Advances in Environmental Biology, 9(23) October 2015, Pages: 368-376

AENSI Journals

Advances in Environmental Biology

ISSN-1995-0756 EISSN-1998-1066

Journal home page: http://www.aensiweb.com/AEB/

Successful and Unsuccessful Stories in Restoring Despoiled and Degraded Lands in Eastern Europe

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ARTICLE INFO

Article history:
Received 28 September 2015
Accepted 30 October 2015
Available online 24 November 2015

Keywords:
Soil compaction, Alnus glutinosa, Height, Root volume.

ABSTRACT

Worldwide, there are over 2 billion hectares of degraded and deforested land. These places have lost their ability to provide nature's benefits to people and the planet. The complexity of land degradation forms imposed reestablishment techniques' identification of lands' economical, social and cultural potential through rehabilitation, remediation, reclamation, mitigation and restoration measures. Several restoration projects were implemented in Eastern Europe, part of them being successful while other not so successful. Understanding what went right and what went wrong are key elements for future restoration projects. However, there are enough signals that in some cases a little attention was paid to sharing and/or observing restoration project results mainly because each project was considered to be unique, not connected to other similar cases or because of a mentality which considered that sharing negative results is shameful. This paper gathered and put together several restoration, reclamation and remediation case studies from Eastern Europe, stressing both positive and negative results.

To Cite This Article: Rares Halbac-Cotoara-Zamfir, Hikmet Gunal, Martha Birkas, Teodor Rusu, Radu Brejea., Successful and Unsuccessful Stories in Restoring Despoiled and Degraded Lands in Eastern Europe. ***Adv. Environ. Biol., 9(23),*** *368-376, 2015*

INTRODUCTION

General considerations:

Land degradation affects large areas of Eastern Europe where social, economic and political changes generated high pressures on land resources, all of these under the global climate change. There is great need to restore existing despoiled and degraded lands and to combat increasing desertification. In Eastern Europe can be identified several main categories of despoiled and degraded lands: drylands, lands with water excess, waste rock dumps, abandoned lands, deforested lands, polluted lands. Environmental degradation resulted from activities like land-use change, resource extraction, waste deposits, aggressive deforestations or indifference and disinterest which alter numerous functions and services provided by ecosystems.

Land degradation is defined by the FAO as a "process which lowers the current and/or potential capability of soil to produce goods and services". This definition focuses more on soil degradation processes which is considered to be the most significant land degradation processes.

The main feature of land degradation – agreed by most of the researchers – is diminishing land quality and productivity. In this sense, we need to mention here the definition proposed by Stocking and Murnaghan which states that land degradation is a composite term describing how one or more of the land resources changed for the worse. We discuss here about "an action" which may take us to a preliminary conclusion: land degradation is not a state but a process. However, applying modern techniques for land works and considering the state-of-art in land use, can be considered this progress degradation? On the other side land development works may have both positive of negative effects. In the last case, can we discuss about negative land development? If we will analyze deeper the meaning of „degradation", we will see that degradation is not meaning „removing" but „not having" or „acting in opposite to". In this way, land degradation will not mean the loss or decreasing some of its qualities but a land without necessary (requested) qualities or with qualities which are not in concordance with the expectances from this land.

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Millennium Ecosystem Assessment document (2005) defines land degradation as being “a persistent reduction of biological and economic productivity” so, in conclusion, the reduction of ecosystem services. We find here a problem of “expectancy”. What do we expect from an ecosystem and what do we get. The state of “degradation” is very subjective considering that is influenced by human expectations regarding ecosystem performance as well as by humans experience in knowing and understanding the system [13,23,33].

According to UNCCD, land restoration means “reversing land degradation processes by applying soil amendments to enhance land resilience and restoring soil functions and ecosystem services” [40]. But what does it mean “land restoration”? Oxford dictionary gives the following definition for restoration: restoration is the action of returning something to a former owner, place, or condition. The Society for Ecological Restoration defines restoration as “the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed”.

We can say than that land restoration can be understand by assisting land to regain the qualities which we suppose that it had it and which are useful for us. Considering that degradation process is subjective, restoration process (acting as opposite to degradation) is also subjective. Regarding strictly from a practical perspective, the followed aim in restoration projects is to regain the so much needed lands ecosystem services largely through revegetation efforts.

In this paper the authors will present several case studies from Eastern Europe as it follows: drylands reforestations, bauxite mine restoration, abandoned lands and lands affected by water excess.

1. Re-greening despoiled drylands:

According to United Nation Convention to Combat Desertification (CCD), desertification is: “Land Degradation in arid, semiarid and subhumid areas resulting from various factors, including Climate Variations and Human Activity”

Several countries from Eastern Europe are facing the desertification. In 1988, Nelson mentioned that „desertification is a process of sustained land (soil and vegetation) degradation in arid, semi-arid and dry sub-humid areas, caused at least partly by man” and which „reduces productive potential to an extent which can neither be readily reversed by removing the cause nor easily reclaimed without substantial investment”. Soule and Reynolds state that desertification principally consists of three major components:

- Meteorological (drought, atmospheric dust, air temperature, elevated atmospheric CO_2, variability of precipitation)
- Ecological (nutrient cycling, plant growth, regeneration, mortality, microbial dynamics, plant cover, herbivore life cycles, evapotranspiration)
- Human dimension (loss of habitat, fragmentation of habitat, overexploitation, spread of exotic organisms, air, soil and water pollution, climate change).

In a much more complex approach, desertification should also include in its definition and other concepts as land capability, land sustainability, vulnerability, resilience and carrying capacity.

Romania has a significant rural population and one of the largest agricultural sectors in Eastern Europe. The sustained efforts made in achieving an intensive and productive agriculture were materialized by implementing land reclamation and improvement systems (irrigation and drainage works) but, unfortunately, also by severely deforestations.

Large areas from southern Romania (where an intensive agriculture is practiced) are exposed to high temperatures and benefit on few precipitations. In these areas Thornthwaite aridity index increases up to 65% [1]. Desertification was more and more obvious on these drylands. More than 100000 ha are covered by sand dunes representing the so called Romania’s Sahara.

This situation is the result of a series of wrong political decisions starting from the end of 1950’s. The communist regime intended to create in southern Romania large agricultural areas covered by irrigation systems. Two decisions of Romanian Government (273 and 385 from 1962) created to legislative path for clearing the protection belts. The acacia forests belts which stabilize the soil in this area were cut (9000 ha until 1970) and large energy intensive irrigation systems were implemented. The sand dunes which were previously stabilized became mobile leading to imbalances in local environment. This situation alerted the authorities which permitted a new stage of forest plantations covering around 1600 ha [25]. These measures were considered as sustainable for an intensive agriculture by communist authorities. However, from an economical perspective, the costs assumed by this large irrigation system (covering more than 75000 ha) were not feasible considering the market and the subsidies policy.

The fall of the communist regime in Romania at the end of the 1989 and the beginning of a period of transition from a central planned to the market economy lead to a total lack of care for the protection forest belts, an excessive fragmentation of land and the emergence of a large number of subsistence farms without the capacity of implementing sustainable land management measures. At the same time, after 1990s all the irrigation works kept degrading, negatively affecting soil quality and land productivity. Various components of irrigation systems were given for administration to several different public and private institutions which presented a lack of communication between them and without a coordinating responsible.

What was considered to be 30 years ago a sustainable measure of land reclamation and improvement – the implementation of large irrigation systems – to the detriment of environment conservation (forests), proved to be finally a wrong measure from several reasons: - all these large irrigation systems were high energy consumers requiring high costs for operation; - the original ecosystem (before deforestations) provided the necessary conditions for the formation and manifestation of “Baltaretul”, a local wind, warm and wet, which used to bring the necessary rain; - the crumbling of farming land in small and very small farms, whose owners have little money for practicing a sustainable agriculture and continuing to use irrigation.

On these despoiled drylands, winds are bringing with them aeolian deflation. Wind erosion is a destructive degradation process in Romania but also in Southern Central Anatolia and Northeastern Turkey which are the driest regions of the country. Slight to severe wind erosion affects almost 46600 ha land in the Central Anatolia. Introduction of heavy equipments to fragile soils of Konya Basin turned majority of lands into a desert in very short period of time. Improper agricultural practices lead to a rapid desertification in Karapinar region where the parent materials of soils were mainly loose detrital/lacustrine deposits which is very sensitive to long-lasting wind activity [34]. The use of disk ploughs which overturned and broke the soil aggregates increased erosion in the region where fallow-cereal rotation system was implemented, and the district is located in an active wind zone [48]. Vegetation cover has been removed either due to the extensive grazing of sheep and excessive cutting of fuel wood from fragile range lands. Wind erosion in time decreased the fertility of agricultural soils, disturbed the daily life of dweller and forced to leave their homes. People in Karapinar had nothing to do but leaving their homelands due to the severity of wind erosion in the region.

Karapinar name is matched with desertification word in Turkey. Since many successful prevention and mitigation measures were implemented in the region in the past, people thought of Karapinar when addressing the desertification phenomena [34]. The conservation practices to halt the problem and reverse the degradation have been started in 1962 by Soil Water Conservation and Irrigation Service of Turkey and continued for 10 years. The efforts covered the 16000 ha [16].

In the 1960s, the moving sand dune system was stabilized by planting and by controlling grazing. This programme, started in 1962, has proved a success. After prolonged efforts, desertification in Karapinar has been initially reversed, with keeping away the human intervention by being enclosed with wire fence from vulnerable lands. After ten years of extensive work conducted by Governmental offices, the situation has been overturned in 16.000 ha of the region.

Re-greening efforts has initially concentrated on stopping the progression of sand dunes by wind breaking to prevent devastating effects, and establishing natural vegetation with herbs (*Agropyron cristatum*, *Onobrychis sativa*, etc.). Physical measures such as wood and bamboo curtains (reed), shrubs fences, rocks and etc were placed against prevailing winds in the direction perpendicular. The wind breaking measures prevented wind drift of soil move, reduced water loss in soil and plants, prevented plants from negative mechanical effect of wind, prevented snow transport [2].

Since the destruction of wind erosion is inversely proportional to surface vegetation cover, establishing a vegetation cover had a vital importance to reverse the situation. Plants selected for plantation were dry and hot-resistant which were suitable for the region's climate and soil characteristics. Weed seeds used in grassing the area between the wind breakers were collected from the pastures around the region [47]. In a short period of time, mobility of sediments on dunes were reduced with fast growing xerophytes and trees and grasses started springing up on dunes. The success in the region proved the importance of local species in re-greening the degraded land. Acar and Dursun also recommended using a combination of plant species to prevent the damage of pest and diseases to the particular plant species. Along with the mechanical benefits of plant cover as breaking the winds, plant residue in time increased soil organic matter and leaded to improve soil structure.

Afforestation studies started to maintain long lasting conservation of the area. The trees selected for afforestation were drought resistant such as oleaster (*Eleagnus sp.L*), acacia (*Robinia pseudeaccacia*), ashen (*Fraxinus sp.L*), elm (*Ulmus sp.L*) and maple (*Acer sp.L*) [48]

The rehabilitation measures in protected land has obviously resulted to the development of vegetation cover on soil surface when compared to the surrounding area where excessive grazing and conventional agricultural practices taken place. The productive conditions of protective lands caused less salinity problem deriving to a higher organic matter content of soils.

In Romania a key element in restoring degraded despoiled lands was the establishment and development of Associations of Local Forest Owners. This way, the members of ALFOs are eligible to access resources for afforestation and reforestation from different national and European funds.

From 2007, these ALFOs developed forestry activities in southern Romania (Marsani area) on an area of 1100 ha, the main specie planted there being Robinia pseudoacacia which has the ability to improve degraded soils by N fixation and by adding organic matter [10]. Another role of this specie is to stabilize the soil surface and prevent the reformation and reactivation of dune sands.

Other areas severely affected by drought and located in Southern, Eastern and Western part of Romania required forest belts to prevent land degradation. The establishment of these forest belts was based on studies involving the analysis of several factors as lithology, topography, climate, hydrology, soil as well as the human factor [12]. Several categories of tree species were identified according to their importance and role played in the forest belts: main or basic species (which ensures the best protection, produces quality wood and have a height between 15 and 20 m), secondary and mixed species (with a height between 6 and 10 m, produces firewood and provide only a medium protection), shrubs (ensuring lateral protection as well as shelters and food for animals having a height between 1 and 5 m).

2. Agronomic and economic effects of land abandonment:

According to FAO, land abandonment is a process, whereby human control over land (e.g. agriculture, forestry) is given up and the land is left to nature. Land abandonment has a multi-dimensional character being identified the following main causes: natural constraints, land degradation, socio-economic factors, demographic structure, and institutional framework.

Cultivating agricultural land is the main way to capitalize the natural resources of land fund. Beginning with 1990 land resource in Romania was used incomplete on various reasons and justifications, which led to a series of changes in the soil, changes of agronomic nature and with consequences evidenced in economic effects. In this context, a series of researches aimed to determine the effects of agronomic and economic abandonment of arable land, from 1990 to 2010, through a series of analyzes related to soil fertility from cultivated and abandoned plots, for a period of 20 year old. Research continued with the crop assessment from both types of plots, between 2010 and 2014, namely by assessing the economic effects.

The researches were conducted in central-western part of Romania in two locations (Frata and Aschileu Mic localities) on lands with relative small slopes (5-7%) between 2010 and 2014.

Annual cultivation of land reduces the humus content by mineralization and due to erosion processes. In an abandoned land for 20 years, the humus content increased especially on 20-30 cm depth from 3.67% (on cultivated land) to 3.8% (abandoned land) for faeoziom respectively from 2.39% (cultivated land) to 3.33% (abandoned land) for luvosol. Humus reserve on 0-45 cm depth increased in 20 years in the abandoned land with 10.54% on faeoziom and with 26.83% on luvosol. The clay content doesn't present significant changes. Only in the case of luvosol, on 0-10 cm depth, it was observed a decrease of clay content from 30.6% (abandoned) to 29.2% (cultivated). Soil structure hydrostability degree increases on abandoned lands on the entire research depth which determines a new soil loosening, at surface but especially in sub-arable where total porosity increases from 48% (cultivated) to 52% (abandoned) on faeoziom, and from 44% (cultivated) to 51% (abandoned) on luvosol.

The abandoned lands for 20 years have a reaction specific to soil type and it was observed a tendency of acidification on cultivated land (luvosol especially which has a lower buffering capacity where the pH decreased from 5.98 (abandoned) to 5.05 (cultivated)). The degree of saturation in basis and the capacity of cationic exchange are correlated with soil pH.

The productions obtained by reintroducing in agriculture the abandoned lands are influenced by soil conservation conditions but mostly by land status from seeds' reserve point of view.

3. Waterlogging – the same problem, different approaches:

The Carpathian basin, considering the geological formation and geographic location and the climate threats is continuously exposed to water-related phenomena that are water surplus and deficit. Four main climate induced risk factors can be formulated from the optimistic and the pessimistic scenarios for the second part of the 21st century that are milder winters with more precipitation, warmer and dry summers, extreme fluctuations in the annual distribution of the total precipitation and increased numbers of stormy incidences. However the events afore-mentioned have already been prevailed the regional weather conditions. The tendencies in the precipitation sums, the number of precipitation events with threshold values, especially the more intense rains shows tendencies having serious effects on the available water amount and the surface water balance [37]. Damages and hazards associated with water surplus appear in the soils or on the surface are expressed with various phrases e.g. excess water inundation, inland excess water, flooding, water-logging, water ponding, water saturation, and over-moistening [37]. However, authors indicated the differences, both fundamental and nuanced interpretation among the phrases.

Inland excess water is a serious hazard in both Hungary and Romania. The Hungarian area endangered by excess water covers about 4.4 million ha, that is 47% of the country's territory [29,21]. In particular, the high exposure to the water hazard occurs at a time following a long-term rainfall activity. Romania's territory is under the influence of 3 hazard types (geomorphologic, hydrologic and climatic) with direct influence upon soil humidity. Soil humidity excess affects in Romania more than 8.5 million hectares (4 million hectares affected by temporary humidity excess from precipitations, almost 2 million hectares with permanent humidity excess caused by high water-table level, and about 2.5 million hectares with humidity excess from water courses infiltrations or caused by flooding) from which about 52% requests direct measures of drainage.

Alternation of the extreme water situation, both surplus and shortage has really been typical phenomenon in Eastern part of Hungary and Western part of Romania, that is in the Great Plains for a long time. The water-induced damages are found to be more serious considering the basic (direct) adverse effect and the further indirect severe consequences.

Natural factors influencing inland excess water are hydrometeorogical (e.g. abundant rains), topographic (e.g. heterogeneous microrelief) and hydrogeological (e.g. impermeability of soil horizons) have closely investigated [28,29,30,17]. Regulation of the river Tisza (1846-1908) has truly been found the possible best solution during decades considering the water threatened area. On the Romanian side, the most important factors leading to water stagnation are similar with those identified in Hungary. They are associated with geological-lithological conditions, the soil and hydrogeological conditions, which together determine the appearance of flood and water excess stagnation on plains and plane plateaus.

Objective of the regulation was to exempt the Great Plain from the floods and to create the security for the river runoff and the navigation. However, experiences gained in the last decades that require additional fact-finding in this relation. As Kovács [20] warns, owing to its geographical location, the Tisza region faces recurrent floods. In addition to floods, inland waters also pose a serious challenge. The hazard of inland waters has risen significantly.

Human factors, including flood control and state of canals in the threatened area are further important factors. Effectiveness of the remediation on water afflicted arable fields is reasonably depended on the land owners’ competence.

Soil attributes, mainly infiltration and storage capacity and soil physical state are also significant factors for the formation of inland excess water. Várallyay stressed that soil is the largest potential natural water reservoir in the Carpathian basin. The problems had already well evaluated and published (e.g. by Pálfai and Rakonczai *et al*.) and, considering the water hazard reality both in the basin and the Tisza Plain, the research will probably be continued.

However, further and peculiar soil phenomena were found at the time of the monitoring and assessing water-logged fields. Considering this, aim of this study is to present findings that may clarify causes and consequences of the water inundation.

In this study, results, obtained from investigation of the water induced damages cited and discussed. Investigation of the water-logging based on long-term experiments [14,8] and field monitoring and soil state measuring [7,8].

Site of the investigation were affected by water stress moderately, that is in micro-region at Mátraalja, and seriously namely in South and South-east part of the Great Plain.

Mechanisms of the soil structure during and following water-logging may more or less be known, however their interaction seems complicated in situations. There are specific aspects when unforeseen reactions can be found.

Differences in soil condition following a natural and a compact pan induced water-logging:

Natural induced water-logging shows three genetic types (Rakonczai 2012), that is accumulative (precipitation accumulates in the deepest area of the terrain), the upwelling type when the groundwater arises at the surface, and the inundation generated by the transportation channels. The upwelling type of the inland water deserves greater interest in SE part of the Plain, where paleo-channels of the river Maros are buried. As Szatmári and Leeuwen noted, in this micro region the coarse sediment is not preventing but rather providing the opportunity for the development of inland water. The formation of the upwelling water often reminders river bed meanders e.g. in the arable field at town Mezőhegyes.

We found that the upwelling water raises the soil at first, then expands on the surface, soaking and silting the soil through, and as the water level drops gradually, soil slumps alike. Degree of the soil settlement depends on the period of the water stagnation and the level of soil degradation. We found wet crumbs below silted and crusty layer of soils were free from tillage induced compacted pan. However, upwelling water is often transported salts from the deeper soil layers to the top layer both in chernozem and meadow soils that have natric or salic horizon.

Rainwater accumulation in larger quantities above the compact layer results in further damages. While compact pan limited water infiltration in soil, and owing to this water that accumulated above pan layer has considerably saturated the soil and disintegrated the crumbs. Moreover, the smallest particles (mainly dust) and mineral colloids that leached to the pan layer by water have strongly adhered to the existing pan. This thickened layer can only be loosened gradually.

Soil deterioration by siltation after a short-term and long-term water damage:

The silting is the outcome of the dust formation in recurrent rainy periods and after-effect of this phenomenon is the crusting in warm and dry period. The degree of the silting, out of the precipitation depends on the soil quality (that is degraded or preserved), and on the covering state of the surface [8]. Disintegration of soil particles leads to the displacement of small soil particles forming a more continuous structure (mud film) that creates a surface seal and later on a surface crust. Authors ranked the degree of the damage in soil surface namely <10 % is slight, and 31-50 % is risky, and 51-70 % is serious and 71-100 % is very serious. Rain stress causes different degree of the damage and that can easily be remedied to a certain degree. However siltation caused by inland water inundation or flood can only be remedy long-term.

Consequence of the dust sedimentation to the nearest compact layer:

Dust, formed in soil top layer has become a noteworthy phenomenon considering the long-term effect of the clod-braking tillage processes and the extreme climate. Some parts of the dust remain in the surface as a silt film and other parts leach into the soil and agglomerate to the nearest compact layer and increase thickness of this layer [8].

The sediment dust adhered to the soil mineral particles constitutes a most firm condition and shows highest penetration resistance of the soil profile [7]. Bottlik *et al*. found close coherence between dust ratio formed in the surface soil layer and the extension of the soil compaction. Birkás *et al*. proved that compacted layer is considered to be serious when contributed to the water stagnation above the consoled layer and the compacted segment extends of 40-50 mm. This phenomenon was found to be a real impediment of the soil remediation following the soil drying.

Soil settling due to the water stress and stagnation:

Soil settling has become a typical phenomenon in the water afflicted soils. A quite intensive settling effect was found on degraded soils and on soils having low organic matter content [8]. Authors outlined that the most severe settling was really occurred on soils where degradation processes has already been exposed. Authors ranked the degree of the soil settling as compared to the soil state at time of sowing. In this way degree of the phenomena was ranked namely <15 mm light (normal), 15-25 mm conspicuous, 26-45 mm is risky, 45-75 mm serious, and > 75 mm very serious.

Surface crusting following water stagnation:

Crust development follows several stages under the effects of cumulated rainfall and following water stagnation. Bottlik *et al*. [8] ranked the degree of the crusting by the ratio of the damaged surface in a unit area, and stated that <10 % is slight (negligible), 11-30 % is conspicuous, 31-50 % is risky, 51-70 % is found serious, and 71-100 % is very serious. Crust formation was found to be very serious in soils afflicted by water stagnation in long-term.

As it known the crust is typically appeared in acidic, alkaline, and clay soils. However a serious crust has occurred in soils desiccated rapidly after a long-term rainy period when soil silting was unavoidable. Citing the ranking by Bottlik *et al*. (2014) the degree of the crust extension may be slight (<5 mm), conspicuous (6-15 mm), risky (16-25 mm), serious (26-35 mm) and very serious (> 35 mm). We may state that only one degree can be found after long-term cover of the inland water that is very serious one.

Remedying soils damaged by water:

Our proposals are based on findings derived from long term experiments and from monitoring on soils that are suffered from inland excess water [7,9,18]:

1. Actions on a national or large regional level:

- Surplus water to be found even today in water-logged fields is a factor practically preventing tillage, so it should be drained and stored in a safe and reliable way.
- The areas damaged by water need to be mapped and documented – specifying those severely, moderately and less seriously damaged areas – for the required remediation plans to be worked out. We may note that there are well documented and mapped areas, however those have regrettably ignored from the immediate actions.
- The alleviation of damage caused by permanent inundation, traffic-induced damage and the damage caused by tillage carried out under the force of necessity should be developed into an annual programme.
- The remediation programme's tasks pertaining to soils should be specified: these should include organic matter conservation, the application of tools causing less damage to wet soils and the provision of financial assistance for the purchasing of such tools.

2. Tasks relating to farmers:

- An inventory of the various forms of water surplus damage relating to extra water – waterlogged soil surface, soil settlement, structure degradation, silting, decrease in workability – should compiled, in an order by the gravity of damage.

- Recognition of factors increasing climate damage (soil condition, wrong cropping practices) is required in order for the remedial actions to be worked out.
- Exploiting the possibilities of remediation in the case of tillage in the season: e.g. where primary tillage could not be carried out in the autumn, techniques limiting the soil's recovery (such as ploughing and disking) should be avoided in soils of clay contents exceeding 35-40 % and in gley soils; techniques minimising the soil condition damage should be applied in the seasons instead of the usually applied techniques.
- Application of stubble tillage techniques encouraging the recovery of the soils, making use of the protection afforded by surface cover (40-50 % of the straw).
- Encouraging the microbial activity required for soil recovery by mixing crop residues (50-60 % of the straw) into the soil.
- Exploiting the soil remediation effects of the application of green manure (producing smaller and more manageable masses instead of aiming at producing large green masses).
- Exploiting the effects of stubble treatment encouraging weed emergence and the weed controlling effects of stubble treatment. The mulch covering the soil after chemical weed killing supplements the available surface protection.
- The traffic-induced damage caused in wet soils can be alleviated by loosening, with reduced energy input in fields after stubble tillage.
- Loosening the layer limiting water transport in the soils damaged by pan formation in wet conditions (deepening the biologically active layer).
- Application of deeper loosening with longer lasting effects where the layer concerned is sufficiently dryer.
- Extending the period of surface protection until after primary tillage leaving a mulch layer (with cultivator), without creating a compact water-impermeable layer.
- In order to improve the bearing capacity of the soils and to prevent crumb degradation, organic matter preserving should be prioritised in the case of every treatment, particularly in the case of primary tillage.
- To maintain the soil's recovery processes ploughing wet soils in the summer and ploughing in the late autumn is not recommended.

Good decisions require knowledge of the condition of the soil across the entire field, to enable accurate assessment of the damage caused during wet soil state, and to be able to critically analyse the whole year's soil remedial treatments after sowing.

4. Landfills reconstruction in the former mining areas:

Few decades ago, mining activities were very important in developing human communities as well as for economical growing. Unfortunately, the resources exploitation was carried out in many cases in an unsustainable manner leading to environment contamination. The efforts for lands remediating and restoration assumed high financial efforts and work volumes.

In Romania, the increased tendency of stopping mining activities since 1990 has led to the abandonment of numerous mines without proper restoration efforts.

The researches on restoration of degraded lands by bauxite industry were performed starting with 2005 in western Romania, Piatra Craiului Mountains. The bauxite exploitation ended in 1998 and six years later started an extensive restoration work based on planting acacia trees in leveled area and spruce in the higher zones.

Acacia and spruce seedlings were planted at distance of 1 m in a row and with 2 m between rows. The holes had dimensions of 40 x 40 x 40 cm, and at every hole there were used 6.0 kg of manure. To ensure a high success rate for the saplings, immediately after planting, they were wet with 16 liters of water each. For acacia tree were used also fertilizers including both organic and mineral fertilization. The organic fertilization (manure 30 t/ha), respective mineral fertilization ($N_{120}P_{120}K_{120}$) determined highly statistically significant increases in plant growth compared to the unfertilized control both in 2006 and in 2007.

The restored area in terms of coverage with herbaceous vegetation the various areas of the former bauxite quarry increased from one year to another. Thus, in 2006 in the leveled area were identified 13 plants/m^2 in the flattened depression, 7 plants/m^2 in the high leveled area, 8 plants/m^2 in the interval equipped with soil erosion control works and 3 plants/m^2 on the slope without erosion works, but with the spruce planted on the direction of the level curves. In 2007, the number of plants in these locations increased to 23 plants/m^2, 14 plants/m^2, 75 plants/m^2 and 5 plants/m^2.

Researches made in the analyzed area established that the covering degree with herb natural vegetation is influenced by the hillside slope; in 2013 the covering degree was of 89% at 20% slope, 73% at 76% slope and 64% at 44% slope. Soil erosion control works on 10% slopes determined a bigger covering degree and a smaller cumulated soil losses in comparison with the slopes without soil erosion control works: 96.6% vs 21.2% and 6.6 t/ha vs 127.8 t/ha.

The results of conducted researches emphasized the need of the soil erosion control works (planting, fertilizers, mattresses, etc.) in the land restoration process.

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Conclusions:

Land degradation is a very complex system involving different types of interactions and links between processes, generated by causes and affected by factors. If we want to reduce the extent of land degradation, scientifically robust and accurate information is needed for a consistent monitoring, for establishing priorities in land restoration and for adopting appropriate solutions. For a better understanding of land degradation we must continue our researches on the links between social and economic factors, we must better understand the factors affecting the ecosystem services and we must involve all the stakeholders bridging together the people with know-why and those with know-how.

Knowing both the successful and not successful cases of restoring despoiled and degraded lands can represent the best solution to develop new specific solutions for land degradation, tailored measures for land restoration. We will also have to better understand the land's value to society considering the continuous demand for new lands.

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