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SOILS OF THE SOUTHERN PART OF MOROCCO

Abstract: Soils of the discussed area have been formed in the arid climatic conditions where evaporation prevails over precipitation. Those are the soils of the aridic and dry desert areas. Gypsisols prevail, also Calcisols can be found. Vast areas of the regions are covered by dune formations where initial Arenosols occur. Within the oasis where agricultural soils are subject to irrigation Solonchaks can be found. The existing described agricultural value of the discussed soils (Categories I-IV) is at present of very little use because of the strong desertification processes that take place in the investigation area.

Key words: Desert soils, Gypsisols, Arenosols.

1. Introduction

Soil cover of Morocco strictly corresponds to the geography of the country. In the northern Mediterranean part red weathering formations of terra rossa prevail. Shallow and usually eroded formations constitute the bedrock of the red Mediterranean rendzinas – Chromi Rendzic Leptosols (Photo 1a, 1b). Deep formations provide bedrock for the soils with argillic horizon enriched with clay fraction (Bt) – Chromic Luvisols (Photo 2). In the middle part of Morocco, in the area of the Atlas and Anti-Atlas Mountains soils characteristic for mountain regions prevail. They are shallow and skeleton initial forms of rock soils – Lithic Leptosols and of forms of Regosols (Photo 3). On gentle slopes with a considerably thick weathering cover different variants of Cambisols occur and they are usually rich in nutrients (Eutric, Andic, Yermic). This differentiation corresponds mainly to the bedrock and climatic conditions. The alluvia and colluvia occurring in the valleys and at the base of the slopes provide bedrock for various Fluvisols sub-types.

In the southern part of Antiatlas arid soil zones begins – Aridisols, previously called Yermosols and Xerosols.

Arid regions cover approximately 36% of the surface of the Earth. That is why soils of these regions are subject to numerous research and investigation projects that consider both the functioning of the natural environment and the possible agricultural use of these soils. Soils of the arid regions function in the climatic conditions where evaporation prevails over precipitation and that means a percolative type of water regime. Weathering rock and mineral products are transported by evaporation processes upward within the soil profile. In the soil profile of the arid regions soils alkaline salt accumulation horizons occur (calcium or sodium salts). These salts can also commonly occur on the surface of the soils in the form of crystallised calcite, gypsum or forms of sodium salts (e.g. halite) (Photo 4, 5a, 5b). Apart from calcification, gypsification or salinisation processes, vertilisation (surface cracking of the clay fraction /takyric/) (Photo 6) and aeolic processes take big part in the soil forming processes.

The near-surface salinity of the soil mass destroys aggregation (structure) of the soil mass which results in the blowing out of the fine fractions of the mineral soil mass. Aeolic processes are also possible due to weak vegetation cover of the arid regions (Boul et al. 1997, Komornicki, Skiba 1978, Yaalon, Ganor 1973).

2. Soils of the Zagora and Mhamid areas

The area is situated in the region of Antiatlas borderland, on vast and geologically differentiated areas of the Sahara Desert (Dłużewski, Krzemień 2003). Slopes of the Antiatlas are built of quartzitic sandstones of the Rouid-Aïssa formation and of weathering clay-gravel, gravel and sand formations.

Those covers form various types of deserts: rocky-hamada, serir and sandy-erg (Photo 7, 8a, 8b, 9). Vast areas are also covered by layered sandy-loam sediments of the Dra river – at present an periodic stream. There are also loamy-clay limnic sediments of the dry Iriqui lake.

Climatic conditions of the area are hot and extremely dry, the annual precipitation does not exceed ca. 50 mm. This means a percolative water regime system, which results in surface salinity in the form of sulphate or carbonate salt crust (gypsum or calcite).

Vegetation in the discussed area forms typical for arid regions scattered patches of desert formations or bigger groups of tamarisk trees. Within the oasis where the water conditions are considerably better (as a result of irrigation) palm trees and agricultural plants (small fields) occur (Photo 10).

Such soil forming factors lead to the formation of the soil cover typical for arid and desert regions (Skiba 2003).

In the previous genetic classifications all soils of this area were considered to be desert serozems and burozems or halomorphic solonchaks of little agricultural use (Gansen 1965). In the USDA Soil Taxonomy all soils of this area are classified as Aridisols because all the discussed area represents dry climatic conditions with the dominance of evaporation over precipitation. Within this order desert clay soils can be found – Argids or Durids together with soils containing big amounts of dispersed calcium carbonate – Calcids as well as soils with surface salt crust – Salids. Nevertheless the prevailing soil formations are soils containing big amounts of dispersed and partly crystallised gypsum – Gypsids.

In the European classification of the International Soil Science Society (ISSS) from 1974 and 1988, known as the FAO classification, soils of the arid regions were classified as Xerosols and the desert formations – as Yermosols (e.g. Takyric Yermosols, Calcic Yermosols, Gypsic Yermosols).

In the area of Zagora and Mhamid near the rock outcrops, on the southern slopes of Jebel Bani, desert initial soils prevail (Yermo-Lithic Leptosols) (Photo 11). Within the wide Coude du Dra valley, in the dune-like areas unconsolidated sandy initial soil formations occur – Aridic, Yermic Arenosols (Photo 12). Loamy-clay layered Dra river sediments and lacustrine sediments of the dry Iriqui lake provide bedrock for the secondarily enriched in sulphates or carbonates alluvial soils – Fluvisols. Those soils have well formed gypsic diagnostic horizons, less often calcic and that is why they can be classified as Gypsic or Calcic Fluvisols. It seems that the fluvial processes that had formed the parent rock of those soils do not influence the functioning of the soils as Fluvisols as both the Dra river and the Iriqui lake are presently dry. Those soils function at present as well-formed desert soil of the Gypsisols type, less often as Calcisols. In the intermittently humid depressions soils enriched with natrium chlorides or carbonates occur – Solonchaks (Photo 6).

3. Agricultural value of the investigated soils

All the discussed above soil units (formations) of the investigated area, can be classified as soils of low agricultural value because of the aridity of climate, the insufficient amount of water and salinisation of the surface soil horizons together with intense aeolic processes in the area.

Small crop fields in the areas of oases (e.g. Mhamid) are subject to secondary salinisation processes caused by irrigation which strengthen the movement of salts from within deeper parts of the soil profile upwards. On the surface of the irrigated agricultural soils white salt pans and crust are formed (crystallised carbonate-sulphate salts) (Photo 10).

Agricultural value of the investigation area is thus difficult to assess. Single irrigated fields within the oases can be the base for barley or vegetable growing and also for the palm trees. Yet the soil can easily be subject to secondary salinisation. Intense aeolic activity also causes loss in the agricultural soil areas of the region as the mobile sands encroach on the fields. (Photo 13).

The agricultural valorisation of the soils for the Coude du Dra region (*Rap. Dra* 3/11.1) proposes four categories of agricultural use of the soils:

Category I – soils on which all plants occurring in a given climate can grow. Those are Fluvisols with stable water-air regimes, usually deep, loamy-clay-silt, that can be used after periodical irrigation.

Category II – soils on which most plants of the given climate can grow. These soils are usually more sandy or stony than those of category I and they may also be subject to salty crust formation processes. They have to be irrigated and the salty crust has to be got rid of.

Category III – soils on which only some plants can grow. They are not very deep (ca. 20 cm), they contain a considerable amount of rock fragments or gravel. They need to be treated and irrigated.

Category IV – soils of very poor agricultural use. They are either very salinised or very unconsolidated (skeleton). They are subject to erosion or they get covered by mobile sands and advancing dunes.

The cited categorisation (bonitation) of the soils of the Coude du Dra region for the area of Zagora and Mhamid from the years 1968/69 is at present of very little use. In the later years a considerable decrease in water flow of the Dra river took place in this area as well as the drying out of the Iriqui lake. Bigger surfaces of saline soils were formed together with the disappearance of the natural aggregate structure of the soils. Soils were more susceptible to aeolic processes which resulted in the decrease of the agricultural soil area.

In many other areas of the Coude du Dra region conditions for agriculture can still be found because of the fact that the occurring there soils e.g. Eutric Fluvisols are considerably rich. Those soils need however to be irrigated and preserved from secondary salinisation. Agrotechnical methods to avoid or diminish surface salinity of the soils are well known both to farmers and to the soil scientists of Morocco (Karrou 1998, Mrabet et al. 2001).

4. Conclusions

1. In the mountain area of the Jebel Bani Mountain range rocky and pebble initial soils prevail (Yermo-Lithic Leptosols, Yermo-Hyperskeletic Regosols).
2. In the Dra river valley formations of the Fluvisols properties can be found and they are in transition towards Gypsisols, Calcisols or sometimes Solonchaks.
3. Earlier (1960-1970) agricultural valorisation (bonitation) of the investigated soils is of very little use as a result of the strong desertification processes in this area.

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