ACHIEVEMENTS AND PROGRESS OF AGRICULTURAL DRAINAGE IN MEXICO

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ABSTRACT

The irrigated areas in Mexico, comprising the irrigation districts and units and rainfedtechnified districts, have a total area of 8.2 million hectares. The presence of high groundwater and the progressive salinization of soils are a major issue to increase agricultural productivity. The area under irrigation has received the benefits of underground agricultural drainage, exceeded 120,000 ha and in irrigation districts representedonly 20% of total affected area, estimatedin 600,000 ha. Soildegradation in productivity due to salinization and high groundwaterrepresent an estimateddecreasing of 80 % in average of itspotential production and in most cases result in abandonment of agricultural land. The constant increase in the cost of underground installation of agricultural drainage, reaching an average of USD $2,500 per hectare, represent the main obstacle to rehabilitate 480,000 hectares which are affected by salinity and high water tables, causing a constant degradation of agricultural soilsaffected. However, the main attraction to solvethisproblem of salinizationneed the support of the MexicanGovernmentthrough the National Water Commission, which have programs to subside up to 50% of total investmentcosts, thishighlyencouraging for water users to rescue the affectedsoilssincesuchinvestmentsrepresent a high economicrentability for users and a significantadvance in food production.

Keywords: Irrigation district, rainfedtechnified districts, National Water Commission.

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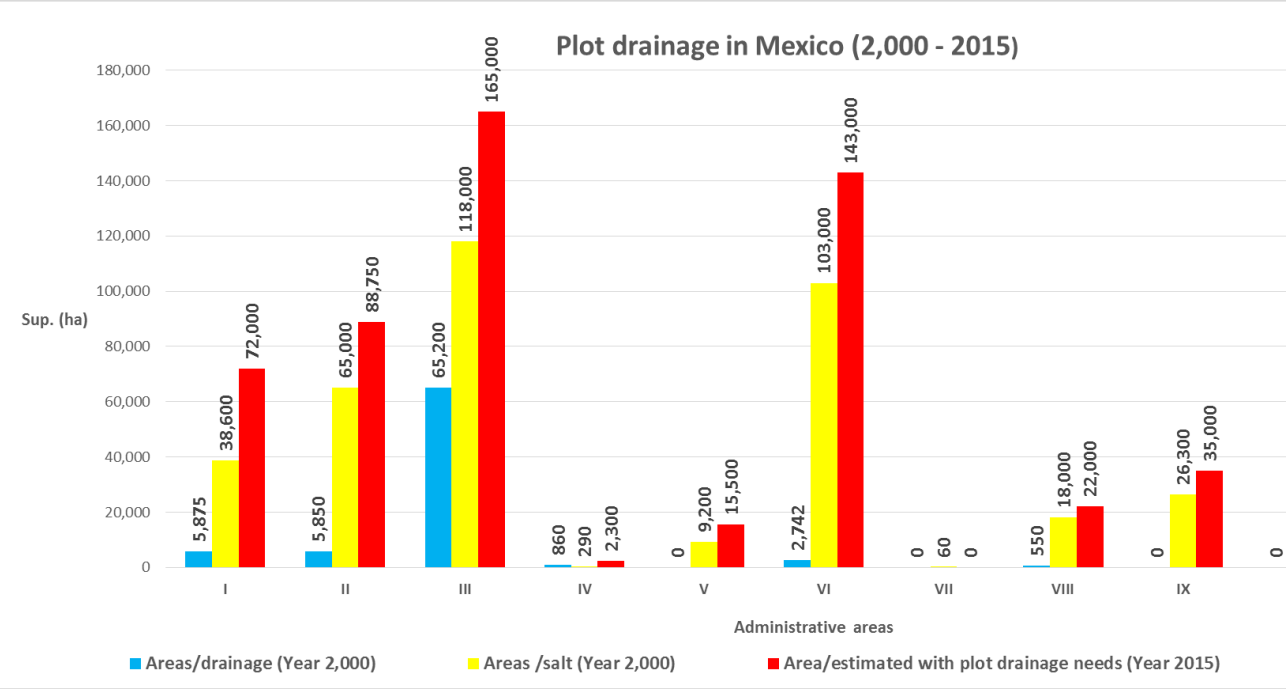
1 Introduction.- Introduction.- Mexico is a country with 8.2 million hectares under irrigation, of which 6.4 are irrigation districts and units located in areas where irrigation for crop development is necessary, and in most cases infrastructure is needed to remove the excess water, either using open drainage or subsurface drainage also known as drain tubing. The remaining area, 1.8 million hectares belong to technifiedrainfed districts, located in coastal areas with precipitations over 700 mm per year, with irrigation infrastructure to remove water drainage and allow an adequate agricultural production; agriculture mainly located on the coast of southern Mexico.

2 Background.-Agricultural drainage in Mexico started to be used in parallel with the construction of large irrigation areas in the country, period that intensifies in the 40s when large storage damswere built, and the network of channels for supplying and distributionfor agricultural irrigation was charted. The construction of infrastructure was also necessary to remove the excess of irrigation water, gradually formed with the elevation of groundwater, which in many casescame accompanied with high salt content, which required the construction of open drainage, allowing to mitigate the levels of high water table and its conductionoutside agricultural areas.

Despite the efforts made withsurface or open drainage, the excess of moisture in the soil profile continued, by the formation of false groundwater, also known as hanging groundwater (Nappe Perchee) forming hydromorphic soils, which coupled in many cases to salinity, required the implementation of drainage at plot level, comprised of perforated clay pipes or plastic pipes (PVC). In the case of installation with plastic pipes and in some cases having fine sand soils, it is used a coating with fine woven mesh (drainage trap), which allows the passage of water but retains the particles of soil preventing clogging. This latest subsurface drainage installation technology recently launched from the ninetiesand had a strong boost from the year 1997, thanks to the efforts and support of the Federal Government of Mexico, through the National Water Comission (Comisión Nacional del Agua), theManagement of Irrigation Districts and Units(Gerencia de Distritos y Unidades de Riego)and the Mexican Institute of Water Technology (IMTA-InstitutoMexicano de Tecnología del Agua).

3 Results obtained.-The surface comprising the irrigation districts, includes a total of 3.496 million hectares (ha) and it is estimated that some 550,000 ha are affected by shallow water tables and salinity, causing a progressive decline in agricultural yields, and in many cases, the abandonment of the affected plots. With the beginning of the federal programs for field support, plot drainage installation was promoted and, nowadays, more than 81,000 ha have been recovered with this scheme of recovery of saline soils or with high water table. See Figure 1.

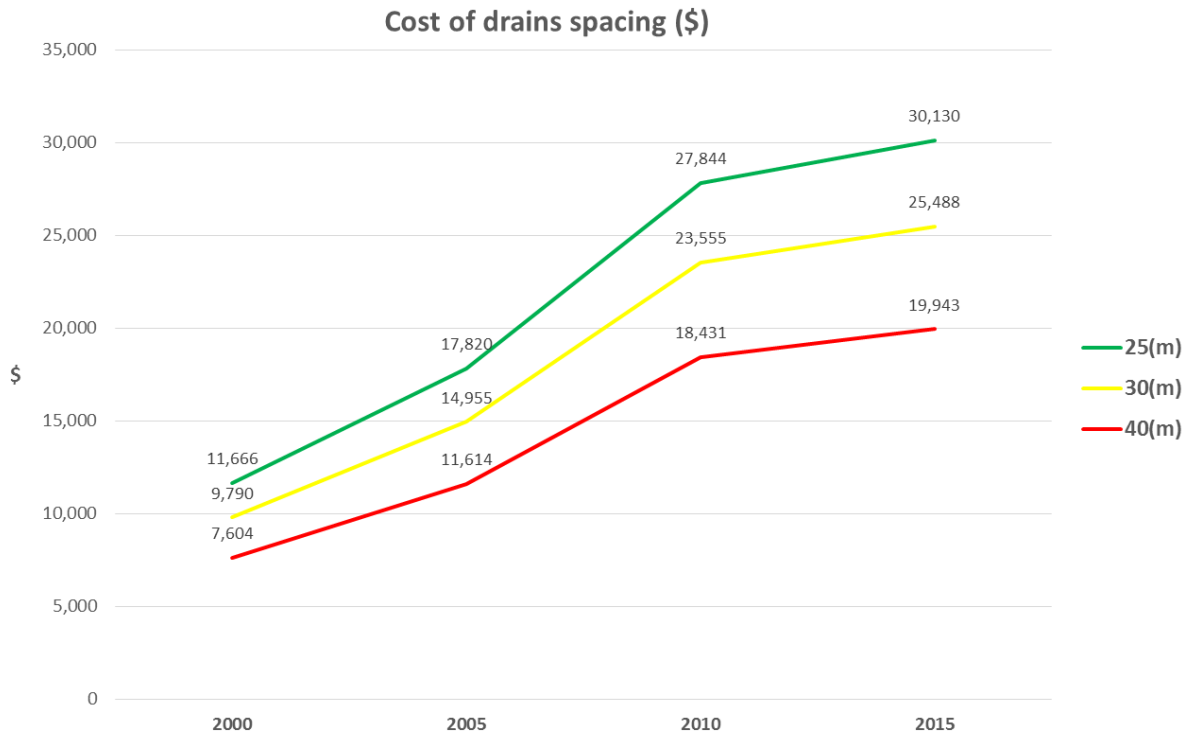
Fig. 1.- Surfaces affected by salts and recovered usingplot drainage.



Insofar as the crop prices and inputs have increased, plot drainage installation costs have suffered cost escalations, which is shown in Table 1. Today, to place drains at a spacing of 20, 30 and 40 meters, the increments from the year 2000 to 2015 are of 258%, which partially prevents the progression of the installation planned between 2000, 2005, 2010 and 2015. See Figure 2.

On the other hand, from 2000 (two years after the installation of drainage) the first problems of clogging of roots occurred, mainly caused by poor installation and shallow drains (less than 1.20 m) which required an analysis and review of the standards that should apply in Mexico for installing the plot drainage, regarding the existing regulations in other countries, but adjusted to the needs "in situ" of types of soils, native plants and their pivoting root system, and regarding the tree species in the plot boundaries.

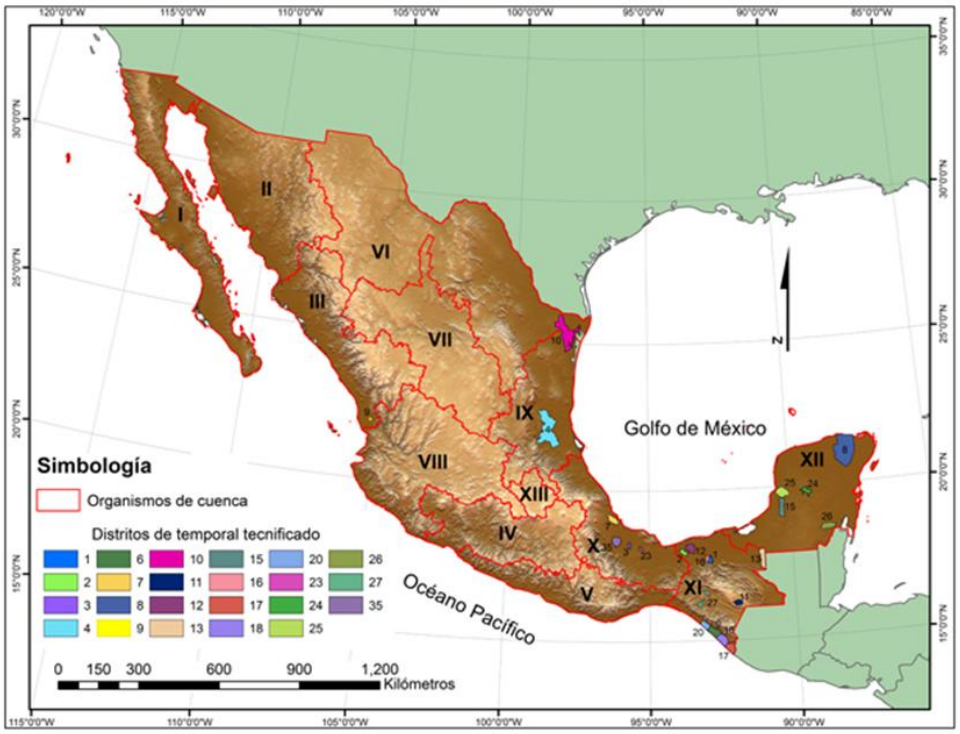
Fig. 2.- Costs ($) and spacing (m) from year 2000 to 2015



With the installation of the plot drainage in irrigation districts, mainly in the northwest of the country, Baja California, Sonora, Sinaloa among others, other types of problems continued such as clogging due to high contents of iron compounds in the soil profile, which are due to the irrigation contribution during the preferential period of autumn-winter crops and the lower contribution during spring-summer. In the latter cycle it is observe a smaller decline or no decrease of irrigation, and thus, allowing greater aeration inside empty water pipes, which causes oxidation and precipitation of iron compounds and magnesium on the walls of the tubes, provoking blockages in perforations and a drop in the proper functioning of plot drainage. The area installed with plot drainage and affected by root and mineral blockages, is estimated at 3% of networks installed, however, as time passes, the problem continues to increase, which involves taking measures to control and fight by means of methods and practices already known in other countries. See fig. 2 area affected by salinity or high water table.

4.-Agricultural drainage systems in humid areas.- Agricultural areas that make up the technifiedrainfed districts, located in 16 agricultural areas, mainly in central and southern Mexico, have irrigation infrastructure, mainly built for evacuation of drainage water provoked by high rainfall in these areas. The technifiedrainfed districts are present in the humid tropics since the formation in the 60s and were officially formalized by Decree and published in the Official Federal Gazette of Mexico, on April 25, 2004 distributed in 5 Basin Organizations and in 9 states (see Figure 1).

Fig. 3.- Distribution of the technifiedrainfed districts in Mexico



5.- Vision of agricultural drainage for 2050.- It is necessary to indicate that in these areas of southern Mexico, large areas of irrigation are in the process of opening, for example, the construction of a large dam leading to the river Usumacinta, known for its location in the region of Bajo Usumacinta. This area will be designed and planned to divert water on an estimated area of 210,000 ha and between the irrigation infrastructure to be planned for discharge, conduction and delivery of water at plot level, we have the planning infrastructure for the functioning of controlled agricultural drainage that will have as main objective the operation and management of subsurface drainage water levels by means of structures that allow the evacuation of water in rainy season or retention of such water in the dry season.

Long-term strategic planning studies (2050) and water availability for the construction of dams and diverter channels for opening new areas of irrigation and drainage, are located south of the Mexican territory, with an area estimated of 3 million hectares, with high technical feasibility of being available for agriculture and high potential in the production of tropical crops such as rice, pastures for extensive grazing, oil palm, fruitgrowing and large areas to produce wood-based products.

6.- Conclusion.-Plot drainage installation in Mexico takes a slow pace compared with the speed of salinity in agricultural soils or the increase in groundwater levels due to excess of irrigation. The increased costs are a major inconvenience and it is necessary to boost the Mexican government's investments to increase the support for users, with a percentage (50/50),as it is currently done, and with total amount earmarked for soil recovery. Moreover, agricultural land in the districts of wetlands, involve major investments, especially because the potential in the southern areas of Mexico exceed the 3 million ha., area of great importance to food production in a growing population, and to consider that to put them into production, we need to design and carry out irrigation infrastructure and works, and to install surface and plot drainage.