Studying the Feasibility of Reclaiming the Land of Plain Tina area in Sinai

Mansour A. M. Yacoub[1], Amany T. Elkashef[2]

1 Researcher In Drainage Research Institute, National Water Research Center

2 Lecture of irrigation and hydraulic structures, faculty of Engineering, Beni-suif University

Abstract: **Water is the source of life for all creatures upon earth, and the axis of sustainable development and improvement. Freshwater represents only 3% of world water. Egypt is one of the semi-arid countries due to the lack of rain. The country depends on a major source of water, which is the River Nile; at a constant quota of (55.5 billion m3/year), to irrigate (8.5 million feddan) of arable lands. The total population is (85 million persons) living on (3.5%) of the total area of Egypt.**

Soil salinity is the process of increasing the salt content in soil. Salts can be transported to the soil surface by natural capillary transport from a saline ground water and then accumulate due to evaporation. The increase of soil salinity in some areas of Egypt, which shows in Plain Tina area in north Sinai is one of the obstacles for agricultural lands in that area which hinder its agricultural and constructional development. However, it is possible for those lands to be productive during few years, only by adopting the right ways of washing such lands that vary according to land type to be reclaimed and washed and to its salinization degree. The heavy texture of clay soil that form a huge area of Plain Tina is distinguished by a layer of salts in the surface layer of land sector. It may have also layers of subsurface salinization that increase soil salinity and decrease its permeability. Furthermore, the climate conditions may help salinization. It is known that heavy structure clay soil needs more time for washing in comparison to light structured soil in order to get rid of salts. This study includes the research work, field work and the office analysis process that accomplished along the time of this study. The study has presented also the important outcome conclusions and recommendations of the feasibility of reclaiming Plain Tina land in north Sinai and submit it to the irrigation and finance resources sector of north Sinai.

1-Introduction

With population growth and the stability of Egypt 's share of the annual Nile River and with a huge project like the new Suez Canal, it was necessary to study how to make use of saline land , which is considered unsuitable for cultivation and make it arable land , leading to

population growth landscape that region and thus lead to the presence of industrial projects future tied to the agricultural domain , because the reconstruction of Sinai is not only the establishment of tourist resorts , but agricultural and industrial investments, youth employment and establish of roads to urban communities over these areas .

The study aims to determine the feasibility of reclaiming some sites (areas) of the plain clayey land of Tina, such land of subsurface layers with too much salinity and how to re-distribution of habitant settlement in order to relieve the overcrowded areas in the Nile valley.

To achieve the above mentioned objective, the following method including the listed down steps were adopted:

1. Review existing topographic and demographic data of the area study.
2- Review a complete Research reports being written about plain Tina area in some further studies.
3- Conducting investigation visits at the site of study.
4- Collecting the available data and detailed maps of the site. Surveying the areas and documented the agricultural activities in the areas that have been leached or reclaimed as well as the water quality of Al-Salam canal and its availability.

All these steps were done by Carrying out the descriptive field study for soil texture and salinity through collecting soil samples from about 300 sectors of the field study site. All those ground sectors located nearby the same site of a previous study investigated by Drainage research Institute in 1997. The samples were collected where 4 samples were taken of each ground sector at different depths (0 – 50), (50 – 100) and (100 – 150 cm) with gross total of 120 soil samples.

2- Area Description

Plain Tina land represents the first part of north Sinai canal. It is at the far west north of Sinai Peninsula and beside the Mediterranean Sea from north and Sues Canal

from west (figure 1). Most of Plain Tina land belongs originally (historically) to River Nile Delta, where it has been separated 150 years ago after digging Sues Canal the link between the Red Sea and the Mediterranean Sea. In the past, one of River Nile Branches has extended all through Plain Tina land that helped establishing the Plain village out of the silt that came with the Nile, till the Nile water stopped few centuries ago. This may explain the nature of the clay soil of Plain Tina that resembles the heavy clay soil of the north Delta land. Because the plain area of Tina is adjoining to the Suez Canal, it was receiving all the cleansing discharge coming out of the Suez Canal passage The land level there is almost flat and extends to cover a huge area where isolated of people and their activities. The duration of cleansing process has prolonged since the reopening of Sues Canal in 1975. The area also was exposed to the influences of of tides and flows of the Mediterranean Sea that flooded the area with water for a long time This led to accumulate salts in some sites especially those of clay texture.

It also led to degradation of soil and the loss of its natural properties. That's how those lands become invalid for cultivation It includes the first inalienable area of Al-Salam Canal rein. Bordering by the Farma drain (El-Tina) to north, El-Cap (Baloza) drain to the south, the along extension of Al-Salam Canal project to east and the Suez Canal to the west. The total area of the plain area of Tina is about 50,000 feddan, where the soil salinity averages before washing process in 1997 between 66 ds/m in the surface layer.

The soil texture of the plain Tina area varies between the sandy and the heavy clayey. This is according to the previous referred to study in 1997 which proved that two-thirds of the total area of Tina is of clay texture whether in the surface layer (5 – 50 cm) or in the subsurface layer (50 – 100 cm and 100 – 150 cm).

3-Results

3-1Soil salinity:

The chemical analysis results that have been conducted to assess the samples' salinity of study area. figure (2), has shown salts movements and how it seeps through soil sector via contour maps that represents the electrical conductivity degree in soil sector at the depth of (0 – 50cm) where salinity has found to range between 30 to 120 ds/m and total average salinity of the study area reaches about 86.32 ds/m. As for the depth of (50 – 100cm), the soil salinity ranges from 30 to 210 ds/m, with total average salinity of 95.9 ds/m for study area.

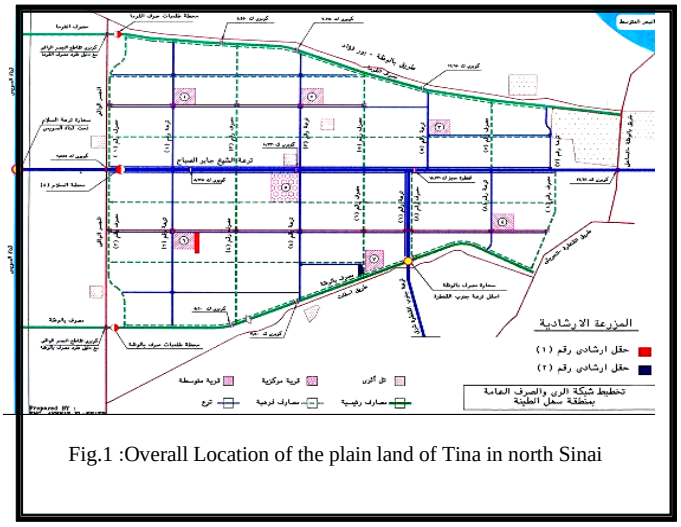

Fig.1 :Overall Location of the plain land of Tina in north Sinai

Fig. (2): salinities distribution in the test layers

3-2 Development of soil salinity at the extension field (1)

The extension field no. (1) Was specified of total area 60 feddan at plain lands of Tina at the south of eastern bridge on extension basis to conduct the necessary leaching experiments and reclaiming the heavy clayey saline lands at the location. The aim also was to provide the farmers and investors with the practical experience based on scientific basis of leaching salt affected lands and reclaiming in the most efficient way both technically and economically. This was done by planning for preparing, cultivating and leaching the extension field and by having the extension layout for designing and implementing both irrigation and drainage systems. Based on this proposal, the whole area was divided into 4 units (A, B, C, D) where the area of each unit is about 15 feddan (figure 3).

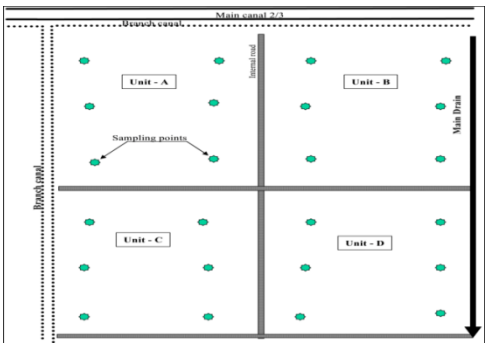

Fig. (3) Sites of collecting samples from the extension field no. (1) During leaching

3-3 Primary laboratory analysis results before washing salts out

Samples of soil and water were collected from the extension field of different sites as it was divided into 4 units as mentioned before, to identify the ground sector and the ground water depth. Each unit represents 6 sites for collecting soil samples at different depths (0 - 50), (50 - 100), (100 - 150) and (150 - 200 cm) to analyze it both mechanically to identify the soil texture and chemically to identify the chemical properties. The mechanical analysis results of soil samples revealed that it is classified as a heavy clayey soil where the clay percentage at different depths is more than 40%, regarding the presence of silt or silt-clay layers as well as a layer of salt covering soil surface of average depth of more than 20 cm, where soil salinity percentage ranges between 370 to 440 ds/m at surface layer (0 - 50). This percentage reaches 260 - 340 ds/m for the subsurface layers.

The increase of salt percentage in surface layers before leaching at the first extension, field refers to the increase of water level up to the surface where the water table ranges between 0.09m and 0.02m at subsurface. The salinity ranges between 96.95 to 143.5 ds/m. The salts were accumulated at a time there was no drainage or irrigation in the ground sector especially in the soil surface layers. Those lands are considered the worst land of the extension field for cultivation, for being characterized by both the heavy texture and high salinity soil.

3-4 Adopting washing salts away technique

One of the main reasons of salt accumulation in any ground sector is the rising of water level and the poor drainage as well as ceased irrigation that works to dissolve salts in water through soil sector and taking it towards drains. After determining the problems and its causes, it is important to choose the optimum method to manage it. It was found that applying excess water to flood the land in order to dispose salts away from roots zone is recommended. As it takes a considerable period of time to dissolve salts, the ongoing leaching will continue till salts concentration degree allow the plants growth.

To guarantee managing the leaching method, the following steps should be done:

1- Finishing all the required land leveling(as it is important and must to be accomplished before leaching process as it helps flooding the area with a regular layer of washing water. The area to be leached should be divided into basins adequately proportionate with the requirements of controlling and managing the leaching process easily

2- Establishing an irrigation network necessary for the leaching.

3- Establishing an adequate drainage network for the leaching.(grouped drainage network was designed in the most lower ground area while the field drains which directly receive discharge water from field to grouped drains, were established in straight, vertical and parallel direction on those grouped drains

Leaching process was started and applied by flooding the field with appropriate quantity of water by using irrigation machines while its specifications were determined according to the needed requirements of enough water for leaching the field area and according to the time table that synced with the leaching cycle at field. The time table and the design were elaborated based on irrigating each unit of the four units along 6 consecutive days and skipping one day a week for maintenance works needed. Each unit of 15 feddan should be served by one pump at the beginning of its canal.

4- Leaching method results

Implementing leaching program was started where washing salts out of the surface layer was done during 6 months since the beginning of leaching as demonstrated in photos (1), (2) and (3). Those photos have shown the area status before leaching which had a crust of salt on the surface layer, it also shown the land status during and after leaching after 6 months of leaching.

Plate (1) of the first extension field before leaching.

Plate (2) of the first extension field during leaching

Plate (3) of the first extension field after 6 months of leaching.

To access the influences of leaching salts out of the soil during the leaching first period (6 months), samples were collected out of the soil both before flooding it, and after drain the same area to dry within the repeated leaching periods. Samples were taken from the following depths (0–25), (25–50), (50–100), (100 –125) and (125–150cm) from the subsurface soil and were laboratory investigated chemically to assess soil salinity as well as its chemical properties.Fig.(4) shows soil salinity at different depths before and after leaching

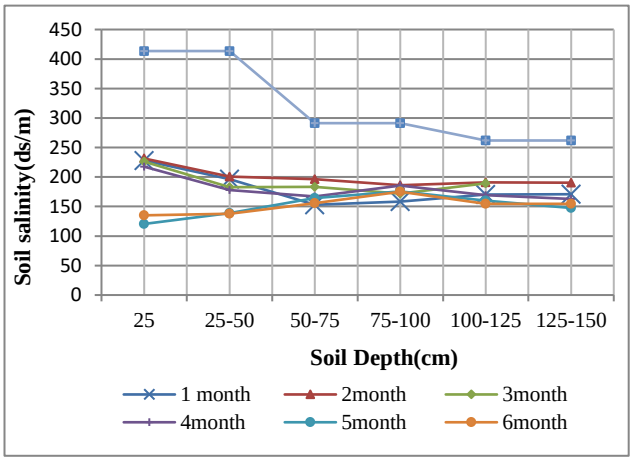

Fig.(4) Soil salinity in different depths before and after 6month leaching

Fig.(5) shows a comparison between average soil salinity before and after 6 month leaching. It can be easily seen that surface layer is more significant by leaching than subsurface layers.

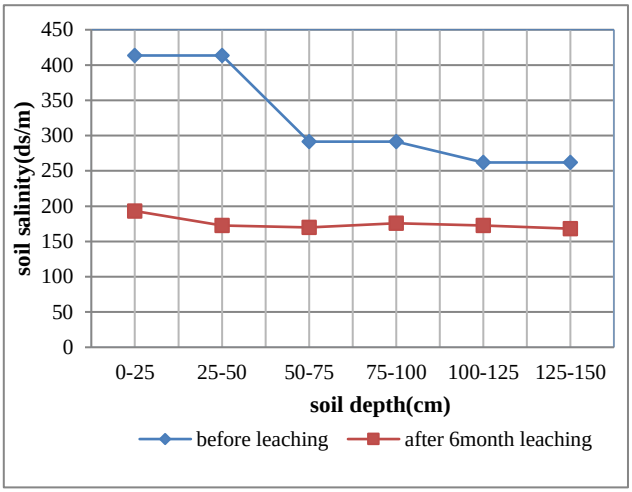

Fig. (5) Comparison between average soil salinity before and after6 month leaching.

Table (1) demonstrates the results of soil salinity before and during the leaching period, it is clear that soil salinity decreases while washing the soil and the reduction rate is much bigger in the first month(almost half the salinity decreases in first month) while this rate decreases after first month. For example, The salinity in the subsurface that its depth goes to 50 cm underground has decreased to 33% only out of the original salinity before leaching. The decrease percentage during the six months only was equal67% development of salinity during leaching management. Table (2) shows the development of soil salinity after 6 month washing for different soil depths. From this table, it can be seen that the most significant decrease in soil salinity was in the surface soil layer and decreases in the lower subsurface layers. This is considered to be a remarkable progress not only for that surface layer but also for the subsurface layers (50 – 100) and (100 – 150 cm) where salinity percentage there reaches 43%, 41% respectively. Taking into account that those two layers are receiving leaching water of high saline concentration, nevertheless, the salinity has decreased to the above mentioned percentage.

Table (1): Summary of average Salinity results before and during leaching management in the first extension field:

Leaching time month	**Average salinity before Leaching**	**Average After Leaching**						**Average salinity After 6 months Leaching**
Depth (cm)		***(1) Month***	***(2) Month***	***(3) Month***	***(4) Month***	***(5) Month***	***(6) Month***	
0 – 25	413.5	228	231.4	226.1	217.5	120.5	135.1	193.1
25-50	413.5	196.5	200.8	182.6	178	138.8	137.9	172.4
50-75	291.4	153	196.1	183.1	166.9	164.6	155.7	169.9
75-100	291.4	158.2	186.1	171.9	185.6	175.6	175.1	175.9
100-125	261.9	170.1	190.9	189.5	169	160.2	154.5	172.4
125-150	261.9	171.1	190.6	183.3	162.8	147.5	154.5	168.1

Table (2): Development of Salinity in soil sector after 6 months of washing out salts at the first extension field before and during leaching management in the first extension field :

Depth of soil (cm)	**Average salinity before leaching**	**Average salinity after 6 month leaching**	**Decrease of salinity**	**% of decreasing**
0 – 25	413.5	193.1	220.4	53.3
25 – 50	413.5	172.4	241.1	58.3
50 -75	291.4	169.9	121.5	41.7
75 – 100	291.4	175.9	115.5	39.6
100 – 125	261.9	172.4	89.5	34.2
125 – 150	261.9	168.1	93.8	35.8

Based on those results and for predicting the development of soil salinity to reach the appropriate salinity for cultivation, graphs were done to demonstrate soil salinity before and during the 6 months of washing against time and was finished with normal logarithm scale for the soil sector layers for the surface layer (0 -50) and the subsurface (50–100) and (100–150 cm) consecutively. The results were recorded and summarized in table 3 which showed that soil salinity for surface layer to cultivated will reach the suitable degree to start cultivation (about 10 ds/m) after 22 months of leaching while it takes 28 months to reach soil salinity of (4 ds/m) after finishing leaching managements. As for the other two subsurface layers (50 - 100) and (100 - 150cm), the time consuming is about 50 and 70 months respectively.

Table (3): prediction results for the development of all soil salinity layers

Leaching time (month) / Layer depth(cm)	Before leaching	1	7	11	22	28
0-50	413.5	276.3	107.4	49.2	10.1	3.9
50-100	291.4	22.6	156.4	110	70	47
100-150	261.9	222	146.9	90.7	51	34.6

5- The feasibility of leaching method in different farms

The recent field study has proved that leaching salts out of the soil in the area lands and specifically at the extention field (1) has achieved an acceptable progress comparable to the leaching time that takes 6 months. This may lead to an acceptable salinity for cultivation crops that tolerating salinity for not longer than 20 months. This may transfer the whole area into a productive land if the leaching process management was applied properly.

6- Conclusion and recommendations:

The most important recommendations of this study are:

1- Major corporations of reclamation and investors can greatly contribute and play a main role in starting reclaiming and cultivating the area till cultivating saline tolerant crops. Lands can be distributed to small farmers with convenient prices and profitable to those corporations as they can afford the whole process from the beginning.

2- Providing agricultural credit bank to play an effective role in helping farmers getting loans or funds for agricultural inputs as well as agriculture providing technical services.

3- Choosing serious governmental technical committees where their staff change periodically to monitor how serious the farmers and corporations are in reclaiming and developing their lands.

4- According to gross area of clay soils east the canal is 50 thousand feddans at Tina plain. The study proposed that the crop pattern of this area which is to be irrigated by Superficial. Improved irrigation system is as follows:

Farm crops 42%, Vegetable crop 42% and Pasture crops 16% of the area.

5- The study also showed that it is necessity to monitor the quality of water at regular basis along the years of cultivation and modify the mixing proportion according to the variation in properties of water and soil, as well as the kind of crops and growing stages of various crops.

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