120 Years of Organized Soil Erosion Control in Bulgaria: A Review

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Abstract

In 2025, Bulgaria celebrated 120 years of organized soil erosion control. The beginning of this activity is considered to be 1905, marked by the French floodplain control inspector Félix Vogeli. The achievements of Bulgaria over these 120 years provide a valuable example of sustained efforts to protect soils, restore natural vegetation, and manage agricultural land sustainably. Throughout this period, Bulgaria's agrarian policy has undergone numerous changes. Various erosion control policies were implemented, particularly during the 1950s and 1970s, followed by more recent reforms linked to European Union policies and strategies aimed at preventing soil degradation. Overall, a significant improvement in soil conditions has been observed, largely due to the restoration of extensive areas of natural, predominantly forest vegetation and the adoption of good agricultural practices that minimize soil disturbance during cultivation.

Keywords: soil erosion control, Bulgaria, review

Introduction

In 2025, Bulgaria marked 120 years of organized efforts to control soil erosion, dating back to 1905, when the Bureau for the Strengthening of Floodplains and Afforestation was established in the city of Kazanlak. Over the past 120 years, erosion control activities in the country have passed through several distinct stages. Despite changes in policies, approaches, and institutional frameworks, substantial progress has been achieved. These successes are primarily attributable to the restoration of natural vegetation and the implementation of effective measures to protect soils from degradation**.** Soil erosion is the most significant soil degradation process on the territory of Bulgaria. This is a result of natural physical and geographical conditions and the way of land use. Agriculture and forestry in our country suffer great losses from the effects of soil erosion. In other sectors of the economy, these harmful consequences related to erosion are very different. Soil erosion annually takes away valuable agricultural lands, which remain wasteland or have lost their soil fertility to one

degree or another. The fact is that arable lands in Bulgaria occupy relatively small areas, therefore soil protection and use is the essential and primary important (Stanev, 1979).

The protection of land from the effects of water and wind erosion is a major problem for the future development of agriculture in our country. Naturally, this concerns a natural national wealth, such as soil. It is systematically destroyed and irretrievably carried away into rivers and seas, thus destroying the main means of producing food, fodder, and all related stocks in our agriculture.

Looking into the distant past

From a historical point of view, the destruction of natural vegetation on the territory of Bulgaria began thousands of years ago. This is a long process that began with the emergence of the first settlements on our territory, as a result of human activity and the first forms of agriculture, animal husbandry, crafts, mining, etc. This was the history how agriculture developed during the Middle Ages when forest areas and lawns were converted into agricultural lands.

At the end of the 14 century after the conquest of Bulgaria by the Ottoman Empire, further development of forest and mountain areas began. This was the period when the fertile plain lands were taken by Ottoman feudal lords, and then part of the Bulgarian population was forced to look for land in the mountainous regions (Biolchev, 1953). In these places, due to unfavourable topographic conditions, the soils quickly become impoverished, washed away and in a short time became unsuitable for further agricultural cultivation. This forced the mountain dwellers to constantly search for new lands for agricultural purposes, which they obtained by destroying forest areas.

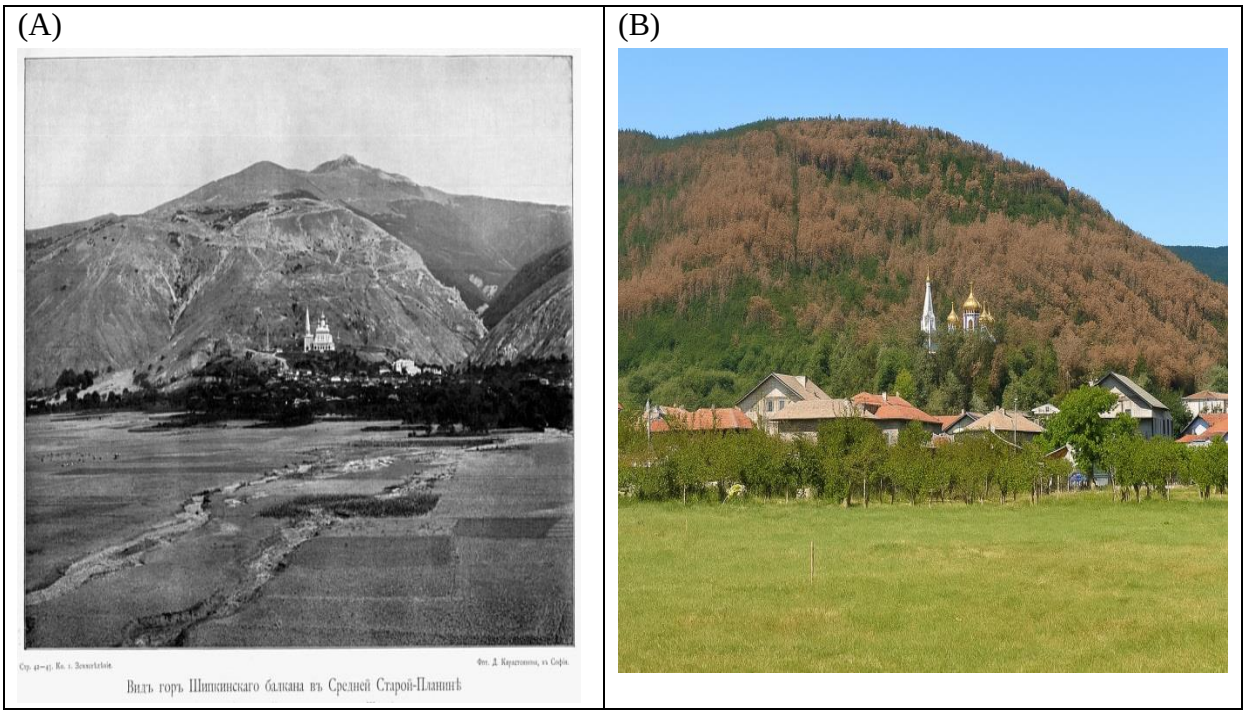


Fig. 1. *The Shipka peak in Balkan mountain, in year 1902 (A) and in 2025 (B).*

The extent of forest destruction was initially limited, but together with population growth, these dimensions reached their maximum magnitude after liberation at the end of the

19th century. In mountainous areas, the activities of the *Yuruk* and *Karakachan* tribes destroyed large forest areas in the mountains through fires in order to have pastures for their herds. Throughout the Ottoman rule, no measures were taken to restore the destroyed forest vegetation, nor to control erosion, which in many places was already in a fairly advanced state. Such measures were far from the policy of the socially and economically backward Ottoman Empire.

After the liberation in 1878, the rapid economic development of our country began, when forests were still being cut down due to the need for timber. This led to a severe deterioration of the vegetation in the watersheds of the mountain watercourses, turning them into typical torrents.

Beginning of the organised soil erosion control in Bulgaria

Afforestation in the country began with artificial reforestation of degraded lands due to erosion. Completely different sites for reforestation and afforestation of barren and degraded lands were treated in the same way and the ecological requirements of different forest tree species were not taken into account. Some good results were obtained only with acacia tree afforestation in the Danubian Plain. Afforestation of degraded lands had occasional and temporary success (Alexandrov et al., 2020).

In 1905, the Bulgarian government, and Ministry of Agriculture and State Property, call for help to the government of France, a country with the greatest success in the management against floodplains, fortification measures and erosion control, with a request for assistance to Bulgaria. In the same year, the first Bureau for the Strengthening of Floodplains and Afforestation was opened in the town of Kazanluk by the frenchman Félix Vogeli, an inspector for the strengthening of floodplains in France. In six years, Félix Vogeli created four sections of the "Bureau" in towns of Sliven, Kyustendil, Tran and Karlovo (1911). They grew up to 38, and in 1948 the "People's Republic of Bulgaria" closed them and created the State Forestry Company (SFC). The successor to the "Bureau" in Kazanlak was SFC-Kazanlak (Tsavkov et al., 2025).

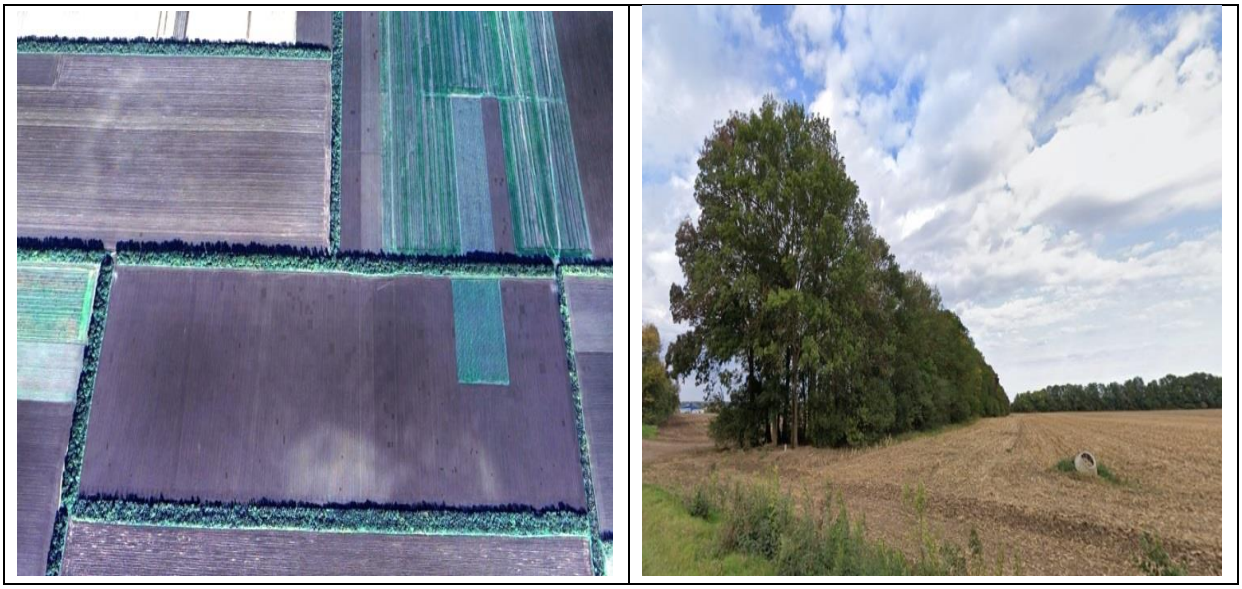


Fig. 2. *Field protection forest belts in Dobrudja to prevent wind erosion (photos: Google-earth)*

After the Second World War and the years after it, the People's Republic of Bulgaria was still strongly affected by erosion in mountainous, forest and pastures areas and it was less affected in agricultural lands. During collectivization, when private property was abolished and the land was consolidated, a process of removing the natural field borders and clearing the natural vegetation around the agricultural lands began, as a result of which erosion also began to increase in agricultural lands. Then the introduction of mechanized equipment in agriculture began, and yields increased, but so did erosion. It is a well-known fact that soil scientist Academician Ivan Stranski was criticized for shallow ploughing by the then chairman of the Bulgarian Communist Party, Valko Chervenkov, because in his textbook from 1940 he recommended shallow ploughing (Chervenkov, 1952).

Soil erosion control during the period 1950-1990

In 1950, a scientific expedition on agroforestry reclamation was organized, which carried out detailed route studies on soil erosion in the cultivated lands of the main hilly and plain regions of the country. By Decree No. 236 of the Central Committee of the Bulgarian Communist Party and the Council of Ministers of the People's Republic of Bulgaria (1951), a plan was adopted for the construction of state and field protection forest belts in Dobrudzha as a measure to prevent droughts and wind erosion in this region. These issues were studied at the Dobrudzha Research Institute near the town of General Toshevo.

In 1955, the Decree of the Council of Ministers of the Republic of Bulgaria "Preventing Erosion on Cultivated Lands" was issued, which marked the beginning of research work on soil erosion in the entire country, by organizing a department on soil erosion at the Institute of Soil Science "N. Poushkarov" in Sofia. This department is the main scientific unit for studying the given issue. In 1956, a section on Soil Erosion was established at the Soil Science Institute at the Bulgarian Academy of Sciences and three experimental fields for erosion studies were opened as well.

Lectures on soil erosion and its control were included in the students teaching programs of the "G. Dimitrov" Agricultural Institute, the "V. Kolarov" Agricultural Institute and the state agricultural technical schools. In the same year, scientific work on soil erosion also began at the Karnobat Agricultural Research Institute, the Tobacco Station in Djebel and the Institute of Forage in Pleven. In 1958, scientific work on soil erosion began at the Institute of Viticulture and Enology in Pleven. The first erosion research stations were organized in the village of Mirkovo and the city of Pleven (later only the one in Mirkovo remained). In 1963-1964, scientific work on soil erosion began at the Institute of Viticulture and Enology in Troyan and at the Agricultural Research Centre in Kardzhali, and an erosion research station was organized in the village of Suhodol. In the second half of the 1960s, complex erosion studies were carried out in the watershed of the Topolnitsa river reservoir under the methodological guidance of prof. Biolchev and prof. V. Koinov, where 6 *limngraph* stations were installed at different types of land use (forests, high-mountain and low-mountain pastures, and agricultural fields). During the period 1970-1979, an experimental station for preventing erosion was established in the city of Ruse with an experimental field for erosion research in the village of Trastenik. An experimental field for erosion research was organized near town of Topolovgrad. Field plot and model erosion studies were carried out under various soil types, climatic and economic conditions (Rousseva et al., 2010).

To improve the soil erosion control management in our country, the State Council adopted Resolution No. 21 of July 9, 1975 "Basic Provisions for Improving the Management against Erosion in P.R. Bulgaria". According to this government document, further work on preventing soil erosion will be conducted in a unified and coordinated manner on the basis of a National Long-Term Program (Stanev, 1979). In 1977, the Methodology for Developing a National Program for Erosion Control was developed and standards for designing anti-erosion measures were prepared (Biolchev et al., 1977). In 1979, 6 national standards (BDS) on soil erosion were developed. For most of the activities related to erosion control and other degradation processes, large and compact areas are required. Until 1989, they were carried out in watersheds covering vast territories - all types of land use (fields, meadows and pastures). Since the restoration of ownership rights over agricultural land after 1990, this situation of soil erosion research had been changed (NAP, 2014).

Soil erosion control since 1990

Since 1990, erosion studies continued under new modern ways as various models for predicting erosion processes were developed. After 2000, also new GIS models were introduced to supplement and harmonize the methodology for assessing and mapping the factors and intensity of water and wind erosion of the soil.

Studies were carried out on optimal practices for anti-erosion land use, territorial organization, organic farming and ecological soil protection, appropriate crops and crop rotations, machines, devices and technologies, water-saving and soil protection practices, etc. (Rousseva, et al., 2010).

In 2019, the World Soil Day, dedicated to soil erosion control, “Stop Soil Erosion, Save Our Future” was celebrated on December 5th around the world, as well as in Bulgaria. Restriction of soil erosion is a key to achieving the Millennium Development Goals such as zero hunger, good health and well-being, access to clean water, innovation in industry, climate action, responsible consumption, and supporting life on land and underwater (Rousseva, 2020).

Nowadays, new agricultural machines are entering the markets that are ecologically friendly to the soil. Conservation agriculture equipment (no-till, strip-till, minimum-till, mulchers, etc.) for tillage and devices related to the application of non-traditional soil cultivation technological operations in the technologies for growing main crops.

Under the EU's Common Agricultural Policy (CAP), soil protection aspects are part of the requirements for good agricultural and environmental condition. Efforts are focused on restricting soil erosion, preserving and improving soil organic matter, and avoiding compaction.

Nowadays, about 85% of the soils in the country are affected by erosion processes (Atanassova, 2021). According to data from the Executive Environmental Agency (ExEA, 2024), in the period 2015-2021, the areas affected by surface water erosion and soil losses increased. Compared to the previous year, in 2021, a slight increase in the intensity of surface water erosion was observed. In the period 2015-2021, the areas affected by wind erosion remained relatively constant. Compared to the previous year, in 2021, a decrease in the intensity of wind erosion was observed.

In 2023, the areas with agricultural land that have a low erosion risk (< 5 t/ha/y) are 1,738,635 ha, those with moderate (5.01-20 t/ha/y) and high risk (> 20 t/ha/y) are 1,989,243 ha and 2,007,111 ha, respectively. With this regard, only the area of arable land with low erosion risk is 1,432,427 ha, with moderate risk is 1,476,175 ha, and with high risk is 726,237 ha (ExEA, 2025). The average annual intensity of sheet water erosion on agricultural lands varies from 10.8 t/ha/y on pastures and 11.1 t/ha/y on arable land to 13.7 t/ha/y on areas occupied by other types of agricultural crops.

Compared to 2022, in 2023 there was a slight increase in the areas at risk of wind erosion, while soil losses slightly decreased. Data on the distribution of the country's territory by degrees of wind erosion in 2023 show that (37.2%) of arable land is at low to moderate risk (0.2-0.5 t/ha y), (ExEA, 2025).

The risk of irrigation erosion is relatively small, affecting irrigated lands with a slope of more than 6%, most of which have been abandoned since 1990. The area of irrigated lands in Bulgaria until 1990 was about 25% of the arable land. As a result of in-depth research, it has been established that the risk of irrigation erosion is highest with gravity furrow irrigation, varying from 2.5 to 8.6 t/ha for one water supply and that the application of rain-fed irrigation can significantly reduce soil losses (Rousseva, 2006). In recent years, drip irrigation has become widespread, in which there is no soil loss from irrigation.

Classification of anti-erosion measures (practices) in Bulgaria.

The entire complex of soil protection equipment, technological operations, methods and technologies forms the system of measures (practices) to control soil erosion (Dimitrov et al., 2014).

The measures of this system can be structured into the following main groups:

I. Organizational and economic measures.

In the system of anti-erosion measures, the leading role belongs to the organization of the territory, which is based on the correct placement of agricultural land and crop rotation fields and production (team) plots on the territory with erosion risk. Such placement is carried out taking into account the features of the relief, the exposure of the slopes, soils and the degree of their erosion risk in order to create the best conditions for agricultural engineering, primarily erosion control and mechanization of agricultural production processes, designing agro-technical facilities, forestry hydrological and technical measures.

II. Agro-technical measures.

Agro-technical measures include all anti-erosion technological operations and technologies for soil cultivation, sowing and planting of agricultural crops and their cultivation. It can be included also anti-erosion crop rotations, selection of alternative and energy crops for non-fertile agricultural lands.

The following anti-erosion agricultural practices (methods) are used in our country: contour cultivation of sloping arable lands, furrow-ridge ploughing, flat-cut cultivation, runoff retention furrows, cutting with course formation, terracing, construction of grassed runoff collectors, mulching, - orienting the rows in the horizontal direction, terracing, grassing the inter-rows, mulching and green fertilizing, minimal and zero tillage of the soil, and others.

III. Biological measures.

Biological (agroforestry) measures include: field protection and water-regulating forest belts and plantations on offshore lands and in the river network, as well as anti-erosion grassing.

Forest belts are placed in accordance with the existing instructions for afforestation of protected belts, contributing to the retention of surface runoff and reducing its destructive force. In flat terrain, to protect the soil from wind erosion, longitudinal field protection forest strips are laid, located transversely to the direction of the prevailing winds.

IV. Land reclamation and technical measures.

Land reclamation and technical measures are the permanent anti-erosion measures, which use land reclamation and technical and hydro-technical facilities to protect arable lands with a slope of more than 6-7^{o} from erosion and to prevent gully and stream bank erosion in the river network.

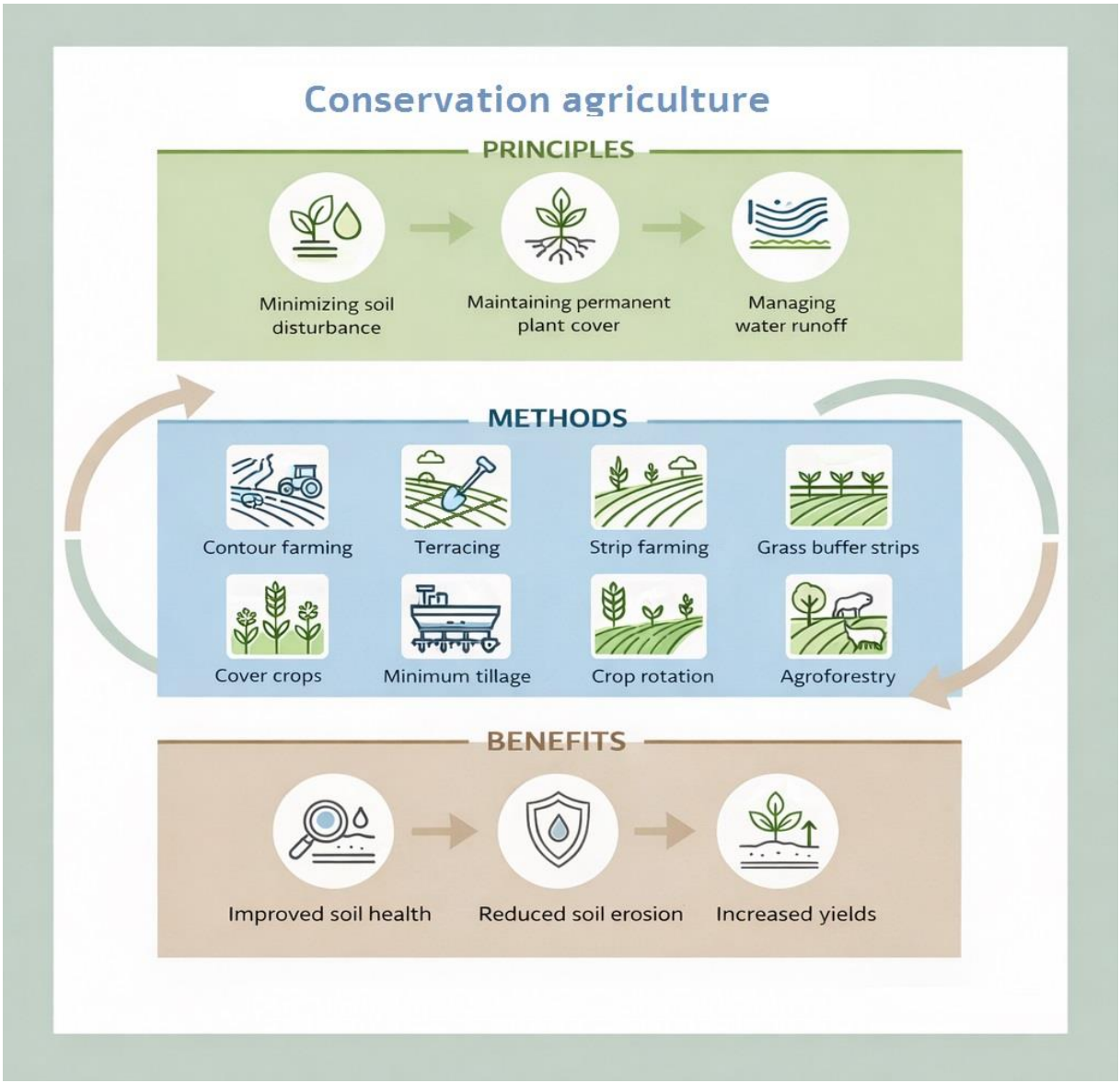


Fig. 3. *Scheme of basic principles, methods and benefits in the implementation of conservation agriculture.*

All practices from the system of measures to prevent erosion must be interconnected and complement each other so that they can be applied comprehensively and simultaneously on the entire territory of a given farm.

According to the national report on the state and protection of the environment of the Executive Agency for the Environment (ExEA, 2024 and 2025), in recent years a consistent policy has been implemented to limit the erosion process in several directions:

1. Annual monitoring conducted by the Environmental Agency for the entire country, the data from which are used to plan land use in a way that limit erosion processes;

2. Informing and assisting agricultural producers in planning the use on a given farm by the regional structures of the Ministry of Agriculture (MA);

3. Compliance with Good Agricultural and Environmental Conditions (GAEC);

4. Support for agricultural producers through compensatory payments for activities limiting the erosion process (MA).

Good agricultural and environmental conditions (GAEC) of agricultural lands are implemented using specially developed standards. They are part of the system of ex ante conditionality (Article 12 of Regulation (EU) 2021/2115 of the European Parliament and of the Council of 2 December 2021), which aims to contribute to the development of sustainable agriculture by raising beneficiaries' awareness of the need to implement these standards.

Strategies and policies to prevent soil erosion in the EU

The EU strategy to prevent soil erosion is based on the EU Soil Strategy to 2030 (2021), which aims for healthy soils by 2050 (Fig. 4). Key initiatives include the Soil Monitoring Act, a new legislative instrument for a harmonised approach across the EU to monitoring and restoring soil health, was adopted on 23 October 2025 (Council of the European Union, 2025). The new directive introduces a pan-European methodology for assessing the physical, chemical and biological status of soils.

The EU Mission: A Soil Deal for Europe, part of the Horizon Europe programme, has also been adopted, aiming to restore soil health by 2030. The EU strategy integrates policies such as the Biodiversity Strategy and the Common Agricultural Policy (CAP) and uses tools such as the EU Soil Observatory to improve data and knowledge on soil health, supporting sustainable soil use and restoration.

The EU Biodiversity Strategy for 2030 states that it is essential to increase efforts to protect soil fertility, reduce soil erosion and increase soil organic matter content through sustainable soil management practices. According to expert estimates, between 61 % and 73 % of agricultural soils in the EU are affected by erosion, loss of organic carbon, excess nutrient (nitrogen) content, compaction or secondary salinization (or a combination of these threats) (Council of the European Union, 2023).

Erosion control policies in Bulgaria and the EU can prevent imbalances in competitiveness and broaden societal and economic benefits. The Republic of Bulgaria as an EU member has access to larger budgets, which can also provide significant funding for projects and research to protect soils from degradation. Erosion control policies need to take these different perspectives into account, by setting universal requirements or providing funding schemes.

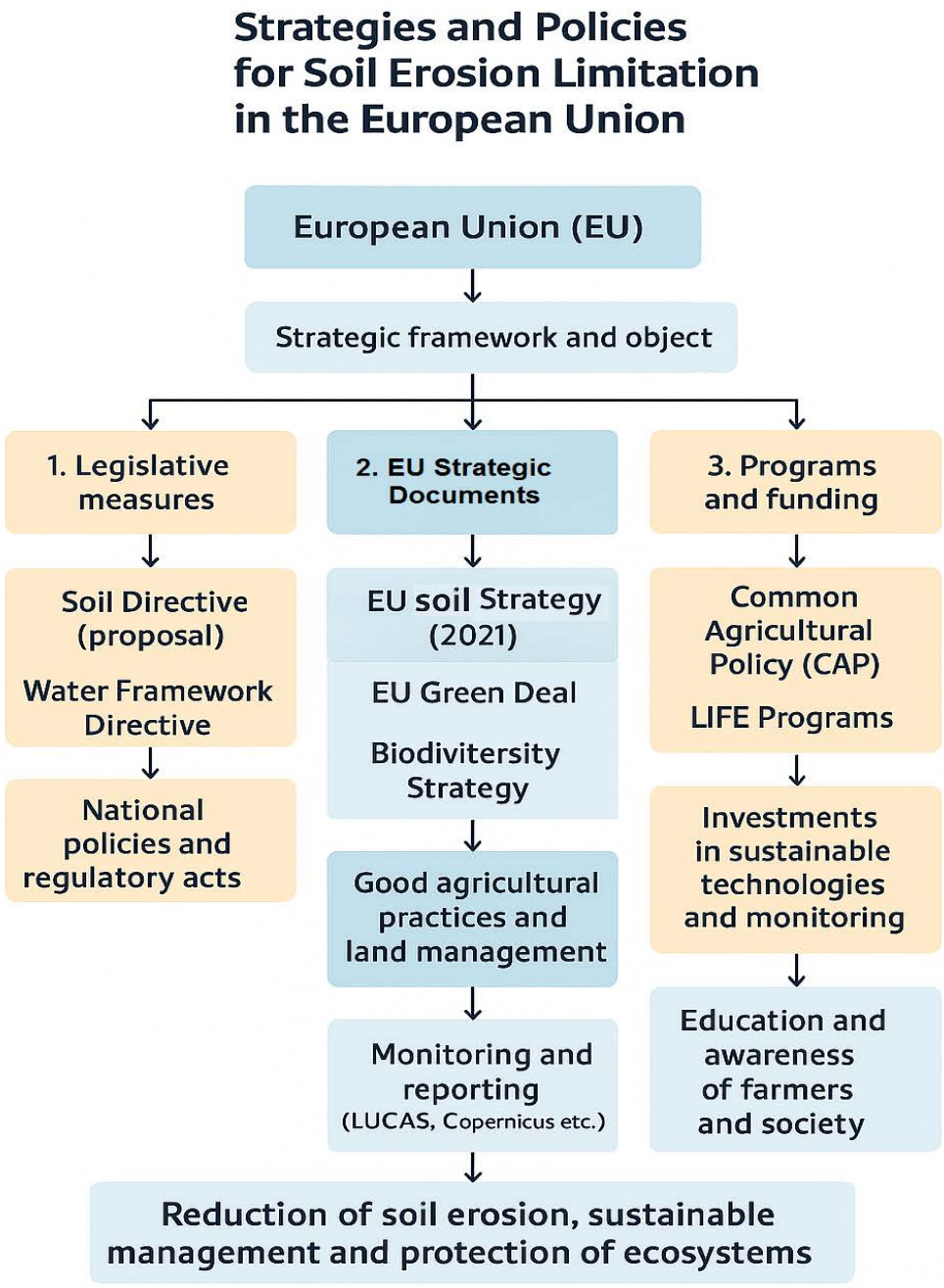


Fig. 4. *EU strategies for preventing soil erosion.*

Conclusion

Over the past 120 years since the beginning of organized erosion control management in Bulgaria, soil erosion has remained the primary threat to soil degradation. Throughout this period, the state has invested substantial effort and resources in soil protection. Research, technological innovations, policy measures, afforestation, and engineering structures have been employed in erosion control, leading to significant progress; however, much remains to be done. With the growth of the global population and the impacts of climate change, soil erosion is expected to intensify at the global scale, adversely affecting the capacity of soils to produce food and other raw materials. Therefore, continued efforts to control soil erosion are

essential, with a strong emphasis on conservation and regenerative agriculture to safe soils from further degradation.

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