The guide "Adaptation to Climate Change and Sustainable Land Use in the Republic of Moldova" was developed within the framework of the CCLU-Moldova project and provides a brief explanation of what climate change means, how it affects soils, water resources, forests, and rural communities, and what adaptation options exist at the farm, local, and public policy levels. It presents types of climate risks, principles of spatial planning, and good land management practices, aiming to turn climate adaptation into a practical and credible tool for sustainable development.

The publication is intended for specialists in the fields of climate change, climate change adaptation, and land-use management, as well as for undergraduate, master's, and doctoral students.

Guide in Romanian, digital version

Guide in English, digital version

Chișinău, 2026

Vitalie MAMOT

Anatolie PUȚUNTICĂ

ADAPTATION TO CLIMATE CHANGE AND SUSTAINABLE LAND USE IN THE REPUBLIC OF MOLDOVA

GUIDE



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" CCLU-MOLDOVA. Climate Change and Land Use in Moldova", 25.80013.7007.01GER

Project funded by the Federal Ministry of Education and Research of the Federal Republic of Germany (BMBF) and the National Agency for Research and Development of the Republic of Moldova.

Chişinău, 2026

The guide was recommended for publication by the Senate of "Ion Creangă" State Pedagogical University of Chişinău (minutes of the meeting No. 5 of 17 December 2025).

This publication was prepared within the framework of the bilateral ProMoMo project – **"CCLU-MOLDOVA: Climate Change and Land Use in Moldova.", 25.80013.7007.01GER**

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DESCRIEREA CIP A CAMEREI NATIONALE A CĂRȚII DIN REPUBLICA MOLDOVA

Mamot, Vitalie.

Adaptation to Climate Change and Sustainable Land Use in the Republic of Moldova : Guide / Vitalie Mamot, Anatolie Puţuntică ; scientific reviewers: Iurie Bejan, Rodica Cojocari ; translated and adapted into english by Tatiana Yavuz. – Chişinău : [S. n.], 2026 (CEP UPSC). – 99 p.

Bibliogr.: p. 97-99 (32 tit.). – Funded by the Federal and Research of the Federal Republic of Germany (BMBF) and the National Agency for Research and Development of the Republic of Moldova. – [100] ex.

ISBN 978-9975-48-350-6. – ISBN 978-9975-48-351-3 (PDF).

551.583:332.3(478)

M 19

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Printed at the Editorial and Printing Center of "Ion Creangă" State Pedagogical University of Chişinău, 1 Ion Creangă street, MD-2069.

Dear reader,

a year certainly can fly by, especially when not learning by the books but by heart, with personal meetings, continuously developing discussions and field trips. And this is, what we from the ***Research and Transfer Centre Sustainable Development and Climate Change Management*** (FTZ-NK) did within the scope of the Project ***Climate Change and Land-use in Moldova*** (CCLU-Moldova).

The country left an extraordinary first impression, with 12°C plus at the End of January, making Moldova look like a potential winter retreat, because most of Europe at that time was freezing with temperatures close to zero degrees. However, the consequences of the missing snow and the temperature variations are severe and the authors of this book collected a lot of evidence for climate change impacts within the county.

The ***Government of the Republic of Moldova*** has indicated several sectors in their Nationally Determined Contributions (NDCs) to fight climate change in line with the Paris Agreement, where climate change mitigation is entangled with urgent steps towards climate change adaptation. This is particularly the case in the sector of land-use, where various techniques can intensify the climate change related stress. In Agriculture, vast areas of monoculture are not only more vulnerable to pests but also can harm the sensitive balance of the soil, causing erosion and evaporation that has consequences on quality and quantity of the harvested products as well as on required steps of water management to nurture the plants and protect the harvest. The struggle can be seen especially within the area of the selected case study, the ***Southern Development Region*** of Moldova. The authors have dedicated much work in gathering insights on the ongoing climatic shift within the area and provide an overview of recommendations on land-use changes to reduce vulnerability and stabilize the living and working conditions.

We, as part of the project team, feel delighted to have had the opportunity to collaborate closely with our colleagues from the ***Ion Creangă State Pedagogical University*** and recommend this book for the general audience as well as for specific interest groups.





Prof. Dr. Walter Leal
Project lead and head of the FTZ-NK

Sven Kannenberg, M.Sc.
Project Manager of CCLU-Moldova

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CCLU-Moldova. Climate Change and Land-Use in the Republic of Moldova / Schimbări Climatice și Utilizarea Terenurilor în Republica Moldova

"CCLU-Moldova – Climate Change and Land Use in Moldova" is an applied research and territorial intervention project dedicated to climate change adaptation and sustainable land use in the Republic of Moldova. The project aims to connect scientific analysis.

Brief project overview: CCLU-Moldova aims to identify climate-related vulnerabilities affecting soils, water resources, forests, and land-use patterns, and then to test practical adaptation solutions at farm and community levels. The initiative combines climate analysis and GIS mapping (risk maps for drought, erosion, and floods), case studies in villages and farmer groups, and the development of a package of recommended policies and measures for local public authorities and the national level.

The project's technical curriculum includes land-use scenario modelling, assessment of agricultural practices (conservation agriculture, crop rotations, perennial crops), identification of degraded land for afforestation and shelterbelts, and the design of riparian buffer strips and rainwater harvesting solutions. The stakeholder engagement component includes workshops with farmers, local administrations, and specialists, practical guides, checklists, and support for integrating adaptation into local strategies.

The project is coordinated by "Ion Creangă" State Pedagogical University of Chișinău, through the Faculty of Geography, and is implemented by a multidisciplinary team of researchers in geography, climatology, agronomy, forestry, and environmental sciences.

An important role is also played by the international partners from HAW Hamburg University of Applied Sciences (Germany), who contribute advanced expertise in regional climatology, spatial planning, remote sensing, and GIS modelling. The Hamburg team supports the development of climate scenarios and land-use models, provides assistance with comparative analysis against other European regions exposed to climate risks, and hosts academic exchanges for teaching staff, PhD candidates, and students involved in the project. This international collaboration amplifies the project's impact and connects the Republic of Moldova's experience to relevant European research and innovation networks.

INTRODUCTION

This guide is a comprehensive tool designed to provide an in-depth understanding of the complex relationship between climate change and land use in the Republic of Moldova. In a period marked by rapid climatic transformations and increasing pressure on natural resources, the need for an integrated and well-informed approach becomes imperative for the country's sustainable future.

The main purpose of this guide is to facilitate a multidimensional understanding of the climate challenges facing Moldova, while also providing practical, evidence-based solutions for effective land management. The guide is intended to serve as a reference point for policy-makers, environmental specialists, farmers, local community representatives, researchers, and all those interested in climate change and sustainable land use.

The guide's specific objectives include: supporting informed decision-making in land management; promoting sustainable agricultural practices adapted to new climate realities; encouraging cross-sectoral cooperation in addressing climate challenges; disseminating scientific knowledge in an accessible and applicable manner; and identifying opportunities for funding and implementing climate change adaptation and mitigation projects.

The document is structured to provide both a macro-level perspective on the national climate and land-use situation, as well as concrete examples, case studies, and practical recommendations applicable at the local level. Each chapter is designed to progressively build a complete understanding, from theoretical foundations to practical applications and implementation tools.

This guide addresses a wide range of stakeholders directly or indirectly involved in land management and in tackling climate challenges in the Republic of Moldova. Clearly identifying the target audience makes it possible to tailor the content and recommendations so that they are relevant and applicable to each category of users.

Central and local public authorities represent an essential category of beneficiaries of this guide. Relevant ministries—such as the Ministry of Agriculture and Food Industry and the Ministry of Environment—as well as mayoralties and district councils will find valuable information in this document for developing public policies, development strategies, and action plans in the fields of agriculture, environment, and spatial planning. Decision-makers can use the guide to substantiate legislative measures, allocate budgetary resources, and coordinate cross-sectoral activities.

Farmers and agricultural landowners represent another important segment of the target audience. They are directly facing the impacts of climate

change and need practical solutions to adapt their farming activities. The guide provides information on sustainable farming techniques, soil conservation methods, efficient irrigation systems, crop diversification, and other practices that can help increase the resilience of agricultural holdings.

Non-governmental organizations and civil society play a crucial role in raising public awareness and implementing community projects and environmental policies. This guide can serve them as a source of information and documentation for awareness campaigns, the development of project proposals, and mobilizing local communities around climate adaptation actions.

The academic and research community will find in this document a useful synthesis of current knowledge on climate change in Moldova, as well as an identification of research gaps and future directions for investigation. Students in related fields can use the guide as supplementary teaching material.

The international community, including development agencies, donors, and implementation partners will be able to use the guide to better understand the national context and to align their interventions with Moldova's real priorities and needs.

The preparation of this guide was based on a rigorous, multidisciplinary methodology, combining the analysis of scientific data, expert consultations, a review of relevant legislation and existing policies, and the use of international best practices adapted to the specific context of the Republic of Moldova.

The research process included a comprehensive review of the specialized literature at both national and international levels. The analysis covered scientific reports of the Intergovernmental Panel on Climate Change (IPCC), regional climate studies for Eastern Europe, national climate change reports produced by specialized institutions in Moldova, as well as academic research published in peer-reviewed journals. This solid theoretical foundation ensures the scientific credibility of the information presented.

Primary data collection was carried out in collaboration with national institutions responsible for monitoring climate and natural resources, such as the State Hydrometeorological Service, the Ministry of Environment, and other relevant organizations. Official statistical data on land use, agricultural production, precipitation, temperatures, and other key indicators were integrated into the analysis.

Expert consultation was an essential component of the methodology. Interviews and discussions were organized with specialists in climatology, agronomy, forestry, soil science (pedology), ecology, and other related fields. Their practical experience and knowledge helped identify real-world challenges and formulate applicable recommendations. In addition, representatives of local communities, farmers, and practitioners who face the impacts of climate change on a daily basis were consulted.

The analysis of the legal and institutional framework focused on mapping and assessing relevant national legislation, sectoral strategies, action plans, and the international commitments assumed by the Republic of Moldova in the areas of climate and land use. This analysis made it possible to identify legislative gaps and opportunities to improve the regulatory framework.

The review of international best practices included examining successful experiences from other countries with similar geographic and climatic conditions or comparable challenges. These examples were adapted to Moldovan realities, taking into account the country's economic, social, and institutional specificities.

A participatory methodology was applied through the organization of workshops and public consultations involving representatives of different beneficiary groups. The feedback received helped refine the content and recommendations to ensure their relevance and practical applicability.

Validation and updating of information were carried out continuously throughout the drafting process, ensuring that the data presented are the most recent available and that the recommendations reflect the latest developments in the field.

NATIONAL CONTEXT

Geography and Climate of the Republic of Moldova

The Republic of Moldova is located in south-eastern Europe, between Romania to the west and Ukraine to the north, east, and south, covering an area of approximately 33,846 square kilometres. This geographic position gives the country unique characteristics that influence both climate and land-use potential. The lack of direct access to the sea and the predominantly lowland and low-hill relief significantly shape the territory's natural conditions.

Moldova's relief is diverse, although altitude differences are relatively modest. The central part of the country is dominated by the Central Moldavian Plateau, with elevations reaching up to about 400 metres; the highest point is Bălăneşti Hill at 429 metres. In the south, the Bălţi Steppe Hilly Plain and the Southern Moldovan Plain provide fertile and flatter lands, favourable for intensive agriculture. The north of the country has a more dissected landscape, with valleys and hills that create a diversified landscape mosaic. This relief diversity leads to regional differences in land use, hydrological conditions, and susceptibility to erosion processes.

Moldova's hydrographic network is mainly formed by the Dniester (Nistru) and Prut rivers, which create the country's natural borders to the east and west, respectively, together with numerous smaller tributaries. These watercourses play a vital role in supplying water for agriculture, industry, and the population, but they are subject to significant seasonal variability and are vulnerable to droughts and floods, which are intensified by climate change.

Moldova has a temperate continental climate, characterized by four distinct seasons, with warm summers and relatively mild winters, although variability has increased in recent decades. The average annual temperature ranges between 8 and 10°C, with notable regional differences between the north, where temperatures are lower, and the south, where the climate is warmer and drier. Summers are generally warm, with average July temperatures between 20 and 23°C, but with increasingly frequent heatwave episodes when temperatures exceed 35°C.

Average annual precipitation ranges between 400 and 550 mm, with an uneven distribution throughout the year and across the territory. The northern zone generally receives more precipitation than the south, which is more exposed to drought. Most rainfall occurs in May–June and September–October, while the summer months are often characterized by precipitation deficits. This uneven precipitation pattern, combined with high temperatures during the growing season, creates water stress for agricultural crops and ecosystems.

Moldova's soils are largely dominated by chernozems—fertile soils characteristic of steppe and forest-steppe zones—which cover approximately 75% of the country's agricultural land. Historically, these soils have had high natural fertility, which has made Moldova an important agricultural region. However, intensive land use, unsuitable farming practices, and erosion processes have led to significant soil quality degradation in many areas. Brown-reddish and brown-grey forest soils occur in areas with richer vegetation, while alluvial soils are found in river floodplains.

Moldova's natural vegetation has been substantially altered over the centuries through deforestation and the conversion of land for agriculture. Today, forests cover only about 11% of the territory; they are fragmented and mainly concentrated in areas less favourable for agriculture. The steppe, once the dominant vegetation formation, has largely been transformed into agricultural land. Wetlands and riparian vegetation along rivers play an important role in maintaining biodiversity, but they are also under pressure.

Moldova's biodiversity includes a variety of plant and animal species adapted to steppe and forest-steppe conditions, yet many of them are threatened by habitat loss, pollution, and climate change. Protected natural areas cover a limited surface and require sustained efforts for conservation and expansion.

Land Categories

Land use in the Republic of Moldova reflects the predominantly agricultural character of the country's economy, as well as the historical legacy of land-use policies from previous periods. Understanding the distribution and characteristics of the different land categories is essential for developing climate change adaptation strategies and for promoting the sustainable use of natural resources.

Agricultural land is the dominant category, covering about 75% of the country's total area, which is equivalent to approximately 2.5 million hectares. This exceptionally high share places Moldova among the European countries with the highest degree of land conversion to agriculture. Of the total agricultural land, arable land accounts for about 74%, being used to grow cereals, industrial crops, vegetables, and other crops. Maize, wheat, sunflower, and sugar beet are among the main crops cultivated on significant areas.

Orchards and vineyards represent a special category of agricultural land, of major economic importance for Moldova. The wine sector is a defining element of the national economy and identity, with vineyards covering approximately 91,130 hectares. Orchards—especially fruit trees and walnut plantations—cover tens of thousands of hectares and contribute significantly to agricultural output and exports. These perennial crops require long-term

investment and are particularly vulnerable to climate change, especially to spring temperature fluctuations, drought, and extreme weather events.

Pastures and hay meadows account for about 10% of the agricultural territory and are used for livestock farming. The quality of these pastures has been affected by intensive grazing, inadequate management, and climate change; many are degraded and have low productivity. The restoration and sustainable management of pastures is a priority for maintaining the livestock sector and conserving biodiversity.

Forests cover only about 11.2% of the country's area, which is significantly below the European average and below the level recommended to maintain ecological balance. Moldova's forest fund is fragmented, consisting of small and isolated forests unevenly distributed across the territory. The dominant species is oak, followed by black locust (acacia), ash, maple, and other deciduous species. Moldovan forests fulfil multiple functions: protection against erosion, regulation of the hydrological regime, biodiversity conservation, carbon sequestration, provision of timber and other forest products, as well as recreation. The low afforestation rate is a major issue that increases the country's vulnerability to climate change and land degradation processes.

Degraded and unproductive lands are a worrying category, including soils affected by severe erosion, landslides, gullies, and other forms of degradation. It is estimated that more than 1,072,667 hectares of agricultural land are affected to varying degrees by erosion processes, and around 150,000 hectares are strongly degraded. These lands have lost a significant part of their fertile topsoil and have much lower productivity. Erosion processes are intensified by the hilly relief, torrential rainfall, unsuitable farming practices, and the lack of protective vegetation cover.

Urban areas and rural settlements occupy approximately 9.8% of the country's territory. Chișinău, the capital, and other major cities such as Bălți, Tiraspol, Cahul, and Soroca concentrate a significant share of the population. Urban expansion, although moderate compared to other countries, puts pressure on agricultural land around cities and requires careful planning to minimize impacts on fertile soils.

Water bodies, including rivers, lakes, and artificial reservoirs, cover a relatively small area but play a vital role in the country's economy and ecosystems. The Dniester (Nistru) and Prut rivers, together with their tributaries, provide essential water resources, but are vulnerable to pollution, changes in the hydrological regime, and the impacts of climate change. Reservoirs created for irrigation or hydropower generation contribute to water

resources management, but require careful management to avoid problems such as eutrophication and sedimentation.

Special-purpose lands include transport infrastructure, industrial sites, quarries, military areas, and other specific uses. Although they cover a limited area, these lands can have a significant environmental impact through pollution, habitat fragmentation, and soil degradation.

Statistical Overview

A quantitative analysis of the current land-use situation and of demographic and economic trends is essential for understanding the pressures exerted on natural resources and for designing appropriate interventions in the context of climate change.

From a demographic perspective, the Republic of Moldova has a population of approximately 2.6 million according to the latest estimates, with a negative demographic trend driven by low birth rates, relatively high mortality, and large-scale emigration. Around 40–45% of the population lives in urban areas, while the rest is rural and directly or indirectly dependent on agriculture. This demographic structure creates specific challenges: continued pressure on productive agricultural land, rural depopulation, and the ageing of the rural population, which affects the viability of traditional agricultural activities.

Population density is about 77 inhabitants per square kilometre, but the distribution is uneven, with higher concentrations around urban centres and along major river valleys. Chișinău and other urban areas have much higher densities, while some rural areas in the south are less populated. This spatial distribution influences land pressure and resource needs across different regions.

Moldova's economy remains strongly dependent on agriculture, which contributes approximately 10–12% to Gross Domestic Product, while employing around 25–30% of the active labour force. This discrepancy between the sector's GDP contribution and its share of employment indicates relatively low agricultural productivity and the existence of a large number of subsistence or semi-subsistence households. The agricultural sector is dominated by crop production, with significant outputs of cereals, industrial crops, vegetables, and fruits, as well as the wine sector, which has strategic importance for exports.

The structure of land ownership changed radically after independence through privatization and agrarian reform. Today, the vast majority of agricultural land is privately owned, and fragmentation is a dominant feature. The average farm size is only a few hectares, with most agricultural holdings being peasant households that cultivate small plots for household consumption

and for the market. There are also larger commercial farms engaged in intensive agriculture with better access to modern technologies, but these represent a minority. Excessive land fragmentation creates difficulties in implementing modern farming practices, mechanization, and the adoption of soil conservation measures.

Agricultural production varies significantly from year to year depending on weather conditions, highlighting the high vulnerability of Moldovan agriculture to climate fluctuations. Recurrent droughts in recent decades have caused major production losses, especially in cereal crops, sometimes reducing harvests by 30–50% compared to favourable years. Average annual cereal production is around 3–4 million tonnes in good years, but it can drop substantially in drought years.

The irrigated area has declined dramatically since independence—from about 300,000 hectares in the Soviet period to less than 30,000 hectares today. This drastic reduction is due to the deterioration of irrigation systems, high operating costs, lack of investment, and land fragmentation. The absence of adequate irrigation amplifies the impacts of drought and limits opportunities for crop diversification and improvements in agricultural productivity.

The forest area, at approximately 485,785 hectares, is insufficient to ensure essential ecological functions. Afforestation has increased only very slowly in recent decades, and reforestation efforts face challenges related to land availability, financing, and management. Average forest area per capita is about 0.15 ha (150 m^2), well below the European average (0.3–0.36 ha per person).

Moldova's greenhouse gas emissions are relatively low compared to developed countries, totalling approximately 10–12 million tonnes of CO_2 equivalent per year. The energy sector, agriculture, and transport are the main emission sources. Although Moldova's contribution to global emissions is marginal, the country has assumed emission-reduction commitments under the Paris Agreement and is developing mitigation and adaptation strategies to address climate change.

IMPACTS OF CLIMATE CHANGE

Temperatures and Precipitation

Climate change, manifested through shifts in temperatures and precipitation patterns, represents one of the most significant threats to the Republic of Moldova, directly affecting all economic sectors and the population's quality of life. An analysis of meteorological data from recent decades reveals clear and worrying trends that require prompt and coordinated responses.

The average annual temperature in Moldova has increased by approximately 1.0–1.2°C over the last five decades—a warming rate that exceeds the global average and reflects the region's particular vulnerability to climate change. This upward trend is not uniform throughout the year: warming is more pronounced in winter, when minimum temperatures have risen significantly, reducing the number of frost days. Summers have become warmer, with an increased frequency of extreme heatwaves during which temperatures exceed 35–38°C for prolonged periods.

Absolute maximum temperatures recorded over the last two decades have often exceeded 40°C in various regions of the country, setting new records and creating conditions of severe heat stress for crops, livestock, and the population. These thermal extremes are frequently accompanied by drought, amplifying negative impacts. The number of very hot days (above 30°C) has increased substantially, while the number of cold nights has decreased.

Seasonal temperature patterns have also changed significantly. Springs have become more variable, with abrupt alternations between warm and cold periods, which affects plant phenophases and increases the risk of late frosts that can damage the blossoms of fruit trees and grapevines. Autumns are generally warmer and longer, which can have both positive effects (a longer growing season) and negative ones (more favourable conditions for pests and diseases). Milder winters reduce snow reserves that traditionally helped ensure soil moisture at the beginning of spring.

Climate projections for Moldova indicate a continuation of warming trends. According to climate model scenarios, by 2050 the average annual temperature could increase by an additional 1.5–2.5°C compared to the reference period, depending on the trajectory of global greenhouse gas emissions. Such an increase would imply fundamentally different climatic

conditions from those to which current agricultural systems and ecosystems are adapted.

Precipitation patterns show similarly worrying changes. Total annual precipitation has recorded a slight decrease or stagnation in most regions, but far more important is the shift in the temporal and spatial distribution of rainfall. Summer months—critical for agriculture—are receiving less precipitation, while short-duration, high-intensity rainfall events have become more frequent, leading to rapid runoff, erosion, and water losses due to reduced infiltration into the soil.

Interannual variability in precipitation has increased significantly, with alternation between extremely dry years and years with excessive rainfall, making forecasting and agricultural planning increasingly difficult. Severe droughts that previously occurred once every 10–15 years now appear at intervals of 3–5 years, profoundly affecting food security and rural incomes. The years 2007, 2012, 2015, and 2020 were marked by devastating droughts that significantly reduced agricultural production.

The spatial distribution of precipitation highlights different regional vulnerabilities. The south of the country, already more arid, is becoming even more susceptible to drought, while the north, although receiving more rainfall, is facing increased risks of floods and erosion due to intense precipitation events. The central zone, with its hilly relief, is vulnerable both to drought and to accelerated erosion caused by torrential rains.

Snow, which played an important role in regulating the hydrological regime and ensuring soil moisture, has become less consistent. The snow cover is thinner and persists for shorter periods, reducing the water reserves accumulated during winter. Early snowmelt, sometimes followed by freezing, creates unfavourable conditions for autumn crops and natural vegetation.

Increased potential evapotranspiration has increased due to higher temperatures and stronger winds during dry periods, has intensified soil moisture deficits even in periods with moderate precipitation. This means that the same amount of rainfall becomes less effective in meeting plants' water requirements.

The combined impact of rising temperatures and changing precipitation patterns is creating an increasingly challenging environment for traditional Moldovan agriculture. Classic crops such as wheat and maize, which have long been pillars of agricultural production, are becoming riskier in the absence of adequate irrigation. Heat and water stress reduce not only yields but also the quality of agricultural products.

Drought and Erosion

Drought and soil erosion are two of the most severe consequences of climate change in Moldova, often acting in tandem and reinforcing each other's destructive effects. These phenomena threaten the foundations of Moldovan agriculture and can lead to irreversible degradation of natural resources if not managed proactively.

Drought in Moldova can be classified into several types: meteorological drought (precipitation deficit), hydrological drought (reduced river discharge and groundwater levels), agricultural drought (soil moisture deficit), and socio-economic drought (impacts on the population and the economy). Over the last two decades, Moldova has experienced all these types of drought with alarming frequency—sometimes simultaneously—creating complex crisis situations.

The 2007 drought was one of the most severe on record, affecting virtually the entire country and causing agricultural losses estimated at over USD 1 billion. Cereal production fell by about 50% compared to normal years, and many crops were completely destroyed. This drought highlighted the extreme vulnerability of Moldovan agriculture and the lack of effective crisis-response mechanisms. The impacts were felt not only in agriculture but also strongly affected rural incomes, food prices, and the economy overall.

The 2012 drought again severely affected agricultural production, especially spring and autumn crops. The lack of rainfall during the critical months of April–June significantly reduced yields of cereals, vegetables, and fodder crops, affecting both crop production and the livestock sector. Pastures were scorched by the sun, forcing farmers to reduce livestock numbers or to buy feed at prohibitive prices.

In 2020, another severe drought struck Moldova, coinciding with the COVID-19 pandemic and amplifying economic difficulties. Extremely high temperatures and a lack of rainfall during the summer period led to substantial agricultural losses, especially in crops such as maize and sunflower. Water reserves in reservoirs dropped dramatically, and many farmers reported total crop failures in non-irrigated areas.

Trend analyses show that both the frequency and severity of droughts are increasing. Drought periods are becoming longer, while recovery intervals between drought episodes are shortening, leaving progressively less time for ecosystems and agricultural systems to recover. This trend is alarming for the long-term viability of Moldovan agriculture in its current form.

The impact of drought on soils is profound and long-term. Low moisture and high temperatures lead to faster decomposition of organic matter, reduced

biological activity in the soil, and compaction of the arable layer. Dry soils become more susceptible to wind erosion, a phenomenon that is increasingly frequent in southern Moldova, where strong winds lift dust and fine soil particles and transport them over long distances.

Soil erosion is a natural process that has been dramatically amplified by human activities and climate change. In Moldova, erosion represents an existential threat to sustainable agriculture. It is estimated that millions of tonnes of fertile soil are lost annually through erosion—a process that is effectively irreversible on a human time scale, since forming just one centimetre of soil can take hundreds or thousands of years.

Water erosion, caused by torrential rainfall on sloping land, is the most widespread and destructive form of erosion in Moldova. The hilly relief of the central region, combined with the lack of protective vegetation cover on many agricultural lands, creates ideal conditions for rapid runoff and soil loss. Intense rainfall events—becoming more frequent under climate change—generate gullies and deep ravines that fragment agricultural land and make some areas impractical for farming.

Existing gullies in Moldova cover tens of thousands of hectares and continue to expand if they are not stabilized through conservation measures. Some gullies reach depths of 10–20 metres and expand by several metres each year, "swallowing" productive agricultural land. The most affected areas are in the central and northern parts of the country, where dissected relief and sensitive soils favour the development of these landforms.

Sheet erosion, although less spectacular, is just as damaging in the long term. It removes the most fertile topsoil layer, rich in organic matter and nutrients, gradually reducing the productive capacity of the land. On many agricultural fields in Moldova, the chernozem layer—initially 60–80 cm thick—has been reduced to 30–40 cm or less, exposing horizons with lower fertility.

Unsuitable farming practices further intensify erosion. Ploughing downslope, the lack of protective shelterbelts, monocropping, excessive use of heavy machinery that compacts the soil, and the absence of cover crops during winter leave soil vulnerable to erosive forces. Land fragmentation makes it difficult to implement anti-erosion measures that require coordination across larger areas.

Wind erosion, which has increased in recent years, is favoured by drought, strong winds, and lack of vegetation cover. In spring and summer, when the soil is dry and not protected by vegetation, dust storms are becoming more frequent in the south and central regions of the country. These storms transport tonnes of fertile soil, depositing it in unsuitable locations or losing it entirely.

The economic impact of erosion is enormous. The loss of fertile soil reduces agricultural productivity, requiring increased fertilizer applications to maintain yields, which raises production costs. The sedimentation of gullies and riverbeds with eroded soil reduces the storage capacity of reservoirs and affects water quality. Erosion-degraded land loses economic value and may become unproductive.

From a food security perspective, the combination of drought and erosion creates a downward spiral: drought reduces the vegetation that protects the soil, while erosion reduces the soil's capacity to retain water, which worsens the impacts of future droughts. Breaking this vicious cycle requires major interventions in soil and water conservation, restoration of degraded land, and the adaptation of agricultural practices.

Biodiversity

The biodiversity of the Republic of Moldova, although lower than in more biogeographically diverse regions, plays a crucial role in ecosystem functioning, the provision of ecosystem services, and maintaining resilience to environmental change. Climate change, combined with human pressures, poses a significant threat to Moldova's biodiversity, with potentially serious consequences for ecological balance and human well-being.

Moldova's flora includes approximately 1,800–2,000 species of vascular plants, reflecting the country's position at the intersection of steppe and forest zones. This plant diversity is mainly concentrated in protected areas, on slopes, in river floodplains, and in the remaining fragments of natural forest. Many species characteristic of the Eastern European steppe, once abundant, have become rare or have disappeared entirely due to the conversion of land for agriculture.

Climate change affects flora by altering the temperature and moisture conditions to which species are adapted. Species adapted to cooler and wetter climates are pushed northward or to higher elevations, but given Moldova's predominantly low relief, migration options are limited. Xerophytic and thermophilic species adapted to warmer and drier conditions are expanding their ranges northward, changing the composition and structure of plant communities.

Forests—dominated by pedunculate oak, ash, hornbeam, and other broadleaf species—are vulnerable to heat and water stress. Repeated drought episodes in recent decades have caused widespread tree dieback, especially of oaks, a process known as forest decline. Thousands of hectares of forest have been affected, reducing tree density and altering forest structure. This dieback

increases the potential for pest and disease outbreaks and reduces forests' capacity to provide ecosystem services.

Rare and endemic species are particularly vulnerable. Moldova hosts a number of endemic or subendemic species, as well as many rare species located at the edge of their distribution ranges. These species have small populations and limited habitat fragments, making them extremely susceptible to change. The Red Book of the Republic of Moldova includes hundreds of threatened plant species, many of which are directly affected by climate change and habitat alteration.

Moldova's fauna includes approximately 460 vertebrate species and thousands of invertebrate species. Among mammals, the country hosts species such as roe deer, wild boar, fox, badger, polecat, and others, most of them concentrated in forested areas and wetlands. Climate change affects fauna by altering habitats, food availability, and reproductive cycles.

Avifauna is particularly important, with over 300 bird species recorded, many of which are migratory and use Moldova as a stopover or breeding area. Wetlands along the Dniester (Nistru) and Prut rivers are crucial for many waterbird species. Climate change is altering migration patterns, breeding phenology, and food availability for birds. Some species are shifting their distribution ranges, while others may disappear from the region if conditions become unfavourable.

Amphibians and reptiles are especially sensitive to changes in temperature and humidity. Drought reduces the aquatic and semi-aquatic habitats needed for amphibian reproduction, leading to population declines. Changes in precipitation and temperature regimes affect phenology, reproductive success, and survival of these species.

Insects and other invertebrates play essential ecological roles as pollinators, decomposers, and key links in food webs. Climate change is altering the abundance, distribution, and phenology of many insect species. Earlier spring emergence can create phenological mismatches with host plants or natural predators. Some agricultural pest species are expanding their ranges and increasing in abundance due to milder winters and longer summers.

Soil biodiversity, though less visible, is fundamental to soil fertility and health. Soil organisms—from bacteria and fungi to earthworms and arthropods—are responsible for decomposing organic matter, cycling nutrients, and maintaining soil structure. Soil degradation through erosion, compaction, and intensive farming practices reduces soil biodiversity, impairing the functioning of the edaphic ecosystem.

Aquatic ecosystems—rivers, lakes, and wetlands—host distinct biodiversity, including fish, amphibians, aquatic plants, and numerous invertebrates. Climate change–driven hydrological shifts, pollution, and human

alterations of river channels severely affect these ecosystems. Lower river flows during drought periods concentrate pollutants, reduce habitats, and increase water temperatures, all of which negatively impact aquatic species.

The ecosystem services provided by biodiversity—pollination, biological pest control, water and air purification, carbon sequestration, regulation of the local climate, and erosion prevention—are vital for agriculture and human well-being. Biodiversity loss reduces ecosystems' capacity to deliver these services, making society more vulnerable to shocks and stresses.

Moldova's protected natural areas cover approximately 5% of the country's territory, which is insufficient for effective biodiversity conservation. These areas include scientific reserves, natural parks, natural monuments, and habitat management areas. Many protected areas are small and isolated, which limits the viability of species populations and their ability to respond to climate change through migration. Expanding and connecting protected areas through ecological corridors is a priority for biodiversity conservation in the context of climate change.

Habitat fragmentation caused by intensive agriculture, urban development, and infrastructure creates isolated "islands" of natural ecosystems, making it difficult for species to migrate and for gene flow between populations. This fragmentation reduces ecosystem resilience and their capacity to adapt to climate change.

Biodiversity management requires continuous monitoring, in situ and ex situ conservation, restoration of degraded habitats, control of invasive species, and the integration of conservation objectives across all economic sectors. Ecosystem-based approaches that recognize the interdependence between species and ecological processes are essential for maintaining biodiversity in the face of accelerated climate change.

LAND USE IN THE REPUBLIC OF MOLDOVA

Agricultural Land

Agricultural land in the Republic of Moldova accounts for approximately 75% of the country's total area—an exceptionally high share that reflects the region's historical agricultural vocation and the natural fertility of its soils. This intensive use of land for agriculture creates both economic opportunities and significant vulnerabilities in the context of climate change and the need for sustainable natural resource management.

The structure of agricultural land is diversified, including arable land, permanent plantations (vineyards and orchards), pastures, and hay meadows. Arable land represents about 74% of total agricultural land and is used for annual crops such as cereals, industrial crops, vegetables, and fodder crops. This exceptionally high proportion of arable land results from the large-scale conversion of pastures and areas with natural vegetation into farmland—a process that intensified during the Soviet period and continued after independence.

Cereal crops dominate the ploughed areas, with maize and wheat together covering over one million hectares. Maize is grown on approximately 400,000–500,000 hectares annually, making it the main crop for grain and fodder production. Winter wheat covers 300,000–350,000 hectares and forms the basis of bread production and cereal exports. Barley, oats, and other cereals occupy smaller areas, being cultivated mainly for animal feed and limited human consumption.

Industrial crops, especially sunflower and sugar beet, occupy significant areas and play an important role in the agricultural economy. Sunflower is cultivated on approximately 250,000–300,000 hectares, with oil and seed production intended for both domestic consumption and export. The expansion of sunflower areas in recent years is linked to this crop's relatively good adaptation to drought conditions and to attractive prices on the international market. Sugar beet, once grown on large areas, has experienced a dramatic decline and currently covers only a few tens of thousands of hectares, due to the closure of most sugar factories and the sector's economic difficulties.

Vegetables and potatoes are grown both in household gardens for self-consumption and on commercial farms for the market. Areas under

vegetables vary between 50,000 and 80,000 hectares, concentrated in peri-urban zones and household plots. Tomatoes, cucumbers, onions, carrots, cabbage, and other vegetables are produced in significant quantities, but the sector faces challenges related to limited irrigation, outdated technologies, and competition from imports. Potatoes cover approximately 20,000–30,000 hectares and are a staple crop in the diet of the rural population.

Vineyards and orchards represent a special category of agricultural land with outstanding economic and cultural importance for Moldova. Viticulture has a millennia-old tradition in the region, and Moldovan wines are internationally recognized for their quality. The total area planted with grapevines is approximately 91,130 hectares, including both wine grapes and table grapes. The main wine-growing regions are concentrated in the central and southern parts of the country, where relief and climatic conditions are favourable. The wine sector contributes significantly to exports and job creation, but it faces challenges related to ageing plantations, the need for investment in modernization, market access, and the impacts of climate change.

Fruit orchards cover approximately 107,480 hectares and include apples, plums, cherries, apricots, peaches, walnuts, and other species. Moldovan fruit growing also has a long tradition and high potential, but the sector has suffered in recent decades due to ageing plantations, diseases and pests, lack of investment, and production variability caused by extreme weather events. Modernizing orchards through intensive production systems, resilient varieties, and frost-protection technologies represents a key development priority.

Natural pastures and hay meadows cover approximately 333,400 hectares, representing about 10% of agricultural land. These areas are used for grazing and for hay production to feed livestock during the cold season. The quality of Moldovan pastures has deteriorated significantly due to overgrazing, inadequate management, the spread of weeds and shrubs, and the impacts of drought. Many pastures are degraded, with sparse vegetation and low productivity, which limits livestock rearing capacity and contributes to soil erosion. Restoring and sustainably managing pastures requires investment in land improvement measures, controlling stocking rates, fertilization, and periodic mowing to manage weeds.

The structure of agricultural land ownership is dominated by excessive fragmentation. Agrarian reform in the 1990s distributed land to citizens, resulting in millions of small plots, most of them between 1 and 5 hectares. This fragmentation creates numerous problems: difficulties in

mechanization and the adoption of modern technologies, high production costs per unit, the inability to implement soil conservation measures that require coordination over larger areas, and limited access to finance and markets for small farmers. Although there are also larger farms resulting from land consolidation through leasing or purchase, most agricultural holdings remain small and poorly equipped.

Individual peasant households cultivating 1–10 hectares make up the majority of agricultural producers. Many of these households practice subsistence or semi-subsistence farming, producing mainly for their own consumption and selling surplus on local markets. Limited access to capital, technology, knowledge, and markets keeps productivity low. At the same time, these households play an important social role, ensuring the livelihoods of many rural families and preserving certain traditional farming practices.

Medium- and large-scale commercial farms, ranging from 50 to several thousand hectares, are fewer in number but contribute disproportionately to commercial agricultural production. These farms have better access to technology, credit, advisory services, and markets. They typically practice intensive farming, using modern machinery, fertilizers, pesticides, and improved varieties. However, even these farms face challenges related to climate variability, limited irrigation, volatile input and product prices, and restricted access to long-term financing.

Predominant farming practices in Moldova are oriented toward maximizing short-term output, often at the expense of long-term sustainability. Conventional ploughing—which inverts the soil layer and leaves it exposed to erosion—remains the norm on most farms. Monocropping or simplified rotations are common, reducing biodiversity and depleting soils. The use of organic fertilizers has declined dramatically since the Soviet period, contributing to lower soil organic matter content. Pesticides are widely used, often without full compliance with safety standards, with negative impacts on the environment and human health.

Limited irrigation is the single greatest constraint on Moldovan agriculture. Of the approximately 300,000 hectares irrigated during the Soviet period, only 20,000–30,000 hectares are currently functional, mainly using old and inefficient systems. The investments required to rebuild large-scale irrigation systems are prohibitive, and operational costs are high. Drip irrigation, which is more water-efficient, is adopted on only very limited areas, mainly in modern orchards and vineyards. Total dependence on rainfall makes agriculture extremely vulnerable to drought.

Agricultural mechanization is uneven. Large farms have relatively modern machinery fleets, although much equipment remains old and energy-inefficient. Small households largely depend on animal traction or on contracted machinery services from larger farms, which limits timeliness and the quality of field operations. The lack of modern cold storage and on-farm processing facilities leads to significant post-harvest losses.

Access to information, technologies, and agricultural advisory services is limited, especially for small farmers. Agricultural extension services are underdeveloped, and the transfer of knowledge on sustainable and climate-adaptive farming practices is insufficient. Many farmers continue to use outdated methods, unaware of more efficient and sustainable alternatives.

Producer organization into cooperatives, associations, or producer groups remains low, despite clear advantages in terms of bargaining power, access to finance and markets, and opportunities to share the costs of equipment and services. Lack of trust, negative experiences from the past, and individualism are major barriers to cooperation.

Organic certification and the adoption of organic farming are still at an early stage, although there is significant potential given the relatively low use of chemical inputs in many small households. Markets for organic products—both local and export—offer opportunities for differentiation and premium prices, but they require investment in certification, marketing, and the development of supply chains.

Forests and Green Areas

Forests in the Republic of Moldova cover approximately 11.2% of the country's territory, equivalent to around 378,286 hectares—a share significantly below the European average of about 40% and below the level considered necessary to maintain the ecological balance of the territory. This low forest cover results from extensive historical deforestation to expand agricultural land and represents one of Moldova's major vulnerabilities in the face of climate change and environmental degradation.

Moldova's forest fund includes natural forests, forest plantations, protective shelterbelts, and riparian woodland along watercourses. Forests are unevenly distributed across the territory, being concentrated mainly in more rugged relief areas, on hill slopes, in river floodplains, and in areas less favourable for agriculture. The largest forest massifs are found in the central region (Codrii), in the north, and along the Dniester (Nistru) and Prut rivers.

Forest species composition reflects the country's climatic–geographical zonation. Pedunculate oak is the dominant species, accounting for about 40% of the forested area, followed by black locust (acacia), an introduced species that covers roughly 25–30% of forests due to its fast growth and adaptability to difficult conditions. Ash, hornbeam, maple, linden, and other broadleaf species occur in smaller proportions. Coniferous species are rare and are largely limited to small pine and spruce plantations. The relatively low diversity of tree species and the dominance of broadleaf forests are characteristic of the forest-steppe zone.

The age and structure of Moldovan forests are uneven. There are both mature and overmature forests, with trees older than 80–100 years, and young plantations. Many natural forests were intensively exploited in the past, resulting in secondary and degraded structures. Black locust plantations—established mainly in the second half of the 20th century for land stabilization and timber production—are reaching maturity and require regeneration, but black locust tends to expand aggressively, which can affect ecosystem diversity.

The ecological functions of Moldovan forests are multiple and essential. Forests protect soils against erosion, intercept precipitation, and facilitate water infiltration into the soil, reducing surface runoff and flood risk. They regulate the local microclimate by moderating temperature extremes and increasing air humidity. Forests provide habitats for biodiversity, hosting the highest concentration of plant and animal species in Moldova. They also play an important role in carbon sequestration, contributing to climate change mitigation. Their recreational and cultural functions are likewise significant for population well-being.

The current condition of Moldova's forests is a cause for concern. Many forests are affected by widespread tree dieback, especially oaks—a phenomenon linked to recurrent droughts, water stress, pest and disease outbreaks, and pollution. Tree dieback reduces forest density and vitality, creating gaps that may be colonized by invasive species or left exposed to erosion. Natural regeneration is often difficult under conditions of persistent drought.

Livestock grazing in forests, although illegal, is still practiced in many areas, impairing natural regeneration by destroying seedlings and compacting the soil. Waste and pollution also affect the quality of forest ecosystems, especially in forests near settlements. Forest fires, although less frequent than in other regions, represent a growing risk under drought conditions and rising temperatures.

Protective forest shelterbelts are a distinct and important component of Moldova's forest resources. These are narrow strips of trees planted along agricultural fields, roads, and watercourses to protect against wind, reduce wind and water erosion, conserve soil moisture, and create habitats for beneficial species. During the Soviet period, tens of thousands of kilometres of shelterbelts were established, but many were neglected after independence, becoming degraded or even destroyed to expand agricultural land.

The role of shelterbelts in climate change adaptation is crucial. They reduce wind speed and evapotranspiration, creating more favourable microclimates for crops. Shelterbelts disrupt the movement of hot, dry air masses during heatwaves, reducing heat stress on plants. They capture snow in winter, ensuring more soil moisture in spring. Restoring and expanding the shelterbelt network is a priority measure for increasing agricultural resilience.

Urban green areas, although limited in extent, play an important role in urban quality of life. Parks, public gardens, street greenery, and tree-lined avenues help reduce urban temperatures (the "heat island" effect), purify the air, retain stormwater, and provide recreational spaces. Planting and maintaining trees and vegetation in urban areas needs to be prioritized, especially in the context of climate change, which increases thermal discomfort in cities.

Forest management in Moldova is carried out mainly by the "Moldsilva" Agency, the public authority responsible for managing the state forest resources. The forestry sector faces challenges related to insufficient funding, limited staff, outdated equipment, and pressure for excessive timber harvesting. Long-term forest management planning needs to integrate climate change scenarios to ensure the resilience of future forests.

Afforestation and reforestation programmes have made only modest progress in recent decades. The national objective of increasing forest cover to 15% by 2020 was not achieved, and the current afforestation rate remains insufficient to reach this target in the near future. Barriers include the lack of available land (most land is privately owned and used for agriculture), the high costs of afforestation works, the need for multi-year maintenance of young plantations, and the low prioritization of forestry in public policies.

Restoring degraded forests and unproductive forest land represents a significant opportunity. Many areas affected by severe erosion, gullies, and landslides could be afforested, contributing both to land stabilization and to

expanding forest cover. Native species should be prioritized in afforestation programmes to promote biodiversity and ecosystem resilience.

Engaging local communities and private landowners in conserving and expanding forests is essential. Financial incentive programmes for owners who afforest degraded land or maintain existing forests can accelerate afforestation efforts. Education and public awareness about the importance of forests and sustainable practices are fundamental for changing attitudes and behaviours.

Degraded Land

Degraded land represents one of the most serious environmental and sustainable development challenges facing the Republic of Moldova. It is estimated that more than 1,072,667 hectares of land—equivalent to 31.7% of agricultural land—are affected. Of these, approximately 150,000 hectares are severely degraded, with extremely low productivity and requiring intensive restoration measures.

Soil erosion is the most widespread and significant form of land degradation in Moldova. Water erosion affects approximately 500,000–600,000 hectares, with intensities ranging from slight to very severe. The process occurs in several forms: sheet erosion, which uniformly removes the topsoil layer; linear erosion, which forms rills and gullies; and deep erosion, which affects the channels of torrents and streams.

Simple and deep gullies represent the most visible and damaging form of linear erosion. Moldova has one of the highest gully densities in Europe, with tens of thousands of active gullies that continue to expand. Some gullies reach depths of 15–20 metres and lengths of hundreds of metres or even kilometres. They fragment agricultural land, make mechanization impossible, threaten buildings and infrastructure, and act as channels for rapid runoff, exacerbating downstream flooding. The large volumes of sediment eroded from gullies are deposited in riverbeds, reservoirs, and downstream fields, affecting water quality and reducing the storage capacity of water bodies.

The areas most severely affected by erosion are found in the central and northern parts of the country, where hilly relief, sensitive soils, and relatively abundant precipitation create favourable conditions. Slopes steeper than 5–7 degrees are particularly vulnerable, especially when ploughed downslope or left without protective vegetation cover. Intensive cultivation of these lands without adequate anti-erosion measures has led to massive losses of fertile soil over decades.

Estimates indicate that Moldova loses approximately 20–30 million tonnes of soil annually through erosion, equivalent to an average of about 10–15 tonnes per hectare of agricultural land, with much higher values on sloping terrain. This loss is dramatic considering that the natural formation of just one centimetre of soil can take hundreds or thousands of years. In many areas, the chernozem layer—initially 60–80 cm thick—has been reduced to 20–30 cm or less, exposing poorer, clayey horizons with low fertility that are difficult to cultivate.

Wind erosion, although historically less problematic than water erosion, has become more pronounced in recent decades due to frequent droughts, reduced vegetation cover, and the degradation of soil structure. In spring and summer, when soil is dry and bare, strong winds lift fine soil particles, creating dust storms visible over long distances. These storms transport tonnes of fertile soil, depositing it in unsuitable locations or losing it entirely. Wind erosion is more severe in the south of the country, where precipitation is scarcer and vegetation is sparser.

Soil compaction is a form of physical degradation caused by excessive and improper use of heavy agricultural machinery—especially on wet soils—and by overgrazing. Compacted soil has reduced porosity, limited water infiltration, restricted root penetration, and inhibited biological activity. Compaction creates dense layers at depths of 20–40 cm, known as a "plough pan," which blocks vertical drainage and limits root development. Rebuilding the structure of compacted soil requires specific interventions and a long period of time.

Chemical soil degradation is manifested through nutrient depletion, acidification, salinization, and pollution. Continuous cultivation without sufficient inputs of organic matter and fertilizers has led to a 30–50% decline in soil humus content compared to natural levels. Humus is essential for soil fertility, water-holding capacity, and structural stability. Its reduction strongly affects agricultural productivity and soil resilience to stress. The application of organic fertilizers (manure, compost) has decreased dramatically after the period of collectivization, as most small households no longer keep enough livestock to produce significant amounts of organic fertilizer.

Soil acidification is caused by the intensive use of acid-forming mineral fertilizers, atmospheric pollution, and the loss of base cations through leaching and erosion. Acidified soils have reduced fertility and biodiversity and can release toxic elements such as aluminium in soluble forms. The application of lime amendments to neutralize acidity is necessary but is rarely practiced due to costs.

Salinization and alkalinization affect approximately 150,000–200,000 hectares, mainly in the south of the country and in the Dniester (Nistru)

floodplain, where dry climatic conditions, high evaporation, and improper irrigation have led to the accumulation of salts in the soil. Salinized soils have very low productivity, with vegetation limited to salt-tolerant (halophytic) species. Reclaiming these lands requires major investments in drainage, leaching, and soil amelioration.

Soil pollution with heavy metals, pesticide residues, and other chemicals is mainly localized in urban areas, near industrial facilities, and on agricultural lands where persistent pesticides have been applied over decades. Although comprehensive assessments are lacking, the risks to human health and the environment are real and require monitoring and remediation in critical areas.

Landslides are a severe form of land degradation affecting thousands of hectares, especially on steep slopes along valleys and gullies. Soil saturation from heavy rainfall or seepage, combined with soil weight and the lack of stabilizing vegetation, can trigger large-scale movements of soil and rock. Landslides destroy agricultural land and threaten settlements, road infrastructure, and utility networks. Stabilizing landslide-prone areas requires drainage works, planting deep-rooted vegetation, and, in severe cases, engineered support structures.

Abandoned land, although not degraded in the strict sense, represents a loss of productive potential and can become a source of degradation. Many marginal agricultural lands—located on steep slopes or with low fertility—have been abandoned by owners due to high cultivation costs and low yields. Left unmanaged, these lands are colonized by spontaneous vegetation, often weeds and invasive shrubs, and become susceptible to fires during dry periods.

The economic costs of land degradation are enormous. Declining agricultural productivity translates directly into lower farm incomes and reduced contributions to the national economy. Where rehabilitation is possible, the costs of restoring degraded land are prohibitive for most landowners. Sedimentation of gullies and river channels with eroded soil requires expensive dredging and desilting works. The impacts on food security and social stability in affected rural areas are profound.

Preventing land degradation is far more cost-effective than restoring land after degradation occurs. Preventive measures include conservation agriculture practices (reduced or no tillage, cover crops, diversified rotations), contour farming, slope terracing, planting shelterbelts, maintaining vegetation on vulnerable land, and educating farmers on anti-erosion techniques.

Restoring degraded land requires complex, long-term approaches. Gully stabilization involves building fascine check dams, planting vegetation, terracing gully slopes, and controlling upstream runoff to reduce future erosion. Afforestation of severely eroded land is often the only viable long-term option. Improving chemically degraded soils requires the application of amendments,

organic fertilizers, rotations with legumes, and other soil fertility restoration techniques.

Agriculture and Food Security

Agriculture is the backbone of Moldova's economy and the basis of food security for the population, yet it is also the sector most vulnerable to the impacts of climate change. The complex relationship between climate, agricultural production, and food security creates major challenges that require fundamental transformations in the way agriculture is practiced in Moldova.

The direct impact of climate change on agriculture occurs through multiple mechanisms. Higher temperatures and drought affect all stages of crop development, from germination to maturation. Heat stress reduces photosynthesis rates, accelerates evapotranspiration, and can cause irreversible damage to plant tissues during extreme heatwaves. Soil water deficits limit nutrient uptake, reduce root development, and impair the formation of productive plant organs.

Cereal production, fundamental to food security, is highly sensitive to climate variability. Winter wheat, cultivated on hundreds of thousands of hectares, requires a delicate balance of temperature and moisture throughout its 9–10 month growing cycle. Mild winters can trigger premature vegetative growth that is then damaged by late frosts. Dry springs reduce tillering and plant development. Drought and excessive heat during grain filling significantly reduce wheat yields and quality.

Maize, the most important spring crop, is particularly vulnerable to drought during the critical months of June–July, when pollination and ear formation occur. Temperatures above 35°C during pollination reduce pollen viability and lead to poor fertilization, resulting in ears with sparse kernels or complete crop failure. Recurrent droughts over the last decade have made maize cultivation extremely risky in many parts of Moldova in the absence of irrigation.

Sunflower, a relatively drought-tolerant crop, has expanded in cultivated area due to its better adaptation to changing climatic conditions. However, even this crop suffers under extreme drought and excessive heat, with yields significantly reduced in critical years. Overexpansion of sunflower—driven by drought adaptation and attractive prices—creates crop rotation problems and contributes to soil depletion.

Sugar beet and other industrial crops are also affected by climate change. Yields and sugar content in roots are negatively influenced by drought and extreme temperatures. Many sugar beet processing factories have closed due to reduced sugar production.

Vegetable production, although it can be practiced on smaller areas with localized irrigation, faces its own challenges. Many vegetable species are sensitive to heat and require consistent irrigation. Prolonged heatwaves reduce product quality and increase losses. Vegetable pests and diseases proliferate under high temperatures and variable humidity.

Fruit growing and viticulture—sectors of strategic economic importance for Moldova—are vulnerable to a wide range of climate risks. Late spring frosts that occur after trees have blossomed can be devastating for that year's harvest. In 2016 and 2017, spring frosts destroyed a significant share of the fruit crop, causing major economic losses. Prolonged drought stresses fruit trees and grapevines, reducing yields and the quality of fruits and grapes. Excessive heat can cause sunburn on fruits, reducing their market value.

Crop diseases and pests are directly influenced by climate change. Milder winters allow larger numbers of pests to survive. Some pest species are expanding northward, colonizing areas that were previously unsuitable. Periods of high humidity followed by heat create ideal conditions for fungal diseases. Pesticide requirements increase, with negative implications for the environment, health, and production costs.

Livestock farming is affected indirectly through reduced feed production and directly through heat stress on animals. Drought dramatically reduces hay yields from pastures and fodder crops, forcing farmers to buy feed at high prices or reduce herd sizes. Excessive heat reduces animal performance, especially in cattle and poultry. The lack of modern climate-controlled shelter infrastructure on most farms worsens the situation.

Irrigation, essential for mitigating the impacts of drought, is dramatically insufficient in Moldova. Irrigation systems inherited from the Soviet period have deteriorated and have largely been abandoned. Investments needed to rehabilitate or build new irrigation systems are substantial and exceed the capacity of most farmers. Energy costs for pumping water and the price of equipment make irrigation uneconomic for many crops at current agricultural product prices. Only a very small fraction of agricultural land is irrigated, leaving the rest entirely dependent on rainfall.

Moldova's food security is directly threatened by the vulnerability of agriculture to climate change. Although in good years the country produces sufficient cereals and other products for domestic consumption and export, years of severe drought dramatically reduce output, requiring imports and driving up food prices. Poor rural households that depend on subsistence farming are particularly vulnerable. A weak agricultural year means both a loss of income from selling products and a shortage of food for household consumption.

Agricultural production variability also affects national economic stability. Agriculture contributes significantly to GDP and exports, and a poor agricultural year has a domino effect on the entire economy. Lower farm incomes reduce purchasing power, weaken demand for goods and services in other sectors, and diminish tax revenues.

Supply chains and the agro-processing industry are likewise affected by production variability. Processing plants for dairy, meat, cereals, fruits, and vegetables operate below capacity in poor years, with negative impacts on profitability and employment.

Adapting agriculture to climate change requires major transformations: introducing efficient irrigation, diversifying crops, adopting drought- and heat-resilient varieties, improving soil fertility, conserving water and soil, and developing agricultural insurance and risk management systems. The transition toward sustainable and climate-resilient agriculture is essential to ensure food security and rural prosperity in Moldova.

URBAN AREAS

Major Cities and Urban Expansion

According to the 2017 legislation, the status of municipality (municipiu) in the Republic of Moldova was granted to the following cities: Chişinău, Bălţi, Bender, Cahul, Ceadîr-Lunga, Comrat, Edineţ, Hînceşti, Orhei, Soroca, Străşeni, Tiraspol, and Ungheni. Moldova's urban system is characterized by an excessive concentration in the capital: over 48.5% of the urban population lives in Chişinău, and about 60% of the country's urban population lives in the municipalities of Chişinău and Bălţi.

Chişinău, the capital city, covers an area of 572 km² and concentrates nearly 780,000 inhabitants, being organized into 35 localities. The capital's urban expansion was shaped by the Soviet period, when planned micro-districts were developed, with an abundance of integrated green spaces. Moldovan cities are characterized by wide main streets and green areas—an inheritance of Soviet urban planning, which emphasized integration into the existing landscape and environmental protection.

Today, the Republic of Moldova is the most rural state on the European continent, with an urbanization rate of approximately 43%. This situation creates specific challenges: secondary cities have lost importance due to deindustrialization, rising unemployment, and infrastructure degradation—a phenomenon known as the "ruralization" of urban life. To counter these trends, the Government launched the National Programme for the Development of Growth-Pole Cities in the Republic of Moldova for 2021–2027, targeting six municipalities: Cahul, Comrat, Edineţ, Soroca, Orhei, and Ungheni, with an estimated budget of about 2.7 billion lei (MDL).

Urban Heat Island Effect

Although no extensive studies on the urban heat island effect have yet been conducted in the Republic of Moldova, the experience of other Eastern European cities and international research suggest that Moldovan cities—especially Chişinău—are also vulnerable to this phenomenon. The concentration of buildings, large asphalted surfaces, a lack of vegetation in some areas, and heavy traffic contribute to higher urban temperatures compared to the surrounding rural areas.

In comparable cities in the region, temperature differences between the urban core and the outskirts can reach 3–5°C, and during hot nights this gap becomes even more pronounced. In Chişinău, the Soviet-era urban layout, with

wide boulevards and open spaces, offers some advantages for air circulation; however, recently built districts with high density and limited vegetation are more vulnerable. Climate change further amplifies these effects, as heatwaves become more frequent and more intense, affecting public health—especially among vulnerable groups.

Drainage and Flooding Issues

Stormwater drainage systems in Moldovan cities are largely inherited from the Soviet period and are undersized for today's extreme weather events. Chişinău has experienced significant flooding, most notably in September 2024, when Cyclone Boris caused the Bîc River, which runs through the city centre, to overflow—flooding several main streets and turning underground passages into lakes. Public transport was suspended, as buses and trolleybuses were unable to move through the flooded areas.

At the national level, the floods in the summer of 2010 affected more than 60 localities across 14 districts (raioane), with approximately 13,000 people impacted, 1,105 houses totally or partially damaged, and material losses estimated at USD 41.92 million. These events highlighted the vulnerability of flood-protection infrastructure and the urgent need to modernize urban drainage systems.

The situation is exacerbated by the increasing impermeabilization of urban surfaces, which accelerates stormwater runoff and reduces natural infiltration into the soil. Many stormwater sewer systems are silted up or deteriorated, and their conveyance capacity is insufficient for increasingly frequent torrential rains. The lack of integrated stormwater management—including nature-based solutions such as rain gardens, permeable pavements, and retention basins—limits cities' resilience to extreme events.

Transport and Air Quality

Urban transport—especially private car traffic—is the main source of air pollution in Moldovan cities. Vehicle emissions are becoming increasingly harmful as the number of cars grows rapidly from year to year. These sources generate large quantities of hydrocarbons, carbon oxides, nitrogen oxides, suspended particulate matter, benzo(a)pyrene, and other pollutants, depending on fuel quality, the technical condition of vehicles, and the size of the active vehicle fleet.

Moldova's vehicle fleet is largely outdated, with many vehicles older than 10–15 years, which contributes to higher emissions. The lack of strict environmental standards for vehicle import/admission and insufficient technical inspections further worsen the situation. In Chişinău, heavy peak-hour

traffic creates significant congestion on main arteries, increasing travel time and pollution.

Public transport has improved in recent years, with modernization of the trolleybus and bus fleet in Chişinău; however, comfort and territorial coverage remain problematic in many areas. Infrastructure for active mobility—such as bicycle lanes and adequate sidewalks—is underdeveloped, discouraging alternatives to private car use. Developing an integrated public transport system, expanding electric transport networks, and promoting green mobility are essential directions for improving urban air quality.

Energy Efficiency of Buildings

Moldova's building stock—especially that dating from the Soviet period—is characterized by low energy performance. Apartment blocks built in the 1960s–1980s, which make up a significant share of the urban housing stock, have inadequate or non-existent thermal insulation, old window frames, and inefficient district heating systems. Energy consumption for space heating is 50–100% higher than in modern buildings in EU countries.

Energy renovation programmes have been launched in recent years with support from development partners, but implementation remains slow due to limited financial resources and the complexity of ownership structures in condominiums. Pilot projects for building insulation have demonstrated 40–60% energy savings, reduced heating costs, and improved thermal comfort.

New buildings are subject to minimum energy efficiency requirements, but enforcement and compliance monitoring remain inconsistent. The potential for solar energy use through photovoltaic panels is significant, yet the uptake of these technologies in the residential and commercial sectors is still limited. Developing a system of financial incentives for energy renovation, introducing mandatory energy performance certification, and promoting nearly zero-energy buildings are necessary steps to modernize the sector.

Urban Planning and Spatial Development

Urban planning in the Republic of Moldova is carried out through general urban plans for municipalities and towns, zonal plans, and local urban planning regulations. Urban plans provide land-use zoning according to the dominant function: residential areas, production/storage/utility infrastructure, social infrastructure, transport areas, recreation and leisure zones, and reserve areas. However, the implementation of these plans faces major challenges, including pressure to change land-use designations, limited institutional capacity, and insufficient financial resources.

The share of green areas and streets (conventionally considered public spaces) within the built-up area of urban localities was 22.7% (SDG indicator

11.7.1.1), reflecting a reasonable level of public-space provision. Nevertheless, there are substantial differences between cities, and the quality of these spaces varies significantly.

The integration of climate change considerations into urban planning remains limited. Risk assessments for natural hazards—floods, landslides, and drought—are not systematically incorporated into urban development decisions. Participatory planning, involving local communities and civil society, is gaining ground but needs strengthening to ensure transparency and accountability in urban development.

Major challenges for urban planning include managing uncontrolled urban expansion at the periphery, protecting green areas and productive agricultural land, upgrading ageing municipal infrastructure, adapting to climate change, and increasing urban resilience. The goal is for the designated growth-pole municipalities to become more attractive to residents, entrepreneurs, and tourists, and to stimulate development in the areas they influence—thus contributing to more balanced territorial development and reducing regional disparities.

Water Resources of the Republic of Moldova

Water resources in the Republic of Moldova are limited both quantitatively and qualitatively and represent a strategic factor that shapes socio-economic development and the country's capacity to adapt to climate change. Moldova relies primarily on transboundary surface waters—especially the Dniester (Nistru) and Prut rivers—alongside a relatively dense network of small internal watercourses, supplemented by reservoirs, ponds, and significant groundwater resources. The volume of renewable freshwater available per capita is relatively low, placing the Republic of Moldova among countries experiencing pronounced water stress and strongly dependent on water inflows from outside the national territory via the Dniester and Prut rivers.

The Dniester (Nistru) and Prut Rivers

The Dniester and the Prut are the main hydrographic axes of the Republic of Moldova, with both ecological importance and strategic relevance for water supply, electricity generation, and irrigation. The Dniester originates in Ukraine, crosses the Republic of Moldova, and flows into the Black Sea, forming a section of the Moldovan–Ukrainian border. It is the country's primary source of drinking water: most of the urban population, including the municipality of Chişinău, is supplied through direct abstractions from this river.

The Prut, on the western side, forms the border with Romania and plays an important role in irrigation, water supply, and flood protection, particularly

through the Stânca–Costești reservoir, developed jointly with Romania. Beyond their role as water sources, both rivers are used for hydropower generation (for example, at Dubăsari on the Dniester and at Costești–Stânca on the Prut), as well as for fishing and recreational activities, which increases pressure on aquatic ecosystems.

Strong dependence on transboundary water resources makes the Dniester and the Prut a matter of national security. Any major upstream change in their flow regime—such as the construction of new dams, changes in discharge management, or accidental pollution—has direct impacts within the Republic of Moldova. For this reason, cooperation with Ukraine and Romania through bilateral agreements and joint monitoring mechanisms is essential to ensure ecological flows and long-term water quality.

Internal Tributaries and Seasonal Flows

The hydrographic network of the Republic of Moldova includes thousands of rivers, streams, and permanent or intermittent brooks, with a total length of tens of thousands of kilometres. Only a small number of watercourses exceed 100 km in length—among them the Răut, Bîc, Botna, Cogâlnic, Ialpug, Căinar, Ichel, and Cubolta—while most internal tributaries are small rivers with low discharges and a strongly seasonal regime.

Their flows are shaped by a continental pluvio-nival regime: in spring, discharges increase significantly due to snowmelt and seasonal rainfall, followed by marked declines in summer, when droughts and high temperatures reduce water volumes and can even lead to the complete drying of minor watercourses.

In recent years, discharge variability has become increasingly pronounced, with alternating flash floods and long periods of low flows. This complicates planning for irrigation and water supply, especially in localities that depend on internal rivers, such as the Bîc River in the case of the municipality of Chișinău. Climate change amplifies these temporal and spatial contrasts: while some sub-basins experience flooding episodes, other regions face severe droughts, limiting water availability for agriculture and other economic sectors.

Reservoirs and Eutrophication

The Republic of Moldova has thousands of ponds and reservoirs used for irrigation, aquaculture, flood attenuation, water supply, and recreation. Many of them are small artificial basins created by damming minor valleys, which has led to strong fragmentation of the hydrographic network.

Among the most important reservoirs are Dubăsari on the Dniester and Costești–Stânca on the Prut. They help regulate river flows, generate electricity, contribute to flood protection, and provide water for irrigation. However, their

operation also has ecological effects: altering the natural flow regime, blocking the migration of some fish species, progressive sedimentation, and accelerating eutrophication processes.

Eutrophication—excessive enrichment with nutrients (nitrogen and phosphorus)—is a common problem in Moldova's reservoirs and ponds, driven by fertilizer runoff and insufficiently treated wastewater discharges. This results in episodes of algal blooms, reduced water clarity, declining dissolved oxygen levels, and fish mortality. In the absence of dredging works and effective management of protection zones, many communal ponds become silted up and turn into local pollution hotspots, undermining both their economic potential and their role in water retention at the catchment scale.

Groundwater and Shallow Aquifers

Groundwater plays an essential role in supplying water to rural settlements and small towns. The Republic of Moldova has a large number of artesian wells tapping deep groundwater, as well as a very large number of traditional wells that exploit the shallow aquifer (phreatic) layer. In rural areas, wells often remain the main water source for the population.

These resources have advantages but also limitations. Deep groundwater is generally better protected from surface pollution and offers superior microbiological quality; however, it may have high salinity, pronounced hardness, elevated iron levels, or other elements, sometimes requiring treatment before consumption. In the south and south-east of Moldova, locally more pronounced salinization can be observed, reducing suitability for drinking purposes.

Shallow groundwater, accessed through traditional wells, is much more exposed to pollution. In many rural localities, nitrate and ammonium concentrations exceed the permissible limits for human consumption, as a result of intensive fertilizer application, improper management of animal waste, and the lack of sewerage and wastewater treatment systems. Wells located near latrines, barns, or informal dumpsites increase the risk of bacteriological contamination, with negative impacts on public health.

Sustainable management of groundwater resources requires systematic monitoring of water quality, control of abstraction volumes, protection of water intake zones, and the introduction of strict rules regarding the placement of wells and potential pollution sources.

Water Quality and Pollution

The quality of water resources in the Republic of Moldova is monitored through a network of hydrometric and hydrochemical stations, especially on the transboundary rivers Dniester (Nistru) and Prut, as well as on the main internal

tributaries. The results indicate, in many sectors, moderate to poor water quality, particularly in areas influenced by urban zones, industrial discharges, and agricultural runoff.

The main sources of surface water pollution are:

- insufficiently treated effluents from urban wastewater treatment plants (especially in large agglomerations where infrastructure is old or undersized);
- industrial discharges, including those from agro-food enterprises, light industry, and other processing facilities;
- runoff containing nutrients and pesticides from agricultural land;
- uncontrolled waste dumps and poorly managed waste disposal sites;
- deforestation and improper land management practices, which increase erosion and siltation.

In many internal basins—such as the Bîc, Cogâlnic, and Răut—water quality is affected by organic and chemical pollution originating from towns and villages, as well as from the livestock sector. This degradation limits their use for irrigation, recreation, or water supply without costly treatment.

Water Consumption by Sectors

Total water consumption in the Republic of Moldova is divided among the household sector, agriculture, industry, and other uses (services, aquaculture, and the energy sector). The population connected to centralized water supply services uses a relatively modest volume compared to the total amount of water abstracted in the country, while a significant share is allocated to economic activities.

Agriculture—especially irrigation and livestock farming—is one of the main water consumers. The volume of water used for irrigation varies from year to year depending on climatic conditions, infrastructure capacity, and farmers' financial resources. In dry years, demand for irrigation increases, but existing systems cannot always meet the need.

The industrial sector uses water both as a raw material and for cooling and various technological processes. In many cases, enterprises have their own water sources (abstractions from groundwater, rivers, or ponds) and are required to retain and treat wastewater before discharge.

Household water consumption increases as water supply and sewerage networks expand and living standards improve. However, in rural areas, a considerable share of the population still relies on wells, which makes it difficult to assess and control actual water consumption.

Water Use Efficiency

Water use efficiency in the Republic of Moldova is affected by significant losses in distribution networks and irrigation systems. In agriculture, irrigation infrastructure inherited from the Soviet period is largely technically and functionally outdated: open canals with losses through infiltration and evaporation, corroded pipelines, energy-intensive pumping stations, and a lack of automation. All of these lead to large conveyance losses and high specific water consumption per irrigated hectare.

As droughts become more frequent, demand for irrigation increases, but without network modernization this results in the waste of substantial volumes of water, combined with high energy costs. In urban areas, old water supply and sewerage networks generate considerable losses in the form of "non-revenue water," reducing the economic efficiency of operators and hindering investments in modernization.

To improve water use efficiency, the following measures are needed:

- modernization of irrigation systems (introducing drip irrigation, efficient sprinkler systems, installing modern pumping equipment and pressure-control systems);
- rehabilitation of urban networks with high losses and reduction of leakages/infiltration;
- full metering of water consumption at household and business levels;
- tariff policies that encourage saving and penalize unjustified losses;
- promotion of less water-intensive technologies in industry and agriculture;
- public information and education campaigns on responsible water use.

Integrated River Basin Management

In recent years, the Republic of Moldova has begun harmonizing its water policies with the principles of Integrated Water Resources Management (IWRM), in line with the basin-based approach promoted at the European level. The current legislative framework supports a shift from a sectoral vision—where water was treated separately for supply, irrigation, energy, and environmental protection—to an integrated approach at the level of river basin districts (the Dniester, the Danube–Prut and Black Sea district).

Responsible institutions—line ministries, specialized agencies, and regional water operators—develop river basin management plans that define water quality objectives and measures to reduce pollution, prevent and mitigate floods, improve water-use efficiency, and strengthen climate change adaptation capacity. The process involves the participation of local stakeholders (local public authorities, farmers, businesses, NGOs, and communities).

Among the measures promoted in the context of integrated management are:

- dredging riverbeds and reservoirs and restoring their water-retention capacity;
- creating and maintaining protective riparian buffer strips to filter runoff from agricultural land;
- reinforcing riverbanks and reconstructing dikes in flood-prone areas;
- assessing and modernizing reservoir dams to reduce the risk of failure;
- introducing water safety plans for centralized water supply systems;
- developing early warning systems for floods and drought.

Moldova's water resources are characterized by limited availability, major dependence on transboundary waters, and increasing pressures from pollution and climate change. The future of economic development—especially in agriculture and rural areas—depends on the country's ability to improve water-use efficiency and to implement integrated river basin management consistently, in partnership with neighbouring states and local communities.

POLICIES AND LEGAL FRAMEWORK

National Legislation

The legal framework of the Republic of Moldova in the field of environmental protection and natural resource management was developed gradually after the country gained independence in 1991, evolving from Soviet-era inherited legislation toward a modern system progressively aligned with European norms. This process of legislative modernization continues today, accelerated by the prospect of accession to the European Union and by the need to respond to the challenges posed by climate change..

Law on Environmental Protection

Law No. 1515 of 16 June 1993 on Environmental Protection is the cornerstone of the environmental protection legislative system in the Republic of Moldova. This fundamental law sets out the general principles of environmental policy, as well as the rights and obligations of citizens, enterprises, and public authorities in the field of environmental protection.

According to Law 1515/1993, natural resources—soil, subsoil, waters, flora and fauna—located within the territory of the Republic, as well as the airspace above that territory, constitute the national heritage of the Republic of Moldova. The law provides that the right to manage all natural resources is exercised on behalf of the state by Parliament, and that the transfer of ownership and use rights over natural resources to natural and legal persons does not exempt beneficiaries from complying with environmental protection legislation.

An important element recently introduced into this law is the National Environmental Fund, which represents the totality of financial resources intended to finance programmes and projects in the fields of environmental protection, climate change, and the sustainable management of natural resources. Established within the state budget, this fund replaces the former National Ecological Fund and ensures the financing of environmental projects based on transparent criteria of cost-effectiveness and prioritization.

The Regulation on the administration of the National Environmental Fund, approved by Government Decision No. 711/2022, governs the procedures for identifying, assessing, selecting, approving, contracting, and monitoring the implementation of projects in the field of environmental protection. The Public Institution "National Office for the Implementation of Environmental Projects" was designated as the institution responsible for administering the fund.

Over the years, the law has undergone numerous amendments to respond to new challenges and to align with European directives,

demonstrating the flexibility and adaptive capacity of Moldova's legislative framework.

Land Fund Law

The Land Code (Codul Funciar), No. 828, initially adopted in 1991 and substantially revised in 2024, regulates land relations in the Republic of Moldova. The land fund of the Republic of Moldova consists of the totality of all lands, regardless of the type of ownership, land-use category, or the legal title under which they are held. The new Land Code, adopted in 2024, introduces important clarifications and modernizes the legal framework for land management.

A significant change introduced by the new code concerns restrictions on land ownership. The right of ownership over agricultural land or land from the forest fund may not be acquired or held by foreign citizens, whether natural or legal persons. If foreign citizens acquire such land through inheritance, a court decision, or mortgage enforcement, they are required to dispose of (alienate) it within one year from the date they acquire the ownership right.

The Code establishes the Government's competences in the field of land relations, including ensuring organization and strategic planning, drafting and approving policy documents, and developing the regulatory and institutional framework for implementing policies related to the use of the land fund, as well as soil improvement and conservation. It also regulates the classification of land according to ownership type, domain, and designated use, along with the rights and obligations of landholders.

The cadastral system functions as the official register of all land, ensuring transparency and legal certainty. Moldova's cadastre provides efficient, transparent, and cost-effective services, and about 97% of the total number of properties registered in the real estate register are in private ownership.

Law on Soil

The Government has recently endorsed a draft law on the use, conservation, and protection of soil—a document that sets new rules and regulates, in a complex and coherent manner, how agricultural land must be managed in order to prevent degradation and conserve pedological resources. This is the first time the ministry has addressed soil protection in an integrated way as a national priority.

The law establishes the institutional framework and the responsibilities of public authorities in the process of monitoring, assessment, and intervention to maintain soil quality. It assigns competences to central and local institutions regarding the identification of areas exposed to soil-related risks, such as erosion, salinization, moisture deficit, or loss of fertility.

For all landholders, regardless of the form of ownership, the law introduces requirements for responsible soil use, aiming to prevent degradation, maintain fertility, and apply agricultural practices adapted to the protection of natural resources. The law will enter into force 12 months after its publication in the Official Monitor, a period during which the regulatory acts necessary for implementation will be developed and training sessions will be organized for landholders.

This law fills an important legislative gap, as the previous regulation of soil protection dated back to the Soviet period and did not adequately address today's challenges related to land degradation and climate change.

Forest Code

The new Forest Code was adopted by Parliament after many years of extensive work; the previous Code entered into force in 1996. The new Code defines the legal status of lands within the forest fund, sets out the competences of public administration authorities, and modernizes the legal framework for the sustainable management of forests.

Forestry legislation aims to regulate the sustainable management of the forest fund through the rational use, regeneration, guarding and protection of forests; the maintenance, conservation, and improvement of forest biological diversity; and the provision of forest resources to meet society's present and future needs, based on the multifunctionality of forests.

The Code regulates forestry relations by establishing rights and obligations for managers of forest-fund lands and forestry beneficiaries. Interference in their activities is prohibited, except in cases provided by law; violated rights must be restored, and any damage caused must be fully compensated. Citizens have free access to the forest fund territory and may use forests free of charge for recreation and for harvesting wild fruits and berries, walnuts, mushrooms, and other forest products.

The Moldsilva Agency functions as the central administrative authority in the forestry sector, coordinating the administration and management of the forest resources. The Forest Code will enter into force 12 months after its publication in the Official Monitor of the Republic of Moldova.

Water Resources Law

The Water Law No. 272 of 23 December 2011, partially harmonized with several EU directives, establishes the legal framework for the management, protection, and use of water resources. This includes the Water Framework Directive (2000/60/EC), the Urban Waste Water Treatment Directive (91/271/EEC), the Nitrates Directive on the protection of waters against pollution from agricultural sources (91/676/EEC), and others.

The law was recently revised with UNDP support to respond to the acute challenge of water scarcity caused by climate change. The Republic of Moldova is considered a country with limited water resources, with about 500 m^3 of water available per capita per year, below the internationally recommended threshold of 1,700 m^3.

Effective water resource management is carried out on the basis of river basin districts: the Dniester River Basin and the Danube–Prut and Black Sea River Basin, with the river basin district serving as the main management unit. The law sets strict requirements for protecting water quality, managing wastewater discharges, establishing sanitary protection zones around water intakes, and preventing pollution from agricultural activities.

An important element of the updated legal framework is the reduction of the validity period of the environmental permit for special water use, reflecting the accelerated decline in surface water flows driven by climate change. The law also stipulates compliance with the rules for using water protection buffer strips, ensuring wastewater treatment before discharge, and compensating environmental damages.

Legislation on Protected Areas

The Republic of Moldova has a system of protected natural areas regulated by several specific legal acts. The Law on State Protected Natural Areas establishes the legal regime, categories, and procedures for the designation, administration, and protection of protected areas. The system includes scientific reserves, national parks, natural monuments, nature reserves, protected landscapes, and multi-functional management areas.

Law No. 1538/1998 on the State Protected Natural Areas Fund defines the categories of protected areas (scientific reserves, natural monuments, national parks, landscape reserves, etc.), their protection regime, and management mechanisms.

Law No. 591/1999 on Green Spaces in Urban and Rural Localities regulates an important aspect of biodiversity protection in urban settings. This law establishes the legal framework for the development and protection of green spaces, recognizing their role in conserving water resources, combating soil erosion and landslides, improving the microclimate, and ensuring conditions for rest and recreation.

The network of protected areas covers approximately 5.8% of the country's territory, with the objective of expanding this coverage to ensure the conservation of biodiversity and valuable ecosystems. Protected areas are administered by specialized institutions under the coordination of the central environmental protection authority.

Environmental Impact Assessment

Law No. 86/2014 on Environmental Impact Assessment (EIA) transposes the requirements of EU Directive 2011/92/EU and establishes the procedural framework for assessing the significant environmental effects of projects before they are authorized. This law is an essential preventive tool for environmental protection, ensuring that development decisions take environmental aspects into account.

The law sets out two lists of activities and projects: Annex 1 includes projects that require a mandatory EIA (large industrial constructions, transport infrastructure, power plants, etc.), while Annex 2 covers projects for which the need for an EIA is determined through a screening procedure. The EIA process includes several stages: notification of the competent authority, screening/scoping, preparation of the impact report, consultation of the public and relevant authorities, examination of the report, and the issuance of an environmental agreement or a reasoned refusal.

Public participation in the assessment process is mandatory and is ensured through the publication of information, the organization of public consultations, and the consideration of citizens' observations and proposals. The final decision on the environmental agreement may be challenged in court, thereby ensuring transparency and accountability in decision-making.

Institutional Framework for Implementation

The implementation of environmental legislation is ensured by a complex network of institutions at both central and local levels. At the central level, the Ministry of Environment coordinates environmental policies, develops the regulatory framework, and monitors its implementation. The Ministry of Agriculture and Food Industry is responsible for policies in the fields of agriculture, forestry, and land relations.

The Moldsilva Agency manages the forest fund and the hunting resources, and is responsible for the sustainable management of forests. The Environment Agency coordinates the national environmental monitoring system, manages monitoring networks for air, water, and soil quality, and administers cadastres of natural resources. The "Apele Moldovei" Agency manages water resources, administers river basin districts, and ensures the operation and maintenance of irrigation and drainage systems.

The Environmental Protection Inspectorate exercises state control over compliance with environmental legislation, carries out inspections, issues environmental permits, and applies sanctions for violations. At the local level, public administration authorities have important competences in managing natural resources, authorizing activities with environmental impacts, and ensuring compliance with environmental protection standards.

The "Moldsilva" Agency is the central administrative authority for the forest fund and hunting (game) fund, responsible for managing forests according to ecological principles and for implementing forestry policy. (moldsilva.gov.md)

Coordination between institutions is carried out through inter-institutional consultation mechanisms, coordination committees, and collaboration platforms. However, institutional capacity remains a challenge, requiring continuous investment in staff training, the modernization of monitoring equipment, and the development of information systems. The process of harmonization with the EU acquis and the prospect of EU accession require ongoing adaptation and strengthening of the institutional framework to ensure the effective implementation of environmental legislation.

International Commitments

The Republic of Moldova is a party to the main international conventions and agreements in the fields of the environment and climate change, demonstrating a consistent commitment to multilateral cooperation and sustainable development. These international commitments form the external pillar of the environmental legal framework, complementing national legislation and providing strategic guidance for environmental protection policies.

UNFCCC (United Nations Framework Convention on Climate Change)

The Republic of Moldova acceded to the United Nations Framework Convention on Climate Change (UNFCCC) on 12 June 1992, and the Convention was ratified by the Parliament of the Republic of Moldova on 16 March 1995. The ultimate objective of the UNFCCC is to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.

Moldova has consistently fulfilled its reporting obligations under the Convention. On 21 December 2021, the Ministry of Environment of the Republic of Moldova submitted to the Convention Secretariat its Third Biennial Update Report (BUR3), accompanied by two technical annexes: the National Inventory Report: 1990–2019 (Greenhouse gas emission sources and sinks in the Republic of Moldova) and the Report on the National System for Greenhouse Gas Emissions Inventory in the Republic of Moldova – 2021. The Republic of Moldova thus became the 20th non-Annex I Party to submit a third Biennial Update Report, demonstrating leadership in meeting its climate commitments.

According to the information presented in Moldova's BUR3 to the UNFCCC, over the period 1990–2019, the dynamics of total direct greenhouse gas emissions showed a downward trend, decreasing by approximately 69.5%, from 45.4 million tonnes of CO_2 equivalent in 1990. This significant reduction reflects both post-Soviet economic transformations and efforts to implement climate policies.

Kyoto Protocol

In November 2004, the Kyoto Protocol had 127 participating countries, including Canada, China, India, Japan, New Zealand, Russia, the 25 member states of the European Union together with Romania and Bulgaria, as well as the Republic of Moldova. Although Moldova did not have quantitative emission-reduction commitments as a transition country, its participation in the Protocol represented an important step in its commitment to combating climate change and in building institutional capacity for monitoring and reporting greenhouse gas emissions.

The Kyoto Protocol provided the Republic of Moldova with a framework for developing its national emissions inventory system and for participating in flexible emission-reduction mechanisms, such as the Clean Development Mechanism (CDM) and Joint Implementation (JI), which facilitated technology transfer and investments in emission-reduction projects.

Paris Agreement and the NDC

The Republic of Moldova has demonstrated exceptional leadership in implementing the Paris Agreement. Moldova is among the first countries to have submitted its updated Nationally Determined Contribution (NDC2), with increased ambition, to the Secretariat of the United Nations Framework Convention on Climate Change (UNFCCC), being preceded only by the Marshall Islands, Suriname, and Norway. This document was developed with the support of the regional EU4Climate project, funded by the European Union and implemented by the United Nations Development Programme.

In its first NDC (NDC1), Moldova already committed to an unconditional reduction of greenhouse gas (GHG) emissions by up to 67% compared to 1990. In the second version, the ambition increased to 70% unconditionally, or even 88% if the country gains access to technologies and financial resources at low cost. In practice, emissions have already fallen by more than two-thirds compared to 1990—due not so much to green policies, but to the economic collapse and depopulation of the 1990s—highlighting the importance of sustaining these reductions through active sustainable development policies.

The updated NDC includes both mitigation and climate adaptation objectives, acknowledging the country's vulnerability to extreme events such as droughts, floods, and temperature changes. The adaptation strategy focuses on priority sectors such as agriculture, water management, public health, and infrastructure.

Convention on Biological Diversity

The Republic of Moldova ratified the Convention on Biological Diversity (CBD) in 1995 and has undertaken several measures to meet its requirements: it prepared the First and Second National Reports in this field, and adopted the National Strategy and Action Plan for the Conservation of Biological Diversity. The Convention has three main objectives: the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising from genetic resources.

The objectives of the Convention are "the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources, including through appropriate access to genetic resources, by appropriate transfer of relevant technologies, taking into account all rights over those resources and technologies, and by appropriate funding."

Moldova has also ratified the Cartagena Protocol on Biosafety, which regulates the transboundary movement of genetically modified organisms. The Republic of Moldova periodically prepares national reports on the implementation of the Convention; the sixth national report was submitted in 2018, documenting progress in biodiversity conservation and the achievement of the Aichi Biodiversity Targets.

United Nations Convention to Combat Desertification (UNCCD)

The Republic of Moldova acceded to the UNCCD (United Nations Convention to Combat Desertification) in 1998. The Convention aims to combat desertification and mitigate the effects of drought in countries facing serious drought and/or desertification problems through effective measures at all levels, supported by international cooperation and partnership arrangements.

For the Republic of Moldova, this Convention is particularly relevant given the country's growing vulnerability to drought and soil degradation. Moldova faces intensive soil erosion, especially in southern areas, the loss of organic matter, and salinization processes in certain regions. Desertification refers to land degradation in arid, semi-arid, and dry sub-humid areas resulting from various factors, including climate change and human activities.

Within the framework of UNCCD implementation, Moldova is developing the National Programme to Combat Desertification and Land

Degradation for 2026–2030, which includes measures for soil conservation, vegetation restoration, sustainable pasture management, and the promotion of agricultural practices adapted to drought conditions. The country reports periodically to the Convention Secretariat on the implementation of these measures and the progress achieved.

Ramsar Convention (Wetlands)

The Republic of Moldova ratified the Convention on Wetlands of International Importance, especially as Waterfowl Habitat (the Ramsar Convention) through Parliament Decision No. 504-XVI of 14 July 1999, and became a member of the Convention in June 2000, when the site "Lower Prut Lakes" (19,152.5 ha) was included in the List of Wetlands of International Importance.

The second wetland accepted by the Convention Secretariat is the natural area "Lower Dniester" (60,000 ha), which includes the Lower Dniester floodplain sector between the communes of Copanca and Palanca. In September 2005, the site "Unguri–Holoşniţa" (15,553 ha) was added to the List of Wetlands of International Importance. Together, these three Ramsar sites cover approximately 94,705 hectares, representing vital ecosystems for the country's biodiversity, especially for migratory waterbirds.

Moldova's wetlands play a crucial role in regulating the hydrological regime, filtering pollutants, storing carbon, and providing habitats for numerous species of flora and fauna. The management of these areas is carried out in accordance with management plans developed for each site, with an emphasis on biodiversity conservation, the sustainable use of resources, and the involvement of local communities.

EU Association Agreement

The Association Agreement between the Republic of Moldova and the European Union, signed in 2014 and fully entered into force in 2016, represents a major commitment to harmonize Moldovan legislation with the EU acquis, including in the areas of environment and climate change. The Agreement comprises 465 chapters, along with annexes and protocols, covering sectors ranging from fisheries, transport, and energy to financial services, public health, and climate policies.

With regard to climate policy, cooperation between the Republic of Moldova and the EU provides for measures at national, regional, and international levels. In 2019, regional programmes—EU4Environment and EU4Climate—were launched in the Republic of Moldova, aiming to provide support for ensuring the sustainable use of natural capital, improving

environmental quality and population well-being, and stimulating economic growth.

Chapter 17 of the Agreement, dedicated to climate policies, предусматривает the development and approval of long-term mitigation measures to address the effects of climate change, as well as adaptation measures. Although some preparatory work has been undertaken, considerable efforts—together with strong political and financial support—are still needed to align the Republic of Moldova's legislation with the EU acquis in the fields of environment and climate policy. Significant reforms will be required in order to meet the objectives of the European Green Deal.

At the plenary session of the Parliament of the Republic of Moldova on 15 December 2022, the draft law was voted on for the ratification of the agreement on Moldova's participation in the European Union programme for environment and climate action—LIFE. This programme will enable Moldova to access funding for projects in biodiversity, the circular economy, the transition to clean energy, as well as climate mitigation and adaptation.

Sustainable Development Goals

In September 2015, the Republic of Moldova, together with 192 other UN Member States, adopted the Sustainable Development Summit Declaration, committing to implement the 2030 Agenda for Sustainable Development. The 2030 Agenda comprises 17 Sustainable Development Goals (SDGs) and 169 specific targets, covering all key dimensions of development: economic, social, environmental, governance-related, and human rights.

These 17 goals build on the achievements of the Millennium Development Goals, while also addressing new areas such as climate change, economic inequality, innovation, sustainable consumption, peace, and justice, among other priorities. The goals are interconnected—often, progress in one area depends on tackling issues more commonly associated with another.

The Republic of Moldova has undergone an extensive process of nationalizing the SDGs, adapting them to the country's specific context and identifying relevant national priorities. The National Development Strategy "European Moldova 2030" (NDS), as well as the Government Action Plan "Building a European Moldova," outline the country's strategic development vision in the short, medium, and long term, aligning national priorities, objectives, indicators, and targets with Moldova's international commitments, including those set out in the 2030 Agenda, and integrating them into the national context.

Progress in SDG implementation is monitored through the national statistical system, coordinated by the National Bureau of Statistics, which has developed a dedicated platform for disseminating SDG-related data. In 2020, the

Republic of Moldova presented its first Voluntary National Review at the High-Level Political Forum on Sustainable Development, documenting notable progress in achieving SDG 1 (No Poverty), SDG 8 (Decent Work and Economic Growth), SDG 13 (Climate Action), and SDG 17 (Partnerships for the Goals).

The 2030 Agenda is integrated into national and sectoral strategic documents, and its implementation relies on collaboration among the Government, the United Nations in Moldova, the private sector, civil society, and development partners. By undertaking these comprehensive international commitments, the Republic of Moldova demonstrates an integrated approach to sustainable development, recognizing the interdependence between environmental protection, economic development, and social progress, and committing to mobilize the necessary resources to build a prosperous and sustainable future for its citizens.

Strategies and Action Plans

The Republic of Moldova has developed a comprehensive strategic framework for the sustainable management of the environment and natural resources, as well as for adaptation to climate change. These strategies and action plans are operational instruments through which the country translates its international commitments and national legislation into concrete measures, setting measurable objectives, institutional responsibilities, and financing mechanisms.

National Environmental Strategy

The new Environmental Strategy aims to guarantee the population of the Republic of Moldova the right to a sustainable, unpolluted, and healthy environment, in the context of economic development. The document states that, over the next 10 years, a modern environmental system will be developed through the drafting and adoption of environmental legislation in line with European standards. The previous strategy, covering the period 2014–2023, was the first comprehensive environmental policy document in the post-independence period.

The Environmental Strategy for 2024–2030 was approved by the Government in June 2024 and ensures safe environmental and living conditions at the national level, in line with European environmental objectives. It therefore seeks to reduce pollution and pressures on the climate and the environment linked to production and consumption, especially in the fields of energy, industry, buildings and infrastructure, mobility, tourism, international trade, and the food system. One key aspect targets a reduction in net greenhouse gas emissions by at least 70% by 2030, compared to the 1990 level.

The Strategy includes provisions that will reduce the negative environmental impact of economic activity and will also increase the level of knowledge on environmental protection by at least 50%. In addition, it предусматри measures for the protection and conservation of biodiversity, the sustainable use of ecosystems, a reduction of greenhouse gas emissions by at least 20% by 2020, a 30% reduction in the quantity of waste landfilled, and a 20% increase in the recycling rate by 2023.

It should be noted that, in order to proactively promote Moldova's transition to a green economy, at the beginning of 2022 the Ministry of Environment set three priorities that are reflected in the new Environmental Strategy: zero waste, rational water use, and nationwide afforestation. The Environmental Strategy for 2024–2030 was developed by the Ministry of Environment, with support from the project "Green justice for a protected environment and sustainable communities in the Republic of Moldova," supported by the Embassy of Sweden.

To implement the Strategy's provisions, nearly 9 billion lei (MDL) are required, with costs estimated during negotiations of the Association Agreement and the EU Free Trade Agreement. Expenditures will be covered from internal sources (the state budget, the National Ecological Fund, the Regional Development Fund, the Energy Efficiency Fund) and from external investments.

Climate Change Adaptation Strategy

The Government considers the National Adaptation Planning (NAP) process essential for achieving the adaptation objectives set out in the Republic of Moldova's 2014 Climate Change Adaptation Strategy and in its Nationally Determined Contributions (NDCs), as well as for continuing the integration of climate change considerations into public policies and budgeting processes. The Government launched the NAP process in 2014 through consultations with national stakeholders and with support from the Austrian Development Agency (ADA) and UNDP.

The Strategy acknowledges the Republic of Moldova's high vulnerability to climate change impacts, particularly droughts, floods, heatwaves, and extreme weather events. A World Bank study on the economic aspects of climate change in Moldova found that the greatest challenges and investment opportunities are in agriculture. The Climate Change Adaptation project will help reduce the vulnerability of rural households to climate change impacts, given that rural communities account for a disproportionately large share of the poor population.

The Ministry of Environment is developing the National Climate Change Adaptation Programme up to 2030 and the corresponding Action Plan for its

implementation. According to an assessment of individual, institutional, and systemic capacities for planning and implementing climate change adaptation conducted under an FAO project, knowledge about climate-related risks and vulnerabilities is insufficient, and the intersectoral coordination mechanism for climate change adaptation has not been operationalized.

The adaptation strategy covers priority sectors such as agriculture, water management, public health, biodiversity, forestry, and infrastructure. Proposed measures include improving irrigation systems, promoting climate-smart agricultural practices, restoring degraded lands, modernizing meteorological forecasting and early-warning systems, and strengthening institutional capacity for managing climate risks.

Strategy for the Agri-Food Sector

The National Strategy for Agricultural and Rural Development 2023–2030, as the umbrella public policy document for the strategic planning of the country's agricultural sector, sets out the Government of the Republic of Moldova's vision and priorities. It aims to develop a competitive agri-food sector, focused on value chains with higher potential, environmentally friendly and resilient to climate change, which strengthens food security and food safety and provides greater well-being and improved living conditions in rural areas.

The strengthening of the policy framework for the agri-food segment has been achieved through the development/promotion of a series of strategic policy documents, including: the National Strategy for Agricultural and Rural Development 2022–2027; the Development Programme for the Wine Sector of the Republic of Moldova 2030; the Development Programme for the Milk Production Sector; the National Development Programme for the Meat Production Sector; the National Development Programme for the Aquaculture Sector; the National Development Programme for the Sheep and Goat Sector; and the Programme for the Development of the Land Reclamation and Irrigation Sector.

The Government has approved the Food Security Strategy of Moldova for 2023–2030. Its goal is to ensure citizens' physical and economic access to sufficient, safe, and nutritious food needed to meet dietary needs and preferences, in order to maintain an active and healthy lifestyle. According to the Strategy, improved food security will be achieved by creating the conditions for the development of an efficient food system, effective supply mechanisms, and social protection that is resilient to emergencies and crises.

According to a 2019 study by the Food and Agriculture Organization (FAO), small farmers and family farms in the country generate over 62% of total national agricultural production, thereby making a substantial contribution to overall food production and food security in the Republic of Moldova. The

Strategy emphasizes strengthening the capacities of small and family farms, modernizing agricultural technologies, improving market access, and promoting sustainable production practices.

Water Management Strategy

Integrated water resources management is a strategic priority for the Republic of Moldova, especially in the context of the growing water deficit caused by climate change. Water resource management is a strategic priority due to the essential role these resources play in economic development and environmental conservation. Although the country has numerous water bodies and hundreds of kilometers of dikes designed for flood protection, currently only a part of them benefit from adequate management.

The Water Supply and Sanitation Strategy (2014–2028) sets the framework for improving the population's access to high-quality water and sewerage services. The management of river basin districts is carried out in line with the principles of the EU Water Framework Directive, based on two main districts: the Dniester River Basin District and the Danube–Prut and Black Sea River Basin District.

River basin management plans include measures for protecting water quality, quantitative management of resources, protection against pollution from diffuse and point sources, and flood risk management. An important element of the strategy is the implementation of the Code of Good Agricultural Practices for protecting waters against nitrate pollution from agricultural sources, in line with the EU Nitrates Directive.

Land Rehabilitation Program

The Government recognizes the need to strengthen the agricultural sector's resilience to risk factors and will continue to push for adaptation to new realities by urgently promoting the following actions: reducing agricultural areas affected by natural disasters and mitigating the effects of climate change through the rehabilitation and expansion of irrigation systems, the development of rainwater harvesting and storage systems, and the expansion of areas protected against hail.

A Concept was developed for the rehabilitation of irrigation systems covering 68,000 ha (rehabilitation/construction of 117 pumping stations), with an estimated cost of MDL 4.2 billion, and it was submitted to the Ministry of Finance to identify funding sources. This concept was developed based on the Land Reclamation Program for ensuring sustainable management of soil resources (2021–2025).

The program includes measures to combat soil erosion, restore degraded pastures, afforest degraded lands, and promote soil conservation practices. The

Climate Change Adaptation Project aims to increase the climate resilience of the country's forests and pastures by restoring degraded land at the level of communities and rural localities, as well as improving the climate-smart management of reproductive forest resources.

National Energy Strategy

The National Energy Strategy is the policy document that sets the medium- and long-term development directions for the energy sector, with a focus on diversifying energy sources, increasing energy efficiency, and integrating renewable energy sources. The document is closely linked to greenhouse gas emission reduction targets and to the commitments undertaken through the NDC.

The strategy promotes the transition to a low-carbon economy by developing renewable energy generation capacities (solar, wind, biomass), modernizing energy infrastructure, improving regional interconnections, and reducing dependence on energy imports. Particular emphasis is placed on energy efficiency in buildings, industry, and transport, as well as on promoting decentralized energy production.

Local Adaptation Plans

Adapting to climate change requires action not only at the national level, but also at the local level, where impacts are felt directly by communities. The FAO project contributes to strengthening climate adaptation capacities both sector-wide and locally through awareness-raising, information, training, and the dissemination of knowledge and good practices. The Ag-SAP project was implemented during 2020–2023 with financial support from the Green Climate Fund, and its main objective is to integrate climate adaptation solutions into agricultural sector planning processes.

Local adaptation plans are developed with the participation of communities, local authorities, and other stakeholders, identifying region-specific vulnerabilities and proposing concrete measures tailored to the local context. These may include local early warning systems, urban green infrastructure, agricultural practices adapted to local conditions, and protection measures against floods or drought.

Municipalities and designated growth-pole towns develop sustainable urban development strategies that integrate climate adaptation considerations, energy efficiency, and pollution reduction. Rural communities receive support to implement pilot adaptation projects, such as small-scale irrigation systems, the restoration of protective forest belts, and the promotion of climate-smart agriculture.

Monitoring and Reporting

Effective implementation of strategies and action plans requires robust monitoring and reporting systems. The National Development Strategy "European Moldova 2030" includes a clear monitoring and evaluation framework, with SMART indicators and transparent mechanisms for communication and institutional coordination. Monitoring is carried out through periodic progress reports, assessed by the responsible institutions and presented to the Government and the public.

For environmental and climate objectives, reporting is conducted to international conventions (UNFCCC, CBD, UNCCD), to EU institutions under the Association Agreement framework, and to the UN system for monitoring the Sustainable Development Goals (SDGs). The National Bureau of Statistics coordinates the collection and dissemination of statistical data relevant to SDG indicator monitoring, maintaining a dedicated online platform.

The Ministry of Environment prepares National State of the Environment Reports, providing a comprehensive assessment of trends in environmental quality, the use of natural resources, and the implementation of environmental policies. These reports are published periodically and made available to the public, ensuring transparency and accountability.

Interim and final evaluations of strategies allow objectives and measures to be adjusted based on progress achieved and changes in the national and international context. The evaluation process involves stakeholder consultations, cost–benefit analyses, and the extraction of lessons learned to improve future strategic planning. This iterative and adaptive approach ensures that policies and programs remain relevant and effective in the dynamic context of environmental and sustainable development challenges facing the Republic of Moldova.

Soil and Water Management

Integrated soil and water management is a strategic priority for agriculture in the Republic of Moldova, given that soil and water resources are under increasing pressure due to erosion, land degradation, and water scarcity driven by climate change. Sustainable farming practices and technologies adapted to local conditions are essential to conserve these vital resources and to ensure the long-term productivity of the agricultural sector.

Anti-erosion techniques (terracing, contour farming)

Soil erosion is the most severe form of land degradation in the Republic of Moldova. In 2024, the total area affected by erosion reached 31.7% (1,072,667 ha) of the country's agricultural land (2,338,805 ha), of which 603,762 ha were slightly affected, 318,779 ha were moderately affected, and 150,127 ha were

severely affected. Annual soil losses are enormous—about 26 million tons. This volume of fertile soil contains approximately 700 thousand tons of humus and 84 thousand tons of nitrogen and phosphorus. Overall, the direct and indirect annual losses caused by erosional processes are estimated at 2.723 billion lei.

A research team from the former IPAPS "Nicolae Dimo" (now part of INCAAMV) developed a comprehensive set of measures to prevent and combat soil erosion, including: the organization and planning of agricultural land; the application of silvo-ameliorative measures on low-productivity land or areas damaged by landslides and gullies; implementation of anti-erosion crop rotations; grassing the inter-row spaces in orchards and vineyards; the use of anti-erosion agrotechnical practices; and the selective application of hydrotechnical measures.

Terracing is one of the most effective anti-erosion methods for steep slopes. Terraces transform slopes into less inclined surfaces, reducing runoff velocity and allowing safe cultivation. Although initial implementation requires substantial investment, terraces reinforced with stone, concrete structures, or gabions provide long-term protection. In Moldova's hilly areas—where about 80% of agricultural land lies on slopes steeper than 2 degrees—this technique could prevent massive soil losses.

Contour plowing (contour farming) is a more economically accessible technique that involves carrying out field operations perpendicular to the slope direction, rather than "up-and-down" the hillside. This practice creates natural barriers to runoff, reducing both the speed and volume of water flowing downslope, and therefore limiting erosion. On slopes, strip cropping—alternating bands of crops with different heights and root systems—offers additional protection.

Dams and check structures for gully control

Deep erosion—expressed through gullies and torrent channels—is particularly destructive for agricultural land. Stabilizing deep-erosion networks can be achieved through phyto-ameliorative measures (grassing, contour ridging/furrowing, and afforestation) or through channel protection works. In practice, rehabilitating deep erosional forms is both technically difficult and financially costly.

Transverse check dams and drop structures installed in gullies help reduce erosion and sediment transport by lowering the effective slope of flow and dissipating runoff energy. Along the drainage network, these works also contribute to stabilizing the channel bed (thalweg) and the banks. Typical longitudinal interventions include bed stabilization, but the most appropriate solutions are often transverse structures such as buried crossbars, sills (weirs), or check dams.

These structures can be built from various materials, including stone, concrete, treated wood, or stone-filled metal gabions. Smaller sills (about 0.5–1.5 m high) are effective for developing gullies, while larger dams may be required for well-established gullies. Sediment accumulates upstream of the structures, gradually forming flatter surfaces that can be revegetated and, in some cases, even brought back into cultivation. This technique works best when combined with afforestation of adjacent areas, which stabilizes gully banks and reduces the volume and speed of runoff reaching the erosional channels.

Efficient Irrigation Systems

In a context where the Republic of Moldova uses only 28 m^3/ha of water for irrigation—compared with Romania (276 m^3/ha) and Ukraine (90 m^3/ha)—the development of efficient irrigation systems becomes crucial. The core challenge for Moldovan agriculture is not the weather conditions or drought itself, but rather the lack of an adequate response to drought through the expansion and modernization of irrigation infrastructure.

Drip irrigation is the most water-efficient method, saving up to 50–70% of the water required compared with traditional sprinkler irrigation or furrow irrigation. Drip systems deliver water directly to plant roots at low pressure, minimizing losses through evaporation and runoff. A major advantage of drip irrigation is reduced overall water consumption, since droplets are distributed at low pressure straight to the crop. In addition, the lack of moisture in non-irrigated zones limits weed development.

In Moldova, a range of drip irrigation technologies is available—from simple systems for small areas (250–1,000 m^2) to complex installations for large commercial crops. Drip tape and drip tubing with emitters placed at predefined distances (20–50 cm) are among the most widely used solutions. Modern systems also enable fertigation—the application of soluble fertilizers together with irrigation water—optimizing plant nutrition.

Micro-sprinkler irrigation represents an intermediate alternative, especially useful for orchards and perennial plantations, where it provides more uniform coverage and allows evaporative cooling during heatwaves. Micro-sprinklers produce fine droplets that moisten the soil without compacting it, making them suitable for a wide range of soil types.

Rainwater Harvesting and Storage

The Republic of Moldova needs smart agricultural solutions for areas that are less well supplied with water sources. First and foremost, it is necessary to store water in dedicated reservoirs during the rainy season, so it can later be used for irrigation. This helps minimize water abstraction from rivers during heatwaves, when natural flows are already low.

One practical approach is harvesting rainwater through reinforced ponds designed both for erosion control and for maximizing additional benefits (such as sapropelic sludge). This is promoted under the post-investment grant program "Sustainable Land Management." Such water-harvesting ponds serve multiple functions: retaining water for irrigation, reducing rapid runoff and erosion, creating local microclimates, and supporting biodiversity.

A relevant example comes from Cahul, where a farmer developed a system to capture water from heavy rains and from the cold season. They started by collecting water from a one-hectare greenhouse roof, storing it, and then using it for irrigation. After receiving financial support, they expanded the capture area to two hectares. Simple systems can include collecting runoff from the roofs of agricultural buildings, greenhouses, and warehouses into cisterns or storage tanks, while larger-scale solutions involve building ponds and accumulation basins.

The Government has also decided that 56 ponds and reservoirs in the Republic of Moldova will be placed under a special protection regime. These water bodies will be granted "national importance" status, based on criteria approved by the Executive, recognizing the strategic role of water capture and storage infrastructure in strengthening agricultural resilience.

Improving Water Infiltration and Retention

Enhancing the soil's ability to absorb and retain water is essential for reducing surface runoff and erosion, and for ensuring water availability to plants during drought periods. This capacity depends on soil structure, organic matter content, and the management of vegetative cover.

Minimizing soil disturbance (no-till or minimum tillage) helps protect the soil's natural structure and pore system that supports infiltration. Excessive plowing breaks down soil aggregates, compacts deeper layers, and exposes organic matter to rapid oxidation. On compacted soils where infiltration is limited, deep mechanical decompaction can be applied, followed by the incorporation of organic amendments.

Maintaining a permanent or semi-permanent soil cover with crop residues or mulch directly reduces evaporation from the soil surface, protects against the impact of raindrops, and improves infiltration. Cover crops sown in the off-season (legumes, brassicas, grasses) add biomass, enhance soil structure through their root systems, and prevent erosion during periods when fields would otherwise remain bare.

Wetland Restoration

Natural and restored wetlands play a crucial role in landscape-level water management by regulating the hydrological regime, improving water

quality through natural filtration, and providing habitats for biodiversity. In the Republic of Moldova, many wetlands were drained and converted into agricultural land during the Soviet period, significantly reducing the natural capacity for water retention and purification.

Wetland restoration involves re-establishing natural hydrology by blocking or removing drainage canals, recreating natural depressions, and replanting characteristic hydrophilic vegetation. These areas can function as buffer zones between agricultural land and watercourses, trapping nutrients and pesticides from agricultural runoff before they reach rivers and lakes.

Wetlands also provide major ecosystem services: mitigating floods by temporarily storing high water flows, recharging groundwater aquifers, sequestering carbon in peat and soils, and supporting migratory waterbird species. In the context of climate change, these ecosystems are becoming increasingly valuable as nature-based adaptation infrastructure.

Application of Compost and Organic Matter

Organic matter is fundamental to soil health and functionality. Intensive use of agricultural land—without proper crop rotations, without the application of organic fertilizers, and with the predominance of annual row crops—has accelerated erosion processes. Low humus content in eroded soils limits their ability to retain water and nutrients, maintain stable soil aggregates, and support biological activity.

Compost produced from plant residues, animal manure, and other biodegradable organic materials is an ideal amendment for improving degraded soils. Regular compost application (10–20 t/ha every 2–3 years) significantly increases organic matter content, improves soil structure, enhances water-holding capacity, and boosts nutrient availability. Proper composting eliminates weed seeds and pathogens, turning waste into a valuable resource.

A farmer may follow these steps: store sapropelic sludge (rich in organic substances), allow time for decomposition, and only then use it to recultivate degraded land. Sapropelic sludge, rich in organic matter and nutrients, is a valuable resource for soil restoration.

Direct incorporation of crop residues (straw, corn stalks, plant biomass) after harvest adds organic matter and protects the soil surface. This practice must be managed carefully to avoid temporary nitrogen immobilization and to reduce the risk of pests and diseases that overwinter in residues. Shredding residues and distributing them evenly accelerates decomposition and integration into the soil.

Soil Amendments for Soil Improvement

In addition to organic matter, various mineral amendments may be needed to correct soil chemical and physical imbalances. Improving acidic soils by applying liming materials (agricultural lime, dolomite) raises pH, enhances nutrient availability, and stimulates microbial activity. Application rates should be determined based on soil analyses and the required neutralization of exchangeable acidity.

For saline soils, which occur in some areas of southern Moldova, gypsum (calcium sulfate) can replace sodium in the soil's exchange complex, enabling sodium to be leached out and improving soil structure. This treatment must be accompanied by adequate drainage and controlled irrigation to prevent salt re-accumulation.

Applying clay materials to sandy or very light soils improves water and nutrient retention capacity, although this practice is expensive and economically justified only when a clay source is nearby. Typically, 300–1000 t/ha of clay material is needed to achieve long-lasting improvement.

Biochar (biocarbon), produced through biomass pyrolysis, is an innovative amendment that improves water and nutrient retention, sequesters carbon over the long term, and stimulates microbial activity. Although this technology is still in the adoption phase in Moldova, its potential for restoring degraded soils and mitigating climate change is significant.

Implementing these integrated soil and water management practices requires initial investments, technical assistance, and supportive policies. However, the long-term benefits—conserving natural resources, increasing resilience to drought and extreme events, improving productivity, and reducing pollution—fully justify the efforts needed to transition toward sustainable agriculture in the Republic of Moldova.

Renewable Energy and Energy Efficiency

The Republic of Moldova is undergoing an accelerated energy transition, aiming to reduce its dependence on energy imports and to meet the decarbonization targets assumed under the Paris Agreement and the EU–Moldova Association Agreement. The development of renewable energy sources and the improvement of energy efficiency are the central pillars of the national energy strategy, with a direct impact on energy security, economic competitiveness, and environmental protection.

Solar and Wind Potential in Moldova

The Republic of Moldova has considerable technical potential for renewable energy sources. One target is that, by 2030, the share of energy from renewable sources in gross final energy consumption should reach 27%. Solar energy—Moldova has significant potential to harness solar power due to its geographic location and climatic conditions.

By the end of 2024, installed capacities of renewable electricity plants—including solar, wind, hydro, and biogas—reached nearly 580 MW, and the share of renewable energy in the final consumption of electricity last year exceeded 16%. A record level of 20% highlights the growing potential of green energy and the importance of investment in this sector; this was recorded in January 2025, when 20.59% of Moldova's total electricity consumption was covered by locally produced renewable sources.

For wind energy, southern Moldova is the most promising region for wind investments due to higher wind speeds and an estimated output of 7.1 GWh per year for a 3 MW turbine. The western area along the Prut River is another strong option, with average wind speeds of 5.0–5.5 m/s and an estimated production of 6.3 GWh/year.

Through Government Decision No. 401/2021, the Republic of Moldova committed to supporting the construction of 410 MW of new renewable energy capacity, with a focus on wind, solar, and other non-variable renewable sources such as biomass, biogas, and micro-hydropower plants. The Ministry of Energy launched the first auction for the construction of wind and photovoltaic parks with a total capacity of 165 MW, divided by technology—105 MW for wind installations and 60 MW for photovoltaics.

In Moldova, three support mechanisms are applied for renewable energy: net billing (intended to cover self-consumption), a fixed tariff (feed-in tariff) for 15 years for producers with a capacity of up to 1 MW, and a fixed price with a guaranteed purchase of the electricity produced. These mechanisms provide predictability for investors and stimulate sector development.

Biomass and Bioenergy from Agricultural Residues

In the Republic of Moldova, agricultural crop residues represent an important source of biomass. At the same time, crops such as rapeseed, sweet sorghum, Jerusalem artichoke (topinambur), and others can be cultivated specifically as energy crops, with relatively high energy potential. Each year, in Moldova's agriculture, biomass—considered the main renewable energy source (RES)—is generated across 1,839.7 thousand ha of arable land, 153.6 thousand ha of vineyards, and 141.5 thousand ha of orchards, amounting to 1.1–1.2 million tons, or about 4.8 million MWh.

Depending on specific climatic conditions, the annual potential of solid biomass in the Republic of Moldova could vary within 600–700 ktep (thousand tonnes of oil equivalent). However, according to official statistics from 2014, the annual consumption of solid biofuels in the form of firewood, straw bales, pellets, and briquettes is only 273 ktep, which indicates a significant unused potential.

In the Republic of Moldova, coal, fuel oil, and gas could be replaced by around 31% with pellets and briquettes made from agricultural waste—such as residues from maize, sunflower, cereals, and other crops—along with forestry residues, biomass from green urban areas, vineyards, and orchards. Specialists note that 1.8–2 kg of pellets has a calorific value equivalent to 1 cubic meter of natural gas.

At present, more than 300 public institutions in the Republic of Moldova (schools, kindergartens, cultural centers) use biomass boilers and produce heat and hot water using pellets, briquettes, and firewood through the "Energy and Biomass" project, funded by the European Union (EU) and implemented by UNDP Moldova. This project demonstrated the technical and economic viability of using biomass for heating public buildings, significantly reducing energy costs and dependence on imported fossil fuels.

A study carried out in 2012 by experts from the Independent Analytical Center IDIS "Viitorul" shows that Moldova's biomass potential amounts to about 21,000 TJ, sufficient to cover 22% of the country's energy demand. If the full biomass potential could be utilized, it would allow a 50% reduction in gas imports.

Energy Efficiency in Agriculture

Moldova's agricultural sector, as one of the country's major energy consumers, has significant potential for improving energy efficiency. Modernizing irrigation technologies, using modern tractors and agricultural machinery with lower fuel consumption, and implementing smart energy management systems can substantially reduce overall energy use.

Using solar energy to power water pumping in irrigation systems, electrifying agricultural equipment where feasible, and applying precision agriculture principles all help reduce the sector's carbon footprint. Farmers who adopt renewable technologies and energy-efficient practices benefit from lower operating costs and improved access to preferential financing mechanisms.

Energy Renovation of Buildings

Over 70% of apartment blocks in the Republic of Moldova have low energy efficiency, and households end up paying for energy losses through their utility bills. Calculations show that a medium-level renovation of buildings—

thermal insulation of exterior walls, roof, and basement; replacement of energy-inefficient windows and doors with high-performance ones; regulation of heat consumption; and upgrading the lighting system—can generate energy savings of around 45%.

The Energy Efficiency Fund in the Residential Sector of Moldova (FEERM) is a national program with a budget of 1.4 billion lei, designed to finance energy rehabilitation projects for housing across the country. FEERM will support the energy renovation of over 8,500 homes, with a total area of more than 507,000 m².

Up to 70% of the investment needed for thermal renovation of apartment blocks will be covered as a grant from FEERM, while 30% will be the residents' own contribution. Homeowners experiencing energy vulnerability who are registered on compensatii.gov.md can receive additional support to cover their contribution through the Energy Vulnerability Fund, ensuring equitable access to the renovation program.

An additional 60 residential buildings in the municipality of Chișinău will undergo energy renovation. The EBRD will provide a €39.5 million grant to implement 57 pilot energy-efficiency projects in buildings in Chișinău. Over the next 25 years, it is projected that about 75% of the total residential building area will be renovated, and energy consumption will be reduced by 40%.

Eligible works for financing include thermal insulation of the façade, roof, and basement; replacement of exterior joinery; modernization of the heating system by switching from vertical to horizontal distribution and installing individual heat meters; and improvements to lighting and ventilation systems. These measures not only reduce energy use and bills, but also significantly improve thermal comfort, indoor air quality, and the market value of properties.

Sustainable Transport and Mobility

Between 2018 and 2024, more than 57,000 electric and hybrid vehicles were registered in the Republic of Moldova. Although the share of electric and hybrid transport in the total number of registered passenger cars remains relatively low—around 4%—the upward trend is clear.

In the first quarter of 2025, 828 electric vehicles were registered in Moldova—almost three times more than in the same period of the previous year. During the same interval, 6,396 hybrid vehicles were also registered, representing an increase of 281%. Between 2018 and June 2025, over 72,600 electric and hybrid vehicles were registered in the country. Of this total, 7,666 are fully electric vehicles, of which 5,905 belong to individuals and 1,761 to legal entities.

Starting in June 2024, vehicles with environmentally friendly propulsion systems in the Republic of Moldova began receiving green license plates. This measure is part of the Government's strategy to reduce greenhouse gas emissions and aims to improve the identification of non-polluting vehicles in traffic and to encourage sustainable mobility.

The authorities have set a goal that by 2030, fully electric vehicles will represent 15% of all registered vehicles in Moldova. Achieving this objective requires continuous financial incentives—such as exemptions from customs duties and registration fees—along with the development of charging infrastructure and awareness campaigns highlighting the benefits of electric transport.

UNDP Moldova, in partnership with the Government, is helping create a favorable environment to expand the use of low-emission transport in response to environmental and climate-change challenges. Twenty new electric vehicle charging stations have been installed by UNDP along urban routes, with additional stations planned. The electric vehicles currently registered in Moldova reduce annual CO_2 emissions by about 500,000 kg.

Another key priority is the development of electric public transport. Modernizing the trolleybus and bus fleet, expanding electric transport networks, and improving infrastructure for active mobility (bike lanes, adequate sidewalks) all contribute to reducing urban pollution and improving quality of life.

Green Technologies in Industry

Moldova's industrial sector faces challenges related to outdated equipment and high energy consumption. Technological modernization—through the introduction of energy-efficient machinery, waste-heat recovery, production-process optimization, and the implementation of energy management systems in line with the ISO 50001 standard—can significantly reduce energy use and emissions.

The transition to a circular economy in industry involves minimizing waste, reusing materials, and valorizing by-products. Eco-industrial parks, where one company's waste becomes another's resource, represent a sustainable development model that lowers pressure on natural resources and reduces production costs.

Investments in green technologies are encouraged through tax incentives, preferential access to finance, and technical assistance from development partners. Support programs for SMEs in green technologies and sustainable innovation stimulate green entrepreneurship and the creation of skilled jobs.

Greenhouse Gas Emissions Reduction

In its first Nationally Determined Contribution (NDC1), Moldova committed to an unconditional reduction of GHG emissions by up to 67% compared to 1990. In the updated version, this ambition increased to 70% unconditionally, or up to 88% if the country gains access to affordable technologies and financial resources. These ambitious targets reflect the Republic of Moldova's strong commitment to fighting climate change.

Emissions reductions are pursued through multiple pathways: increasing the share of renewable energy in the national energy mix; improving energy efficiency across all economic sectors; electrifying transport; promoting low-carbon agriculture; and protecting and expanding forests that sequester carbon. Developing a domestic carbon market and participating in international carbon credit trading mechanisms can provide additional financial resources for mitigation projects.

Rigorous monitoring and reporting of GHG emissions, in line with UNFCCC and Paris Agreement requirements, ensures transparency and accountability in the implementation of climate policies. Moldova's national emissions inventory system is being continuously improved, incorporating international methodologies and modern technologies for data collection and processing.

Moldova's energy transition toward renewable sources and higher energy efficiency is not only an environmental necessity, but also an economic opportunity—reducing external energy dependence, boosting competitiveness, and improving citizens' quality of life. Large-scale investments in green energy infrastructure, building renovation programs, sustainable transport development, and industrial modernization create jobs, stimulate innovation, and position the Republic of Moldova as a credible partner in European integration and global climate action efforts.

RECOMMENDED POLICIES AND MEASURES

Strategic pillars for managing climate change and resource use in the Republic of Moldova

The Republic of Moldova is among the most climate-vulnerable countries in Europe. An economic model strongly dependent on agriculture, limited water resources, and a relatively low level of forest cover mean that any severe drought, flood, or heatwave has disproportionately large effects on the population, especially in rural areas. At the same time, the country has undertaken ambitious commitments to reduce emissions and increase its adaptive capacity, and recent strategic documents increasingly call for mainstreaming climate considerations across all public policies.

The Climate Change and Land-Use in Moldova (CCLU-Moldova) project synthesizes these developments into a coherent set of strategic pillars that can guide both decision-makers and local stakeholders. The core idea is clear: it is not enough to have a list of isolated projects; what is needed is a conceptual and institutional "backbone" that brings coherence to all climate- and resource-related interventions.

Pillar 1: Mainstreaming Climate Change Across All Development Policies in the Republic of Moldova.

Climate change can no longer be treated as a "niche" topic handled only by the Ministry of Environment. It directly affects agriculture, infrastructure, health, energy, transport, regional development, and social policy. Therefore, the first strategic pillar requires that every sectoral strategy—whether for agriculture and rural development, energy, transport, or regional development—include dedicated sections on climate risks, adaptation measures, and monitoring indicators.

Major infrastructure projects (roads, irrigation systems, dams, water supply and sanitation networks) must be assessed not only in terms of economic costs and benefits, but also in terms of climate compatibility: will they withstand temperature and precipitation scenarios over the coming decades? Will they reduce vulnerability in communities, or will they unintentionally increase it?

Pillar 2: Climate Governance and Strengthened Institutions.

Even the best strategic documents remain ineffective if there are no institutions capable of implementing them. Therefore, the second pillar focuses on strengthening climate governance: clarifying responsibilities across ministries, reinforcing the Ministry of Environment's capacity to coordinate climate policy, strengthening the Ministry of Agriculture's role in adapting the agricultural sector, and ensuring the Ministry of Infrastructure and Regional Development is actively involved in resilient infrastructure projects. At the local level, each district (raion) and municipality should have a designated focal person for climate and natural resources to serve as a bridge between central authorities and communities. Instruments such as the National Environmental Fund and specialized implementation offices must be strengthened financially and technically, and their transparency must be improved.

Pillar 3: Green and Climate-Resilient Economic Development.

Moldova's climate vulnerability is directly linked to a development model characterized by low productivity, limited value added, and dependence on imported resources (especially energy). The green and resilient development pillar proposes a qualitative leap: moving from extensive agriculture to modern agri-food systems based on efficient technologies, product and market diversification, reduced losses and waste, and the integration of circular economy principles. Investments in renewable energy, energy efficiency, low-emission technologies, and green infrastructure are not only environmental measures—they are also tools for boosting competitiveness and reducing socio-economic vulnerability.

Pillar 4: Sustainable Management of Soil, Water, Forests, and Biodiversity.

Natural resources—fertile soil, water, forests, grasslands, and biodiversity—are the foundation of the rural economy and population well-being. Soil degradation through erosion, overexploitation of water, illegal logging, and habitat fragmentation reduce the country's ability to adapt to a warmer and more unstable climate. Pillar 4 promotes an integrated package: conservation agriculture, anti-erosion programs, afforestation of degraded lands, rehabilitation of shelterbelts and riparian zones, integrated water

resources management at the river-basin level, and the expansion and ecological connectivity of protected areas. This pillar is the core of the CCLU-Moldova project because it directly addresses how land and landscape resources are used in rural areas.

Pillar 5: Energy Transition and Reducing the Vulnerability of the Energy System.

Although the CCLU-Moldova project focuses on land use, the connection with energy is clear. The energy transition—increasing the share of renewables, reducing import dependence, and improving energy efficiency—has implications for land use (biomass, photovoltaic parks, energy infrastructure). An energy system vulnerable to external crises reduces the adaptive capacity of the entire economy. The energy pillar therefore supports the development of renewable solutions in rural areas (small-scale photovoltaics, biogas from agricultural and livestock waste), while respecting criteria for soil and ecosystem protection.

Pillar 6: Community-Based Adaptation, Equity, and Protection of Vulnerable Groups.

Climate change does not affect all citizens equally. Small farmers, low-income households, older people, women involved in agriculture, and communities in areas with limited access to water or infrastructure are often the most exposed—and have the fewest resources to adapt. Community-based adaptation means directly involving residents in diagnosis, decision-making, and implementation: community afforestation initiatives, rainwater harvesting projects at village level, community gardens, shared pasture management, and local partnerships for green infrastructure. In addition, this pillar emphasizes equity: equal access to climate information, financing, and training programs, so that measures do not deepen social inequalities but instead help reduce them.

Integrated Package of Measures for the Sustainable Use of Resources (Soil, Water, Forests, Biodiversity)

If the strategic pillars outline the broad directions for action, the integrated package of measures proposed by the CCLU-Moldova project brings the approach down to the practical level of soil, water, forests, and biodiversity. The core idea is that adaptation to climate change cannot be achieved through

isolated or fragmented interventions; it requires combinations of measures that reinforce one another at the level of plots, farms, river basins, and entire regions.

Measures for Soil and Agriculture

In the Republic of Moldova, soils are among the most valuable resources. Chernozems form the backbone of agricultural production, but they are exposed to intense processes of erosion, structural degradation, and loss of organic matter. The package of measures proposed for soil and agriculture is built around the following directions:

- Gradual transition to conservation agriculture, by reducing the intensity of tillage, maintaining a protective layer of crop residues, and introducing cover crops—especially on sloping land and in drought-prone areas.
- Designing diversified crop rotations, where monoculture is replaced by rotations that include cereals, legumes, industrial crops, and—where possible—perennial crops. Diversification reduces climate risk, improves fertility, and helps control erosion.
- Large-scale implementation of anti-erosion measures: contour farming (along contour lines), grassed strips, vegetated buffer zones, and micro-terracing where slopes are steep.
- Strengthening organic matter management: composting, using well-fermented manure, incorporating crop residues, and avoiding stubble burning. Through these practices, the soil becomes a reservoir of carbon and water, increasing resilience to drought.

These agricultural measures have a dual effect: on the one hand, they reduce vulnerability to drought, torrential rains, and erosion; on the other hand, they contribute to mitigation objectives by storing carbon in the soil.

Measures for Forests, Shelterbelts, and Green Infrastructure

The forest cover of the Republic of Moldova is below the European average, and the network of shelterbelts created during the Soviet period is, for the most part, degraded. The CCLU-Moldova package proposes:

- Afforestation of degraded land and land with very low agricultural productivity, through nationally supported programs backed by financial and technical assistance. Species selection should take into account adaptation to drought conditions and the preservation of local biodiversity.

- Rehabilitation and expansion of protective forest shelterbelts along agricultural fields, roads, and irrigation canals. Shelterbelts reduce wind speed, water losses through evapotranspiration, protect soils, and help stabilize yields.
- Establishment of forested and shrub buffer strips along rivers and streams (riparian zones), which stabilize banks, filter pollutants, reduce flood impacts, and provide corridors for wildlife.
- Development of green infrastructure in rural areas: tree alignments in villages, green spaces around schools and public institutions, hedgerows, and small parks and squares.

In this way, forests and linear vegetation become tools for climate adaptation while also improving quality of life and the rural landscape.

Measures for Water Resources

Water is the resource most strongly affected by climate change: prolonged droughts alternate with episodes of torrential rainfall, and available water reserves for irrigation and household use are under increasing pressure. The package of measures includes:

- Rehabilitation and modernization of existing irrigation systems, shifting to efficient technologies (drip irrigation, micro-sprinklers) and reducing losses in distribution networks.
- Creation or strengthening of Water User Associations for irrigation, so that infrastructure management becomes participatory, transparent, and tailored to local needs.
- Implementation of the "natural water retention" concept, by maintaining or restoring wetlands, floodplain grasslands, and forested strips in river floodplains, and by building local rainwater harvesting and storage basins.
- Rethinking water use at farm level: collecting water from rooftops, creating small ponds, applying smart irrigation based on soil-moisture monitoring, and reducing water use during critical periods.

These actions increase water availability during dry periods, reduce the risk of rapid flooding, and improve the flexibility and resilience of the agricultural system.

Measures for Biodiversity and Protected Areas

Effective climate adaptation is impossible without healthy ecosystems. Biodiversity provides "natural insurance" against climate shocks: more fertile soils, pollination, biological pest control, and landscape stabilization. CCLU-Moldova recommends:

- Expanding the network of protected areas in zones with high ecological and climate value (floodplain forests, steppes, natural grasslands, wetlands) and connecting them through ecological corridors.
- Establishing buffer zones around protected areas, where agricultural activities are compatible with resource conservation (e.g., agroecological practices, controlled grazing, limiting chemical inputs).
- Inventorying and protecting species and habitats sensitive to climate change, and incorporating adaptation measures into management plans (assisted migration, genetic diversification).

Taken together, these measures form an integrated package that directly links climate policies to how we use soils, water, forests, and biodiversity. They are designed to work synergistically: for example, shelterbelts and conservation agriculture reduce erosion and increase water infiltration, which in turn supports the adaptation of irrigation systems and the protection of water resources.

RECOMMENDATIONS AND ACTION PLANS

For public authorities

In recent years, the Republic of Moldova has made important steps toward strengthening its climate policy framework. The National Climate Change Adaptation Programme to 2030 (NCCAP 2030), approved in 2023, was submitted to the UN in 2024 as the National Adaptation Plan, outlining a vision for resilient infrastructure and strengthened adaptation capacities. At the same time, the Environmental Strategy 2024–2030 explicitly предусматривает integrating climate change into all environmental and sectoral policies, and NDC 3.0 (2025) includes an adaptation component that emphasizes agriculture, water, and land use.

In this context, the CCLU-Moldova project proposes a set of recommendations for central and local public authorities to translate these strategic documents into concrete, on-the-ground action mechanisms.

Strengthening the legal and institutional framework

From a legislative perspective, the main priorities are:

- harmonising environmental, water, soil, forestry, agriculture, and regional development legislation with the objectives of NCCAP 2030 and NDC 3.0;
- explicitly integrating climate risks into the new Land Code, the Soil Law, the Water Law, the Forest Code, and spatial planning regulations;
- including climate resilience criteria in urban planning and territorial planning documentation at all levels.

NCCAP 2030 highlights that Moldova already bears significant costs due to extreme climate events (droughts, floods) and that these costs will increase if adaptation remains fragmented. Therefore, it is necessary to clarify responsibilities among the Ministry of Environment, the Ministry of Agriculture and Food Industry, the Ministry of Infrastructure and Regional Development, the Ministry of Economy, and local public authorities, and to strengthen the National Office for the Implementation of Environmental Projects (ONIPM) as a technical unit for large-scale adaptation projects and ecosystem restoration.

At the local level, each district (raion) and municipality should appoint a climate–environment–land-use focal point to coordinate the development of local adaptation plans and to serve as a "contact point" for projects targeting afforestation, shelterbelts, efficient irrigation, and stormwater management.

Allocation of adequate budgetary resources

Without adequate resources, strategies remain merely declarative. The National Environment Fund (NEF) is the key financing instrument for environmental protection and adaptation projects, but EU assessments have indicated the need for reform to increase its efficiency, transparency, and capacity to support strategic projects. In 2024–2026, the NEF (successor to the National Ecological Fund) finances dozens of projects in areas such as waste management, water, and climate change, selected through competitive calls administered by the National Office for the Implementation of Environmental Projects (ONIPM).

The guide recommends that:

- the Government set each year a minimum "climate quota" in the state budget, explicitly earmarked for adaptation measures (especially in agriculture, water, forestry, and green infrastructure);
- the NEF and regional development funds include thematic axes dedicated to climate change adaptation and sustainable land use, and that CCLU-Moldova projects be prioritised under these axes;
- local public authorities introduce budget lines for co-financing adaptation projects (e.g., a 5–10% local contribution to projects financed by the NEF or external funds).

Policies to incentivise sustainable practices

The 2024–2030 Environmental Strategy highlights that agricultural resilience depends both on using resilient crop varieties and on adopting sustainable practices: conservation tillage, diversification, organic matter use, and integrated water management.

Authorities can introduce:

- tax exemptions or reductions for investments in efficient irrigation, farm-level renewable energy, rainwater harvesting systems, and low-emission technologies;
- support schemes to facilitate the transition to conservation agriculture (partial subsidies for machinery, grants for cover crops);
- support programmes for agro- and silvopastoral systems in areas with degraded land.

Targeted subsidies for climate adaptation

The new strategic framework for agriculture and rural development 2023–2030 (NSARD) places strong emphasis on climate change adaptation and technological modernisation. Subsidies administered by AIPA can become a major instrument for steering farms towards resilience if:

- subsidy schemes are reorganised into "climate packages" (e.g., a drought-resilience farm package: drip irrigation + cover crops + agricultural insurance);
- projects that include adaptation measures recommended in the CCLU-Moldova guide receive additional scoring and a higher subsidy intensity;

Investments in green infrastructure

NCCAP 2030 and the Environmental Strategy recognise green infrastructure and Nature-based Solutions (NbS)—forests, shelterbelts, ecological corridors, restored wetlands, and green spaces in settlements—as key pillars of adaptation. Authorities should treat investments in green infrastructure with the same level of seriousness as "grey" infrastructure.

Concrete recommendations:

- integrate protective forest strips, riparian shelterbelts, and constructed wetlands into road, irrigation, water supply, and wastewater projects;
- include, in the selection criteria for projects financed through the NEF and external funds, a mandatory "green component";
- prioritise afforestation and shelterbelt rehabilitation/expansion in areas exposed to severe erosion and drought risk, especially in the Southern Region.

Cross-sectoral cooperation

IMF and World Bank analyses show that Moldova is more vulnerable to the impacts of climate change than the European average, precisely because of its high dependence on agriculture, limited financial resources, and still-fragile infrastructure. This vulnerability cannot be reduced by a single ministry.

Recommended actions:

- establish an inter-ministerial council on "Climate and Land Use", coordinated by the Ministry of Environment, with participation from Agriculture, Infrastructure, Economy, Finance, and Public Administration;
- set up regional coordination committees (at the level of development regions) that bring together local public authorities (LPAs), agencies, farmers, and community representatives;
- develop standard procedures for designing complex projects (e.g., the rehabilitation of a river basin) through joint authorship among ministries, in order to avoid conflicts between sectoral objectives (roads vs. forests, irrigation vs. environmental flows, etc.).

Long-term planning

The "Moldova 2030" Strategy is the overarching framework that guides all sectoral and regional strategies, while NCCAP 2030 complements it with a climate vision. In the long term, however, Moldova is committing to alignment with the objective of climate neutrality by 2050, reflected in its NDCs and in new development plans.

Authorities should ensure:

- periodic updates (every 5–7 years) of sectoral and regional strategies, based on new climate scenarios;
- alignment of spatial/territorial planning documents with climate vulnerability maps (drought, floods, landslides);
- explicit integration of long-term (2050) objectives into infrastructure projects so that they are "future-proof" (compatible with projected climate conditions and with future EU standards).

Transparent monitoring and reporting

Moldova's First Biennial Transparency Report (BTR1), submitted in 2024, strengthens the database and indicators used to monitor climate action. The guide recommends that this effort be complemented by:

- common indicators across all relevant programmes (the National Environmental Fund, AIPA subsidies, regional development funds, and externally funded projects) covering adaptation and land use;
- a single public online platform where projects and results are visualized (maps showing reforested areas, land under conservation agriculture, efficient irrigation systems, and community-based adaptation projects);
- periodic independent audits of climate and environmental funds, with simplified public-facing reports to increase trust among citizens and external partners.

By implementing these recommendations, public authorities can turn existing strategic documents into a coherent system of policies, financing, and concrete on-the-ground actions, aligned with the objectives of the CCLU-Moldova project.

For farmers and landowners

Agriculture is one of the backbone sectors of Moldova's economy, and at the same time the sector most exposed to climate risks. Analyses by the World Bank and FAO show that repeated droughts, heatwaves, and torrential rains have significantly reduced agricultural output in recent years; for example, the

2020 drought caused an almost 30% decline in agricultural production, triggering knock-on effects across the economy. UN studies emphasize that small-scale farmers and rural women are among the groups most vulnerable to these shocks.

In this context, the CCLU-Moldova project's recommendations for farmers and landowners are structured around **eight major directions**.

1. Adopting Conservation Agriculture

Agricultura de conservare (AC) este deja promovată în Republica Conservation Agriculture (CA) is already being promoted in the Republic of Moldova through IFAD projects, rural resilience programs, and research, training, and capacity-building initiatives.

It is based on three principles:

1. minimal or zero soil disturbance (reduced tillage / no-till);
2. permanent soil cover with crop residues or cover crops;
3. diversified crop rotations that avoid monoculture.

For farmers, adopting CA means: lower fuel and labor costs; reduced soil compaction; improved water infiltration and storage; protection against erosion; increased organic matter content and natural fertility. Case studies analyzed within IFAD projects and other programs show that, after a transition period of 3–5 years, farms applying CA become more stable under drought conditions, with smaller year-to-year yield fluctuations.

The guide recommends that farmers:

- start gradually, on a portion of their land, in order to learn the technology without excessive risk;
- combine CA with regular soil testing and tailored fertilization plans;
- join networks of innovative farmers, participate in demonstration fields, and attend trainings organized by projects (IFAD, AGGRI, university and NGO programs).

2. Diversifying Crops and Income

Reliance on one or two main crops (for example maize and sunflower) increases both economic and climatic vulnerability. NSARD 2023–2030 and UN documents on SDG implementation emphasize the need to diversify agriculture by expanding legumes, perennial crops, orchards, modernized viticulture, high value-added crops, and short supply chains.

Diversification means not only more crops, but also more income streams:

- primary processing (drying, preserving, producing juices, cheeses, artisanal bakery products);

- providing services for other farmers (machinery services, storage, consultancy);
- rural tourism and agrotourism;
- farm-level renewable energy (rooftop photovoltaic panels, biogas from livestock waste).

These models are supported by World Bank projects (AGGRI), IFAD, and rural development programs aimed at modernizing agricultural services and increasing resilience.

3. Investing in Efficient Irrigation

Drought is the number one climate risk for Moldova's agriculture, and national strategies and drought plans recognize the essential role of irrigation in stabilizing yields. The World Bank's AGGRI project aims to improve agricultural services and resilience, including through the rehabilitation of irrigation systems, such as the works in Crocmaz and Căplani (51 km of new pipelines).

Farmers are advised to:

- choose high-efficiency irrigation systems (drip irrigation, micro-sprinklers) that reduce water use and allow fertilizers to be applied together with irrigation water (fertigation);
- install simple soil-moisture sensors and use agrometeorological forecasts to schedule irrigation;
- join Water User Associations (WUAs), benefiting from the legislative simplifications recently adopted by the Government to facilitate their establishment and operation.

In parallel, farmers can include in their plans investments in rainwater harvesting (tanks, small ponds) and on-farm water storage infrastructure.

4. Improving Soil Fertility

Soil is a farm's main "capital." Assessments of climate change impacts on agriculture in Moldova show that soil degradation (erosion, loss of organic matter, compaction) worsens the effects of drought and heatwaves.

Key recommendations include:

- systematic application of organic matter (well-composted manure, compost, shredded crop residues);
- crop rotations that include legumes (peas, beans, soybeans, clover, alfalfa) to enable biological nitrogen fixation;
- gradual reduction of intensive tillage that destroys soil structure and accelerates the mineralization of humus;

- introducing agroforestry elements (rows of trees/fruit trees in arable fields, hedgerows) to increase carbon stocks, reduce erosion, and diversify production.

Farmers can use soil testing laboratory services and expert guidance from projects (IFAD, AGGRI, extension services) to develop multi-year fertilization plans aligned with technological changes (CA, irrigation, diversification).

5. Joining Cooperatives

Small and medium-sized farmers face limited access to capital, technology, and markets. Rural development programs and international institutional reports emphasize the importance of cooperatives for creating economies of scale and increasing resilience.

The guide recommends:

- input and service cooperatives (joint purchases of seeds, fertilizers, equipment, machinery services);
- processing and marketing cooperatives (shared cold storage, local brands, joint exports);
- energy cooperatives (community-scale photovoltaic or biogas installations).

Cooperatives can also become "climate adaptation vehicles," implementing larger-scale shelterbelts, irrigation projects, composting centers, early warning systems, and supporting members in accessing financing programs.

6. Accessing Support Programs

Moldova has many support programs available: AIPA subsidies, ODIMM programs, IFAD projects (Rural Resilience Project, Inclusive Rural Economic and Climate Resilience Programme), World Bank projects (AGGRI), and grants from UN or EU funds.

Farmers are encouraged to:

- continuously monitor calls for grants and subsidies;
- develop simple but well-structured projects in collaboration with consultants, NGOs, or universities;
- smartly combine different sources—for example, an efficient irrigation project can be financed partly through AIPA subsidies, partly through a preferential green loan, and partly through the farmer's own contribution;
- take part in courses and information sessions on "how to write a project" and "how to manage a project," to reduce dependence on intermediaries.

7. Certification and Access to Markets

As Moldova advances on the path to European integration, quality, traceability, and sustainability standards are becoming increasingly important. Organic products, those with geographical indications, or those certified under good agricultural practice schemes can access market segments with higher prices.

National strategies and international projects encourage a transition toward environmentally friendly practices, which are essentially also adaptation measures: reducing pesticide use, increasing organic matter, diversifying crops, and using water efficiently. Farmers who implement these practices may have a clear advantage in the certification process.

The recommendation is that farmers should:

- assess which certification scheme best fits their profile (organic, GlobalG.A.P., national schemes);
- include certification costs in their investment plans and grant applications;
- work in groups or cooperatives to share both the costs and the benefits of certification.

8. Long-Term Farm-Level Planning

Finally, farmers are encouraged to view their farm from a minimum 10-year perspective, taking into account climate change and evolving markets.
A "farm-level adaptation plan" may include:

- risk analysis (drought, frost, torrential rains, price drops);
- a phased transition to conservation agriculture;
- priority investments in irrigation, water infrastructure, and energy;
- diversification of crops and income streams;
- use of insurance and green loans;
- alternative scenarios (what to do if a severe drought like in 2020 occurs again; what to do if input prices suddenly rise).

This type of plan can be used as an annex in subsidy applications, in discussions with banks, or in negotiations within cooperatives. In this way, farmers shift from ad-hoc reactions to strategic adaptation, aligned with the NCCAP 2030 vision and the recommendations of the CCLU-Moldova project.

For Local Communities

Climate change affects not only economic "macro-systems," but also people's everyday lives in villages and towns: less water or poorer water quality,

failed harvests, degraded pastures, overheating in settlements, and latent conflicts over resources. Documents such as the National Climate Change Adaptation Programme up to 2030 (NCCAP 2030) and the Environment Strategy 2024–2030 recognize the role of local communities in implementing adaptation "on the ground" and call for the involvement of local authorities, civil society, and citizens in concrete measures. The CCLU-Moldova project helps operationalize these orientations by offering communities a set of clear directions for action.

Community Afforestation Initiatives

In 2023, the Republic of Moldova launched the National Programme for Forest Expansion and Rehabilitation 2023–2032, aiming to establish and rehabilitate forests on about 145,000 hectares, including through annual planting campaigns with community participation. In 2024, the national afforestation campaign targeted the planting of over 26 million seedlings on 4,000 hectares in approximately 160 localities, with local public authorities (LPAs), schools, NGOs, and volunteers directly involved.

Beyond the figures, these campaigns are a strategic resource for adaptation: forests reduce erosion, stabilize slopes, increase water infiltration, protect against wind, and help lower extreme temperatures. The CCLU-Moldova project recommends that every rural locality develop a 5–10 year mini-plan for community afforestation aligned with the national programme: identifying degraded or unused land, setting priorities (protective shelterbelts, riparian strips, plantations on gullies), mobilizing volunteers, and integrating activities into community celebrations ("Forest Day," "Green Week," etc.).

Shared Management of Pastures

Many communities own communal pastures or traditionally used grazing lands. Studies on climate-change vulnerability in agriculture indicate that extensive livestock farming and degraded pastures are highly exposed to drought and temperature variability, and that non-adaptive practices can worsen soil degradation.

Shared pasture management, with clear locally negotiated rules, can become a pillar of adaptation:

- setting stocking-rate standards (number of animals per hectare) according to the real carrying capacity of pastures;
- rotational grazing and rest periods to allow vegetation cover to recover;
- introducing drought-adapted perennial species;
- planting isolated trees or small alignments to provide shade and reduce evapotranspiration;

- creating community funds to maintain infrastructure (watering wells, access roads, living fences/hedgerows).

Pilot experiences (including the Clima East project on sustainable management of community forests and pastures in Orhei National Park) show that direct community involvement—through pasture-user associations or village councils—leads to more prudent resource use and reduces conflicts.

Rainwater Harvesting Projects

Climate scenarios for Moldova indicate a trend toward increasing aridity, with more frequent droughts and episodes of torrential rainfall that run off quickly without replenishing water reserves. A simple and effective local-scale response is to develop projects for capturing and storing rainwater.

One example is the rainwater retention basin inaugurated in Antoneşti village, Cantemir district, with UNDP support, designed as a measure to help the rural community adapt to climate change. Such solutions can be replicated on a larger scale: retention basins upstream of villages, systems for collecting water from the roofs of schools, warehouses, or barns, and small ponds for irrigating community gardens.

The CCLU-Moldova project recommends that each locality vulnerable to drought identify at least one priority "rainwater harvesting" project (basin, pond, ditch-and-swale system, and micro-dams) that can be financed through the National Environment Fund or external grants, with in-kind community contributions (voluntary labor, locally available materials).

Green Spaces and Community Gardens

In urban and peri-urban areas, communities can directly help reduce the urban heat island effect and improve quality of life by creating green spaces and community gardens. UNDP's "Moldova Sustainable Green Cities" project has shown that investments in sustainable mobility, green spaces, and low-emission solutions can significantly improve urban comfort. Recent initiatives—such as a climate shelter for children at a kindergarten in Chişinău, designed as a "climate shelter" to reduce the heat island effect—illustrate how small but well-designed infrastructure can combine education and climate protection.

At neighborhood or village level, community gardens (on municipal land, near schools, or places of worship) can provide: local production of vegetables and fruit, learning spaces for children, venues for intergenerational social interaction, and a micro-laboratory for agroecological practices. Such projects can be supported through small local grants or by integrating them into larger urban and rural regeneration initiatives.

Local Education and Awareness

A UNDP report on climate change and vulnerable groups in the Republic of Moldova emphasizes that informing and engaging the population is essential for adaptation—especially in low-income communities, where climate shocks can intensify poverty and migration. Formal educational programs (in schools) and non-formal ones (youth clubs, NGOs, libraries, parishes) can incorporate topics such as: saving water, preventing vegetation fires, sorting waste, the role of forests and shelterbelts, and sustainable agriculture.

Inspiring examples come from the Cahul and Ungheni regions, where young people have developed projects to create green spaces, promote organic agriculture, and support recycling, with international partners' assistance. The guide recommends that every community have at least one "green club" or civic initiative dedicated to adaptation, including practical activities (planting, clean-up actions, environmental monitoring) and communication components (social media campaigns, public events).

Public–Private–Community Partnerships

Experience from green cities projects, agri-food clusters, and infrastructure investments shows that the most robust projects are those in which the municipality, the local private sector (businesses, cooperatives, small enterprises), and the community (NGOs, initiative groups, local public institutions) work together.

Applied to climate adaptation, a public–private–community partnership can look like this:

- **The municipality** provides the land, facilitates permits, and co-finances the project.
- **Private investors** contribute financial resources, materials, or know-how (for example, an agricultural company sponsoring a shelterbelt or an irrigation system for a community garden).
- **The community** contributes volunteer labor, oversight, and innovative ideas.

This model can be used for afforestation projects, rehabilitation of green spaces, creation of ecological corridors, rainwater harvesting basins, community composting centers, and more.

Leveraging Local Resources

Many communities have underused local resources: attractive landscapes, culinary traditions, local varieties, crafts, and ecotourism/agritourism potential. By combining adaptation measures (forest conservation, pasture management, water protection) with the valorization of

these resources, communities can develop "green" economic models that reduce environmental pressure and provide alternative income sources.

Examples include local brands of "clean" agri-food products (honey, dried fruit, cheeses, wines), thematic tourism routes focused on nature and heritage, and festivals dedicated to natural resources (celebrations of water, forests, or plums). Supported through clusters and regional development programs, such initiatives strengthen both the local economy and the community's motivation to protect natural resources.

Resilience and Social Cohesion

The National Disaster Risk Reduction Strategy 2024–2030 emphasizes that resilience is not only a technical issue but also a social one: communities with strong networks of solidarity, trust, and civic participation are better able to cope with climate shocks and disasters. The measures described above—afforestation, shared pasture management, community gardens, rainwater harvesting—are not only "green" interventions, but also opportunities for people to work together, make collective decisions, and strengthen intergenerational ties.

The CCLU-Moldova project recommends that each locality integrate the social dimension into local adaptation plans: identifying vulnerable groups (elderly people living alone, low-income families, persons with disabilities), including them in volunteering activities, and prioritizing infrastructure that protects them (climate shelters, access to water, shaded public spaces). In this way, climate adaptation becomes part of a broader project of cohesion and community development.

Financing and Implementation

Climate change adaptation and the transition toward sustainable land use in the Republic of Moldova cannot be achieved only through policies and plans—they require consistent, long-term, well-coordinated investments. The World Bank report "Country Climate and Development Report: Moldova" highlights that climate vulnerability is closely linked to the country's dependence on agriculture, insufficient infrastructure, and limited financial resources, which calls for a massive mobilization of both domestic and external funding. NCCAP 2030 and its Action Plan detail, for each measure, the estimated costs, financing sources (national budget, external funds, blended finance), and responsible institutions. Building on this, the CCLU-Moldova project proposes an integrated framework for financing and implementation.

National financing sources

The central instrument is the National Environmental Fund (FNM)—the successor to the Ecological Fund—which allocates resources for environmental protection and climate projects. EU4Environment assessments have shown that the FNM is crucial, but needs reform to increase its transparency, resources, and impact. Currently, the FNM is operationally managed by the National Office for the Implementation of Environmental Projects (ONIPM), which organizes calls for proposals and selects initiatives for multiannual periods (for example, the list of projects funded for 2024–2026).

The guide recommends:

- strengthening the FNM by broadening its revenue base (environmental taxes, contributions from the exploitation of natural resources, and potentially revenues from future carbon schemes);
- introducing a thematic axis dedicated to climate change adaptation and sustainable land use, under which projects on afforestation, shelterbelts, efficient irrigation, rainwater harvesting, and agroecology can be funded;
- allocating a minimum "climate quota" from the state budget (e.g., 1–2% of total expenditures) for adaptation measures, including co-financing of external projects.

In addition to the FNM, important resources can come from:

- the budgets of line ministries (Environment, Agriculture, Infrastructure, Economy), which should include dedicated budget lines for adaptation;
- regional development funds;
- AIPA subsidies for investments in climate-resilient agriculture (irrigation, conservation agriculture, orchards and perennial plantations, water infrastructure).

International funds and grants

The Republic of Moldova already benefits from substantial support from external partners for climate and the environment. The National Adaptation Programme (NCCAP 2030) was developed with support from the NAP-2 project, financed by the Green Climate Fund (GCF) and implemented by UNDP, with the goal of strengthening human and financial capacities for adaptation. The GCF and UNDP also support institutional capacity-building for climate action, including the development of reporting and planning systems.

Other key donors and financial institutions include:

- The World Bank—through projects such as AGGRI (Agriculture Governance, Growth and Resilience Investment), which supports

agricultural services and irrigation infrastructure, and through the CCDR report, which provides a strategic investment framework.

- IFAD—through rural resilience and economic inclusion programmes focused on small farmers, rural infrastructure, and adaptation.
- The European Union—through budget support programmes, regional development projects, and investments in green cities and sustainable infrastructure.
- EBRD and EIB—through green infrastructure projects and Green City Action Plans (GCAP Chişinău), as well as financing programmes for green and smart infrastructure.

The CCLU-Moldova project recommends:

- creating a "national portfolio of land-use adaptation projects," structured into packages (afforestation, shelterbelts, efficient irrigation, pasture management, riparian zones), ready to be presented to donors;
- aligning external funding requests with the priorities of NCCAP 2030 and the Environmental Strategy, to avoid fragmentation;
- developing a publicly accessible "climate finance map" that shows existing projects, funding sources, and gaps.

Co-financing mechanisms

The NCCAP 2030 Action Plan details, for each action, both estimated costs and how these are split between budgetary and external sources, emphasizing the need for co-financing. For large projects (e.g., river-basin rehabilitation, regional afforestation schemes, irrigation systems), it is realistic to combine:

- the state budget (including the FNM) to finance components of broad public interest;
- external funds (GCF, EU, development banks) for major investments;
- local contributions (local public authorities, beneficiaries, cooperatives) in cash or in kind.

At the local level, a simple "80/20" rule (80% external + national financing, 20% local contribution) can increase accountability among communities and farmers without blocking projects. For small community initiatives (gardens, rainwater basins, mini shelterbelts), micro-grants can be used with co-financing through volunteer labor or local materials.

Innovative financial instruments

An important step is the "Roadmap for Sustainable Finance 2024–2028" approved by the National Bank of Moldova, which aims to align the financial system with the principles of sustainable development and the EU taxonomy for green activities. The document includes actions to green public investment, support SMEs and farmers, and integrate climate risks into financial decision-making.

In the medium term, this framework can support:

- the development of green loans for adaptation investments (efficient irrigation, conservation agriculture, on-farm renewable energy, energy-efficient buildings);
- potential green bonds issued by the state or municipalities for afforestation, urban green infrastructure, or water projects;
- "payments for ecosystem services" (PES) instruments, through which farmers and communities that maintain forests, shelterbelts, or wetlands are rewarded for the benefits they provide to society.

Blended-finance mechanisms can also be explored, where donor grants reduce risk for commercial loans, improving access to credit for farmers and local authorities for climate projects.

Green credit and agricultural insurance

Because agriculture is highly exposed to drought and other climate risks, access to tailored credit and agricultural insurance becomes crucial. The World Bank's report on agriculture's vulnerability to climate change and recent studies on vulnerable groups show that the lack of such instruments amplifies losses and rural poverty.

Recommendations:

- developing green credit lines, with advantageous interest rates and conditions, for investments in adaptation technologies (drip irrigation, efficient greenhouses, water-harvesting systems, machinery for conservation agriculture, modern storage);
- improving the affordability of agricultural insurance through premium co-payment schemes (a part subsidized by the state or projects, a part paid by farmers);
- promoting weather-index insurance products (based on rainfall, temperature), which can be simpler and faster to pay out than traditional insurance.

Integrating green credit and insurance into subsidy packages (e.g., a "climate-smart farm" package) can create a financial ecosystem that supports adaptation.

Public–private partnership

For large-scale projects (regional irrigation systems, urban green infrastructure, green industrial parks), public–private partnerships (PPPs) are essential. Development strategies and EBRD/EIB projects for Chişinău already show models in which investments in sustainable mobility, energy efficiency, and green infrastructure can be co-financed by the private sector.

Applied to CCLU-Moldova, PPPs can support:

- the development of irrigation and drinking-water infrastructure, with investment recovery through tariffs;
- photovoltaic parks on public land, with benefits shared between authorities and investors;
- riverbank rehabilitation with recreation and tourism components, where private investors manage certain facilities while the state ensures environmental protection.

It is important that PPP rules include clear environment and climate criteria (green taxonomy, resilience standards) and mechanisms to protect the public interest and vulnerable group.

Implementation timelines

The NCCAP 2030 Action Plan already provides a time framework, with actions scheduled for 2023–2030, responsible institutions, and potential funding sources. The CCLU-Moldova guide proposes structuring the implementation of sustainable land-use and adaptation measures across three horizons:

- **short term (1–3 years):** low-cost measures with rapid impact— afforestation and shelterbelt campaigns, community rainwater projects, farmer trainings, piloting conservation agriculture;
- **medium term (4–7 years):** scaling up efficient irrigation systems, restoring pastures, creating ecological corridors, developing networks of community gardens and urban green spaces, strengthening the National Environmental Fund and the sustainable finance system;
- **long term (to 2030 and beyond):** full implementation of the National Afforestation Program, transforming critical infrastructure (roads, water, energy) into climate-resilient infrastructure, fully integrating green criteria into public and private financing.

For each category of measures, clear targets must be set (hectares afforested, km of shelterbelts, number of communities with rainwater basins, area under conservation agriculture, etc.) along with precise responsibilities.

Continuous evaluation and adjustment

Finally, financing and implementation are not static processes. The Environmental Strategy 2024–2030, the Disaster Risk Reduction Strategy, and reporting to the UNFCCC (including the first Biennial Transparency Report and new NDCs) provide mechanisms for monitoring, reporting, and evaluation.

The guide recommends:

- defining a set of common indicators for all relevant programs (FNM, AIPA, regional funds, external projects) regarding adaptation and land use;
- annual public reporting of progress (including in an accessible format, with maps and infographics);
- independent evaluations every 3–5 years, analyzing funding efficiency, real impact on climate vulnerability, and any unintended effects;
- periodic adjustment of funding priorities, based on lessons learned, new climate data, and economic dynamics.

In this way, financing and implementation become an adaptive process—aligned with the very logic of climate change—and enable CCLU-Moldova to contribute sustainably to transforming how the Republic of Moldova uses its land, protects its resources, and builds resilience.

SPECIALIZED TERMS

Climate terms

Climate change – long-term changes in climate parameters (temperature, precipitation, frequency of extreme events), mainly caused by increasing concentrations of greenhouse gases. In the Republic of Moldova, this already translates into hotter summers, more frequent droughts, more intense torrential rains, and shorter winters.

Climate variability – natural fluctuations of the climate over periods from a few years to a few decades. For example, the alternation of years with severe drought and relatively wet years. Variability overlaps with the long-term warming trend.

Climate change adaptation – the adjustment of natural, social, and economic systems (farm, community, agricultural sector, infrastructure) to current or expected climate conditions in order to reduce damage and take advantage of potential opportunities. In Moldova, agricultural adaptation includes efficient irrigation, conservation agriculture, crop diversification, and the protection of soil and water resources.

Mitigation – actions aimed at reducing greenhouse gas emissions (e.g., CO_2, CH_4) or increasing their absorption capacity (through forests, fertile soils). Afforestation, soil humus management, and the use of renewable energy are examples of measures with mitigation co-benefits.

Climate vulnerability – the degree to which a system is exposed to a climate hazard, sensitive to its impacts, and has a limited capacity to adapt. A rural community highly dependent on rainfed agriculture, with weak infrastructure and limited financial resources, is considered highly vulnerable.

Climate resilience – the ability of a system (farm, community, sector) to anticipate, absorb, withstand, and recover from the impacts of a climate event (drought, flood, heatwave), while adapting to future conditions.

Climate hazard – a potentially harmful climate phenomenon, such as drought, torrential rains, floods, late frosts, or heatwaves. A hazard becomes a disaster when it coincides with high vulnerability.

Climate risk – the combination of hazard, exposure, and vulnerability. Risk is high where extreme climate events intersect with communities and sectors that are highly sensitive and poorly prepared (e.g., fields not protected against erosion).

Exposure – the presence of people, infrastructure, crops, or ecosystems in areas where they may be affected by climate phenomena (e.g., villages located in floodplains, cultivated land on steep slopes).

Sensitivity – the extent to which a system is affected by a climate change. For example, maize crops are highly sensitive to water deficit during flowering, while certain perennial crops are more resistant.

Adaptive capacity – the ability of a system to adjust to climate change, reduce potential damage, and take advantage of opportunities. It depends on financial resources, knowledge, infrastructure, legislation, and social cohesion.

Extreme climate event – a rare and intense climate phenomenon (in terms of magnitude or duration), such as a multi-year severe drought, a heatwave with temperatures above 38–40 °C, or a torrential rain that brings in one day the average rainfall of an entire month.

Meteorological drought – a prolonged period with precipitation below the multi-year average.

Agricultural drought – a situation in which soil moisture is insufficient to meet plants' water needs, even if total precipitation is not extremely low. It is frequent on degraded or poorly structured soils.

Hydrological drought – a significant decrease in river flows and in groundwater and surface-water levels, affecting water supply and energy generation.

Heatwave – a period of at least several consecutive days with temperatures far above the seasonal average, affecting human health, animals, crops, and infrastructure. In areas with little vegetation, the effect is amplified (urban heat island).

Flash flood (pluvial flood) – a rapid flood caused by intense torrential rainfall, usually in small catchments or in urban areas with many impermeable surfaces.

Climate scenario – a projection of future climate evolution based on assumptions about emissions, economic growth, and environmental policies. Scenarios help plan adaptation measures for periods such as 2030, 2050, or 2100.

Climate neutrality (net-zero) – a state in which net greenhouse gas emissions are zero, meaning that remaining emissions are fully offset by removals (forests, soils, capture-and-storage technologies).

Climate services – information and products (maps, forecasts, warnings) provided by specialized institutions (e.g., the State Hydrometeorological Service) to support informed decisions in agriculture, water, energy, health, and other sectors.

Agricultural terms

Conservation agriculture – a system of farming practices based on minimal or no soil disturbance, permanent soil cover, and diversified crop rotations, aimed at reducing erosion, conserving water, and improving soil fertility. It is promoted as an adaptation measure in many programs in the Republic of Moldova.

Climate-smart agriculture (CSA) – an integrated approach that simultaneously aims to: increase productivity, adapt to climate change, and reduce greenhouse gas emissions. It includes practices such as conservation agriculture, crop diversification, efficient irrigation, and integrated pest management.

Monoculture – repeatedly growing the same crop on the same plot of land. It can increase vulnerability to pests, diseases, drought, and price fluctuations, and is discouraged within climate adaptation approaches.

Crop rotation (asolament) – the planned sequence of crops grown on a given area over a certain period (e.g., 4–6 years) to maintain fertility, limit weeds and diseases, and reduce climate-related risks.

Cover crop – a crop sown to protect the soil between two main crops (e.g., a mix of legumes and grasses), often not harvested and left on the soil as mulch.

Agroforestry – the deliberate integration of trees with crops and/or livestock on the same land area to achieve multiple benefits (better soil moisture, wind protection, diversified incomes, carbon sequestration).

Soil erosion – the process of losing the fertile topsoil layer due to water or wind action. It is one of the most serious problems in the Republic of Moldova, especially on slopes cultivated without protection measures.

Mulching – covering the soil with organic materials (straw, plant residues) or synthetic materials to reduce evaporation, suppress weeds, and protect the soil from the direct impact of raindrops.

Drip irrigation – an irrigation system that delivers water directly to the plant root zone through emitters, reducing evaporation losses and allowing precise dosing of water and nutrients.

Yield (production per hectare) – the amount of product obtained per unit area. In a climate context, the focus is not only on maximum yield in a single year, but also on yield stability under variable conditions.

Forestry and ecological terms

Forest – an ecosystem dominated by trees, with specific structures and functions (biomass production, habitat provision, soil and water protection,

carbon storage). In the Republic of Moldova, forest cover is below the European average, which justifies forest expansion programs.

Forest fund (stock) – the total area of lands with forest vegetation and lands designated for afforestation, regardless of ownership form, as defined by the Forest Code.

Shelterbelt (forest belt / forest windbreak) – a linear strip of trees and shrubs created for protection (against wind, erosion, and drifting sands), placed along fields, roads, irrigation canals, or riverbanks.

Natural regeneration – forest recovery through seeds or sprouts originating from existing trees, without manual planting. It is preferred where feasible because it preserves local genetic composition.

Artificial regeneration – forest restoration through planting seedlings produced in nurseries. It is commonly used on degraded lands, farmland taken out of production, or for establishing new shelterbelts.

Biodiversity – the variety of life forms (plant, animal, and microorganism species) and ecosystems. Forests and wetlands with high biodiversity are generally more resilient to climate change.

Ecosystem – a dynamic complex of communities of plants, animals, and microorganisms and their physical environment, interacting as a functional unit (e.g., forest, river, grassland).

Ecosystem services – the benefits people obtain from ecosystems: drinking water, fertile soil, pollination, timber, flood protection, recreation. In the CCLU-Moldova project, soil and water protection services are especially important.

Ecological corridor – a linear area (e.g., a forest strip or a river valley) that connects natural habitats and enables species movement, reducing population isolation and climate vulnerability.

Buffer zone – a transition area around a protected area or sensitive ecosystem where human activities are regulated to reduce pressure on the core natural area.

Riparian zone – the strip of land along water bodies (river, stream, lake), typically with specific vegetation (trees, shrubs, reeds) that stabilizes banks, filters pollutants, and provides habitat.

Technical and scientific terms

River basin (drainage basin / watershed) – the area of land from which all surface water drains into the same river or lake. Climate adaptation planning is increasingly carried out at the basin level (e.g., the Prut and Dniester/Nistru basins).

Spatial modeling – the use of geographic data and GIS tools to simulate processes (erosion, runoff, precipitation patterns) and to assess land-use scenarios.

GIS (Geographic Information System) – a set of software, data, and methods for collecting, storing, analyzing, and visualizing geospatial data. In CCLU-Moldova, GIS is a core tool for vulnerability mapping and planning measures.

Remote sensing – collecting information about Earth's surface using sensors from a distance (satellite, aircraft, drone). It is used to monitor crops, soil moisture, and forested areas.

Indicator – a measurable variable used to assess progress (e.g., hectares afforested, kilometers of shelterbelts, number of farms applying conservation agriculture).

Baseline – the initial reference situation against which later changes are compared (before a project or policy is implemented).

Impact assessment – a systematic analysis of a project's or program's potential effects (on environment, climate, economy, society) before the implementation decision is made.

MRV (Monitoring, Reporting, Verification) – an integrated system for monitoring, reporting, and verifying climate actions and their results. It is important for international reporting and for transparency in the use of climate/environment funds.

Abbreviations used

CCLU-Moldova – Climate Change and Land-Use in Moldova (the project title on which this guide is based).

NCCAP / PNASC – National Climate Change Adaptation Programme / National Programme for Climate Change Adaptation.

NDC – Nationally Determined Contribution (under the Paris Agreement).

UNFCCC – United Nations Framework Convention on Climate Change.

IPCC – Intergovernmental Panel on Climate Change.

IPAPS "Nicolae Dimo" – Institute of Pedology, Agrochemistry and Soil Protection "Nicolae Dimo".

INCAAMV – National Institute for Applied Research in Agriculture and Veterinary Medicine.

FNM – National Environment Fund.

AIPA – Agency for Intervention and Payments in Agriculture.

APL – Local Public Authorities.

MAIA – Ministry of Agriculture and Food Industry.

MM – Ministry of Environment.

ONIPM – National Office for the Implementation of Environment Projects.

BM – World Bank.

IFAD – International Fund for Agricultural Development.

GCF – Green Climate Fund.

GEF – Global Environment Facility.

PNUD / UNDP – United Nations Development Programme.

UE – European Union.

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