aimed to the expansion of inhabited land from 4% to 25% of the total area of Egypt. The sandy areas in the desert one of the most common land features. It covers about 16 % of the whole country. Morphologically, these forms are subdivided into sand seas, isolated dunes, dune fields, sandy plains and sheets.

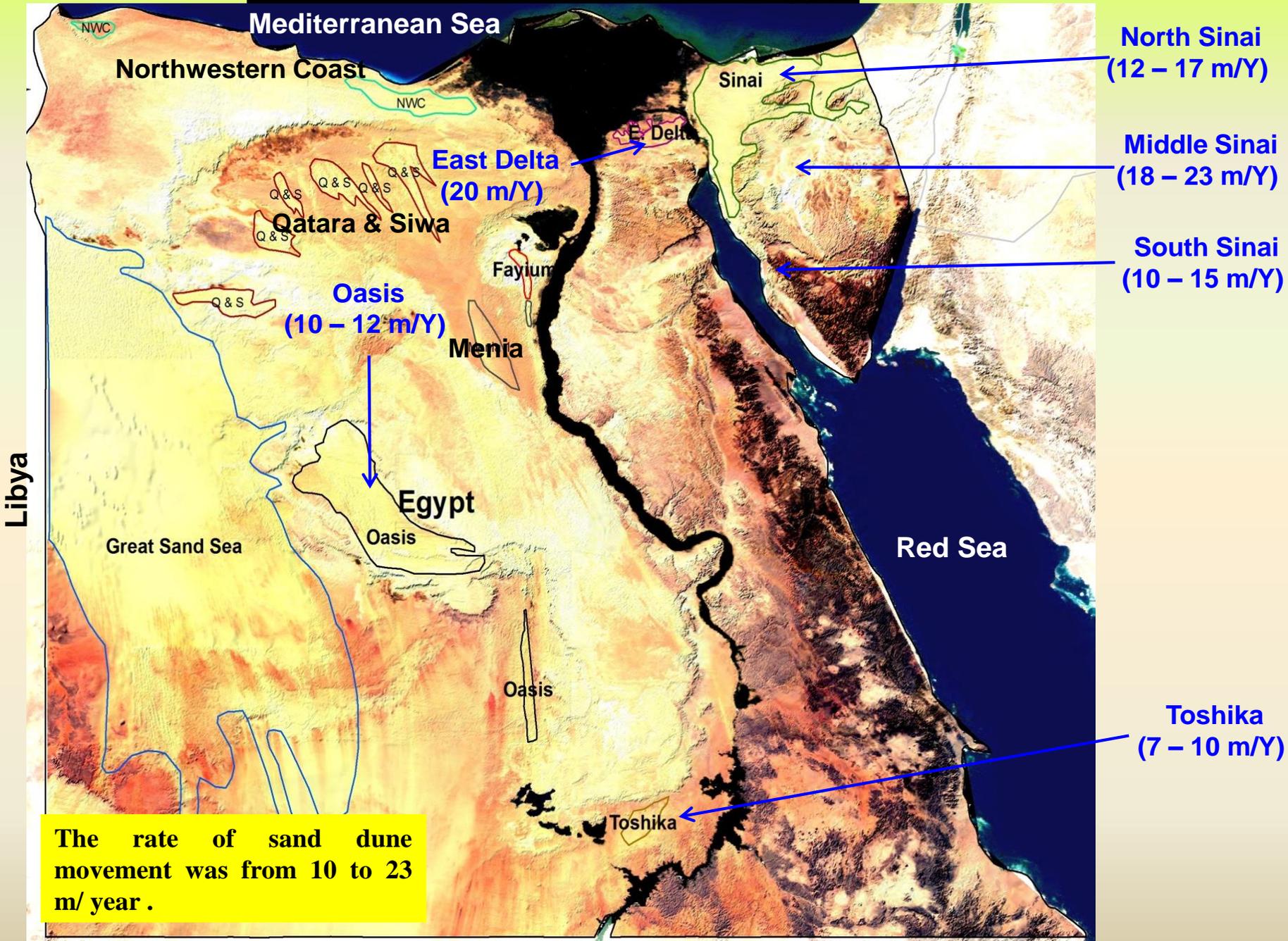
Distribution of sand dunes in Egypt



Eastern Desert and Sinai : 5300 km²

Western Desert : 201300 Km²

Movement of sand dunes in Egypt



The rate of sand dune movement was from 10 to 23 m/ year .

Sudan

Hazard effects of sand encroachment



Hazard effects of those at Egypt are shown from consequences of sand encroachment on infrastructures i.e. irrigation and drainage water canals, new reclaimed areas, agricultural lands, roads, buildings and other vital activities.

Canals

Railways

These hazards are considered to be one of the major challenges, currently facing the Egyptian Authorities, hence research and development programs are urgently needed to overcome this problem.



Buildings

Farms

Roads

History of Sand Dunes Stabilization in Egypt (1929- 2016)



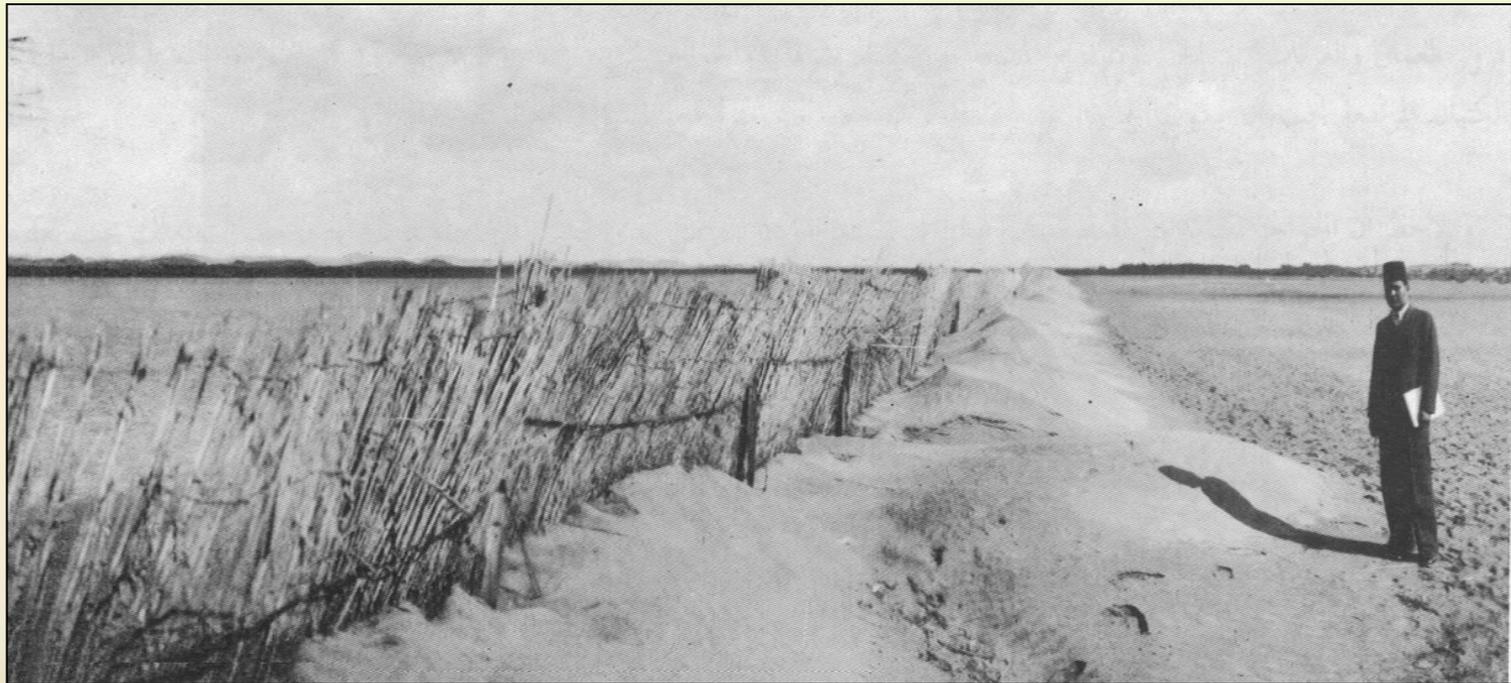
Many projects were achieved at various locations in Egypt during the period from 1929 to 2016, as shown on the map.

Since 1929, the fixation programs of sand dunes have been started by Ministry of Agriculture in south region through building of bricks and cemented walls which erected on the instance of Ganah village at EL Kharga Oasis. This method did not succeed and was buried by sands within few months.



Ganah village 1929

In 1939, the sand dunes fixation experimental station was established by DRC at El Busily area (east of Alexandria). Both temporary and permanent fixation were attempted. The temporary fixation was based on the construction of fences from local materials, whereas, the permanent one was focused on trees, shrubs and grasses which selected from indigenous species . The obtained results were significant and applied in other areas which characterized by similar conditions.



Elbosely Village 1939

During the period between 1954 and 1956, intensive efforts by DRC for sand fixation has taken place. Some plant species i.e. *Acacia saligna* and *Tamarix articulata* have been planted at the northern coast of Sinai and at Ras El Hekma along the Western Mediterranean Zone.



Ras Elhekma 1954 - 1956

North Sinai 1967

During the period of 1962-1967 at north Sinai , about 30000 feddans in north Sinai were cultivated by Caster plant (*Ricinus communis*), shrubs such as Acacia and Tamarix as applied example method of biological fixation. However, these plants were uprooted during 1967 war.



Biological dune fixation by use of Acacia, Tamarix and Caster plants

1978 - 1983: Sand Dunes Research

In 1978, scientific research and studies on sand dunes fixation and sand properties was established by Desert Research Institute.

In 1982, the first documents were published dealing sand distribution and techniques of sand dunes stabilization.(Mounier,1982) .

In 1990, the first PH.D Thesis was published .

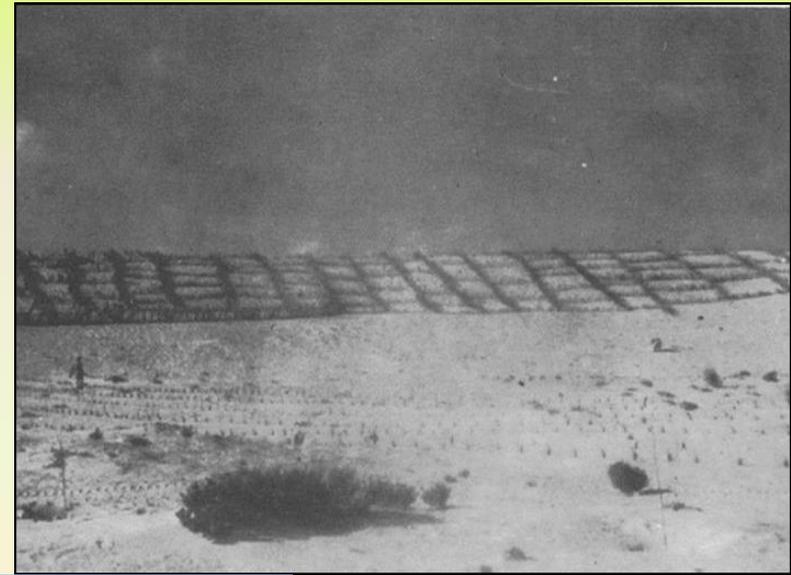
Studies and research plan focusing on :

1) Initiated data base and monitoring of the movements of different sand bodies both through field observation and using aerial photos and remote sensing techniques.

2) Evaluation of environmental conditions that affect the dynamic processes of sand dunes, such as climate, plant cover, soil moisture content, soil temperature, and physical and chemical properties of sand.

3) Evaluating the different mechanical, chemical, and biological methods for sand dune fixation and determining the resulting benefit/cost ratio if the technique is applied.

From 1984 to 1990, a project for sand dunes fixation at North Sinai was carried out. The aim of this project was to select the best methods for stabilizing sand dunes in this region. Both temporary and permanent fixation were used to know the role of soil conditioners in increasing of survival plants (*Acacia sp.* and *Tamarix sp.*) used in sand dunes fixation in this region.



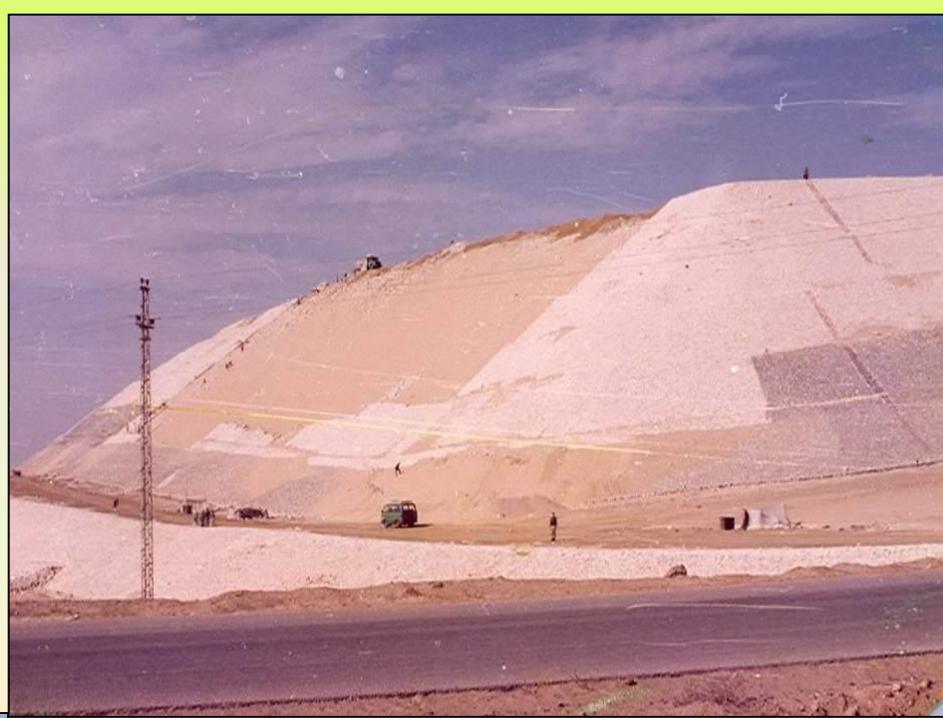
From 1988 to 1992, in Siwa Oasis, fixed thirteen feddans of sand dune at Khamisa by using drainage water (3000-7000 ppm). Many varieties of botanical plants namely, *Tamarix aphylla*, *Prosopis juliflora*, *Acacia saligna*, *Agava sisalana*, *Atriplex nummularia*, *Olea europaea* and *Punica granaatum*. Shelterbelt was efficient for the protection of drainage canal from sand encroachment.



Shelterbelt at Siwa Oasis 1990



1992 - 1995, DRC carried out sand dunes fixation project in the area of Ahmed Oraby (desert road Cairo-Ismailia).



Ahmed Oraby 1992

Stabilization of 1000 feddan at Siwa Oasis - 2001



In 2001, 1000 feddans were established by trees of different spp. in the inter-dunal areas at Siwa Oasis. Drainage water was used for irrigation.

Darb Elarbeen – Toshka depression road
2003



Trenches for protect the desert roads

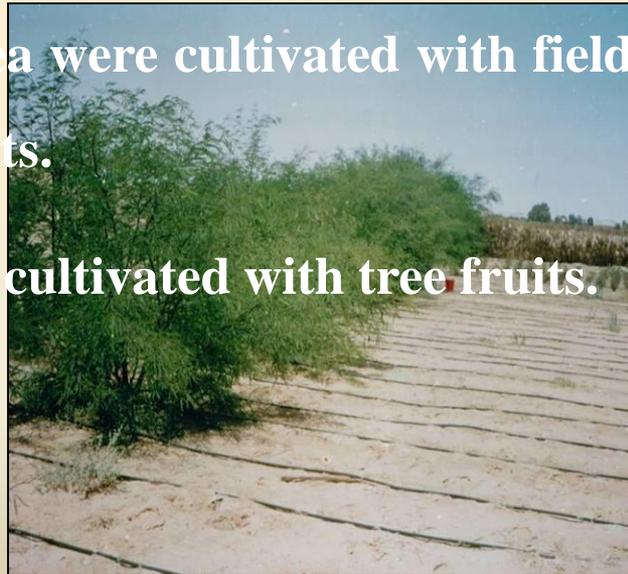
❖ Some trenches were used to trap the sand transportation and to avoid sand encroachment. This method was used to protect Darb-El-Arbeen / Toshka depression road from sand encroachment. The road efficiency increased from 40 % to 80% by using this method.

Stabilization of 30 feddan at Siwa 2001-2007

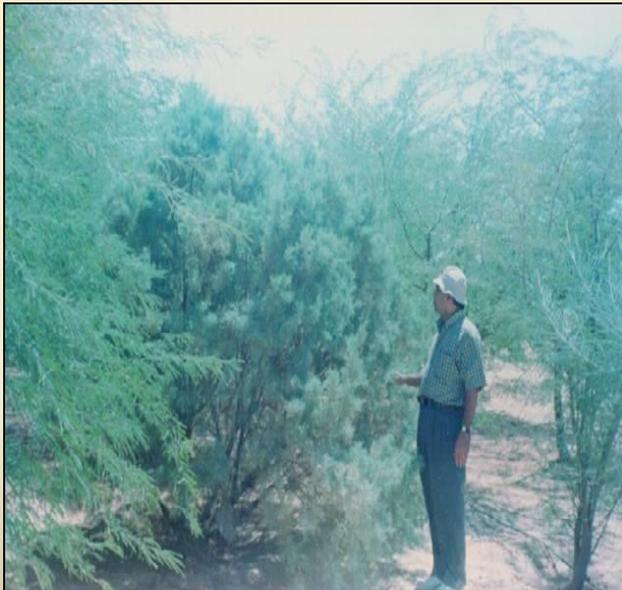


Fifteen feddan of this area were cultivated with field crops and medicinal plants.

Whereas the others were cultivated with tree fruits.

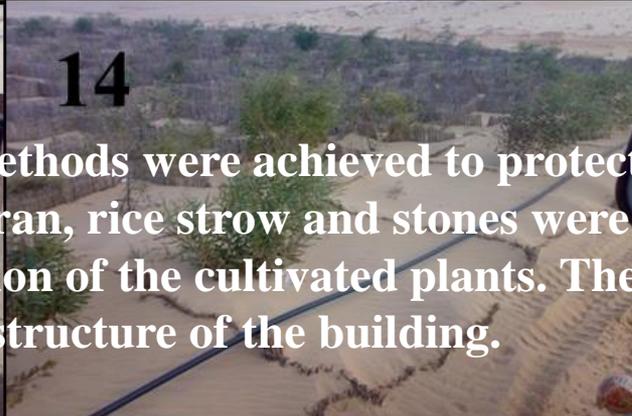
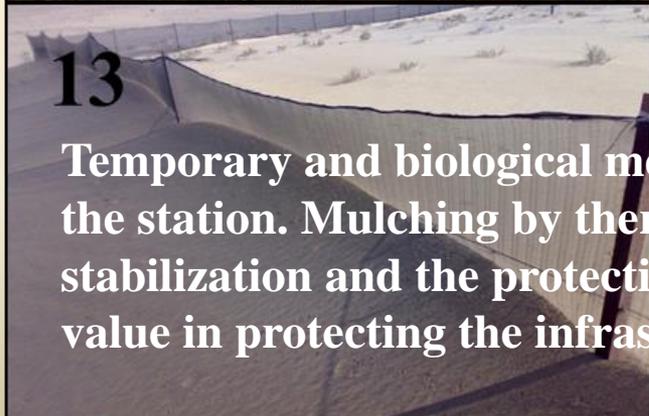
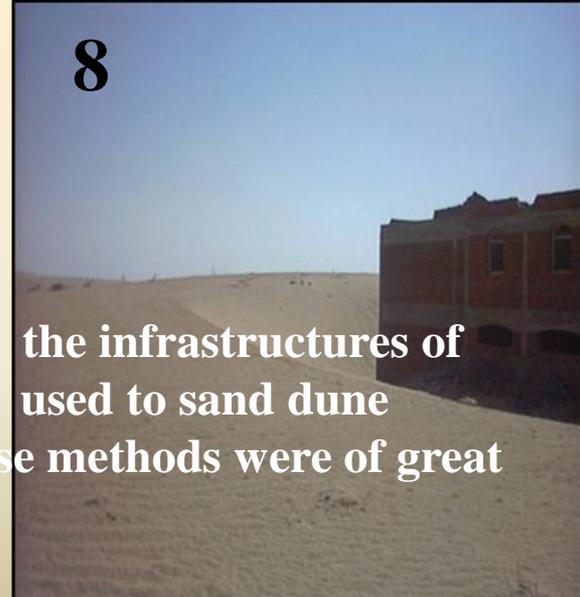


Protection the irrigation canal 2001-2013



From 2001 to 2013, cultivation of two green belts, on El Sheikh Zayed canal at Toshka. Ten combinations of botanical plants were used. These plants namely, *Tamarix articulata*, *Prosopis juliflora*, *Acacia saligna*, *Casuarina equisetifolia*, *Eucalyptus sp.* and some tree fruits. These shelterbelts were performed for the protection of El-Sheikh Zayed canal from sand encroachment. Shelterbelts efficiency for sand encroachment control varied from 70-90%

Sand Dunes Stabilization at Research and Demonstration Station, North Sinai 2008- 2012



Temporary and biological methods were achieved to protect the infrastructures of the station. Mulching by theran, rice straw and stones were used to sand dune stabilization and the protection of the cultivated plants. These methods were of great value in protecting the infrastructure of the building.



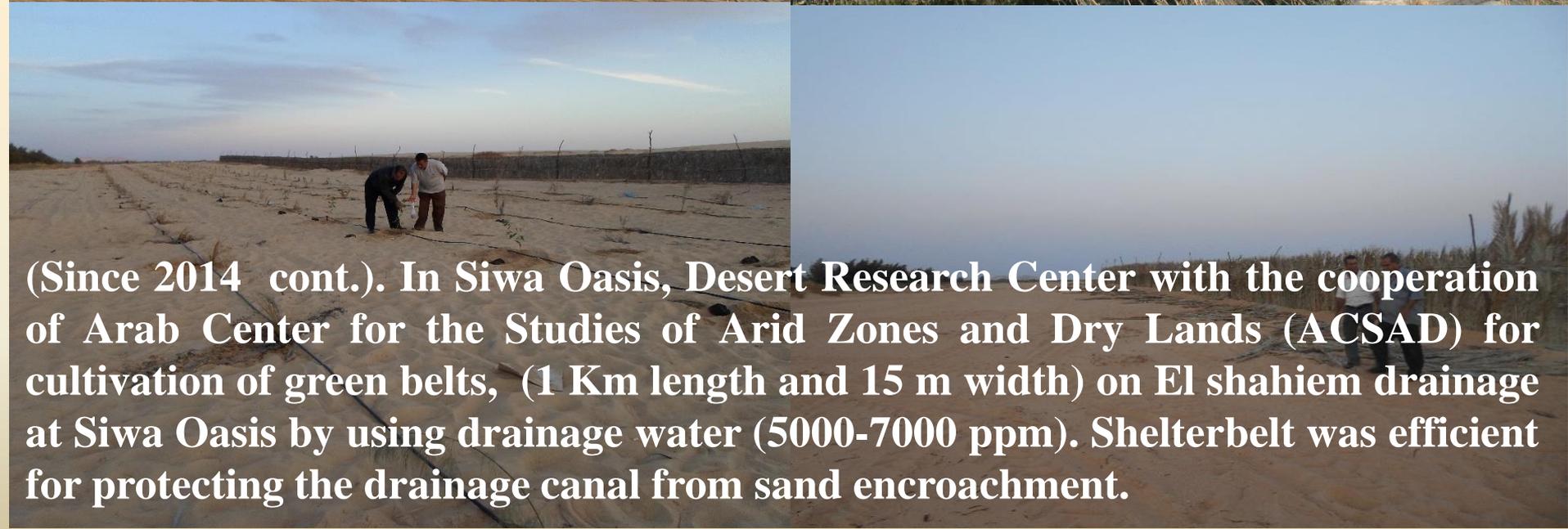
30 km shelterbelt was achieved with a right angle to the wind direction, to protect Elsalam Canal, north Sinai .

The efficiency of the shelterbelt is 60%.



**Shelterbelt at Elsalam Canal, North Sinai
2006- 2012**

Using drainage water in sand dunes stabilization at Siwa Oasis



(Since 2014 cont.). In Siwa Oasis, Desert Research Center with the cooperation of Arab Center for the Studies of Arid Zones and Dry Lands (ACSAD) for cultivation of green belts, (1 Km length and 15 m width) on El shahiem drainage at Siwa Oasis by using drainage water (5000-7000 ppm). Shelterbelt was efficient for protecting the drainage canal from sand encroachment.

Experiences gained

Methods of sand dunes stabilization

Temporary methods: Different methods are carried out to decrease the impact of wind erosion around the protected area. Also to protect plants in the first growth.

Mulching



- ❖ In this system, the top soil layer of the dunes is fixed by the use of a thin layer of any several materials, heavy soil, oil and chemical products.
- ❖ The effectiveness of chemical stabilizers could be descendingly arranged as follows: Bitumen emulsion > Latex emulsion > Holicole > Polyacrylimide + glyoxal [El Hadidy *et al* 1997].
- ❖ Stabilizing 30% of sand surface by Bitumen polymer reduced wind erosion by 80 to 90%. [El-Hady *et al* 2002].

Mechanical methods

- Many materials used i.e. (plant residues, empty containers, metallic and wood sheets, maize stalks, palm leaves and residues of palm date trees).

Checkerboards



(multi direction wind)

The results revealed that each square meter covered by the checkerboard trapped about 0.6 m³ of sand during one year, (Fac. of Agric., Alexandria University 1990). (Zaghloul, 2012). Indicated that each square meter covered by the checkerboard trapped about 0.95 m³ of sand during one year. Cost per m² (including the cost of labour and transportation) of checkerboard was three Egyptian Pounds (LE).

Fences



(one direction wind)

-The double rows fence of palm leaves gave superior growth characters and yield of alfalfa, (Zaghloul, 2006 b).

- porous fences play an important role in infrastructure protection. Theran net 27% and Palm leaves treatments gave the highest efficiency of sand deposits. (Zaghloul, 2012).

Engeneering methods



Trenches

This method is used when there is no any local materials



Thank You

