

## Soil erosion in the Republic of Moldova—the importance of institutional arrangements

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**Abstract** Due to the breakdown of the former Soviet Union, the centrally organized large-scale agricultural structures became obsolete as markets for agricultural products disappeared overnight. The Republic of Moldova was left with an energy- and cost-intensive agricultural infrastructure. It was impossible to quickly adopt the existing infrastructure to the regional needs of the country. In addition, natural processes such as drought, and soil loss due to extensive landslides, wind erosion, degradation of soil fertility and many other negative erosion-related impacts, threatened the agricultural productivity of the soils as well as agricultural economy and the wealth of the rural population. It is estimated that soil erosion in Moldova results in a financial loss of 45–55 million Euro annually. The lack of available information and data on natural processes, as well as the lack of legal and strategic guidance to farmers, can be seen as a major cause of the devastating situation of the country.

**Key words** benefits; costs; institutions; legislation; Moldova; policy; soil erosion and conservation

## INTRODUCTION

Soil cannot be reproduced and is hard to regenerate. Therefore it is necessary to guarantee the extensive conservation of land that has the potential for a wide range of uses. In the *European Soil Charter* of the Council of Europe, soil is considered to be among the major natural resources available to man, because of its significance for:

- (a) food and biomass production;
- (b) cleaning groundwater;
- (c) the food chain;
- (d) the atmosphere; and
- (e) as a habitat function for many organisms (gene reserve).

The paramount importance of soil protection has also been recognized in the instructions of the FAO (*World Soil Charter*) and the UNO (*World Soil Policy*). The project carried out in the Republic of Moldova demonstrates how relevant the importance of know-how is, in soil related agro-hydrological information as well as in appropriate legal and institutional regulations, and the role it plays in the socio-economic impact.

In Moldova (Fig. 1), soil protection must be embodied as a cross-sectional matter in regulations and laws, which are often related to the respective source of danger.

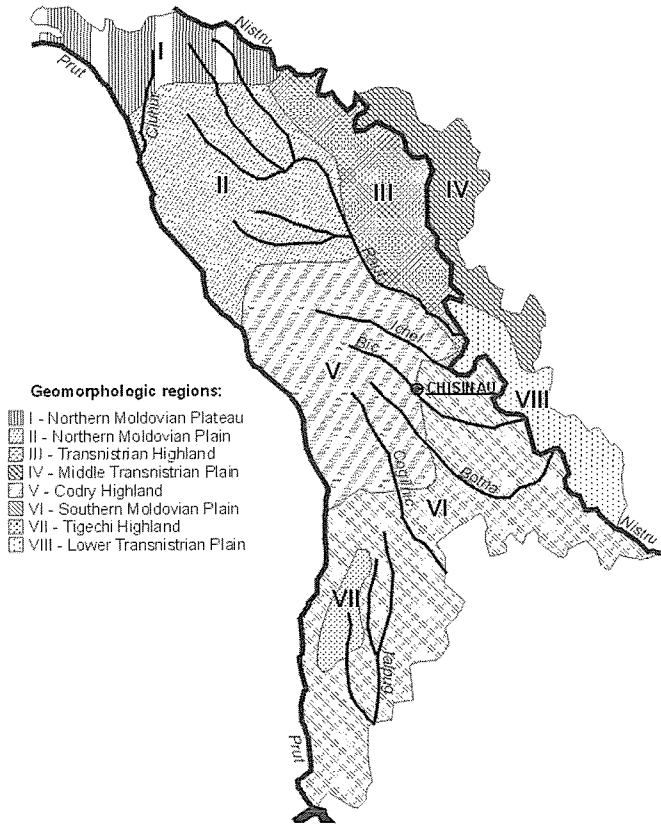


Fig. 1 Geomorphological regions of Moldova.

Regulations relevant to soil protection include laws on: air purity for power plants, smog, the ozone layer, fertilizers, forest economics, water rights, refuse economics, chemicals, industrial codes. and in particular soil protection laws. However, in many countries current legislation has to be improved in such respects.

## HISTORICAL ASPECTS

According to the policies of the Communist Party of the Moldovan Soviet Socialist Republic, during 1949–1950 the collectivization of agriculture was implemented and the *kolkhoz* and *sovkhos* farms were formed. Land became a collective or a state property. During the first years of the collectivization the slope lands were cultivated.

During 1954–1960 the slopes that were  $>10^\circ$  inclined were cultivated, the watersides and the swamps having been desiccated. This led to the acceleration of the water and wind erosion process for soils on slopes as well as to the process of salinization of soils in the watersides. During the process of collectivization the territorial organization of large land areas took place. Strips of forests on the boundaries of the fields and along the roads were planted, thus partially assuring the protection of the soil against water and wind erosion.

In the 1970s, by the decision of the central body of the Communist Party of the Moldovan SSR, all the forest strips along the field boundaries and along the roads were cleared and nut-trees were planted instead along the roads. These trees did not perform any anti-erosion functions. The activities increased the soil erosion risk and accelerated the process of soil erosion.

In the 1990s, with Moldova's gain of independence, the government took several measures, among them land reform. Over the period 1998–2000, with the financial support of the US Government the "Land" programme was implemented. During the implementation of this programme the farmers became landowners, receiving documents on their land shares. The average size of one land share was 1.38 ha. There are approximately 1.2 million citizens that possess the right to the allocation of a land share. The problems generated by the land reform were that the general issue of the privatization process caused the excessive fragmentation of the agricultural landscape—every farmer was presented with his 1.4 ha share in three to five different places. There is virtually no practical/technical possibility for the performance of land conservation works, proper fertilization and utilization of the soils, as well as for profitable farming. In addition, the land reform lead to a massive acceleration of the process of soil decay, increasing the risk of water and wind erosion of the soils and essentially decreasing soil fertility.

It can be concluded that the land reform in Moldova did not create conditions for improvement of soil fertility, the durable use of soils, the increase of agricultural production and so forth, but instead had a negative impact result on the economy of the country. As a result of the land reform, Moldova risks losing its most valuable resource—the fertility of the chernozems.

## **SOIL SITUATION AND AQUISITION OF DATA AND INFORMATION**

Soil erosion is often as high as 30 tons ha<sup>-1</sup> year<sup>-1</sup> and >1.4 × 10<sup>6</sup> ha run a potential risk of erosion. More than 55000 ha have been recorded as susceptible to landslides—approximately 5% can be considered as annually active. Soil fertility poses another related problem, as does soil salinity, due to hydrogeological conditions as well as the poor quality of irrigation water used in the past. Over the past 100 years, the soil organic matter content has decreased from 9 to 3.6%. Organic topsoil materials are easily eroded and washed off cultivated slopes, causing eutrophication in rivers and lakes. Sandy and clay layers are thus exposed at the soil surface. Soil pollution by pesticides exceeds maximum permissible concentrations and degradation due to natural soil salinity effects has also increased. "Physical soil structure pollution" is triggered by working with heavy machines on wet soils. Consequently, water quality is influenced over the long term by these process factors. Of rural wells, 60% are polluted by nitrates and other nitrogen compounds, and the maximum concentration of nitrates measured in the drinking water of decentralized systems shows maximum values of 150–250 mg l<sup>-1</sup>, in addition to ammonium, pesticides, as well as heavy metals, which are also detectable in surface waters.

The acquisition of information and data on all aspects of the overall soil situation represents the basis for the establishment of relevant regulations and laws on land management. But due to the immense lack of financial funds such activities are highly restricted. For example, the Radionuclide Laboratory of Moldova has collected and

stored unique data on contamination before, during and after the Chernobyl accident, but the results cannot be published due to financial restrictions.

Recommendations could consider:

- (a) the establishment of a radio-ecological model that will allow for prompt decision-making for the agricultural sector;
- (b) domestic research initiatives in the development and the standardization of appropriate measures, such as biological soil characterization, nutrient circulation, soil protection measures for cultivated soils; and
- (c) the introduction of a law/regulation on fertilizers as they also have high relevance to soil protection, since registered fertilizers, auxiliary soil substances, cultivation substances meet minimum requirements regarding possible pollutants.

## **POLICY OBJECTIVES, LEGISLATION AND INSTITUTIONAL ARRANGEMENTS**

The legal as well as the administrative structure under which agricultural schemes are practiced will often insure the success or seriously retard, if not destroy, the undertaking. Therefore the discussion of technical aspects alone is not sufficient. It is therefore important to understand the importance of legal, administrative and institutional aspects.

The Parliament of the Republic of Moldova has adopted a number of important legal instruments such as the Land Code, legislation on private farming, privatization, the land tax and various taxation procedures. These instruments also influence the country's environmental conditions. However, there is no direct integration of environmental issues in the agricultural development strategy—although agricultural activities are of course widely mentioned in Moldova's National Environmental Action Plan, NEAP. Furthermore, most economic incentives for agriculture aim at boosting production.

Moldova suggests many changes in agriculture to reduce the impact of fertilizers and pesticides on soil and groundwater, as well as to prevent degradation. In addition, its environmental policy lists objectives that concern agriculture:

- (a) areas requiring or enjoying environmental protection must not be privatized;
- (b) the shift from “traditional” to “biological” agricultural production, with a minimal use of chemicals, should be encouraged;
- (c) agricultural management schemes including crop rotation systems that correspond to the soil's agro-ecological potential should be introduced;
- (d) new managers of agricultural units should be given training in agro-ecological management practices;
- (e) agrarian reform should be backed up with agro-pedology, selection of agrochemicals, diagnosis and prediction of plant diseases and pests through the creation of informal consulting services.

The Ministry of Agriculture and Food of the Republic of Moldova coordinates:

- (a) the scientific production association “Fertilitate” with its subdivisions;
- (b) the Institute for Agrochemical Services with its chemical stations (Chisinau, Balti, Cahul) and six district production quality stations. They are responsible for moni-

toring nutrient and pesticide use, radiological contamination of soil and agricultural produce;

- (c) the Service Against Agricultural Pests and Diseases with its national station and district stations;
- (d) the Institute for Research and Technology Design in Pedology, Amelioration and Agrochemicals;
- (e) the State Association Apele Moldovei (formerly ACVA, 1995), which is an independent body;
- (f) the Moldova Institute for Water and Land Improvement Research;
- (g) the National Veterinary Diagnosis Control, which deals with animal disease and epizootic disease prophylaxy, as well as monitoring foliage and animal products for radionuclides.

Some institutions work in agriculture but come under the responsibility of another ministry or, more often, directly under the Government. The "Service Hidrometeo" monitors soil pollution with pesticides in the framework of a special programme. The "State Ecological Inspectorate" monitors soil pollution within a programme for soil pollution and degradation prevention. It also controls the distribution of land, owners' ecological expert assessments, and the annual cutting of wood. The Inspectorate collaborates with local bodies and organizations.

Since April 1994, soil control has been performed within a unified programme, developed in coordination with ecological monitoring. But the Ministry of Agriculture and Food receives data only from time to time. During recent years, much of the soil monitoring and/or water and soil fertility monitoring have had to be stopped due to a lack of money and research findings remain unpublished due to financial restrictions.

Several NGOs, which have sprung from scientific and research institutions, deal with agricultural problems such as soil erosion, sewage disposal, groundwater quality, soil fertility, education of rural populations, or alternative technologies. Most of them are now seeking a new way of raising money. Independent farmers have created two associations of their own. None of these organizations have sufficient funds to function properly.

## **A COST-BENEFIT CONCLUSION**

Moldova is naturally exposed to intensive rainfall. Torrential rain affects about 80% of agricultural land, often located on slopes. According to data from 1993, 886 000 ha, or about 25.8% of the total land area including agricultural land, has been affected by different forms of primarily water erosion. More than 310 000 ha were considered eroded to a medium-high degree. The rapid soil erosion has serious implications for the long-term sustainability of the agricultural production in Moldova, as the natural regenerative capacity of soils is low.

In addition to diffuse soil erosion, linear erosion processes such as landslides along slopes produce noticeable damage. A total of 55 427 ha of land-slide susceptible area was recorded in 1993, of which 2362 ha were active annually. The latest data on erosion (Table 1) show that the situation has become worse.

Crops are grown without consideration to proper relief and soil type in terms of soil conservation. The excessive transformation of hilly pastures and meadows into

**Table 1** Annual soil erosion and related loss in soil nutrients, 1995. Source: Bulletin of Ecopedological Monitoring, 3rd edn, Chisinau (1996).

Region	Eroded area 1000 ha	Loss in 1000 t:				
		Soil particles	Humus (org- anic matter)	Nitrogen	Phosphorus	Potassium
North	652.4	3880.6	115.0	8.2	4.9	104.2
Central	289.9	9828.0	255.5	17.6	12.6	2298.6
Southeast	103.6	740.8	21.2	1.6	0.9	17.2
South	384.9	7694.9	214.8	15.9	9.4	178.5
Total	1430.8	22 144.3	606.5	43.3	27.8	2598.5

land for annual crops, without any attention paid to relief, physical or biological monitoring must also be mentioned. By cultivating slopes intensively, the organic topsoil layer is washed off and only sand and clay layers are left as topsoil on the slope. The emphasis on short-term production resulted in a lack of soil conservation measures.

It can be concluded that the overall eroded area increases by 0.86% a year. The annual loss of fertile soil particles amounts to about  $22 \times 10^6$  t year<sup>-1</sup>, with maximum erosion rates greater than 30 t ha<sup>-1</sup> year<sup>-1</sup>. The loss of topsoil reduces the productivity over time. Field experiments in Moldova on maize, wheat and sunflower show that the decrease in production is significant. The sustainability of agricultural production is endangered.

The economic value of eroded soil corresponds to an estimated annual loss of €45–55 million. The total benefits of soil conservation are estimated at €450–550 million. A suggested action plan to improve the negative soil erosion situation within the Prut basin of approximately 50 000 km<sup>2</sup> in size, requires agro-technical conservation measures, which need to be performed in parallel with institutional, legal and socio-economic adaptations, to be successful. The soil conservation measures taken are most efficient in technical as well as economic terms when applied to slope gradients ranging between 2° and 6°, which refers to approximately 10% of the overall Prut basin. Ecological measures are suggested to create an ecologically important network of hedges and forests (Green Network) on a large scale. The costs for the protection measures are estimated as 6–7 million € year<sup>-1</sup> over a period of 20 years, which is approximately 25% of the estimated final annual benefit. Thus, it can be concluded that maintenance costs as well as costs for monitoring activities are relatively small in comparison to the investment costs for upgrading a highly damaged natural ecosystem.

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