

Salt Affected Soils in Latin America

A. ZAVALETA

Agrarian University, La Molina, Lima (Peru)

Our Hungarian colleagues recently celebrated the 100th anniversary of the birth of the late Prof. A. A. J. DE 'SIGMOND. He was one of the first, most outstanding soil scientists who realized the importance of the problems of salt affected soils and the necessity to organize and co-ordinate scientific research in this field on an international level. His activities and achievements are known and highly appreciated by soil scientists all over the world, and it is to his memory that I dedicate the following short survey on the distribution of salt affected soils in Latin America.

Salt affected soils commonly occur in arid and semiarid regions. Such territories are widespread in Latin America and as there is an ever growing demand for the increase of agricultural production, the problems posed by salt affected soils become more and more serious.

In the past the occurrence of salt affected soils on this continent was due to natural causes such as the presence of salts in the parent material, flooding, imperfect natural drainage, high water table, high evapotranspiration. During the present century, however, man has increased the extent of irrigated areas in many cases without providing adequate drainage systems, and using sometimes excessive amounts of irrigation water, or water of poor quality. This resulted in the secondary salinization of soils at many places.

Salt affected soils have been identified along the Pacific coast (e.g. on the Guayas coast of Ecuador), where they developed under the influence of tidal fluctuations; around lakes and estuaries (Northern Peru, Southern Ecuador, The Argentine); around salty lakes (Dominica); along salty streams sometimes overflowing their banks (in the forest region of Peru — San Martin Department).

These soils occur, usually in association with "normal" soils, in localized patches as well as on vast areas, frequently under characteristic hydrological and topographic conditions. Their salt regime displays intensive season dynamics. The salt content shows its maximum during the dry season; then salt accumulation on the surface — salt efflorescence — may frequently be observed.

According to rough estimates, the extent of salt affected soils in Latin America exceeds 30 million hectares; they occur mostly in the Argentine, Paraguay, Bolivia, Mexico, Peru and Chile.

Geographic distribution of salt affected soils in Latin America

Mexico

Due to the prevalence of arid and semiarid conditions, salt affected soils are widespread in the northern and central regions of the country, mainly on the Pacific coast of the northern part. Also a "belt" of salt affected soils stretches across the central part of Mexico from the Pacific Ocean to the Gulf of Mexico.

At the early sixties they covered about 750 000 ha and their extent has probably increased since then.

Puerto Rico, Dominican Republic, Haiti and Cuba

In the tropical zone, to the south-west of Puerto Rico (USA) salt affected soils occur in the Lajas Valley (semiarid region). In Dominica they may be found in the Neiba Valley, located in the south-western part of the country in an arid and semiarid region, as well as in the arid zone extending towards Haiti. The water of Lake Enriquillo (Dominica) contains a higher amount of salts than sea water. Also there are important salt and gypsum mines in Dominica.

In Cuba the occurrence of salt affected soils is very limited because of the dominant climatic conditions. They appear only in small patches.

Central America

Here the problems of soil salinity are insignificant. In Panama the salt affected soils are very limited in extent due to the very humid climate. Problems connected with soil salinity are geographically limited to coastal patches which are under marine influence.

In the other Central American and Caribbean countries the situation is much the same.

The Argentine

The Pampa region (500 000 square kilometres) represents the most extensive and fertile agricultural land in South America. In its western part, however, salt affected soils -- saline gleys associated with planosols -- are widespread, their extent amounting to about 10 million hectares. In the eastern part of the pampas humic solonetz soils, while in the south-western territories solonetz soils in association with "tozca" occur.

According to the latest estimates (1960) in the Buenos Aires Province alone, where the total area is 5 million hectares, about 40-50% of the land are affected by salts. In the northern part of this province, in the "cuña boscosa" the extent of salt affected areas is about 1.4 million hectares, due to the influence of mineralized groundwaters rising near the surface.

Soils affected by salts to a higher or lesser degree cover about 1 million hectares in the Entre Rios region.

On the eastern side of the Andes -- looking towards the low-lying lands of Gran Chaco -- there are relatively extensive alluvial plains. Though

solonetz soils occur there only in localized patches, these plains are potentially saline.

In the steppe region of Patagonia and on the Altiplano solonetz and/or solonchak soils in association with brown earth or various types of desert soils are found. The vast saline areas are called "salina" and "solar".

Brazil

Solonetztes in association with regosols and vertisols occur in the north-western region of the country, near Floresta city, and to the south of Bahia. In the northern and western parts of the piedmont plains formed in the quaternary period mostly solodized solonetztes occur. Saline gleys are found in the coastal areas of the transitional zone of North-Eastern Brazil. On the Atlantic coast, where the height above sea-level rarely exceeds 50 meters, the water table is high and groundwaters are frequently saline. Here the dominant soil type is gley in different states of formation. Saline-gleys, humic-gleys, ochric-gleys are quite common, often with saline subsoil.

In the Parana-Paraguay region bog soils are associated with solonetztes.

Bolivia

In the northern and central parts of the Altiplano salt affected soils occur only in patches, but in the southern region (the so-called "Desertic Altiplano") extensive areas are occupied by barren plains called "salares". Here there is a considerable moisture deficit, annual rainfall never exceeds 100 mm.

Strongly saline and alkaline soils have been formed at the bottom of valleys in the southern part of Sierra Central.

The southern part of the eastern plains is similar in many respects to the coastal region of Paraguay. Here the soils, which after long dry periods are subjected to flooding for a short time, are saline or soda-saline in a considerable degree.

Columbia

In this country salt affected soils are found on the Caribbean coast and in a few valleys of the Andes. They occur in the plain of Bajo Magdalena as well as in the valleys of the Rancheria, César Ariguani, Sinu and Bajo Cauca rivers.

In the Andean area salt affected soils are less extensive. They are found in the Alto Magdalena valley and in the Chincamocha valley between Paipa and Sagamosa.

According to rough estimates the total extent is about 300 000 hectares, excluding the salt affected desert soils of the Guajira Peninsula.

Chile

Salt affected soils occur between Arica and Santiago (from 19 to 32° of latitude). Within this territory three well-characterized regions are distinguished: the Tamarugal pampa and the Atacama desert; oases and valleys; the Batuco basin.

In the first region there is hardly any rainfall, and salinization is typical. On the Pacific coast dense, salty mist is forming (the so-called Camanchara) and it transports the salts inland, depositing them continuously on the soil surface. The parent material also contains large amounts of water soluble salts, mostly chlorides.

In the other two regions mostly saline irrigation waters and imperfect drainage conditions are responsible for the formation of solonchak and/or solonetz soils.

Ecuador

Solonchak soils — though limited in extent — occur in small patches, in shallow depressions along the Pacific coast. Their formation is due to the capillary rise of saline groundwaters. Salt concentration is so high that it prevents all plant growth on these soils.

In the semidesert zone situated at about 2000 m above sea level between the chains of the Andes as well as on the slopes and in the deep valleys of the mountains slightly saline soils yellowish in colour and of light mechanical composition have been formed. Annual rainfall is about 250 mm but there are long, exceptionally dry periods.

The Guayanas

Some salt affected soils, associated with hydromorphic soils, have been identified on the Atlantic coast. Their formation has been caused by the fluctuations in the level of sea water.

Paraguay

To the east and south-east of the Chaco plain saline gleys and pseudogleys occur in association with chestnut-brown and reddish-brown soils; they are solonetzic on the slightly elevated parts of the plain.

To the north-west of Chaco, under dry, subtropical conditions reddish-brown, solonetzized soils have developed together with solonetztes, solonchaks, sandy regosols and saline, sandy aluvial soils.

In the central and south-western regions of the Chaco's Paraguayan reach extensive areas of degraded solonetzized reddish chestnut soils occur.

In the plains of the Parana-Paraguay region salt affected soils are associated with planosols.

Peru

For the agriculture of Peru the extensive occurrence of salt affected soils is a source of grave problems because they are located in areas of intensive, irrigated farming.

The majority of the alluvial valleys and pampas of the coastal region are salt affected to various degrees. In lands where irrigation was started only 18 years ago salt affected soils may amount to 20%, while in some old alluvial valleys they cover up to 80% of the area due to secondary salinization, or alkalization. The total extent of soils affected by salts to a higher or lesser

degree is roughly about 600 000 hectares. 90% of the pampas — lands to be used under irrigation in the future — are potentially saline.

Salt affected soils occur in the Titicaca region (Puno), in the Vilcanota Valley (Cuzco) and in dry subhumid tropical areas of northern Peru (Tarapoto). In the highlands solonetz and/or solonchak soils are dominant, while in the jungle soda-saline soils have developed.

Uruguay

The climate of Uruguay is moderately warm and moderately humid, consequently saline soils occur only very rarely, mostly at places having imperfect drainage. Saline and alkali soils may be found in the eastern and south-eastern coastal region.

Saline soils form a narrow strip of land along the coast, while the alkali soils have developed on the higher plains. These soils may be classified as salic gleys or salic-histic gleys. Solonetz, solodized solonetz and solod soils occur, too; solonetztes are in association with planosols.

Venezuela

In the Maracaibo region, at less than 75 meters above sea-level and under semiarid climatic conditions, some salt affected soils have been identified.

Solonetztes have developed in very dry valleys of the Andes, but the determination of their extent has not yet been possible.

Conclusions

It is apparent even from this short survey that extensive areas of salt affected soils occur on this continent, limiting, to a higher or lesser degree, agricultural production in practically all Latin American countries. In spite of this only few attempts have been made to survey these lands and to obtain precise data on their extent.

Larger agricultural production can be achieved only with the extension of irrigation farming, and this will result, at many places, in secondary salinization and alkalization, further increasing the extent of salt affected areas.

These serious, very complex problems could be solved more easily and more efficiently through cooperation and co-ordination on an international scale, to the mutual benefit of all Latin American peoples.