MAIN NATURAL RESOURCES SUSTAINABLE MANAGEMENT OF AGRICULTURE

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Abstract:
In the process of agricultural production we are using natural resources, human resources and capital. Responsible management of natural resources will allow the development of sustainable agriculture with the possibility of agricultural products to satisfy both quantitatively and qualitatively food requirements of the population. Natural resources that are irreplaceable in agricultural production are soil and water and now must be taken global measures for slowing and stopping global warming and climate change, which could jeopardize the attainment of agricultural production. In the paper reference is made to the quality of agricultural soils of Romania, the existence of water resources and measures to be taken to preserve soil fertility and combating drought.

Keywords: *agricultural production, natural resources, agricultural land , arable land , soil quality, water resources for irrigation .*

JEL Classification: Q01, Q24, Q25

1. Romanian agriculture in the current international context

Since the early twentieth century, but especially after World War II, agriculture has become increasingly complex activity, of which development contributed many of the gains of science and technology. Genetics together plant and animal breeding have contributed to obtain plant varieties and animal breeds more efficient, while production technologies have changed by introducing mechanization, the widespread use of chemical fertilizers, disease, weed and pest control products, as well as veterinary products, etc. All this made possible global food production to grow at a rate greater than population growth. Progress highest were recorded especially in developed countries, while in many areas of the planet is still practiced a rudimentary agriculture, based on animal traction, great consumption of manual labor and low yields.

It is clear that to meet such an increase in population, with a greater need for food, housing, clothing, transportation, etc, took great resource mobilization, some of which, such as fossil fuels, significantly decreased.

The many methods that have created this abundance of agricultural products in developed countries, such as industrial growth and intensive farming of animals using chemicals, have degraded production capacity of natural systems. Pressures on agricultural productivity growth through excessive and irrational exploitation of natural resources inevitably lead to negative consequences for sustainable development of agriculture.

Farmers will practice agriculture in the future will have to produce more food without having the advantage of cheap energy, abundant water and stable climate conditions. Global warming, along with the changing frequency of rains and storm, will reduce global food production while the demand is increasing.

Romania is considered a country with a high agricultural potential due to large agricultural area: 14,731 thousand ha of which 9.434 thousand hectares is arable land. Agriculture is one of the key sectors of the Romanian economy and has an intake of around 6% of GDP.

However, a long period of time (1991-2012), the foreign trade balance for food products was unbalanced, imports had usually much higher than exports. Balancing the scales took place only in 2013 and the favorable trend continues in 2014.

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Within the European Union, in the year 2012, Romania occupies leading positions in several elements: 10th for number of cattle; 7th place for dairy cows; 9th place for number of the pigs; 4th in the number of sheep and goats ; 9th place in the laying hens and other poultry; 8th for the value of animal production; same place for value crop production and gross value added agri-food industry; 5th place in the area cultivated with cereals and wheat; 5th in production of cereals and wheat; 1st and 2nd places for cultivated area with sunflower respectively production. In most cases, however, the productivity per hectare or per animal is lower than in countries with advanced agriculture.

2. The main natural resources of agriculture

To produce and sell goods and services, the agri-food chain operators are using a number of resources or inputs (raw materials, capital, labor, etc.). Combining these factors as a well-defined technology, each producer will obtain a range of products or provide certain services.

In agriculture is estimated that in the category of resources are three essential components: land, labor and capital, which some authors add on the fourth category - leadership - management. Production factors can be divided into three categories:

- Natural factors (land, forests, water, climate);
- Employment (directly productive workers, professionals, managers);
- Capital (machinery, utilities, construction, raw materials).

Each resource has a decisive role in achieving the final result.

In this paper we discuss only the role of natural factors in agricultural production and the measures to be considered for the proper conservation of these factors so that they will produce crops for an unlimited period of time.

Natural capital of agriculture mainly consists of agricultural land (soil), water, biodiversity and climate factors Land resources are the total area of land used in agriculture, both quantitatively and qualitatively. Soil has an important role by ensuring food security and environmental security. He also has a role in purification, filtration and water conservation, carbon sequestration, economic and social welfare, maintenance and development of biodiversity. For agricultural production, soil is indispensable.

Soil is the most important natural resource, being considered as the most important renewable natural wealth of the country. Romania, in terms of total agricultural land occupies seventh place in the EU; for agricultural area and arable land per capita, Romania is the 5th and respectively 6th in the EU.

The land suitable to obtain crops, whether or not cultivated, are frame in agricultural land. Some areas are worked annually, more regularly, while others, such as pasture or hay fields are not subject to agricultural work, but being a fodder base, forming part of the agricultural land.

The land use category means how some land is used. We distinguish five categories of use:

- *Agricultural land;*
- *Land for forestry;*
- *Land permanently under water;*
- *Urban land (covering rural and urban);*
- *Special purpose land (for roads, rails , airports , etc.)*.

In the category of "agricultural land" fits surfaces arable land, pastures, meadows, vineyards and orchards.

The category "arable land" includes any land that can be plowed (including land on the slopes with an incline of up to 30% if it is not covered with forest vegetation) and sown with various plants. Land cultivated with vines and trees, theoretical can plowed (at least between the lines) but, by convention, it is not part of the arable land. The category

"arable" is the most important part of the agricultural land, as plants that are grown in this area are essential in human nutrition, animal feed or for different industries. In Romania, by law, is prohibited removal of arable land for other agricultural or non-agricultural uses.

Romania has about 14.8 million ha of agricultural land, of which 62% (9.4 million ha) is arable (table 1). Agricultural land per capita is 0.65 ha of which 0.41 ha is arable, close to the world average. Of this area, only 0.18 ha is the quality I and II. Resources for growth are limited for arable land (about 400,000 ha) and can be: cultivating floodplain meadows, after a preliminary damming (solution now rejected by many scientists, especially ecologists) and saturated sandy land improvement, cultivation of pastures and meadows situated on flat land but give far smaller productions .

Table 1. The situation in Romania on land uses

The use of surface	Area		The use of surface	Area	
	Thousand ha	%		Thousand ha	%
Arable	9383	39.4	Forest	6681	28.0
Pastures	3331	14.0	Waters, marshes	893	3.7
Hay fields	1471	6,1	Roads	394	1.7
Vines	299	1.2	Courts, construction	631	2.7
Orchards	307	1,3	Unproductive land	449	1.9
Agricultural land- total	14,791	62.0	Non-agricultural land	9048	38.0
Total area of country				**23 839**	**100**

Source : Ministry of Agriculture, Forests and Rural Development, 2013 data

Evaluation of fertility level are most important to base agricultural strategy. Romanian soils are perceived by many people as having high natural fertility. Even if this is true to some extent, in reality things are a little more different. In very good suitability class falls actually only a small part of the total agricultural area, while nearly a quarter are good quality soils, and most fall into the category of medium or low quality.

In terms of soil quality, Romanian soils can be grouped into five quality classes. There are several classifications of evaluation of soil quality or soil that regard texture, slope inclination, degree of supply of organic matter and minerals, groundwater depth, etc.

The national strategy for sustainable development of the agri-food sector and rural areas in the period 2014-2020-2030 considered appropriate classification made by the authors of Agricultural Atlas of Romania. According to this classification (table 2), in terms of favorability agricultural land (arable land, natural grasslands, plantations), about half (48.3 %; 7.17 mil . ha) has good fertility and medium and more than half (51.7 % ; 7.68 mil . ha) has low fertility. However, in terms of the most important agricultural land, the arable distribution favorability classes is much more balanced: favorability good and very good - 39.3 % (3.67 mil. ha), medium - 25 5% (2.37 mil. ha) and low - 35.2 % (3.28 mil. ha). Natural factor limiting crop of Romania is the water, which, together with the permanent shortage of capital, determined to obtain for two decades (1990-2010), a vegetable production compared to the EU15 average of only 40%. To practice a differentiated agriculture, need to be considered and other information; for example in Romania, 2.571 million hectares of arable land are located on steep gradients above 5% ; 1.985 million ha are podzolic soils (high acidity); 306,000 ha are salinity; 3.2 million hectares are equipped for irrigation, although its irrigation - actual practiced on a much smaller area. The 3.1 million ha were made desiccation and drainage works and the 2.3 million ha of soil erosion control works.

Table 2. Distribution favorability classes for agricultural and arable farmland in Romania

Favorability classes	Categories of use			
	Agricultural land		Arable land	
	thousand ha	%	thousand ha	%
First class, of which	4079	27.5	3665	39.3
- Very good	414	2.8	357	3.8
- Good	3665	24.7	3308	35.5
Second class - Medium	3092	20,8	2373	25,5
Categoria I+II	7171	48,3	6038	64,8
Third class, of which.	7683	51,7	3283	35,2
- Low	3628	24,4	1726	18,5
- Very low	4055	27,3	1557	16,7
Total (I+II+III)	14854	100	9321	100

Source: Agricultural Atlas of Romania (D. Davidescu , N. Florea et al.)

On the other hand, the supply of nutrients to the soil is deficient in many areas. It is estimated that of the total arable area is well supplied only 10 % with nitrogen, 25% with phosphorus and only 71% with potassium. The Romanian agriculture reduced fertilizer use, which is reflected in lower average yields compared to those from where they are based agriculture inputs higher (table 3). For comparison, we present in table 4 nitrogenous fertilizer consumption in Romania, compared with three other European Union countries. In Romania although the production of nitrogen fertilizers has increased in recent years, we are still far from consumption per hectare of developed agricultural countries.

With respect to phosphorus fertilization, things are worse that the areas that apply such fertilizers are too low. Normally, it should be where it is not possible to apply chemical fertilizers to be applied in compensation manure, and in this respect things have evolved unsatisfactory. Factor that led to this situation is the high price of chemical fertilizers. All forecasts indicate a growth trend of price, but increases will be differentiated from one product to another. In our country, the price of chemical fertilizers has increased enormously, leading to 1,700 ron/t of ammonium nitrate and 2,380 ron/t of 15:15:15 NPK complex.

Table 3. The use of chemical fertilizers in agriculture Romania

Year	Fertilisers used (to s.a.)				NPK (kg/ha)	
	N	P_2O_5	K_2O	Total	Arable	Agricultural
1986	706,934	387,375	200,990	1,295,299	129.9	86.4
1990	656,094	313,108	133,875	1,103,075	117.0	74.8
1995	305,800	149,600	1,700	470,100	49.7	31.8
2000	239,300	88,300	14,600	342,200	36.5	23.0
2005	299,000	138,000	24,000	461,000	48.9	31.2
2006	252,000	94,000	17,000	363,000	38.5	24.6
2007	265,000	103,000	19,000	387,000	41.1	26.3
2008	280,000	102,000	16,000	398,000	42.2	27.0
2009	296,000	100,000	30,000	426,000	45.2	28.9

Source: Dumitru M., Session NURC Agriculture where? May 13, 2010

Table 4. Nitrogenous fertilizer consumption in Romania compared to other European countries

Country	Year 2003 tons	Year 2010 tons	tons in 2010 compared to 2003 -%	Consumption per ha in 2010 - kg
France	2,375,400	2.050,015	-14%	73.6
Netherlands	290,559	217,959	-25%	116.4
Poland	895,000	1,294,223	44%	89.6
Romania	252,139	305,757	21%	23.0

As a result of this situation the main soil characteristics were negatively evolve (table 5), and average yields per hectare reflects this situation (table 6).

Table 5. The evolution of soil characteristics during 1990 – 2000 years

Characteristics of soil	Area(ha) in 1990	Area(ha) in 2000	%
Small and very small reserves of humus	4,876,000	7,485,000	35
Poor nitrogen ensured	3,448,000	5,110,000	35
Weak and poorly supplied with mobile P	4,473,000	6,330,000	29
Weak and poorly supplied with mobile K	498,000	785,000	37
Highly and moderately acidic soils	2,369,000	3,424,000	31

Source: Dumitru M., Session NURC Agriculture where? May 13, 2010

Table 6. Average yield (kg / ha) hectare for main crops

Period	Mais	Wheat	Barley	Sunflower	Sugar beet	Potato
Average 1980-1990	3082	2937	3515	1564	21 574	13 665
Average 1991-2001	3011	2495	2595	1158	19 646	11 194
Differences%	-2,4	-15,0	-26,2	-26,0	-10,0	-18,1

Source: Data taken after Yearbook

It should be noted that the same surface can be affected by two or more cumulative limiting factors (frequency drought, nitrogen deficiency, erosion, etc.).

For illustration we present the state of fertility of soils in greenhouses planted with vegetables during the period 2002-2012. The Agrochemical Laboratory of Research Institute for Vegetable Growing Vidra, Ilfov county analyzed 493 soil samples from 11 counties and Bucharest. Situation of agrochemical main indicators is presented in Table 7. We can observe a decrease in soil fertility after 2009. These decreases in content of organic matter and N, P and K in soils of plastic tunnels, is due to the economic crisis that affected purchasing power of farmers and increase solarium areas, which meant taking into service of new lands with low fertility to crop needs .

Table 7. The dynamics of the average values of the main indicators of fertility momentary soil in greenhouses in the period 2002-2012

Year	MO	N-NO3	P	K	Ca	Mg	Na
	%	ppm					
2002	12,50	923	24,6	78	204	107	127
2003	8,00	50	23,0	75	134	67	147
2004	8,81	95	26,1	112	177	69	104
2005	8,96	85	10,9	82	211	68	120
2006	9,14	80	9,4	71	180	68	87
2007	8,80	176	11,1	174	260	107	176
2008	9,57	134	14,1	157	220	115	78
2009	8,52	114	20,7	122	200	110	153
2010	8,06	42	17,9	48	188	46	78

Year	MO	N-NO3	P	K	Ca	Mg	Na
	%	ppm					
2011	7,86	139	23,8	179	219	150	167
2012	6,69	26	8,5	42	48	44	84

Source: Analysis performed by V. Lăcătuş in RIVFG Vidra

Based on the average situation of soil fertility status of our greenhouses planted with vegetables, from the structure of culture, total consumption of major elements and coefficients average use of fertilizers, we calculated a necessary indicative of active substance:

- Partially fermented stable manure with an average dose of 40 t /h /year;
- N: an average consumption of 286 kg/ha/year;
- P2O5: with an average consumption of 190 kg/ha/year;
- K2O: with an average consumption of 595 kg/ha/year.

3. Climate change and the provision of water needed for agriculture

A big problem is awaiting solving global temperature increase that correlate with multiplying extreme weather. Destructive storms, hurricanes, cyclones, occur more frequently than in other historical periods. Effects on the atmosphere is manifested by increased water evaporation, precipitation and the number of storms. As in other European countries, such phenomena occur frequently in Romania.

Increase in average temperature, scorcing heat days in summer and installation of longer periods of drought, increase the risk of desertification of large areas of land. It is estimated that desertification threatened area in our country is 2,449 million ha or 16.6 % of total agricultural area.

Important effects occur and the hydrosphere. The average age of Arctic ice has decreased in the period 1988 - 2005 from 6 to 3 years, and the average ice thickness has decreased by 40 % in the period 1993-1997, compared to the period 1958 - 1976. Melting glaciers terrestrial phenomena and continuously reducing their volume, weight of snow and ice narrowing in the main alpine areas of the planet: the Rockies, Andes, Alps and Himalayas. As a result, more rain will fall in the rainy season and less snow will melt to feed rivers in the dry season, which would affect the water supply of about one billion people. In this case, it will restrict water resources for irrigation in summer, and the water supply of cities will suffer.

One of the effects of global warming is rising sea levels, an effect which has two causes:

-increasing water by volume expansion after heating;

- addition of melt water ice in the polar caps and glaciers terrestrial.

Rising sea levels lead to serious problems of flooding, especially low-lying areas such as the Netherlands, Bangladesh and some areas of the US coast.

Global warming causes raising soil temperature, which leads to drying and favoring forest fires.

Environmental imbalances lead to lower rivers during hot periods, and some rivers come to be drained completely. Water levels are dropping due to faster melting of snow in mountainous areas, high water consumption for irrigation and industrial uses or long periods of drought. For this reason, in many areas of the world population faces water shortages. Other environmental imbalances with implications for agricultural production are stepping acid rain and destruction of ozone in the troposphere, both phenomena with a negative impact on life forms on Earth. Due to more intense exploitation of natural resources of the planet, is affected biological basis, complex phenomenon often materialized in the following aspects:

- fisheries areas, forests and grasslands reach collapse due to resource exploitation at a rate higher than the natural capacity for regeneration, or in some cases due to adverse climatic conditions, pollution, the impact of acid rain, etc.;

- soil erosion due to deforestation, lack of vegetation on slopes or as a result of irrational agricultural works;

- the disappearance of a large number of species of flora and fauna is the expression of all of these disequilibrium, as we have seen, following anthropogenic activity;

- intensifying droughts.

Drought is a natural phenomenon resulting from lowering average rainfall , which produces major hydrological imbalances, negatively affecting production systems.

Drought differs from other phenomena in that it develops slowly, it may take months or years and affect large geographical areas. Drought has a significant impact on the economic, social and natural regionally and nationally. Drought causes may be:

- natural - caused by low rainfall, accompanied by a high rate of evapotranspiration over a long period of time;

-anthropogenic - that increase the impact of drought. They are due to: population growth (2020 planet is expected to have 7.9 billion inhabitants, 50% more than in 1990 - so food and water requirements greater; land use and degradation of land, reduction of vegetation cover, reducing water infiltration into underground reservoirs; degradation of water quality - reduces resource available for use; growing demand for water; legislation and inadequate management may exacerbate water scarcity.

Areas south of the Romanian Plain, Moldova Plateau, Northern Dobrogea Plateau and the western Piedmont Plateau (Oltenia Plain) are affected primarily by moisture deficit, frequently interspersed with flooding, such as in spring and summer this year. If the phenomenon becomes permanent, causing dryness, as a first step in installing a dry climate and subsequent desertification, which is identified by the sharp decrease in water availability by reducing agricultural production, biomass required as feed material and wood biomass and by extending the sandy areas. For Romania, dry periods are characterized by the lack of rain for a period of at least 14 consecutive days within the year cold (October-March) and at least 10 days during the warm period.

To mitigate the effects of drought in agriculture using irrigation, cultivation of drought resistant plant species and using different agrosystems that reduce water loss from the soil. Drought tolerance expresses the degree of adaptation of plants to drought or arid areas and is a genetically controlled mechanism. The discovery of the genes responsible for drought tolerance will allow biotechnology to obtain plants resistant to drought.

Losses due to drought and salinity risk crop production to fall by 50% by 2050, so drought tolerance should be a priority for research programs in biotechnology.

Strategies to combat drought on the following:

a) avoidance of drought by growing early varieties;

b) selection of plant for increasing the thickness of the cuticle, roots deeper and smaller leaf area, stomatal conductance decreased, reducing evapotranspiration, reducing albedo, reducing CO2 content, etc.

c) drought tolerance introduced by genetic methods: the use or handling of genes that protect and maintain the functions and structure of the cell under conditions of abiotic stress.

Global warming affecting our country shows a clear trend of desertification on an area of three million hectares in the south of Moldova and the south and south- eastern Romania, of which 2.8 million ha of arable agricultural land (20 % Romania's agricultural land).

Of land improvement are complex and agropedoameliorative hydraulic works aimed at preventing and eliminating risk factors - drought, excess water, soil erosion, floods, pollution - land at any destination.

Provision of water for irrigation is a major priority at least for some of the areas most exposed to drought. Some irrigation systems are made and must be restored, others are in progress or on the work of designers. Thus, to the south, marked one of the most important facilities in the country irrigation: Irrigation System " Sadova - Corabia".

Area Siret - Ialomita, part of the Romanian Plain, with an agricultural area of 500,000 ha (of which 68% of the agricultural area falls within first class fertility) due to prolonged droughts (between 10 and 120 days/year) the frequency of high winds that overlap with periods of drought, agricultural production is unsatisfactory. Economical solution to provide water to irrigation land in the area is achieving Bypass Channel Siret – Bărăgan. Works are begun, but takes place in a very slow pace. Irrigation complex in south eastern Dobrogea, generically called "Carasu" is one of the largest in the country (197,300 ha) is located in the area with the greatest water scarcity - Dobrogea Plateau, with maximum agro-economic requirements, having consider the sea coast .

Complex Carasu water source is masterly Channel Danube - Black Sea, including the branch represented by the Channel Midia - Năvodari . Other irrigation systems use water from the Danube or the accumulation of the interior rivers.

Water Potential of Romania amounts to 127 bn. M³/year, contributing about 40 bn. M³/year from interior rivers and Danube with approx, 87 bn. M³/year, while groundwater potential is estimated at approx. 10 bn. M³/year. One must also consider that there is a significant interannual variability and spatial (in most dry years, water resource decreased to about 20 bn. M³/year). Therefore, measures should be taken in water storage reservoirs on the rivers inland.

Average water availability in Romania is about 2,000 M³/year/person, compared to the average for Europe, which is 4,500 M³/year/person. However, experts consider that a good management of this potential, could provide for the full range of water uses.

Current water consumption amounts to 6.59 billion M³/year (2013) of which 69% industry, 16% agriculture and 15% of the population. Consumption of water intended for irrigation of agricultural land has decreased significantly from 1980 to 1990 decade. Irrigated area in Romania decreased from about 2 mil. Ha in the early 1990s to about 300,000 ha in the last five years, and the corresponding water requirement was reduced from 8 to 1 billion M³/year .

Over the years, human activities have affected the quality of surface water and underground. Only 57.5% of the total river length monitored, water quality are able to be used to power the water supply. Of the total potential resources, only 45.5% are technically usable, especially due to the contamination of resources.

Interior rivers are supplied mostly from rain and snow, less of springs groundwater, leading to a high degree dependent on the conditions and vulnerability to seasonal climate.

On medium and long term, water demand for household, industry, agriculture and other uses in Romania is not possible without the development of large hydraulic works, which accumulate during heavy precipitation and redistribute water resources in time and space (dams, reservoirs , temporary reservoirs, inter-basin flow) .

Conclusions

- Climate change in recent years, the frequency of increasingly sharp dry periods and drought, temperature extremes, determined the emergence and expansion of high-risk areas (12%) and medium (35%) of desertification, which requires the development/ rehabilitation of irrigation in drought affected areas;

- Unbalanced distribution of green coverage of Romania and the need for restraint and conservation of rainwater, the snow and wind strength reduction, requires realization of protective forest in the Romanian Plain (Bărăgan), Southern Moldova, and in a lesser extent in West Plain of Romania.

- food security can be achieved, especially in this period with changing global climate, only through proper use of natural resources that Romanian agriculture has, superior resources of many EU countries;

- maintaining soil quality and avoiding its degradation through: measures to avoid erosion, restitution by fertilizers of any kind (mineral, organic) nutrients with nitrogen, phosphorus, potassium and others, extracted with crops;

- performing minimal work and good quality;

- Water is a scarce resource, which quantitatively will become increasingly reduced, so that the national strategy must provide for: speed improvements for irrigation, new techniques and technologies leading to substantial reduction of water losses and to obtain a bigger increase crop per cubic meter of water used in irrigation;

- Organization of protective forests ;

- Maintenance of biodiversity; plant, animal, microbial, through measures to prevent and combat losses of species.

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