Genesis of Soils with Anthropogenic Influences and their Classification

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Abstract

The genesis of anthropogenic soils is widely studied. Soil changes or the formation of new soil types due to human activities are a basic and major factor about anthropogenic soils. A genetic-diagnostic characteristics of anthropogenic influences and the current processes, which influence the formation of specific by composition, properties and structure soils, has been performed. Generally human activities and the consequent running processes are of a different nature and the reflection of these activities on soil cover is durable and visible. All that provides grounds for anthropogenic soils to be grouped and systemized as a separate soil type with subtypes and to be correlated according to according to FAO diagnostics and classification (2014) and the accredited criteria for soil assessment in the world referential base.

Key words: anthropogenic soils, genesis, diagnostics, classification

Introduction

Anthropogenic soils have been recently formed or heavily modified natural soil formations as a result of human activities. They are poorly researched in our country and in the world as a whole. Anthropogenic influences and processes, which are observed only in agricultural activities (agro-technical, agro-chemical, plant protective, hydro-ameliorative, ameliorative, irrigational and agro-ecological) lead to profound changes in their initial properties and characteristics. At the same time, it is possible to enhance the soil properties and to increase their productivity by well-performed ameliorative activities. In the national classification they are defined as Agrogenic soils on second taxonomic level (Penkov, et al, 1992). In the latest national classification of Bulgaria are examined as independent soil type Anthrosols (Teoharov et all, 2019). In the World Reference Base of soil resources (2014) also are definite as Anthrosols.

Results and Discussion

Genetic-diagnostic and Processing Characteristic of Soils

These soils are spread locally in the whole country and their morpho-genetic characteristics is proved up to establishing and determining their existing peculiarities or problems. On this basis they are separated from the normally developed soils, their

anthropogenic load is investigated and the functions which reproduce their secondary genesis are improved. They differ essentially from initially formed soils, while the modern (anthropogenic) soil-formation process forms new diagnostic horizons (anthric, anthraquic) in the course of time. The large variety and their territorial partition provide the opportunity of general characterization of the conditions of their formation in the framework of the soil type (Penkov, et al, 1992). This must definitely be done at lower taxonomic levels (classifiers), where there is the opportunity of better concretization and definition. The most general anthropogenic influence is manifested in two directions, as follows: - first – changes of natural soils under the influence of different factors and conditions, caused by man, within which the genetic (horizon) composition of the soil profile is preserved, but gradually modern processes start running. They alter the soil properties and thus formation of the anthropogenic horizon is virtually observed; second – appearance of new soils by natural or anthropogenic influences from different (mixed) soil-formation materials, most often of soil or rock origin. In this case the profile has a layered (binomial) structure, which is characterized by a different origin, composition and content. Nevertheless, in both cases the changes are caused directly or indirectly by man and he is the main, basic and primary factor of the line of the anthropogenic soil-formation process. The different agricultural methods, ways and forms of anthropogenic impacts determine the occurrence of different processes, which form very specific in composition, properties and structure soils

1. Building paddy fields, secondary water logging (glaying) processes and the formation of the so called ”rice soils”, which are spread in the Upper Thracian valley (Plovdiv and Pazardzhik region). Old abandoned paddy fields are still observed in the regions of Petrich, Haskovo, Yambol and other southern regions as well as the lower watercourses of the Maritsa, Struma and Mesta rivers on heavy, clayey and hydro-morphed soils (Teoharov, Ninov, 2005) These soils are initially formed in a mechanic way, the surface horizon of the zonal soils serving for enclosure walls of the paddy fields, in some regions called “smelters” because of the water logging during the rice vegetation.

The water layer according to the FAO classification is determined as anthraquic, and the one below as hydragric. According to their essence the newly formed soils are characterized by seasonally (spring-summer) caused water logging and must be determined as secondary seasonally water-logged soils. The soils initially acquire a new structure of the B_1–B_2–C, type and later – the $B_{1(g)}$–$B_{2(g)}$ because of the continuous underwater position during the vegetation period and the running of anaerobic and gleying processes. They are characterized by hydro-morphed stages of development with the occurrence of grayish spots in the wet period and rusty-black ones in the dry period which is a proof of acidification processes, the formation of sesquioxides and the occurrence of oxidation and reduction processes of iron and manganese taking active part in them. They are characterized by a hydro-morphed stage of development with appearance of grayish spots in the moist period and rusty-black ones in the dry one, which are a proof of acidification processes, sesquioxide formation and occurrence of acidification-reduction processes with the active participation of iron and manganese.

2. Terrain terracing surface horizon excavation and the formation of the so called "excavated soils", which are spread over sloping and hilly-ridge areas, where the terrain is leveled and terraced for forestry and agricultural purposes or for road construction, railway

lines, etc. The soils acquire a new structure of the B1–B2–C–D type. According to research by Myanushev and Teoharov (1990), these soils are determined as soils of artificially disturbed (eroded) profile. The authors artificially eroded the profile by excavating layers of up to 60 cm of A and B horizons of leached Leptosols and Calcic Chernozem, i.e slight, average and strong excavation (eroding) by mechanical withdrawal is applied. In their essence these are artificially eroded (excavated) soils of almost all degrees of erosion. Traditional tillage and mineral fertilization for growing agricultural crops have been applied. The soil properties have been studied for a period of 8 years. It has been established that for the period of research there have been no durable alterations of the chemical and physico-chemical properties of the modeled soils. According to the FAO classification these soils are determined on second level as escalated, i.e. terraced soils.

3. Trenching and mixture of horizons determine soils as "trenched " and "aerated" known also as soil ripping and subsoiling. These soils have wider distribution on terrains of vine and orchard plantations. The aim is to create suitable conditions for their root system. During the aeration, which is done until and about depth of up to and around 60 cm substantial alterations occur in the mixed A and B horizons, which lose their natural horizon; profile structure, which acquires a new habitué of new BA, AB, AC, CA horizons, i.e. they are mixed, splintered or inverted. The new (modified) soil changes its morphology, color, structure, contents and properties (chemical, physical, water-physical, physico-chemical, microbiological and biological). The altered characteristics of the particular indicators depend on the degree of mixing of the separate (A and B) horizons. It is very often that the soil profile turns from differentiated into undifferentiated and it inherits the properties of loose (soft) soil-formation rocks (in Regosols, Solonchack, Solonets, Chernozems, Rendzinas) or of the clayey alluvial horizons (Podsolic and Pseudopodsolic). At aeration of Pseudopodsolic soils at depth of 40-50 cm, Ninov and Teoharov (1986) determine alteration the morphological properties, the amount of soil moisture, the mobile forms of iron, aluminum and manganese, thus the soils are correctly named Aric Anthrosols. The term “trenching” is incorrectly introduced into science and practice meaning “trench””or “ditch" originating from the French word “rigole”. A suitable classificatory for these soils is “fractic”.

4. Deposition of alluvial soil materials and overlapping of naturally formed soils. This process leads to formation of the so called Colluvisols (Teoharov, Ninov, 2005). They are distributed in different regions of the country and occupy the lower (accumulative) parts of the relief. Most frequently the alluvia overlap the zone Cambisols and Luvisols at the foot of the mountains - the brown soils at the lower part of the mountain, the arable ameliorated ones - at the depression parts of the fields. The overlapping of natural soils is also implemented through the spread of large amount of soil mass during excavation activities in construction (non-industrial) sites, open irrigation canals, irrigation systems (reservoirs and dams), etc. The main and basic factors for the deposition of alluvial soil materials are the mankind (root cause) and water. Logging and burn of forests are the exact reason for torrents, floods and modern soil formation of layered structure above the old soil formations. Teoharov et al., (1995) have conducted research on soils at the foot of southwest Pirin mountain and have found out diluvia soils of complex two-membered (modern) and relict (on former Leptosols) profile of the following structure: АСк I layer–АСк II layer–ВСК III laye.-Ck IV layer–AB_1k–B_2tk–Ck.

The profile indicates that initially there were erosion processes (A horizon not available) and the alluvial layers were formed thereafter. Similar soils were studied by Duchaufour (1988) at the foot of Jura Mountain (France) and he defined them as poligenetic. . According to second level of FAO classification they are determined as terric.

5. Drainage of hydromorphic soils and their transmission into automorphic.

Drainage is performed in regions of marshy soils such as Gleysols, Histosols, Solonchak, Solonetz, etc. Thus the soils of hydromorphic stage of development pass into automorphic and due to the change in their water status they are called "drained" or "hydro meliorated". According to the hydro geological, soil and other conditions the ameliorations are conducted by a surface (open), subsoil (closed), horizontal or vertical drainage (Kavardziev, 1985).

The drainage systems applied regulate the level of subterranean waters by limitation of the water outflow and elimination of the inflow of nurturing waters. They lead to full water repellency of soil and the level of the water layer is substantially below critical. Processes of dehydration and oxygenation of soil, activation of microbiological processes as well as transformation of organic and mineral substances into mature humus and free chemical compositions and plant absorbent nutrients occur.

Processes of hydromorphic sod formation, sod availability, turf formation, over wetting and claying are completely reduced due to the permanent drainage of the soil profile and can be used for growing agricultural crops. Thus the diagnostic hydraquic, hydragric и histic horizons alter their properties and characteristics and the newly formed horizons and soils, according to FAO criteria are determined as drainic. From ecological point of view the hydromorphic (marshy) soils should not be drained as that would disturb the habitat of the fauna in the whole environmental niche.

6. Excessive fertilization of garden soils with organic manure (muck, compost, etc.), use of non-regulated manure deposits and water contamination.

These soils have been formed due to continuous planting of vegetable and flower crops in yards and greenhouses even due to an exceeding desire of conducting organic agriculture. Imposing agrochemical and agroecological control is mandatory especially in regions of water deficiency (in Dobrudza area) or regions of nearby subterranean water around river arteries, where in both cases well water is used for household purposes. The main disadvantage of soil use in these regions is that in yards manure deposits with protective (concrete) walls for manure storage are not constructed an it is dissiminated into gardens and greenhouses before undergoing the necessary microbiochemical fermentation. The annual organic fertilization combined with frequent watering of the crops planted leads to contamination of well water with organic acids, salts and different chemical elements which manure is abundant of. Nowadays producers use non-decomposed poultry manure, which leads to water contamination substantially above the maximum admittable concentrations. The excessive enrichment of garden soils with organic nutrients is not a good indicator of their qualities and the agricultural products as well as to the health of soil and man. Agrochemical and agroecological control should be additionally conducted on the basis of lyzimetric research of waters and soil. Otherwise garden type of soils of hortic horizon and good agroecological condition are transformed into organically overloaded and contaminated ones having acquired plaggic horizon and degraded balance.

7. Soil contamination from plant protection and mineral fertilization.

The annual conduction of plant protection for preservation of plants of diseases and pests and their nourishment with mineral fertilization lead to the accumulation of residues (contaminators) in soils, agricultural products and people. Insufficient conservation protection and guarding of plant protection preparations left in storehouses and sites after the system change in agriculture have reflected in a negative way the local anthropogenic and agrochemical soil load. Copper accumulation in the surface horizons of massive fields of vines, orchards, cereals and vegetable crops due to the use of copper preparations and substantial qualities of nitrogen and nitrogen compounds in the lower horizons and waters have been established and it is due to unbalanced application of nitrogen and acidic fertilizers.

The soil horizons are defined as anthrotoxic because of the genesis of their formation. Te strict observation of Bulgarian State Standard of preparations and the nitrite directive are not sufficient for extinction of these processes. The application of lyzimetric methods for establishing of the soil contamination is of specific importance.

Classification:

1. Secondarily superficially wetted - Anthraquic-Hydragric – characterized by a excavated for ridges of rice fields surface horizon and a newly formed seasonally over wetted anthraquic хоризонт with depth of ≥ 15 cm и hydragric horizon of depth ≥ 10cm, gleying processes - indicators of a glayic хоризонт with yellowish-brown, reddish-brown and iron-manganese spots.
2. Artificially eroded - Escalic – they have an excavated surface horizon and a newly formed one turned into a surface one of transient of AB, (B), Bt или AC characteristics of the natural soil with qualifier anthropogenic terrace (escalic) и anthric properties.
3. Aerated - deeply ploughed (Fractic) – they have an altered horizontal profile, anthric properties and fractic qualifier, deepening up to 40-50 (60) cm by roll over, mixture and breaking of soil and degradation of its initial structure.
4. Colluvisols - buried (Terric) - they have a alluvia layer of soil with a depth of ≥ 5 до ≤ 50 cm and formation of a terric horizon, covering the original (buried soils).
5. Hydromeliorated - drainedи (Drainic) – they have a drained hydromorphic soil profile, turned into an automorphic one through drains. Their qualifier is drainic soils.
6. Organic - garden (Hortic) - with a hortic horizon, depth of 20 cm, organic carbon ≥ 1,0 %, conditions for fast turfing with acid grass varieties.
7. Anthrotoxic - contaminated - with strongly anthric properties and a qualifier anthrotoxic. They contain toxic (above maximally admitted concentration) substances of mineral fertilizers and plant protection preparations.

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