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## AGRICULTURE AND SOILS OF MOLDOVA: ASSESSMENT, FINDINGS, SOLUTIONS

TAMARA LEAH

**Abstract.** *The paper includes evaluation of agriculture, including soil resources of Moldova. Agricultural land area is continuously being extended and changing trends in production and consumption putting increasing pressure on land resources, which has a limited character. Small areas of agricultural land, the large number of landowners and their inappropriate placement involving deficiencies in the organization and sustainable management of agricultural land. Climate change intensifies soil degradation, desertification of agricultural land and lead to the vulnerability of ecosystems and habitats to adaption. Protection of farmland and environmental, economic, social, environmental and cultural functions are not achieved by determining the legal status of the soil as natural-historical body, basis of ecosystems with multiple functions, partially renewable natural resource. The current policy, legal-regulatory and institutional framework should be focused on the image of soils, constant supervision of changes in the composition of land resources, required to analyze and predict the ecological status of the land, to assess these changes, drawing up concepts, programs and implementation measures prevention of negative processes and determine the trends of these processes for the protection and rational use of land resources, their conservation and improvement.*

**Key words:** *agriculture, degradation, measures of protection, soils.*

### INTRODUCTION

UNO has declared 2015 the International Year of Soils in an effort to raise awareness and promote more sustainable use of this critical resource. Healthy soils are the foundation for food products, fuel, fiber material and medical products, but also are essential for our ecosystems having an important role in the carbon cycle, storing and filtering water, and improving resistance to floods and droughts [2].

Activities in the agricultural sector of Moldova in the last 50 years have had a negative impact on the environment, particularly on the soils, manifested by degradation and desertification of land due to poor management, soil compaction (using agricultural heavy machinery) and pollution through overuse pesticides (pest control) and fertilizers (used for soil fertilization). Soil erosion in Moldova ranks first in terms of land degradation due to excessive fragmentation, inappropriate agricultural practices, grazing, rational exploitation of land, inadequate application of a technological system in particular on the small and medium farm land.

Sustainable use of soil involve some long-term measures that would ensure achievement of positive economic results, while preserving and improving soil quality. Application of modern agriculture principles (crop rotation, use of local organic fertilizers, promoting the works of qualitative improvement of the soil) are prerequisites to ensure sustainable development of agriculture of the Republic of Moldova.

The assessment of the financial situation of the agricultural sector as a result of average annual financial allocation from the state budget, from international financial resources and expected future benefits and investment shows that the sector is adequately funded to solve current problems. But the planned actions in national and sectoral development strategies and action plans, on the medium and long term fulfilled and partially implemented.

In connection with this it is necessary to reveal and analyze barriers to implementation of adaptation actions identified and recommended in the agricultural sector. The focus should be on achieving a multiannual research on adaptation to climate change; organizing an information campaign nationally through such regional workshops, etc.

## MATERIAL AND METHODS

The methodological issues resulting from the essential complementary approaches: integrated and componential (analytical or specialized) of the agricultural sector. The first approach perceives the real situation in agriculture, the second approach involves a specialized analysis on the state of soil resources. In this mode is presented evolutionary explanation of land resources, and issue of integrated agricultural sector. Analytical module (componential) are in dialectical unity with integrated research module; they complement each other and merging parallel develops a unifying highlighting individuality of the goal.

As materials were used bibliographical sources of reference, information obtained from the Internet, statistics, documents of agricultural policy farming with reference to national programs, development strategies, action plans intended to diminish soil degradation and increase their fertility, elaborated on this subject and in the process achieved.

## RESULTS AND DISCUSSION

**The current state of agriculture.** Republic of Moldova is an agrarian-industrial state, which came in a strong economic decline after 1990, which has not recovered than in 2000 (Table 1). The maximum weight in the economy holds agricultural sector. It contributes over 13% to GDP (Figure 1).

Table 1. Moldova's economy (1991 - 2014)

Years	Increasing / decreasing, %	Years	Increasing / decreasing, %	Years	Increasing / decreasing, %
1991	-7.5	1999	-3.4	2007	+3.0
1992	-29.0	2000	+2.1	2008	+7.8
1993	-1.2	2001	+6.1	2009	+6.5
1994	-30.9	2002	+7.8	2010	+6.9
1995	-1.4	2003	+6.6	2011	+6.4
1996	-5.9	2004	+7.4	2012	+0.7
1997	+1.6	2005	+7.5	2013	+8.9
1998	-6.5	2006	+4.8	2014	+8.5

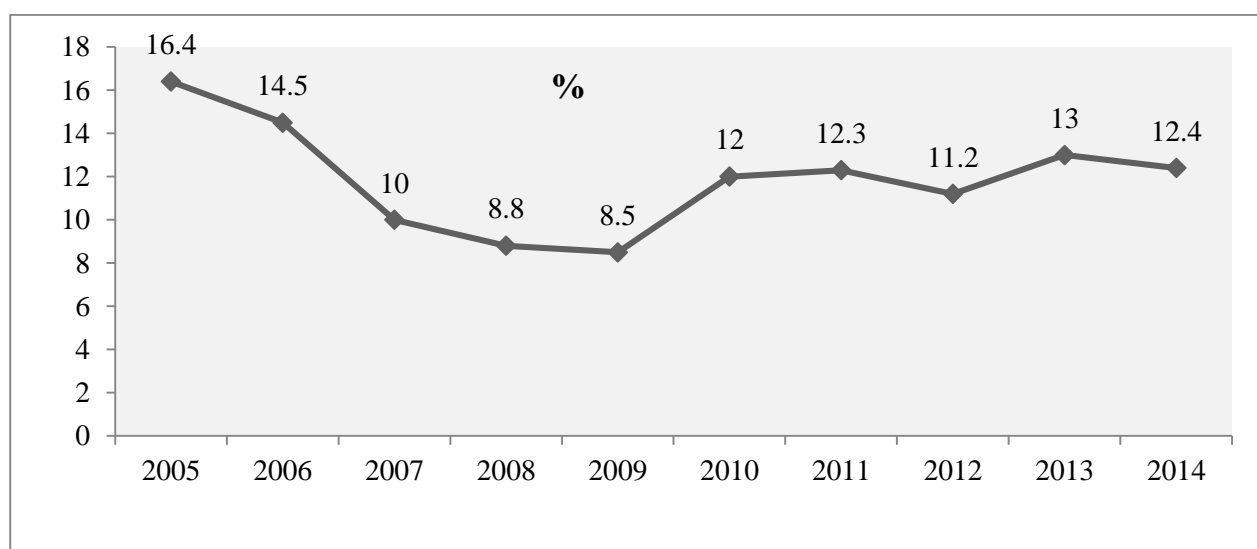


Figure 1. The contribution of agriculture to GDP

It should be noted that compared with neighboring countries, the contribution of agriculture to GDP in the Republic of Moldova is one net significant. Thus, in 2013, in Romania [6] the contribution of agriculture to the GDP amounted to 5.6% and in Ukraine - 9% [9].

A study by the World Bank show that agriculture in Moldova is inefficient [1]. For example, in 2013 it registered a low productivity, investment in the field were small and costs exaggerated. Agricultural productivity is 2-3 times lower than in Europe and its situation is comparable to that in Europe '70s [10].

Moldova's agricultural sector is dominated by crop production, livestock sector having a smaller role in production. In the years 2001-2014, the crop production represents 60-70% of total agricultural production, the land endowment favoring crop production, which like other countries in Eastern Europe. The share of arable land in the utilized agricultural area in Moldova is among the highest in Eastern Europe (70%).

The structure of agricultural production can be considered as a relatively stable, which in general, in Moldova is 55-70% for the vegetable and 30-45% animal. In 2014 this ratio was 66.3% for plant production and respectively 33.7% for the animal (Figure 2 and 3).

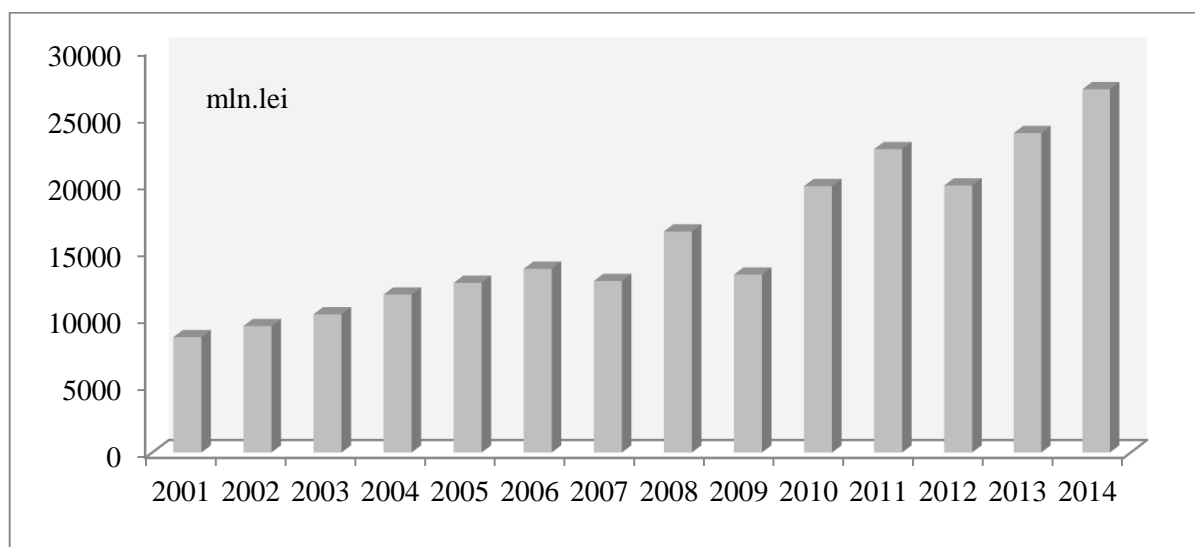


Figure 2. Agricultural production (total)

In general, the Moldovan agriculture focuses on low-value crops, production sectors of nuts and honey are niches that were discovered and who is to pay attention. In the last decade, these two products have access to EU markets and are successfully exported to EU and other markets.

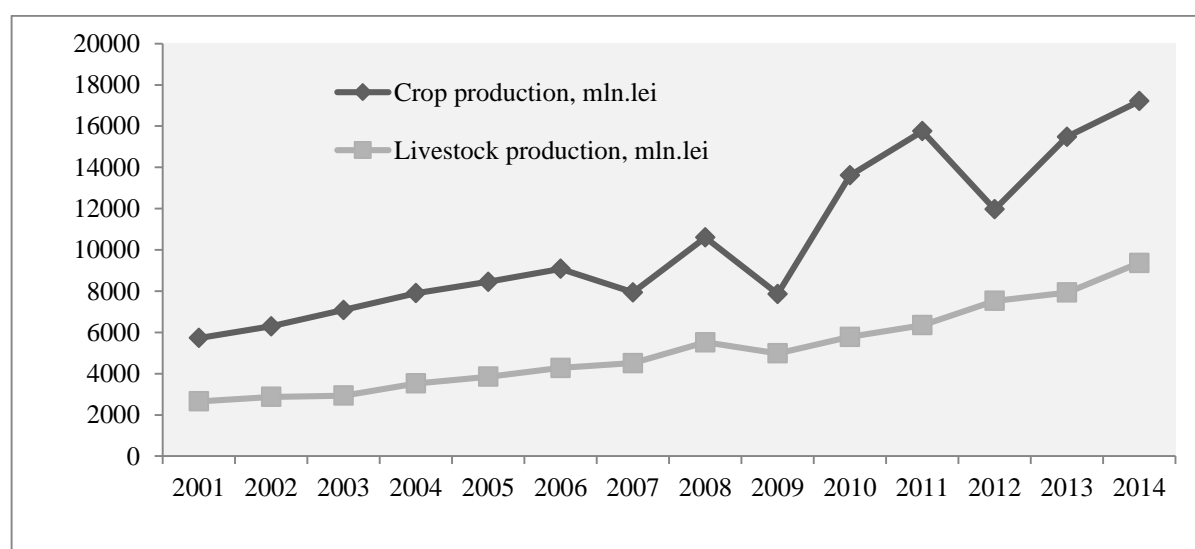


Figure 3. Crop and animal production

Low profitability in agriculture is determined by the dominance of low-value crops in agricultural production to the detriment of high-value crops. Over 80% of the cultivated area in Moldova is covered by low value crops (such as cereals, oilseeds, sugar beet and fodder crops),

while fruits and vegetables occupy less than 20%. Only cereals (these include wheat, corn and barley), occupying more than half the areas sown in Moldova.

In the last decade the development of livestock sector has been problematic due in respect of the impediments and market competitiveness. The livestock sector is faced with the challenge of internal resources (limited supply of feed) and harsh pressures caused by cheaper imports of animals. Providing local forage is limited because of the lack of good quality pasture, which is in turn caused by adverse weather conditions and limited irrigation capacity. On the other hand, relatively high domestic production costs, low productivity and uncompetitive animal breeds considerably reduce the ability of Moldovan animal products to compete with products from meat / dairy cheaper (subsidized) provided by the EU and CIS markets. As a result, Moldova is a net importer of most animal products.

**The current status of soil resources.** The soils in Moldova is presented by fertile black soils (chernozems) and productive farmlands. Almost every second hectare of land have average quality, of which 689 thousand ha (27% of agricultural land) is of good quality. However, the creditworthiness of the soil decreased by 7 notes in 30 years as a result of climate change and intensive agricultural use. According to the situation of 01.01.2015 the national land fund is 3384.6 thousand hectares (Table 2). Agricultural land area is 2499.1 thousand ha or 73.8% of total area, including arable land - 1817.4 thousand ha, perennial plantations - 291.7 thousand ha, meadows and pastures - 348.6 thousand ha. In Moldova, as in other countries, take place the reduction of arable land per capita. According to recent data this area is 0.407 ha. The soils affected by various degradation processes occupy over 2 million ha [3].

Table 2. Land Fund according to utilization, on January 01

Land Fund	2011		2012		2013		2014		2015	
	th. ha	%	th. ha	%	th. ha	%	th. ha	%	th. ha	%
<b>Land – total, of which:</b>	3384.6	100	3384.6	100	3384.6	100	3384.6	100	3384.6	100
Agricultural lands, of these:	2498.3	73,8	2498.0	73.8	2497.8	73.8	2500.1	73.9	2499.7	73.8
arable land	1812.7	53,6	1810.5	53.5	1814.1	53.6	1816.1	53.7	1817.4	53.7
perennial plantings, of which:	298.8	8,8	298.7	8.8	295.3	8.7	295.3	8.7	291.7	8.6
orchards	133.3	3,9	134.5	4.0	135.1	4.0	135.8	4.0	134.5	4.0
vineyards	149.6	4,4	147.3	4.3	142.6	4.2	141.2	4.2	137.5	4.1
pastures	350.4	10,4	350.3	10.3	348.9	10.3	348.0	10.3	346.4	10.2
hayfields	2.2	0,1	2.0	0.1	2.1	0.1	2.1	0.1	2.2	0.1
fallow land	34.2	0,9	36.5	1.1	37.4	1.1	38.6	1.1	42.0	1.2
Forests and other forest land	463.1	13,7	462.7	13.7	464.2	13.7	465.2	13.7	464.5	13.7
Rivers, lakes, pools and ponds	99,6	2,9	99,5	2,9	99,2	2,9	96,9	2,9	96,8	2,9
Other land	323,6	9,6	324,4	9,6	323,4	9,6	322,4	9,5	323,6	9,6
Land equipped for irrigation	228,3	6,7	228,3	6,7	228,3	6,7	228,3	6,7	228,3	6,7

According to the General Agricultural Census (GAC) in 2011 [5] the using average agricultural area (AAA) is 2.29 ha, is similar to that seen about 49% of all farms in EU Member States. However, according to the results of GAC, index AAA / capita is 0.54 ha, so that Moldova is placed above the media / capita in the European Union (0.34 ha of AAA / capita). The results of GAC illustrate the excessive fragmentation of agricultural land, which also results in a reduction in agricultural productivity, disruption of crop rotation, soil degradation and other negative effects (Figure 4).

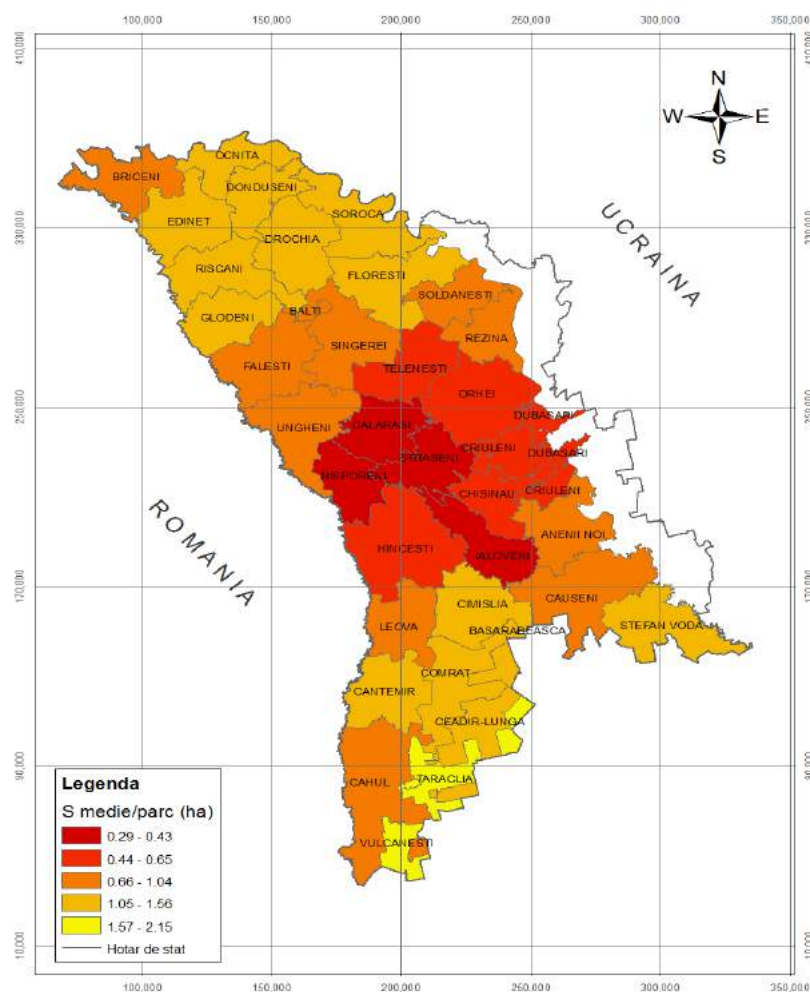


Figure 4. The average area of an agricultural parcel of the districts

At the same time, the average area of a parcel of land in the country is 0.85 ha, the Central Zone is the most fragmented, this the minimum area of plots representing 0.29 ha (Strășeni district).

Moldovan soils, characterized in the past by a high natural fertility, in the last 20-25 years, due to increased degradation processes and forms, degraded and risk losing their fertility. The worst forms of degradation, leading to reduction of production capacity or damage the soil cover are: water erosion, affected area - 40% of the agricultural land; humification, soil nutrient depletion, extensive secondary compacting on the entire arable land; salinization - on 220 thousand ha; active landslides on 25 thousand ha of land [7].

In the agricultural exploitations are not observed the regional crop rotation in farms, protecting the soils. The share of leguminous crops, amelioration, biological nitrogen fixing, decreased by 5-6 times.

The volume of organic fertilizers incorporated in soil decreased 20 times, the minerals - 15 times. The balance of humus and nutrients in soils is negative. The average weighted creditworthiness note of agricultural soils is 63 notes, while 178 thousand ha are highly degraded or damaged with creditworthiness less than 20 notes. The damage to the economy of the processes of soil degradation is about 3 billion MDL annually [11].

To improve the situation on the quality state of the soil cover, the Moldovan Government by decision no.636 of 26.05.2003 and no.841 of 26.07.2004 approved the "Complex Program of exploitation of new lands and increasing soil fertility" for years 2003-2010 [8]. The work covered by this program due to lack of finance, have been met by volume below 5 percent. Given the current state of quality status of the soil cover has decided to extend land reclamation works in the "Program of soil conservation and fertility improvement" for the period of 2012-2027 [4].

Program goal is to provide measures to halt the degradation and increasing soil fertility by upgrading and extending the land improvement system implementation of modern technologies and environmentally friendly agricultural practices.

Program objectives: to create Automated Information System of the soil quality state based on the pedological and agrochemical research; stopping active forms of damage the soil cover; improvement soil fertility for growing crop productivity.

The basic principle of the strategy to combat land degradation, conservation and increase their fertility consists of applying complex of measures - economic effective, environmentally safe, simple in execution, with low power consumption. The work is carried out in three main directions:

- combating soil erosion, stabilization of landslides and ravines, through simple hydro-ameliorative works, reforestation and revegetation, hydrological organization of farmland; founding grassed channels and outlets, dams;

- stopping the degradation of soil cover by extending land reclamation works (organizational, forestry, plant cultivation, agro-technical, draining-drying, amendment and ameliorative fertilization);

- increasing soil fertility by applying environmentally friendly agricultural practices; implementation of harmless fertilizer, irrigation expansion and application of modern technologies.

The program is the basic document for planning and promotion by central and local government bodies unique state policy on the protection, rational use and increasing soil fertility.

In developing the program were used scientific results of research and practical, education and design institutions, materials contained in the Complex Program of new lands and increasing soil fertility approved by Government Decision no.636 of 23.05.2003 and no.841 of 26.07.2004 [7].

The Program of soil conservation and increasing the soil fertility is developed by the Ministry of Agriculture and Food Industry, Land Relations and Cadastre Agency, Ministry of Environment and Agency "Moldsilva".

The program is developed for the period 2012-2027 and sets out the objectives, actions, expected results and the performance indicators, the volume of works, volume and sources of funding. Program implementation will ensure minimizing or stopping the main forms of soil degradation of the Moldova and will create prerequisites for increasing agricultural production by 1.3-1.5 times. The activities provided by the program will have beneficial impact on the ecological situation in Moldova.

Creating the layer Geoinformation "Soils of Moldova" is provided in order to execute the provisions of the Government Decision no.1298 of 28.10.2003 on the creation of National Geographic Information System. There is not any one source of information that could be express truthfully, on-line information about the creditworthiness note of agricultural land, their pretability, monitoring of erosion processes, etc. The principle of creating the databases is transforming soil maps, including their attribute information, available to the relevant authorities in digital format. Preliminary assessment of these works are estimated in accordance with the level of administrative-territorial unit (ATU) in the amount of 6.6 thousand MDL, representing at the national level approximate 6.0 million MDL.

Pedological mapping of agricultural land is provided in compliance with the enforcement of Law no.1247 of 22.12.1992 on *State Regulation of land ownership regime, State Land Cadastre and Land Monitoring* and Government Decision no.24 of 11.01.1995 approving the *Regulation on the content of the documentation general cadastre* with a periodicity 10 - 15 years. Evaluation of these works according to time rules approved by the Land Relations and Cadastre Agency is estimated from 1 ha conventional amounting 35 lei, representing at national level about 66.5 million MDL or 6.65 million MDL annually.

Development of cartograms to recovery measures and improving the degraded lands is needed to monitor in time and space the measures of stopping the soil degradation (conservation), both designed and those capitalized actions.

Cartograms will be prepared on paper support and in digital version for each ATU (scale 1: 10000) and at the administrative district level (scale 1:50000). Preliminary assessment of these

works according to specifications is estimated at administrative unit in the amount of 5.8 thousand MDL, representing at national level about 5.25 million MDL.

What keeps to re-parcelling drafting of agricultural land is provided by the Land Code and the Government Decision no.416 of 17.04.2007 on implementing the Program of Land Consolidation. Evaluation of these works is estimated to 1 conventional quota of farmland (three parcels), including their registration in the Land Register, amounting to about 500 MDL, representing annual 4000 quota and 2.0 million MDL.

Projects of organization and planning erosion control works of agricultural lands based on the landscape succeed from the re-parcelling of land having the imperative aim the rational and efficient use of farmland in perspective. This process is regulated by Government Decision no.1075 of 01.10.2007 on the approval of the Land Consolidation Regulation. Preliminary assessment of these works according to specifications is estimated at 1 ha of agricultural land amounting to about 165 MDL, representing annual about 1.0 million MDL [4].

## CONCLUSIONS

To improve the situation in the agricultural sector of the country, including the current status of soil resources the imperative mission lies with both science and policy makers, in fact, the whole society to conserve soils, preventing its degradation, mission precedes any political, economic or otherwise, as soil is the foundation of perpetuating our existence.

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