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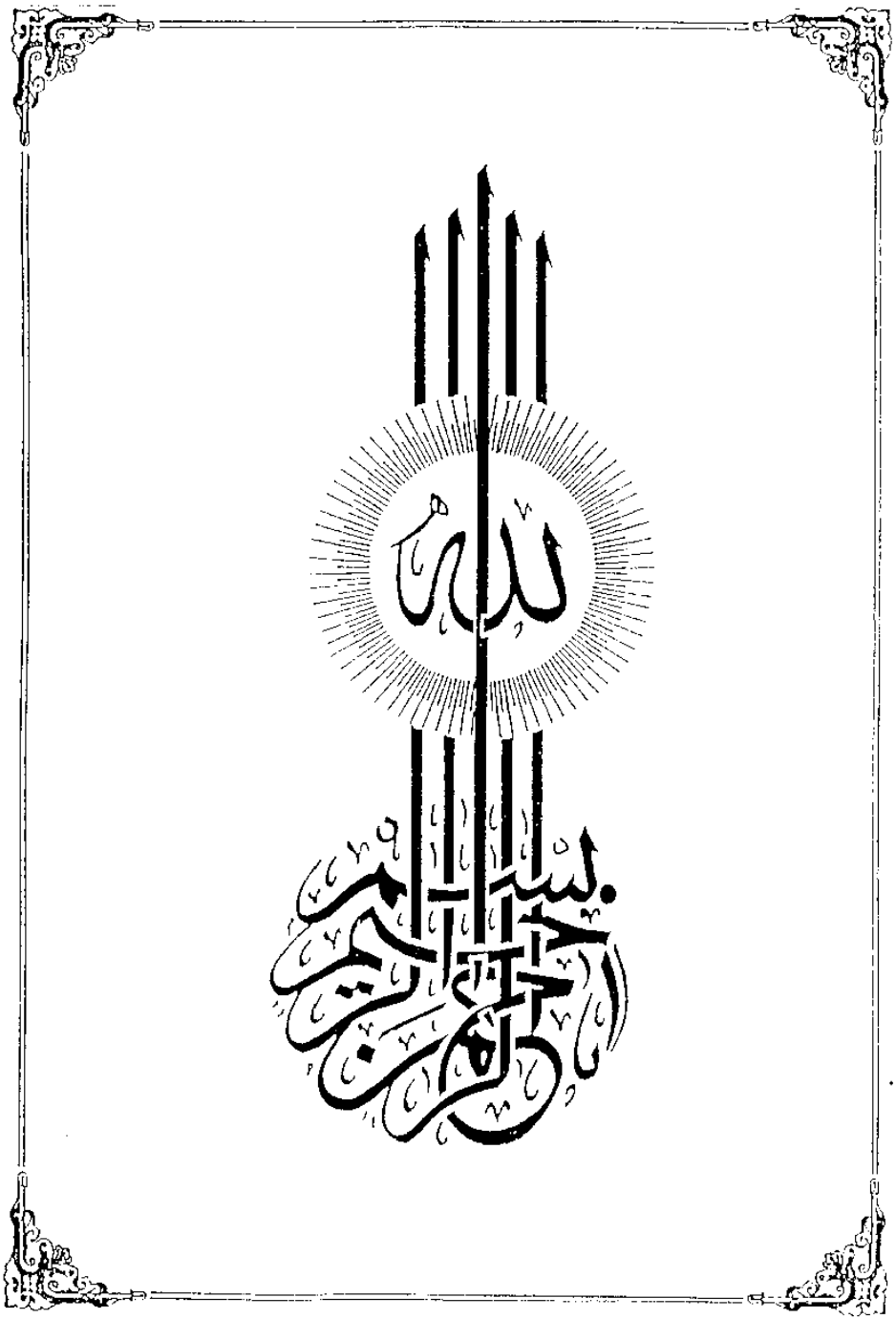

CONTENTS

1. INTRODUCTION

In Arab Republic of Egypt, horizontal agricultural expansion aims at reclaiming and cultivating more than two million feddan of barran lands. One of the areas which is now under investigation is Siwa Oasis.

The Depression of Siwa is about 980 square kilometers in area lies in far west of Egypt on the Libyan border, only $\frac{1}{6}$ of which is now under cultivation, while the rest of the area is virgin soil and mainly saline, rock, or occupied by salty lakes. Some historians believe that large areas of highly productivity were cultivated in Siwa for a long time. However, according to the recent studies no evidance is found indicating that these large areas were once extensively cultivated according to the different local problems (Parsons 1962). Through proper and suitable management a good area of this Oasis can be used.

There are about 200 naturally flowing springs in Siwa Oasis, their water is relatively of poor quality since it contains high amounts of soluble salts.

The present work was carried out to study the fertility status of cultivated and the virgin soils which could be put under cultivation.

Also the study has included the evaluation of water quality since it is considered one of the limiting factors for expansion with respect to salt concentration and boron content for most springs in this area.

1.1 Location of Siwa Oasis:

According to Parsons (1962) Siwa Depression is a closed inland basin situated in the Western Desert between longitude of 25°and 26 °E, and latitudes of 29° and 30 °N. It is located about 65 Kilometers East of the Libyan - Egyptian frontier and 300 Kilometers south of the Mediterranian sea.

Siwa Oasis is elongated, about 75 Kilometers in E-W direction and from 5 to 10 Kilometers in N-S direction. It is bounded in the north by escarpments rising about 100 meters above its floor and bounded in the south by belts of sand dunes trending in North East-South West direction.

1.2 Formation of the Oasis:

The geological nature of the Oasis was postulated by some investigators into three hypothesis :-

1) The first hypothesis was reported by Metwally (1953) and Said (1962), they stated that wind is the main

excavation agent which is responsible for the formation of all Oasis in the Western Desert of A.R.E. Siwa Depression, therefore, was formed in the extreme arid conditions that prevailing during the Holocene time.

ii) The second hypothesis is defined by El-Askary (1968) and Gindy et al (1969) as the structural hypothesis where folding and faulting in the early tertiary time resulted in an uplift movement of the area. The major excavation agent is streem erosion, from rainfall, which occurred during the plesitocene time and continued in the early Holocene time until the depression attained its slope. They stated that this is evidanced by the presence of dry drainage lines and playes.

iii) The third hypothesis reported by Zakaria (1972) is considered a modefied resultant of the previous two hypothesis. He stated that Siwa Depression resulted from the combined work of,

a) The action of tectonical movements (compressional forces),

b) The action of water erosion during the present arid conditions. According to the recent hypothesis, Siwa Oasis and its surroundings formed an

upward zone oriented in an E-W direction plunding to the eastern side during the Early Tertairy time.

Intensive erosional processes occured during the humid climatic conditions that prevalied in the pliocen - pleistocene time (late Tertiary). Therefore, excavations took place by means of water abrasion which led to the initiation of sub closed depression.

1.3 Land use and natural vegetation:

Siwa Oasis is about 980 square kilometers in area, and only about 1/6 of this area is under cultivation while the most of it contains saline patches, rocky formations and salt lakes as stated byZakaria (1972).

The cultivated soils of Siwa Oasis are considered man made due to the presence of the deep plough layer. The surface is occupied by a variety of younger unconsolidated deposits comprising eaolian sand and salts.

Five main land forms are easily distinguished in this area as stated by Haraga et al (1974).

i) Playas: They occupy wide tracts of the piedment plain and are characterized by the occurrance of scattered cultivated areas, portions of such areas are salinized

and the surface become occupied by rough slabs composed of mixed sand and salts locally known korsheif wich are not suitable for cultivation.

ii) **Buttes:** They present throughout the piedment plain, as mentioned by Zakaria (1972) and Haraga et al (1974). Their hights range from 30 to 100 meters above the floor of Depression such as Gabel Siwa and Gabel El-Mouta.

iii) **The Cultivated land:** The land used for permanent cropping (barly, alfalfa, etc.) are about 900 feddan restricted to vicinity of Siwa Town and Aghurmi. Other cultivated areas reach 2000 feddan near El-Zeitoun Maraqui and Khamissa are cultivated with data palms and olive trees. Besides other areas scattered are recently cultivated with palm, olive and citrus trees.

iv) **The sand dunes:** Sand dunes, reported by Zakaria (1972) and Haraga et al (1974) oriented in a NW - SE direction and rising more than 10 meters above the floor of the piedment plain. They occupy the Southern portion of the Depression.

v) Lakes and lacustrine deposits. They are mainly located at the shorlines of old lakes at elevations of 8 - 12 meter below sea level.

Haraga et al (1974), reported that the surface horizons are essentially composed of Nacl crystals and gypsum mixed with sand, these saline deposits are very hard and thick.

The principal agricultural production of Siwa Oasis are date palms and olive trees, while small areas of soils are suitable for citrus, barley and alfalfa. On the other hand some native forage such as common sadge, Marsh Sheargrass (Clodium Mariscus Cypera ceae). Camal throme (A. Mourorum lequminosea) and Matsedge (Juncus arabicus) are also grown in small areas having relatively high water table.

1,4 Climate:

The meteorological records of Siwa Oasis covering a period of about 30 years show that the prevailing climatological conditions are as follows :-

- The mean rainfull is 0.9 mms/annun.
- The mean relative humudity is 48 %.
- Evaporation ranges from 15.3 mm/day in Jully to 5.0 mm/day in December.
- Monthly maximum temperature range between 19.7°C in Januray to 38.7°C in Jully.
- The prevailing wind blows the north west, north and north east.

1.5 Previous Studies on Siwa Soils:

1.5.1 Texture:

Previous investigations indicated that Siwa Soils are generally light in texture. Zein El-Abdien (1952) reported that the textural classes of Siwa soils are sand, sand loam, and loam in few locations scattered in the Oasis. He added that this type of texture has been originated from wind born sand.

Similar results are found by Saleh (1970) who reported that the textural classes of fiwa Oasis are sand, sand loam, loamy sand and sand clay loam. On the other hand Gomha (1976) added that the texturel classes in Siwa Soils are sand, loamy sand, sandy loam and loam.

1.5.2 Calcium carbonate and its distribution:

Most of Siwa soils considered as highly calcareous, since calcium carbonate content is generally higher than 10 % except in the wind born Sand soils, Zein El-Abdein (1952). He also stated that calcium carbonate content widely vary from one location to another.

The wind-born sand soils localities, which have low carbonate content and high percentage of coarse sand, are found on the skirts of the southern and northern plateaux, as well as in the eastern part of the Depression.

1.5.3 The salinity status of Siwa Oasis:

In Siwa Oasis Forbes (1921) found that the loamy soils contain 47.52 % of total soluble salts, but ht soils which are characterized by its sandy loam texture contain from 5.48 to 22 percent of total soluble salts. Zein El-Abdein (1952) classified Siwa soils to coultivated, where salinity is not more than 8200 ppm., and neglected areas where the salinity reaches as much as 500,000 ppm., in the soil surface. Saleh (1970) stated that the salinity of the saturation extract of some cultivated soils in Siwa ranged between 900 to 7000 ppm. while the salinity of irrigation water ranged between 1900 to 8200 ppm., He also added that when the water table is low, soluble calcium was found to be the prodominant cation followed by sodium and that sulfate is the major anion followed by the chloride. Haraga et al (1974) stated in a study on Siwa soils that the electirical conductivity of the soil extract ranged from 2.4 to 37 mmhos/Cm 25°C. Moreover the surface accumulatior of salts which is locally named korsheif, reaches to 200 mmhos/cm at 25°C.

1.5.4 Marshes formation:

Zein El-Abdein (1952) mentioned that salt marshes are formed at the bottom floor of the Oasis Depression due to the seepage from springs and drained water, therefore the water table raises to the soil surface and forms salty marshes (Korsheif). He further added, confirming the results of Azadien (1930), that soluble salts are contineously removed downward in the deep strata due to excessive use of irrigation water. The auther also found that the aridity of the region with its continental climate on one had, and the salinity of irrigation water with a subsoil water table near the surface on the other hand, create severe conditions in the calcareous soils of the Oasis. He added that annual plants do not endure the high salts content in the soil of the neglected areas, but palms and olive trees furnished with deep root system grow satisfactorily in such contitions.

Eurther analysis was carried out by Saleh (1970) Haraga et al (1974) and Gomha (1976) indicating that the organic matter in Siwa Soils is relatively low owing to the prevailing climatic condition and ranged between 0.03 to 2.83 %. They added that the exhhange properties clearly indicate that Siwa soils are relatively poor as they have:

a) Low organic matter content, and

b) relatively low clay content besides its higher $CaCo_3$ percent.

The C.E.C. values of Siwa Soils ranged between 0.4 - 25.2 meq/loog soil.

1.5.5 Water managment of Siwa Oasis:

1.5.5.1 Sources of irrigation water:

In this area the only source of the irrigation water is the ground water that flows from many springs spread all over the Depression. Most of the presently springs were used in ancient time and some have been recently developed. The springs with larger flows are sometimes allowed to discharge continuously into irrigation Canals, but the flows of the weaker springs are usually stored by plugging the outlets of their reservoirs and then releasing the stored water from time to time.

The source of the ground water discharge from the Miocene bedrock appears to be from the deeply underlying Nubian sandstone reservoir.

1.5.5.2 Quantity of irrigation water:

The flows of springs vary widely throughout the region. The better springs flow in excess of 1000 m^3/day and the larger ones produce much more, i.e., Ain El Gobba