

THE SOIL USE IN RURAL AREAS

Abstract: The soil is becoming one of the crucial problems for the Nature and its proper functioning due to many reasons of its misusing or abusing. The market forces in agriculture are rapidly deteriorating the soil wild biodiversity and its capacity. The importance of the soil and its wild biodiversity, related to the water system and other ecological functions, are presented in short outlines. Understanding the soil quality means assessing and managing soil that it functions optimally now and is not degraded for the future use. Evaluation of the soil quality in a different manner serves for agriculture embetterment and for keeping water and habitat organisms quality. Further, the instrument for soil protection policies implementation are given such as regional development planning, incentives for regional integration, social impacts oriented actions, education etc. The further soil decay will generally jeopardize the whole idea of sustainable development. Therefore it asks for more efficient understanding from decision makers, producers, but from planners as well.

Key words: Soil, agriculture, sustainability, water management, rural areas

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Introduction

Four elements in the Nature had been extracted by Leonardo Da Vinci (Da Vinci L., 1959) as the key components of the Universe: water, land, air and fire, mutually interconnected and dependent on each other. Land occupies the center surrounded by water; then comes a layer of air, and enveloping the whole is the fire (sun). Da Vinci concluded that “encircling Air envelopes and circumscribes a more complicated structure of land...suspended between the elements of water and fire” (Da Vinci L., 1959). The water he estimated as the driving force of the Nature. The Man as adaptor and user of the Nature he didn't mention in this context. Marx commented it by an idea that “by acting upon the Nature Man directly acts up to himself” (Marx K., 1949). All four elements are thus understood as being under Man's control, even the Sun i.e. its impact to the Earth. The modern history (XX-XXI century) proofs that Man's controlling is often unconscious of its consequences to some of the elements and ultimately to the Man himself. Nowadays, after so many

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evidences, threats and challenges the Man is becoming more aware of the harmful consequences and possible catastrophies in the near future, and has started to articulate new ideas and policies trying to save himself or the future generation; but is it enough or, maybe, too late?

The land as one of the key natural elements is also one of the key victims of Man's acting upon the Nature. At the beginning it was given to the Man and now it is overwhelmingly taken, or even raped by him, used, overused, misused, and abused in so many parts of the globe.

The expansive growth of global population, with 6.5 billion stomachs to be fed daily, the explosive growth of the world economy, not evenly distributed and the lack of proper understanding consequences of different land uses, jeopardizes the whole of the Nature and some of its driving forces, such as is the Water (Da Vinci L., 1959).

Threats to the soil

In many parts of the globe, especially the developing ones, the success of a developing region is still measured by the rate of economic growth and the speed of development with no comments on harmful consequences to the Nature. Gains are calculated without measuring losses in environmental quality indicators. But situation is getting worse as times goes by. The social implications have been neglected, one of them being the fact that disseminating soil use for agriculture to help poor people means increasing the food production for 50-60 % in only thirty years of XXI century (UN, 2000). The cultural level of a nation or a region is therefore becoming the major driving force to redirecting orientation of social groups and, in many cases, now prevailing towards the new idea where economy, without certain social and ecological context, cannot be estimated as a paramount goal of development any more. The same is with use of resources where criteria of sustainability is becoming prevailing issue, unfortunately, too late in many cases.

Due to economy and market forces the nature and natural resources are rapidly losing their capacities with soil as one of the capital elements for the Mankind existence being inevitably under the most dangerous pressures. Attached by sealing, different kinds of agricultural activities, superficial land use planning, natural dangers induced by human activities, the soil has been progressively losing wild biodiversity. The rate and technology of soil use for agriculture is therefore becoming the major threat to the soil natural quality and henceforth the threat to its feeding capacities.

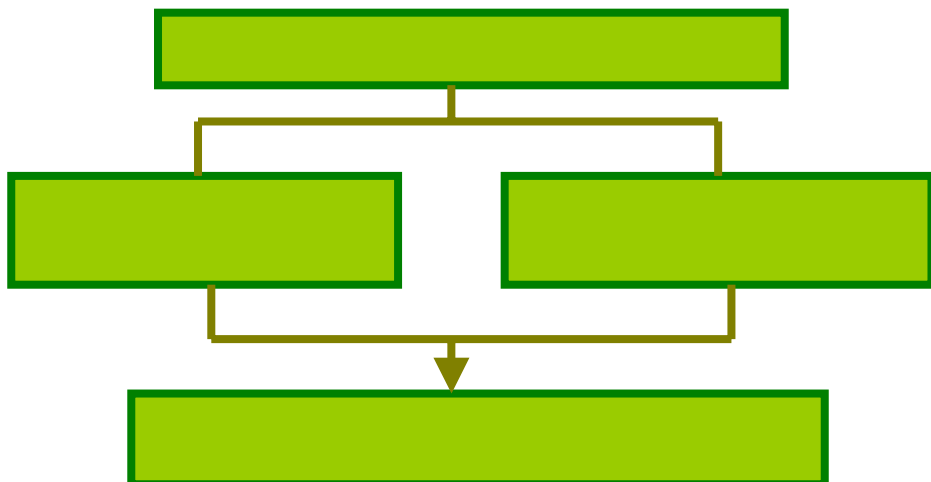


Fig. 1. Threats to the soil in rural areas

The relation to the land use, and to the soil use in particular, has been changing through the history. Firstly, understood as given to the Man by the natural order, the soil had been endangered, changed and shifted (eroded) mostly by water and wind and slightly by sealing. Later it was progressively exploited in direct correlation with urbanization and technological progress, growth of both state and market economy, with specific misunderstanding that the land has to be primarily planned for sealing[†], constructing and for agricultural uses. The two confronting principles on land use, as a basis for land use and building regulations say:

1. Land is generally free to be used for building, if not forbidden by planning regulations;
2. Land is generally forbidden to be used for building except where allowed by planning regulations.

A number of building acts are still in concordance with the first principle. Thanks to this, the increasing number of population on the Earth progressively threatens quality of soil which is consequently becoming irreversible resource either by population, or by sealing, compression, erosion, contamination etc. By this only, 25 % of the world species could happen to disappear in 50 years. 10 % of official protected land on the Earth does not count with agricultural land, which “has been constantly ignored by conservationists, assumed to have habitat conditions so radically modified from the original state that their contribution to biodiversity conservation could be marginal” (Mc Neely J., Scherr S.J., 2002). The negative impact of improper agriculture to ecosystems and soil is evidently becoming increasingly obvious, with its increasing production and its intensification. Humus has been lost at a rate of cca 25 mil. metric tons/year for the last 10.000 years, 300 mil. metric tons/year for the last 300 years and 760 mil. metric tons/year for the last 50 years, with 16 % of the original stock of organic soil carbon lost so far (Costanza R., 1992).

The confrontation of the wild life and agriculture is evident in the vast quantity of forests torn down for agricultural reasons and for firing or wood industries changing rich natural habitat and its biodiversity into simplified forms of pastures and agricultural fields. The impact to the biodiversity is enormous in both cases: agriculture and forestry. 5-7 million ha of land, formerly in cropland (0.3-0.4 % of the world arable land) are abandoned annually due to severe soil degradation (Rožanov BG et al, 1999).

As a conclusion, “diverse natural ecosystems have been converted into oversimplified ecosystems led to pollution of soil and waterland. The modern commercial agriculture has had a direct negative impact on biodiversity” (Mc Neely J., Scherr S.J., 2002) (ecosystem, species and natural diversity). This theoretical evidence, being a basis for many world declarations, is not induced into the practice of many regions around the world, not to mention the ones in developing countries even in the middle of Europe today.

The meaning and importance of the soil

The soil, as a thin layer of the Earth, substantial for the whole life on the planet, is understood and, henceforth, treated in different ways. The soil quality is taken for granted by consumers who unconditionally expect to get healthy, plentiful and affordable food out of it. Opposed is idea of a peasant who expects the maximal profit out of the soil by growing its productivity adding fertilizers, chemicals, pesticides and other additives. This is again opposed to the idea of environmentalists who take care of biodiversity, harmony of the

[†] The dominant planning theory during 60ties and 70ties was formulated by land use planners and the American school of planning, with emphasis on urban land use. See Chapin Jr. S., (1970): *Urban Land Use Planning*. University of Illinois Press

Nature, biomass production and nutrient cycling. Often uses of the soil (construction, tourism, transport etc) look for the soil quality as a prerequisite for their investment ideas. The contradictory meaning and understanding of the soil, and different driving forces standing behind, produce diversified pressures on the land and on the soil in the particular, contributing progressively to the soil degradation.

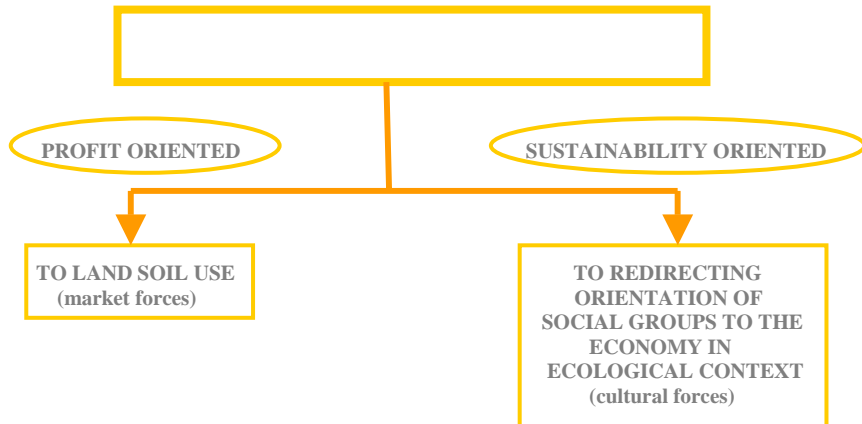


Fig. 2. The major driving forces

The importance of the soil is in many cases totally neglected, thus producing the state-of-art with local and diffuse contamination, soil acidification, salinisation, eutrophication, nutrient depletion, physical and biological degradation (Scherr S.J., 1999). On the other hand the soil performs five essential functions:

- regulating water
- sustaining plant and animal life
- filtering potential pollutants
- cycling nutrients
- supporting building structures

The soil has inherent and dynamic qualities. Inherent soil quality is a soil's natural ability to function. Dynamic soil quality is how soil changes depending on how it is managed (Blum W., Varallyay, 2004). But the soil is crucially important component of the biodiversity system, representing structure within ecosystem together with vegetation biomass (Mc Neely J., Scherr S.J., 2002). By threatening wild biodiversity we threaten the natural system with the role of soil consequently depleted and its potential to renew diminished. The direct relation between biodiversity and the soil renewal capacity is something that must be precisely considered in agriculture planning and practicing. This is one of the issues underestimated in developing countries in particular where uncontrolled food production jeopardizes the soil as a main natural resource. The very meaning of biodiversity is well defined in the sentence "the variability among living organisms from all sources...; this includes diversity within species, between species and of ecosystems" (Natural Resources, 2006).

Of course, protecting biodiversity is hard task to the people where existence depends on agriculture. That is more than evident in poor rural parts of developing countries. How to explain them that their production should be changed, reduced or even controlled for keeping wild biodiversity? On the other hand the state, due to scarce financial powers, has

the problem of implementing international conventions and their own policies if these are oriented towards keeping biodiversity and maintaining healthy ecosystems based on biodiversity on account of the agricultural production, usually inherited as a part of tradition or the former policies.

The negative impact of agriculture to the soil is nowadays clear enough. As a reverse effect some estimations proof that the potential productivity in agriculture has declined on 16 % of land in developing countries and 50 % of intensively managed cropland (Mc Neely J., Scherr S.J., 2002).

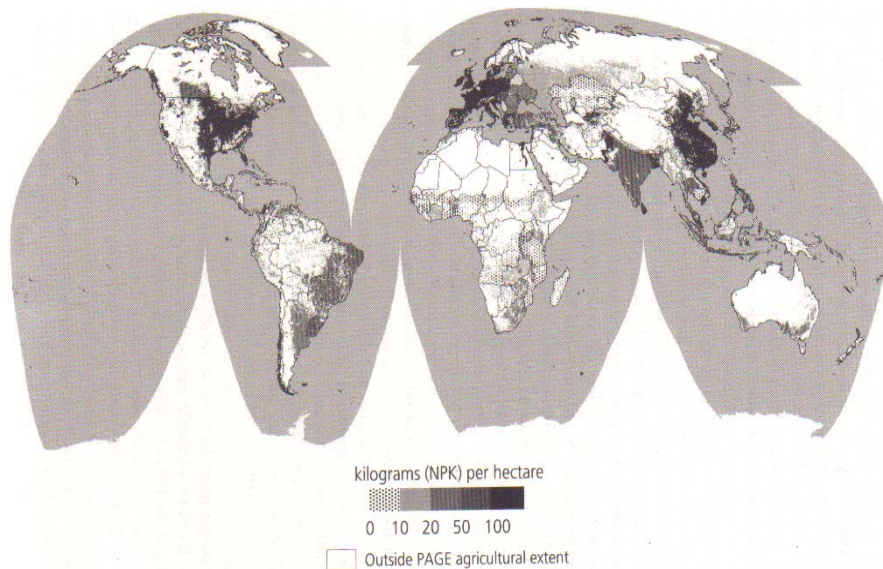


Fig. 3. Map - Chemical Fertilizers Input Intensity within the Global Extent of Agriculture
Source: Wood, Sebastian, and Scherr 2000, based on FAO, 1999

The soils characteristics as of biologically active layer of land that provides nutrients, helps water circulation and secures necessary articles for plant growth, is seriously challenged in rural parts with both intensive agriculture and extensive nonqualified agriculture. Soil capacities for its multifunctional use (biomass production, air and water circulation, microorganisms needed for ecosystems development etc) are progressively confronted with superficial land use planning in huge parts of developing countries especially, as well as with careless acting in rural areas where land cultivation endangers the nature ecosystems and wild biodiversity (the soil is the living environment for 100 % species of 6 taxonomic groups and 50 % for another 8 groups) (Mc Neely J., Scherr S.J., 2002). It raises an issue of the biota sustainability in general. R. Costanza concludes that biota can sustain itself – it is very resilient – when faced with normal environmental variation, ...but the same biota may not be able to withstand even the smallest disturbance outside the range of its evolutionary experience (Costanza R., 1992).

The sustainable future objective of the soils in rural areas

Understanding soil quality means assessing and managing the soil so that it functions optimally now and is not degraded for the future use (Natural Resources, 2006). The quality of soil should be monitored and measured by the set of indicators (physical, biological and chemical values).

Table 1. Examples of soil quality indicators

Indicator	Relationship to Soil Health
Soil organic matter (SOM)	Soil fertility, structure, stability, nutrient retention; soil erosion
PHYSICAL: Soil structure, Depth of soil, Infiltration and bulk density; Water holding capacity	Retention and transport of water and nutrients; habitat for microbes; estimate of crop productivity potential; compaction, plow pan, water movement; porosity; workability
CHEMICAL: pH; Electrical conductivity; extractable N-P-K	Biological and chemical activity thresholds; Plant available nutrients and potential for N and P loss
BIOLOGICAL: Microbial biomass C and N; Potentially mineralizable N; Soil respiration	Microbial catalytic potential and repository for C and N; Soil productivity and N supplying potential; Microbial activity measure

Source: NRCS, US Department of Agriculture, 2006

The future of the soil in rural parts is expected to be based on the multifunctional soil use. According to some ideas the main objective would be: Increasing agricultural production and decreasing negative impact on ecosystems (Mc Neely J., Scherr S.J., 1999)

Decreasing the negative impact of agriculture to the soils means different approach to agriculture as basic activity in rural parts, the agriculture that is more vernacular, friendly to the natural context or in concordance to the wild biodiversity.

The way to the soil protection in rural areas

The shift in behavior, especially in rural parts, being often conservative or based on poor life conditions in developing countries is the challenging task in their transitional period. Unsolved matter of objectives and instruments for transforming and enhancing rural parts development, without adequate agricultural and regional policies, raise the sensitive question of saving the soil from misusing, overusing or abusing. Misuse is evident with crops and fruits wrongly seeded for traditional reasons, wrong use of land (meadows, pastures, arable land, orchards) or the lack of education. Overuse is oftenly the case in areas with intensive agriculture where excessive tillage often takes place. Abuse is in the case of uncontrolled, not so rare illegal, sealing or constructing, or even under planning conditions where young market makes pressure to local governments and their planners.

The US Department of Agriculture gives a few basic principles for managing the soil quality with presumption that “each combination of soil type and land use calls for a different set of practices to enhance the soil quality” (Natural Resources, 2006). These are:

- * adding organic matter to the soil and thus improving water holding capacity, nutrient quality and protecting against erosion
- * avoiding excessive tillage to avoid disrupting the soil structure and compaction
- * carefully measuring fertilizer and pesticide use, to protect water and air from polluting and to prevent harming many organisms
- * increasing the ground cover, to protect soil of wind and water erosion and to provide habitats for larger soil organisms
- * increasing the plant diversity to help widening diversity of soil organisms, diversity of cultural practices and increasing the landscape abundance (small fields, buffer strips, different tillage practices etc) (Mc Neely J., Scherr S.J., 2002).

Evaluating the soil quality in a different manner serves for agriculture embetterment and for keeping water and habitat organisms quality. We use soil characteristics as indicators of soil quality, but at the end, the soil must be identified by how it performs its

functions (NRCS, 2006) which is often forgotten if it is taken for profit or other economic reasons only.

Six basic functions of soil and its multifunctional use (agriculture and forestry, infrastructure, filtration and buffering, gene reserve and protection, geogenic and cultural heritage forming, and source of raw material) as given by W. Blum (Blum W., Varallyay, 2004), must be critically controlled in rural areas especially. For this reason J. Mc Neely and S.J. Scherr are suggesting idea on ecoagriculture as an approach that treat equally the agricultural development (as an economic reason) and conservation of habitat for wild biodiversity. Taken the Convention on Biological Diversity for granted (UN Convention, 2001), with its premise that ecosystem has to be managed as a whole, they suggested that land use has to influence wild life protection, biodiversity strategy of soil use has to be integrated to land use and development plans, and the agricultural land has to be treated as a part of surrounding protected areas (and vice versa, the protected land as a part of surrounding agricultural land). The same authors define their list of priorities for protecting adequate soil use and promoting the idea of ecoagriculture:

- * creating biodiversity reserves that benefit local farming communities
- * developing habitat networks in nonfarmed areas (compatible with farming)
- * reducing (or reversing) conversion of wild lands to agriculture by increasing farm productivity
- * minimizing agricultural pollution through more resource-efficient methods of filters for waterways
- * modifying management of soil, water and vegetation resources
- * modifying farming system to mimic natural ecosystems (Mc Neely J., Scherr S.J., 2002).

Instruments for soil protection policies implementation

Redefining strategies, goals, objectives and policies in rural areas in developing regions means some contradictory actions to be taken such as: poverty reduction, agricultural reduction increase, biodiversity protection, intensive agricultural development etc. The sustainable principles in land and soil use ask for the prudent approach to the complex problem of rural areas development. Moreover, the instruments and measures for implementing new objectives and policies need a sort of multiple feasibility (social, economic, ecological), encompassing all actors and stakeholders in the rural ambiance which is more vivid and vital than it looks like. The simple reason is that all four elements, water, land, air and sun play ubiquitous and synchronous role over rural area permanently.

The sustainable development based on ecological agriculture, and on multifunctional soil use in particular, could be imagined under the following conditions[‡]:

1. **Regional and local development planning** must start thinking more on local / regional identity, where biodiversity is one of important factors. Attractiveness and competitiveness of the area as results of its enhanced identity must be soundly founded on careful research on land/soil capacity and finalized with precise list of priorities and projects referring to wild biodiversity protection on one hand and to successful agriculture on the other hand. Specific attention will be paid to small agriculture and poor people agricultural activities (present or potential), incentives to low income

[‡] The list of conditions was discussed with a group of students at the IPSOIL II seminar in Neusiedl am See, (2005)

producers and to small scale agriculture. The whole rural economy will be treated as a whole with agriculture as one of basic economic activities combined with other compatible activities. Land use maps in regional and local spatial plans will be the result of reasons for the land use patchwork but also evidence of final consequences to the soil quality and to biodiversity.

2. **Incentives to regional integration** of local communities (municipalities) are important instrument for the learning region in rural area. Connecting small rural communities in less developed and border regions could be one of crucial impacts to better understanding the problem of lagging rural and agricultural development, and to getting increased capacities for more sustainable projects in agriculture which are rather costly and complex at the beginning. Land use planning, coordinated among small communities, with common idea of soil quality protection, is one of crucial tasks for planners. The integrated rural region, with both high ecological quality and high productivity in agriculture may expect raising its competitiveness in the wider continental context in the future. Transregional integration is an additional instrument for better development of rural areas.
3. **The social impacts** can impede actions on sustainable agriculture promotion. Decaying demographic situation, conservative attitudes, tradition of poverty, lack of social motifs and other social reasons can produce frictions against learning region efforts and concrete agriculture and sustainable soil use. Negotiating with different social groups in a rural area therefore is becoming indispensable step towards the idea of better, more efficient and more sustainable land/soil use. The chief argument, difficult to defend in many cases, is keeping the common spirit of a village or a wider rural area. The regions where rural population is living in closed family (even tribal) circles, with no socially profiled attitudes to common or public interest, are difficult to get explained the meaning and importance of sustainable soil use. They usually think and behave in day-to-day manner with future out of their mind. Motivation towards new projects based on common agreement and understanding the meaning of soil biodiversity is hard to initiate in such regions, very familiar case in South East Europe.
The local/regional identity as a basic prerequisite for stronger attractiveness, competitiveness and, finally, to better development is an idea to be generally conceived, if possible at all. The identity based on both productive and sustainable soil use will be one of distinguished objectives in the future.
4. **The role of local/regional governments** in promoting and supporting idea and projects of ecologically sustainable agriculture is highly important. Comparison between best practices in some Austrian regions with many lagging regions in South East Europe clearly illuminates the meaning of multifunctional and nature-friendly use of soil, both productive and sustainable on the positive side and destructive and economically ineffective on the other side. The diversity of fruit production (120 sorts of apples in an Upper Austrian village or highly sophisticated grape growing in Burgenland, with closed cycle of processing, marketing, trading etc) as opposed to completely neglected fruit growing in some parts of Balkans countries, is not so much matter of the local population as of local governments without power, responsibility or ideas to cope with the drastic problem of lagging rural areas still dominating in South East Europe. The agriculture in developing countries is still conceived as a problem of central governments, ministries and state institutions. Henceforth the role of local governments in

rural domain (agriculture) can be considered weak in developing countries and highly active in many successful rural areas in developed ones.

5. **The role of state** and its policy and the legal system created for rural development, agriculture/forestry, land, wetlands and other compatible issues, will stay as a significant column in implementing sustainable soil use idea. The state (helped by EU funds) as a partner to local/regional governments, with prudent regional development policy and budget and legal system oriented to sustainability of land/soil use, should insist on soil biodiversity as critical point. Now, the open question for the legal system and land policy is the soil ownership. If we treat the soil use as a critical problem for the future of the Mankind and a soil as a hardly renewable resource threatening the food production for billions of people and majority of poor people, than the question is:

Could the soil in rural areas, where seriously threatened by activities, be considered as scarce and hardly renewable resource and therefore controlled by:

- (a) stronger planning measures, instruments and regulations, or by such as agricultural zoning ordinance (Diamond H., Nooman P., 1996), or by
- (b) stimulating economic instruments to make incentives to more appropriate soil use, or by
- (c) public and private sectors agreement and partnership on projects for the soil use and keeping biodiversity (Endicott E. ed. 1992), or finally, if in case of emergency, by
- (d) transferring soil to stronger public control, similar to other natural goods such as minerals, water, air, etc.

Of course, the last measure is strongly opposed to the idea of private ownership (Coyle D.J., 1993) which must be treated as sacrosanct and supported by other measures of keeping the public interest in the soil use.

The challenging questions that could provoke many reactions but necessary to be discussed.

6. **Education and informing** on the problem of soil and land use is not only public concern but has to be discussed among experts and governing people as well. The vast majority of people are not aware on the problem of soil misuse and potential problems coming out of it in the future. The land is treated as private ownership and, as such, is free to use, especially in rural areas. Urban areas are more controlled by town planning instruments but rural ones are usually left alone in developing countries in particular. The matter of wild biodiversity is unknown even to planning experts and treated usually by traditional land use planning, land use maps and land use regulations. Information on the state-of-art of wild biodiversity is usually missing, tillage is out of control, use of chemicals and pesticides is open to one's responsibility, and the soil is downgraded with no instantly evident consequences. Information and education on the issue is therefore indispensable through planning activities but also in other ways organized by expert institutions, supported with both regional and state instruments and means.

Conclusion

The soil use is becoming harsh issue of the contemporary generation with questionable perspectives if it continues as up to date. The issue is more than critical in underdeveloped and even developing countries and regions with speedy decreasing of soil quality and with soil depletion and loss of soil as the final consequence of rapid agricultural growth and the superficial land use planning. The soil has to become the common concern primarily within local/regional communities but also within state public enterprises and offices.

The question raised by W. Kvarda, how to establish regional development with great responsibility in relation to the vertical system of land use for getting an economic yield (Kvarda W. 2002), is now becoming the acute dilemma for responsible institutions and persons in governments but also in planning circles and (should be) among individual producers.

Structural changes in agriculture and their serious consequences for rural areas in recent years, one of them being the negative impact to hydrological cycle (Dorner W., 2005), clearly shows that it is not enough to protect agricultural land from sealing but primarily from agriculture itself. As discussed by Carl Steinitz, the major stressor that cause impacts on biodiversity are urbanization related “ development” in the region and construction and land use practices ... As development spreads, habitat is lost first. These direct impacts are caused by... human activities (Steinitz C., 1995). Precise and strict analysis of different land and soil uses and their impact to soil ecosystems, wild biodiversity and potential soil multifunctionality is therefore one of the major tasks not only for experts in agriculture but for spatial and urban planners in particular. Good land and soil use planning rests on a good selection of criteria and indicators as well as the proper agricultural zoning ordinance[§]. The evident fact with general soil decay in the world is that the decision makers must understand the soil quality as a paramount responsibility as crucial to attaining the goal of sustainable development in rural areas. If not, the regional wellness and general social benefit will obviously fall down sooner or later.

[§] Patil G. P. in Encountered Data, Statistical Ecology... (Environmetrics 3) says that the success of biological monitoring rests on our ability to select good indicators, ones sensitive to the underlying effects we want to measure – human influence – but insensitive to extraneous factors

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S u m m a r y :

The article is elaborating the issue of soil and land/soil use. Also the meaning of soil and its wild biodiversity is emphasized. Finally the importance of better understanding the multifunctionality of soil use is given as an important issue for the future with agriculture as the main user but in many cases as the main threat as well. The methodology applied in the article is based on integral approach to the soil use problem with its ecological, economic and social dimensions encompassed. Compared are ideas of European and American researchers and institutions as well as some actual declarations on the soil and soil use.

As the result some important measures for the more adequate soil use are proposed such as : more careful regional and local development planning with the soil use as an important issue and incentives to regional integration for more feasible soil use projects implementation. Negotiation and partnership among users and stakeholders with the significant role of decision makers together with adequate education and information are underlined too.

The conclusion is that the soil is becoming one of the global critical issues with the open threat for the future. The great responsibility of experts, producers and decision makers is becoming progressively evident. And, finally, specific attention to agricultural activities, as one of the key activities threatening the soil asks for proper criteria, indicators and agricultural zoning ordinance .