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SUSTAINABLE MANAGEMENT OF LAND RESOURCES IN THE CONTEXT OF AGRICULTURAL POLICY IN THE REPUBLIC OF MOLDOVA

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Abstract: *Natural and anthropogenic conditions determine the intensity and direction of pedogenesis, as well as the nature and degree of degradation of the soil cover of the Republic of Moldova. Depending on the combination of natural and anthropogenic factors, the forms of land degradation are expand. The main natural factors of land degradation are: quaternary deposits, represented by loess clay, ancient and modern alluvial deposits of different granulometric compositions, from clays to sands; parental rocks; the presence of seven orographic units in a restricted area. The most common exogenous processes leading to land degradation are: erosion, landslide, proluvio-deluvial, avalanche, fusion and karst process. The evolution of the balance of organic matter in arable soils became negative. In a period of 150 years, the chernozems lost up to 50% of their initial humus content. The annual losses of organic matter through decomposition are on average 600-700 kg/ha, in the last 20 years – 900 kg/ha. The torrential nature of the precipitation in the conditions of a fragmented relief contributes to the intensive development of land erosion and the manifestation of different forms of soil degradation. The arid character of the climate, the frequent dry periods (droughts), the predisposition of the territory to the manifestation of desertification processes, require the adaptation of agriculture to these conditions.*

Keywords: *land degradation, land resources, sustainable management, agricultural policy.*

JEL classification: Q1, Q15

INTRODUCTION

Food security is one of the key global challenges of this century. Agriculture plays a strategic role in all countries of the world, as it is the main sector responsible for food security of the population, having, at the same time, a special contribution to the general process of sustainable economic development and environmental protection.

The sustainable management of land resources is a primordial social problem, because increasing agricultural production can only be achieved through the rational use of soil resources. The rational management of the land fund within the national economy and the sustainable exploitation of soil resources in the Republic of Moldova must be based on (Leah, 2012):

- a) the production of the necessary volume of agricultural production to satisfy the needs of the population in the respective products and for export;
- b) the organization of agriculture in such a way that the agricultural production process ensures the protection of soils, their conservation and increasing their fertility.

Soil degradation is a pedological process generated by the action of natural and anthropogenic factors with a negative impact on soil functions, which leads to a decrease in its fertility.

The total land area of the Republic of Moldova on 01.01.2022 is 3.384.938 thousand ha, including: agricultural land - 2.260.81 thousand ha; lands in the urban areas of the localities - 316.07 thousand ha; lands intended for industry, transport and other special purpose - 60.01 thousand ha;

lands intended for nature protection, health protection, recreational activities - 4.11; lands of the forestry fund - 450.62 thousand ha; lands of the water fund - 87.95; lands of the reserve fund - 205.35 thousand ha (Land Cadastre of 01.01.2022).

According to the Land Cadastre data, on January 1, 2022: the surface of irrigated land was 215.93 thousand ha, with a decrease of 2.01 thousand ha, compared to 2020; the area of drained land is 57.85 thousand ha, with a decrease of 350 ha, compared to 2020.

According to the type of ownership, the land surface is: public property of the state constitutes - 783.86 thousand ha (23.1%), public property of administrative-territorial units - 698.81 thousand ha (20.7%), land private property - 1902.2 thousand ha (56.2%), (Land Cadastre of 01.01.2022).

MATERIALS AND METHODS

The policy documents developed in which the management of soil resources and the main causes of soil degradation and their impact are characterized served as material. The method is based on the analysis of agricultural policies in which the aspects of land management are reflected. The soil is subject to a series of degradation processes. Some of these processes are closely related to agriculture: water erosion, agricultural soil preparation works; compaction; decrease in the amount of organic carbon in the soil and soil biodiversity; salinization and sodification, etc.

Soil degradation processes imply the need to protect, maintain and improve soil quality through the implementation of conservation technologies. The object of the analysis of the situation in the field of land improvements in order to ensure the sustainable management of soil resources can be formulated as follows: the study of all aspects of the degradation forms and the development of methods to reduce them.

RESULTS AND DISSCUSION

The strategic objectives, foreseen for the next 20 years, specifically aim at increasing the well-being of the entire people and each citizen, as well as the prosperity of the next generations. For the Republic of Moldova, sustainable development requires a complex approach to the problem of resource use (National Environmental Strategy for 2014 – 2023. GD no.301 of 24.04.2014):

- 1) lack of resources limits development;
- 2) the development of urban and rural settlements causes pollution of the environment - soil, air, surface and groundwater, etc.;
- 3) the intensive exploitation of some resources (soil, water, forests) reduces their regeneration capacity, leads to the poverty of the population.

The Republic of Moldova recognized the importance of applying the principles of sustainable development in all sectors of the national economy and in the social sphere (National Environmental Strategy for 2013 – 2023, GD 301 of 24.04.2014). The 18 principles of sustainable development are paramount for the strategic planning process at national and sectoral level (Cainarean Gh., et al., 2015), taking into account that:

- People have the right to a healthy and prosperous life in harmony with the environment.
- Today's development must not undermine the development and environmental needs of future generations.

- Nations have the sovereign right to exploit their resources, but without causing destruction outside their borders.
- Nations must propose international laws to provide compensation for damages caused outside their country's borders.
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- Nations must propose international laws to provide compensation for damages caused outside their country's borders.
- In order to achieve sustainable development, environmental protection must become an integral part of the development process.
- The reduction of poverty and the disappearance of economic differences between various parts of the world are essential for the achievement of sustainable development.
- Nations must cooperate to conserve and protect ecosystems.
- Nations should reduce and eliminate unsustainable patterns of production and consumption and implement appropriate demographic policies.
- Environmental problems are better solved with the participation of all citizens.
- Nations should facilitate and encourage citizen participation in solving environmental problems, therefore environmental information must be made accessible to the general public.
- Nations must pass laws to protect the environment, protect the victims of pollution and when appropriate prevent actions on the environment that would have irreversible negative impacts.
- Nations should cooperate to create an open economic environment that ensures sustainable development for all countries.
- The polluter must cover the costs of the damage caused.
- Nations must inform each other about natural disasters.
- Sustainable development requires a scientific approach to the problem.
- Nations must share knowledge and innovative techniques to achieve the goal of sustainable development.
- Peace, development and environmental protection are inseparable.

The transition from economic growth and development is difficult and achievable only in the long term. It involves serious costs and certainly affects productivity. However, it starts from the premise that these losses, strictly economic and in the short term, will be compensated in the long term by an increase in the quality of people's lives (Mitchell et al., 2004).

The Land Improvement Program for the purpose of ensuring the sustainable management of soil resources for the years 2021-2025 and the Action Plan regarding its implementation for the years 2021-2025 (GD 864 of 09.12.2020) provides for land improvement works, protection, conservation and enhancement of soil fertility, made for:

- 1) to protect the soil against the mechanical action of water and wind (category that includes the complex of works to prevent and combat / control the soil erosion);
- 2) to restore (complete) the moisture deficit (category that includes land irrigation);

3) to prevent or remove excess water from the soil, from its surface (category in which desiccation and drainage fall);

4) to restore the soils (category in which the works of construction and exploitation of hydrotechnical objects, the works of selective uncovering and covering of damaged or degraded lands, the works of improvement of alkaline and saline soils).

The objectives of the 2030 Sustainable Development Agenda establish Objective no. 15. Life on Earth, National Target 15.3: By 2030, combat desertification, restore degraded lands by implementing the Land Degradation Neutrality (LDN) mechanism, to achieve a land degradation neutral world and Objective no. 12. Responsible consumption and production, National Target 12.2: By 2030, achieving sustainable management and efficient use of natural resources.

In recent decades, the intensification of multiple forms of soil degradation, especially through erosion, has been recorded (Andrieș, et al., 2004; Constantinov, 1998; Constantinov et al., 2003). Thus, in conditions of rugged relief of the Republic of Moldova, the most degraded soils are: soils with surface and deep erosion (rivers), soils affected by active landslides and solonized and salinized soils. Soils affected by surface erosion occupy about 981.560 ha including: with moderate and strong degree of erosion – 423.390 ha (or 43%). Compared to non-eroded soils, the productivity of moderately eroded soils decreases up to 50%, and of strongly eroded ones - up to 70% (IPAPS, 2005a, 2005b).

Annual losses of fertile soil through erosion are approximately 26.000.000 tons. This amount of soil contains 700.000 tons of humus, 50,000 tons of nitrogen and 34.000 tons of phosphorus (Andrieș, 2011). The cost of washed soil is about 1.85 billion lei, and that of agricultural production losses about 0.873 mil. lei. Thus, the direct and indirect damage caused by erosion is 2.723 mil. lei. In the republic, about 80% of arable soils are located on slopes, therefore, the works to prevent and combat surface erosion are a priority for the sustainable development of agriculture (Andrieș, et al., 2004; IPAPS "N.Dimo" (1996).

Thus, in 2008 the surface of the eroded land was about 877644 ha, and in 2019 about 1015693 ha, which shows an increase of about 16% (Land Cadastre of 01.01.2008 and 2019) (Table 1).

Table 1. The current situation regarding the area of eroded agricultural land

Year	Agricultural lands, ha	Eroded land, ha			
		Total	Weakly	Moderate	Strongly
2008	1939114	877644	504777	259332	114165
		45%	26%	13%	6%
2019	2019359	1015693	572353	300341	143204
		55%	28%	15%	7%

The main causes of soil degradation and their impact are (IPAPS "N.Dimo", 2001):

1) non-observance of crop rotation in crop rotations - changes the soil structure, soil nutrient imbalance, soil erosion and crop reduction;

2) reduction of fodder and leguminous crops - reduces the nutrients necessary for the development of agricultural crops;

3) reducing the use of organic and mineral fertilizers - they lead to the loss of organic matter in the soil, soil compaction, the reduction of the physical structure of the soil and the reduction of soil fertility;

- 4) improper tilling of the soil - decreases the productivity potential of the soil, increases the compaction and degradation of the soil surface;
- 5) change in hydrological conditions - lead to reduced water infiltration and soil loss on the surface;
- 6) deforestation of forests and protective strips of fields - causes severe droughts, wind and water erosion of the soil, desertification of the soil and loss of biodiversity;
- 7) improper management of pastures - degrades the structure and soil cover;
- 8) improper use of heavy machinery in agriculture - compacts the soil surface and degrades its structure;
- 9) biological degradation of the soil - leads to the reduction of soil fertility and the loss of productive potential.

To increase the volume of agricultural production, simultaneously with the long-term preservation of soil quality, it is recommended to implement conservative technologies, which includes a complex of organizational, pedo-ameliorative and agrotechnical measures. The implementation of conservation technologies in agriculture requires (Boincean, 1999):

- improving the national system of pedological and agrochemical research, creating the computerized soil quality information system (soil quality monitoring) for the management and correct use of the land fund at the level of parcel, agricultural enterprise, commune, district and republic;
- development of standards, technical regulations, land exploitation rules;
- improving land legislation, solving problems regarding the calculation of land tax, the price of land, rent payments, the tax on land operations, the way of accumulating and using the means collected in the form of land payments;
- specifying the form and limits of state supervision over land transactions, the order of contractual relations and responsibility for these relations;
- the consolidation of land into profitable agricultural holdings of optimal sizes, which would allow the implementation of crop rotations and modern technologies, the development of a system of sustainable use of soil resources;
- the creation of a viable economic mechanism that would ensure the improvement of the price, credit and taxation policy and that would allow the implementation of programs with a special purpose in the agro-industrial complex, especially in the field of protection, improvement and rational use of soils;
- the creation in different pedoclimatic zones of model households of specialized farmers, of high profitability and optimal sizes, determining the optimal size of peasant households of different specializations, taking into account the pedological and economic conditions of the concrete territories and the existence of the machines necessary;
- the distribution of agricultural crops within the land for the creation of a rational correlation between the field crops and the livestock sector, which would ensure the annual production of at least 10 mil. tons of manure, necessary to stabilize the humus balance in the soil and preserve its fertility. The recommended crop structure will allow the production of the necessary volume of grain to ensure the food security of the population, as well as the necessary volume of fodder for the livestock sector and the necessary volume of technical and vegetable crops for the needs of the processing industry. At the same time, this structure of crops will allow protective soil rotations to be applied in agriculture.

- restoring the irrigation/drainage systems and carrying out pedological research in order to assess the quality of the irrigated soils and establishing pedo-irrigational monitoring.

The principles that define the development of sustainable management are defined for the agricultural sector by the fact that (Strategia națională de dezvoltare agricolă și rurală 2014-2020, HG nr. 409 din 04.06.2014):

- renewable resources are only used according to their regeneration rate;
- exhaustible sources of raw materials are only used by humans as long as they can be replaced, both materially and functionally, with renewable resources, guaranteeing, at the same time, a higher productivity;
- the damage to the environment does not exceed the natural regeneration capacity of the main environmental factors - air, soil and water;
- a temporary equivalence must be maintained between the time of the intervention and the time of the processes in nature.

Sustainable agriculture, primarily viable from an economic point of view, meets the demand for healthy and high-quality food, being an agriculture that guarantees the protection and improvement of natural resources in the long term and transmits them intact to future generations. Such type of agriculture determines a sustainable management of the lands and diversifies rural economic activities, because the raw materials appear and are subjected to primary transformations at the level of agricultural exploitation, for which it is necessary, along with preserving the quality of the natural production environment, to develop infrastructure and to increase the economic potential of the villages (Măgdălină, 1994; ACSA, 2006; Ministerul Agriculturii și Alimentației al Republicii Moldova, 1997).

Therefore, effective sustainable agriculture, based on conservative technologies, can be conceived within a system of long-term protection and preservation of the quality and productive capacity of soils. These measures are provided for in the Land Improvement Program for the purpose of ensuring the sustainable management of soil resources for the years 2021-2025 and the Action Plan regarding its implementation for the years 2021-2025 (Directive no.2 of 25.01.2011, Ministry of Agriculture and Industry Food of the Republic of Moldova).

CONCLUSIONS

It was found that the existing system in the agriculture of our country leads both to the decrease in the volume of agricultural production and to the degradation of soil resources. The situation can be changed by the gradual implementation, simultaneously with land consolidation, of conservation technologies in agriculture, so that agriculture and research are concerned not only with increasing harvests, but also with optimizing the system as a whole, to maintain soil productivity in the long term. The activity in a household with sustainable agriculture is based, first of all, on the use of natural processes, on the biological and renewable resources of the household and only secondly - on the purchased resources.

A primordial necessity remains the creation of a rational correlation between the field crops and the zootechnical sector, which allows the return of perennial grasses to the fields and the production of the necessary organic fertilizers. The support of agriculture is a major priority, but currently more attention is being paid to its new branches - precision agriculture, biological agriculture, carbon sequestration, etc. - and, at the same time, the restoration of degraded lands

(conservative agriculture), that is, all aspects related to land consolidation (The program for the valorization of land and the increase of soil fertility, GD no. 636 of May 26, 2003).

The ultimate challenge for soil science is the accumulation and provision of useful information related to the appropriate, optimal use of agricultural land, taking the necessary precautions in time to essentially preserve the vital functions of the soil.

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