AREA BASED RISK ASSESSMENT
ANENII NOI RAION
MOLDOVA

September 2023

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STRIVE Consortium: Enhancing the preparedness in Anenii Noi Raion to reduce both natural and man-made risks

The STRIVE Consortium, composed of international NGOs Acted, REACH (an initiative of Acted and IMPACT) and Libraries Without Borders (BSF) launches a two-year project aiming to strengthen the preparedness and resilience of communities in the Anenii Noi Raion against such risks as heat waves, drought, soil erosion, air pollition, other environmental and economic stressors, influx of refugees, etc. The project is funded by Agence Française de Développement (AFD), and cofunded by USAID.

The ABRA aims to identify the potential for disasters, exposed population and their vulnerabilities to disasters, and estimate impact, so protective measures can be taken to reduce damage and harm to the population and environment. Natural, industrial, and environmental hazards pose a significant risk to the life and health of the local population, and to the resilience and supply of essential service delivery systems.

This report follows standards set by the Sendai Framework for Disaster Risk Reduction 2015-2030, an international framework for disaster risk reduction which outlines seven global targets to be achieved over this 15-year period, a well as the Hyogo Framework for Action 2005.

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1.1 KEY FINDINGS

Natural Hazards

Flooding in Telița following protective dam collapse, 28.06.2020.
Radio Chișinău.

Wildfires in barley and wheat fields near Calfa, 10.07.2023
AgroTV Moldova.

Soil and sand degradation in Anenii Noi, 13.05.2022.
NewsMaker.

Eleven natural hazards and four physical and social resources were evaluated in this ABRA, along with a case study of a unit of critical infrastructure. These hazards were condensed and normalized to compare relative exposure within the raion.

Across the landscape, the **Bâc and Dniester Rivers both mitigated and aggravated natural hazards**. They create barriers to fire, reduce ranges of air temperature, lower rates of soil erosion, and lower levels of detected air pollutants. However, the rivers are a major driver for floods, and can be highly sensitive to climate change. As the Bâc River may have lower, or even dry, water levels in warm weather, its impact on the ecology and weather of Anenii Noi Raion is extremely important.

The **quality of the water in these two rives impacts the whole of Anenii Noi Raion**: not only are these rivers are also used for irrigation, but also for domestic and livestock water supply.

Their infrastructure, such as protective dams, is aging, and poses a threat to communities in the river basin for flash floods, such as the flood in Teliţa in 2020 that followed a protective dam collapse.

Average monthly temperatures have seen an increase, and monthly precipitation has increased in cooler months, but decreased in warmer months. This may have an effect on agricultural planning as well as natural life cycles of flora and fauna. Natural protected areas, such as Pădurea Hîrbovăț, which have a significant cooling effect on air temperatures, can see deterioration in the diversity and overall health of its ecosystem.

Moldova has been experiencing severe drought since 2021, and drying of these landscapes can also increase the risk of fires, which can occur in high intensities, particularly in the eastern parts of the raion, and can result in ecologically- and environmentally-damaging fires, such as the intense fire in 2023 that burned through barley and wheat fields.

Climate change may exacerbate a number of these eleven hazards: expected average temperature rise and increased intense heat or cold may precede an increase in precipitation or a change in its patterns, which in turn can affect the quality and health of soil.

Anenii Noi Raion relies on chernozem-type soils (luvic, calcic, and haplic) for agriculture, and if these soils are to become drier, the soil quality and health may deteriorate. This may lead to lowered crop yields or crops that are in poorer health, and the economic landscape of available food products is altered, potentially increasing costs both to producers and consumers.

Anthropogenic Hazards

Road damage in Puhăceni, 12.01.2021
Stiri.md

Ţînţăreni landfill, 04.07.2017.
Agora.md

Underground power cables under repair, 09.09.2020
ÎCS "Premier Energy Distribution" JSC.

While there are multiple laws and regulations addressing land use and land alteration, oversight may be lacking, particularly in rural or low-income areas, where communities may not have multiple choices available to them for sustainable land management.

Overall, **rural communities are more exposed to natural hazards and have higher rates of social and economic vulnerability**, lessening their capacity to prepare and respond to hazardous events.

Rural communities have fewer roads leading to them, and less oversight in their maintenance. This can result in greater degrees of isolation, such as longer response times from emergency services (e.g.: fire brigades or ambulances), and potential blockage of escape routes in the event of a natural disaster.

Rural communities also may have a higher potential of severance from power networks. **Weather events, such as storms, wind, cold waves, and heat waves can lead to disruption of utility networks**, and the social and geographic isolation of communities can lead to longer response times. Without access to power, heat, or water, the coping capacity of the population is significantly reduced, and they are at a higher risk of susceptibility.

Urban areas such as Chișinău send their solid and household waste to Anenii Noi Raion: the Ţînţăreni landfill accepts solid waste from surrounding areas, though nearby residents complain of the smell and are concerned about its impact on the soil and water. Solid waste management is an important public service, though it benefits urban areas more than rural, as **some rural areas do not have access to waste collection services**.

Costs of living have overall increased, and energy consumption is in flux: as of November 2022, Moldova no longer purchases natural gas from Russia, which has seen an increase in cost and changes in availability of energy in the winter of 2022 and the spring of 2023.

As many rural communities across Moldova are seeing a reduction in population, their social vulnerability profiles may change: younger people are moving to more urban areas, as they often have difficulty finding employment, and rural communities are seeing an increase in the average age of residents.

Social changes such as youth relocation and the current conflict in Ukraine can result in a more vulnerable community: more residents who are unemployed or underemployed, are over 60 years of age, are refugees, or who are single parents. These are vulnerable demographics of society, and may have difficulty adapting their lifestyles and safety plans, due to limited financial flexibility and potential physical limitations.

1.2 INTRODUCTION

Background

The Republic of Moldova is a constitutional republic in Eastern Europe, with a population of 2.5 million and an area of 34,000 km[2]. It has with a unicameral parliamentary system of government, and is divided into 32 districts (referred to as *raions*), three municipalities, and two autonomous regions. It is bordered by Ukraine to the east and Romania to the west.

The climate is moderately continental: Dfb in the center, Cfb in the north and south[1], with an average of 300 days of sunshine per year, and warm summers. Moldova is heavily dependent on agriculture: nearly 74% of its territory is agricultural land[2]. Agriculture makes up 21% of formal employment and 60% of informal employment[3]. The rural population strongly relies on agriculture: 70% identify it as the primary source of their livelihoods, and nearly 99% of agricultural producers are "smallholders"[3]. These smallholder and family farms generate over 62% of the total volume of agricultural produce[3].

The agricultural sector represents 12% of the gross domestic product (GDP) and 45% of total exports in 2021[2, 3].

Moldova is the 21st-largest wine exporter in the world, with wine being the country's fifth-largest export, representing 3% of Moldova's GDP[4].

Agriculture is one of the most-affected sectors of climate change, along with health[5]. Impacts on agriculture can lead to issues with food security, sanitation, development of diseases, increased costs of living, and stress on energy sectors.

Since 2021, Moldova has been experiencing an ongoing drought, which is one of the most severe in the last five years[6]. Droughts can increase the risk of wildfires, as well as potentially increase the severity of flooding. The irregular nature of these events can complicate planning and response.

Moldova has also experienced the highest rate of consumer price inflation in Europe, reaching a record high of 34.62% in October 2022[3]. Energy has been particularly affected by increases in price, partially due to the war in Ukraine: gas (531%), electricity (75%), and fuel (42%), compared with 2021[3].

There has been a significant increase in the population, also related to the 2022 invasion of Ukraine, with over 100,000 refugees staying on the territory[7].

The increased cost of living and changing economy in regards to import and export availability has had an effect on multiple sectors and impacts the everyday choices of residents of the country.

This Area Based Risk Assessment (ABRA) aims to analyse the spatial distribution and severity of the multiple hazards that settlements are exposed to, both natural and anthropogenic, and the risks of these hazards in Anenii Noi Raion in Moldova.

Overview of Assessed Area

Anenii Noi Raion is on the South Moldavian Plain in the center of Moldova, and bordered by Chișinău on the northwest, Criuleni to the north, the Transnistrian region to the east, Căușeni to the south, and Ialoveni to the west. The raion measures 892 km[2]. It has a minimum elevation of 12m along the Bâc River and a maximum elevation of 184m in the southwest, near Geamăna.

As of 2014, the population was 78,996, of which 10% (8,100) were urban and 90% (70,896) were rural[8]. Census data is collected every 10 years, with the next census scheduled for 2024. The raion is home to 36 public libraries, three houses of arts and culture, and a sports club and sports school, as well as recreational tourism areas and protected forest.

Anenii Noi district has 26 communes and 45 localities: 1 town, 11 communes and 33 villages, collectively referred to in this report as "communities"[9]. The largest community is Anenii Noi City, with 10,872 people. It is considered the only "urban" area in the raion.

The most important rivers in the region are the Dniester (68 km in the raion); and Bâc (42 km in the raion). Anenii Noi has 57 artificial aquatic objects with a a total area of 10km[2] and 155 anthropogenic objects with a total area of 28km[2] [10]. The raion is crossed by several dozen smaller rivers and streams, some of which dry up in the warm months.

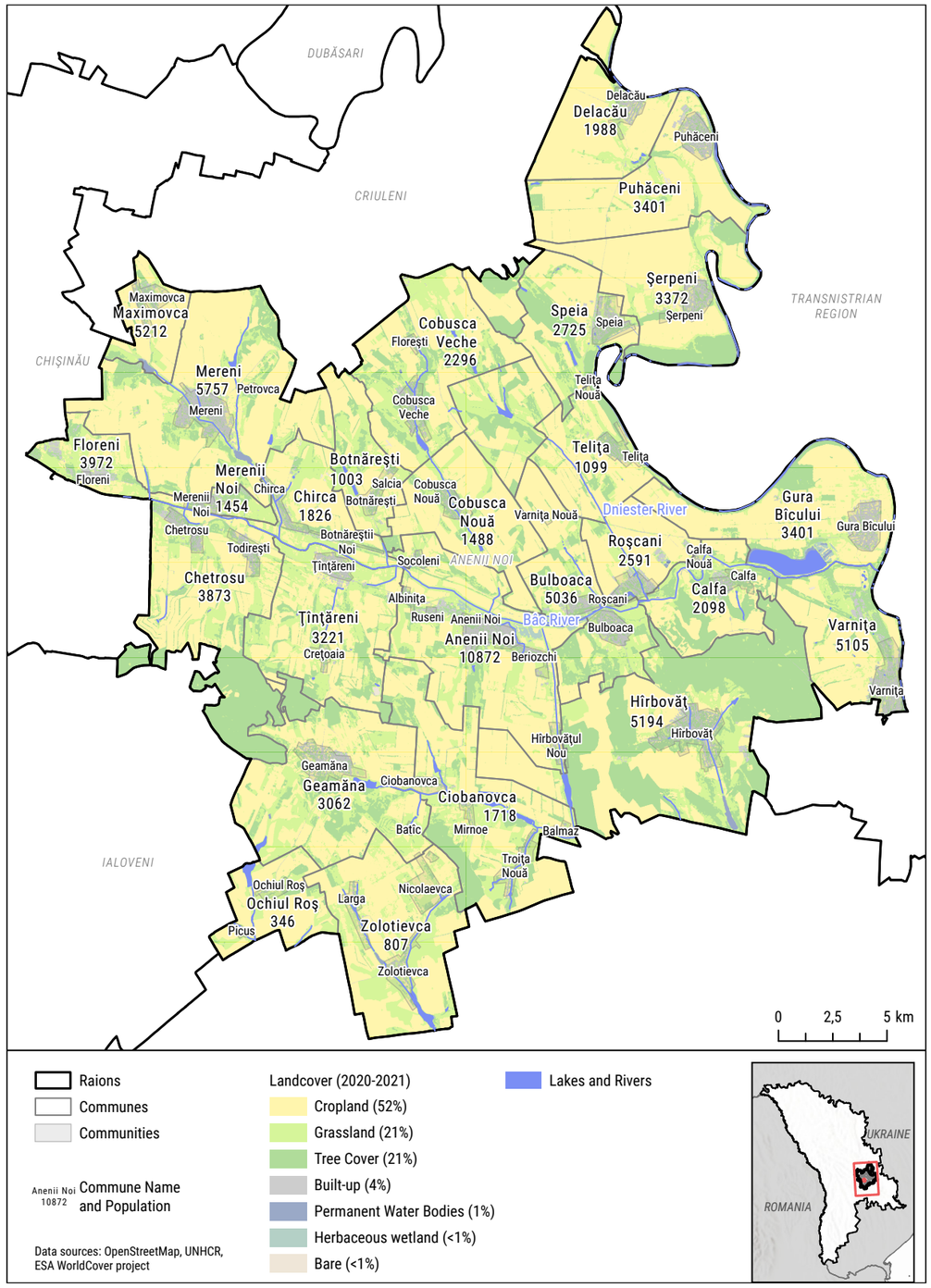
Arable land occupies 55% of the total area of the raion (**Overview map**). Multiannual plants account for 10.4%, pastures account for 8.8%, forest vegetation accounts for 13.7%, and other non-productive land accounts for 12.1%.

Agriculture in Anenii Noi Raion is classed at "high risk" for an increased impact of agricultural pests, diseases and weeds, increased irrigation requirements, increased soil erosion, salinization, and desertification, and increased flood frequency and intensity[11]. These risks are all related to climate change, and could potentially change both the landscape of agriculture and yields as well as exposure to natural hazards for the population. Should temperatures continue to increase and precipitation patterns alter in both temporal and spatial distribution, yields of wheat, corn, wine grapes, or other crops is expected to decrease[11].

Manufacturing of medicine, food, clothing, furnitures, and carpentry items drive the economy[10]. Recently, S.A. "Fabrica de conserve", a major producer in the region, declared bankruptcy[10]. SRL "Dar" and Fabrica de nutreţuri combinate "Fertilitate Anenii Noi" S.A. are important economic agents in the raion[10].

Anenii Noi Raion is in the Codru PGI region[4], which helps drive tourism to industries such as Castel Mimi, a winery located in Bulboaca, as well as the production of wine and table grapes.

Map 1.2: Overview map for Anenii Noi Raion



1.3 METHODOLOGY

Methodology overview

This ABRA for Anenii Noi Raion aims to develop a disaster risk profile which assesses indicators for multiple hazards, and their exposure and vulnerability component for communities. This is calculated using a risk equation, which assesses several indicators for hazard, exposure and vulnerability.

The ABRA analyzes geospatial data on hazard exposure to assess both natural and anthropogenic risks, and interviews with the community for vulnerability. It is conducted at the sub-regional level, and relies on both locally- available data and global datasets. As of 2023, there is no centralized and functional platform for open geospatial data access for Moldova or Anenii Noi Raion which makes disaster risk practitioners seek information from a variety of sources.

Global datasets were also used during the assessment when possible. However, due to the localized area of the research, it was only possible to use datasets where the resolution was high enough to be appropriate.

The methodological approaches used within this work fall within the framework of The Global Facility for Disaster Reduction and Recovery (GFDRR), which is a global partnership that helps countries better understand and reduce their vulnerability to natural hazards and climate change[12].

For assessing anthropogenic hazards, the Flash Environmental Assessment Tool (FEAT) 2.0 was used to highlight human and environmental exposure to hazardous substances. The FEAT methodology was developed by the National Institute for Public Health and the Environment (RIVM) for the United Nations Environment Programme (UNEP) and UNOCHA. The FEAT Pocket Guide helps to support initial emergency actions and is seen as the entry point for more comprehensive expert assessments. The FEAT process can also be used in preparedness and community awareness efforts, which is the approach taken in this risk profile and the case study.

The risk profile is based on available secondary data review and it was not possible to include all relevant indicators to determine risk. However, this risk analysis can serve as a useful indication of which settlements to prioritize for implementing risk reduction programmes, as well as evidence for further primary data collection to support DRR initiatives in areas of higher concern.

Risk

According to the United Nations Office for Disaster Risk Reduction (UNDRR), "disaster risk" is defined as "the potential loss of life, injury, or destroyed or damaged assets which could occur to a system, society or a community in a specific period of time, determined probabilistically as a function of hazard, exposure, vulnerability and capacity."[13].

The World Risk Index, developed by the United Nations University's Institute for Environment and Human Security (UNU-EHS) and Alliance Development Helps (Bündnis Entwicklung Hilft), calculates disaster risk based on the exposure to key natural hazards as well as social vulnerability in the form of the population's susceptibility and their capacity for coping and adaptation[14].

The ABRA takes this approach for assessing disaster risk, through assessing the multiplication of a settlement's hazard exposure and its vulnerability to the hazard. The specific indicators and their weighting used in the risk calculation is further illustrated in **Figure 1.3.1.**

It is important to highlight that the objective was to assess overall risk to the main hazards of the region, but is not inclusive or exhaustive of all natural and anthropogenic hazards.

Inclusion was based on consultations with local authorities and STRIVE members, and hazards exacerbated by climate change that are most relevant to the region were prioritized.

Natural Hazards and Exposures

Hazards refer to the "process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation"[15]. The major natural hazards that were identified during consultations and secondary data review for Anenii Noi Raion were: wildfire, drought, heat waves, cold waves, floods, air pollution and a short exploration of minor hazards. The identified drivers were: climate change, biodiversity loss, landcover change, and soil erosion.

For each hazard, the approach was to identify potential exposure across Anenii Noi Raion. Exposure is not limited to human population exposure, but also refers to 'the location, attributes and values of assets that are important to communities[15]. These are accounted for in discussions on impact on economy, infrastructure, agriculture, and biodiversity where appropriate.

Natural hazards may be exacerbated by anthropogenic activity, such as the use of natural resources in unsustainable ways. Hazards were assessed for all communities in Anenii Noi Raion.

The results of these analyses on individual hazards were normalized from a scale of 0 to 1, and multiplied together to result in the Multi-Hazard Exposure Index. A full bibliography of data sources for this Index is available in **Annex 1**.

Anthropogenic Hazards

National Infrastructure is an open complex interdependent system comprised of physical built infrastructure, governance structures, regulatory frameworks, and management processes for critical services[16]. Failures of this system can pose a major threat to the population, particularly vulnerable groups that may already face barriers to access and assistance.

For the purposes of this ABRA, a brief exploration of infrastructure is included in the scope of hydrography, wastewater and waste management, electricity, and gas and oil resources. These aspects of infrastructure are major drivers in the quality of everyday life for local residents, and are quantifiable in use and can serve as an exposed asset.

These aspects of infrastructure may be developed in new ways to enhance systemic resilience, which is when infrastructure is able to provide critical services under stress and alteration to the system[16].

Vulnerability

Vulnerability refers to the societal sphere, and its spatial interaction to a hazard is what defines disaster risk. Without societal exposure to a hazard, there is no risk, and where there is exposure to a hazard but low societal vulnerability, there is low risk. The societal sphere of vulnerability is a crucial component to defining disaster risk. The societal sphere of vulnerability is comprised of three components that interact with each other; namely these are susceptibility, coping capacity, and adaptive capacity as depicted in **Figure 1.1**.

Susceptibility is the likelihood of suffering harm from one of the assessed hazards. Coping capacity refers to the capacities of the society to reduce negative consequences. Lastly, adaptive capacity, or capacity development are the societal capacities in place to develop and maintain long-term strategies to ensure social resilience to hazards and shocks, which may include various types of training, institutional development, awareness, financial resources, technological systems, etc.

The most recent data available for Anenii Noi Raion which assesses vulnerability was an Area-Based Assessment done in tandem with this ABRA. Several indicators from this ABA conducted on susceptibility and coping capacity were available to be extracted to calculate vulnerability to the hazards assessed and highlighted further in **Figure 1.3.2.**

Unlike natural hazards, vulnerability was not assessed for all communities in Anenii Noi Raion. Instead, four communities were chosen in order to facilitate data collection for both host and refugee families in the region. These communities were Anenii Noi City, Floreni, Bulboaca, and Gura Bîcului.

A stratified simple random sampling approach was used for the sampling of the host population. From the total host population of 8358 individuals in the urban area and 12235 in the rural area, as reported in the 2014 government census, the total household numbers were calculated using the average family size of 4.3, as reported in a recent study conducted in Anenii Noi[17]. This resulted in a total of 1944 host population households in the urban area and 2845 in the rural area. The sample of the host population surveys was calculated with a confidence interval of 95% and a margin of error of 8% at the target area (rural, urban) level, resulting in 155 host population household interviews in the urban area and 159 interviews in the rural area, including a 10% buffer.

The refugee population was estimated at 298 individuals as of April 2023, and resulted in an average family size of 3.1, and 95 refugee household interviews.

The data from these interviews, along with data from the Inspectoratul General Pentru Situații de Urgență, was stratified by indicators (**Section 1.3**) to determine risk susceptibility and coping capacity by community. No distinction was made between host and refugee households, with the community vulnerability score representing the community as a whole. These indicators are multiplied together to result in the Vulnerability Index.

1.3 METHODOLOGY: RISK INDICATORS

Hazard Exposure

The exposure of communities to these natural hazards is something that requires further investigation at the local level with proper response and contingency plans in place. Considerations for mitigation, prevention, and response should all consider the unique makeup of each community, such as accessibility and longevity.

This analysis will be performed for all communities, with each hazard normalized to a scale of 0 - 1 for comparative purposes.

Natural Hazards

Relevance: The natural hazards described here are the most immediate and deadly threats that households may encounter.

Indicator 1.1: Wildfire
- Proximity of settlement to fuel within 580 m (forest and grassland landcover); number of satellite-detected fires (2012-2022) from the Visible Infrared Imaging Radiometer Suite (VIIRS).

Indicator 1.2: Drought
- Determined by drought severity index within a 500m distance of the borders of the community. Drought severity index was calculated based on an accumulated vegetation condition index (VCI) from the years 2000 to 2022 (calculated from MODIS NDVI).

Indicator 1.3: Heat wave
- Percent of days which a settlement experiences land cover temperature of +35°C or higher (a "heat wave") during June, July and August (2000-2019), determined using remote sensing methodologies from MODIS Land Surface Temperature and Emissivity (MOD11).

Indicator 1.4: Cold wave
- Percent of days in which a settlement experiences land cover temperature below -10°C (a "cold wave") during December, January and February (2000-2022), determined using remote sensing methodologies from MODIS Land Surface Temperature and Emissivity (MOD11).

Indicator 1.5: Flood
- Settlements located in potential flood zones, determined with PERSIANN Dynamic Infrared–Rain Rate (PDIR-Now), Shuttle Radar Topography Mission (SRTM), and the Global River Classification(GloRIC) HydroRIVERS database.

Susceptibility

Population groups that are more susceptible to a hazard have increased vulnerability to adverse effects from emergencies or disasters. These indicators do not affect all households (HHs) equally, but are treated as an equal factor for analysis and comparison. DRR strategy should further investigate the nature of these indicators and their role in residents' planning and response capabilities.

This analysis is only performed for the four communities covered under the ABA: Anenii Noi City, Florești, Bulboaca, and Gura Bîcului.

Dependency-Related Indicators

Relevance: Households with vulnerable members may require assistance or specialized equipment in relocating during emergencies or disasters.

Indicator 2.1: Households with Refugees
- Relevance: Refugees are more susceptible to hazards as they may have less awareness of the climate risks as well as mitigation techniques in a new environment. Their awareness of emergency service locations, social networks, and evacuation routes may be poorer than the host population, and they may face linguistic barriers to safety alerts and information or gaining assistance in emergencies.
- Indicator: Proportion of HHs with refugees

Indicator 2.2: Head of Households (HoH) who are single parents or a female
- Relevance: Single parents and female-headed HHs are found to be disproportionately affected by disasters due to their compounded social vulnerabilities and need to provide for dependents. In this context, "parent" refers to the in-home caretaker of a child, which may be a grandparent or other relative.
- Indicator: Proportion of HoHs who are either a single parent or a female

Indicator 2.3: Households with three or more children
- Relevance: Children are more susceptible to hazards as they have higher dependency on others, and are less able to protect themselves or evacuate if necessary. Higher numbers of children also require more caretakers to adequately respond to their needs.
- Indicator: Proportion of HHs with three or more children (persons under 18 years of age)

Indicator 2.4: The Elderly
- Relevance: The elderly are also more susceptible to hazards as they are more likely to have a higher dependency on others and may need assistance in emergencies.
- Indicator: Proportion of HHs with a member who is 60 years or older

Indicator 2.5: Households with a Person With a Disability (PWD)
- Relevance: Those with physical or mental disabilities may require physical assistance for daily tasks or for evacuation, and may need assistance with services that are inaccessible to them (e.g.: the use of an interpreter or mobility aids).
- Indicator: Proportion of HHs with a member(s) with one or more disabilities

Economic Capacity-Related Indicators

Relevance: Economic capacity determines a household's ability to both prepare for emergencies or disaster by purchasing emergency equipment or upgrading their homes, as well as replacing or repairing damaged items afterwards.

Indicator 3.1: Unemployment
- Relevance: Unemployment hinders the economic capacity for preparedness mitigation measures as well as the financial ability to cope during and after the shock of the hazard and are more susceptible.
- Indicator: Proportion of HHs that have an adult who is unemployed

Indicator 3.2: Low-Income Households
- Relevance: Households with below average income are less able to cope with inflation or emergency spending, and are more susceptible.
- Indicator: Proportion of the households who are receiving income that is below the national 2021 average (8107,5 MDL per month)[18].

Indicator 3.3: Agricultural Workers
- Relevance: Agricultural workers are a susceptible group because their livelihood is heavily dependent on agricultural land and the environment, which is extremely exposed to hazards arising from conflict, facilities with hazardous substances, wildfires, floods, soil erosion, and extreme temperature.
- Indicator: Proportion of HHs who rely on agricultural activities

Lack of Coping Capacity

The ability of a population to cope during and after a hazard occurs is crucial in reducing negative consequences and influences the ability to recover in a timely manner and build resilience to the future hazardous events. OpenStreetMap and authorities in Anenii Noi Raion have been contacted for available data. Data is also available on preparedness awareness, resource management, and displacement status.

This analysis is only performed for the four communities covered under the ABA: Anenii Noi City, Floreni, Bulboaca, and Gura Bîcului.

Public Service-Related Indicators

Relevance: Distance to services affect coping capacity, both in terms of accessing important networks of information regarding preparedness and early warning, but also as a response mechanism during the shock of a hazard.

Indicator 4.1: Barriers to health care
- Relevance: Barriers to healthcare can result in underlying conditions being unidentified or untreated, increasing vulnerability. Being unable to access healthcare can also isolate residents from important medical information and prevention or treatment strategies.
- Indicator: Proportion of HHs that report encountering barriers to healthcare.

Indicator 4.2: Distance to emergency shelters
- Relevance: Emergency shelters offer a central gathering place for safety from the elements as well as distribution point for aid.
- Indicator: Proportion of HHs that reports greater than 15 minutes traveling distance to an emergency shelter identified by the Inspectoratul General Pentru Situații de Urgență.

Indicator 4.3: Distance from emergency reponse facility
- Relevance: Emergency services are crucial in an emergency to provide first aid and critical care. Rapid response times can improve health and safety outcomes.
- Indicator: Proportion of HHs that reports greater than 10 minutes response time to or from an emergency response facility (Emergency Situations Stations, Rescuers and Firefighters Posts, etc.).

1.3 METHODOLOGY: MULTI-HAZARD RISK INDEX

Utility-Related Indicators

Relevance: Use of utilities in the home impacts the ability of the household to address basic needs, as well as their ability to receive information about emergencies or disasters and respond appropriately.

Indicator 5.1: Households with interruptions to electricity

- Relevance: Households that experience interruptions to electricity may both be unable to access information about emergencies in critical times, but also are less able to prepare.
- Indicator: Proportion of households that report insufficient heat in November 2022 - March 2023.

Indicator 5.2: Households with interruptions to water

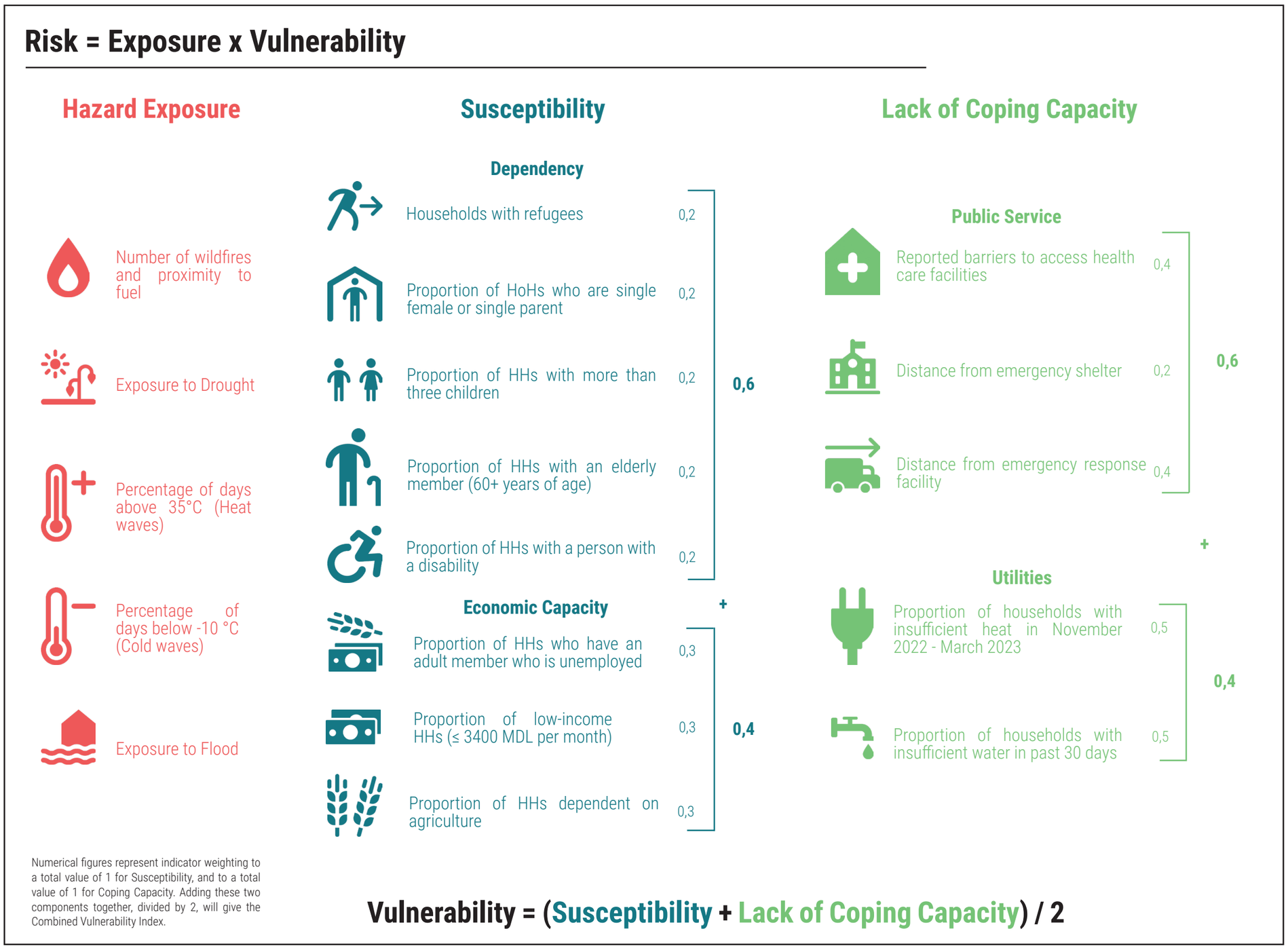
- Relevance: Households that experience interruptions to water may be unable to prepare for emergencies as well as respond to them.
- Indicator: Proportion of households that report insufficient water in the past 30 days.

All of these indicators intend to capture a type of vulnerability that makes a household less capable of preparation for disaster as well as create barriers to responding to them.

Natural, Anthropogenic, and Combined Multi-Hazard Indices are intended to capture the geographic distribution of risk and vulnerability for communities as a unit, and do not analyze the cost, efficacy, or availability of specific emergency response mechanisms, particularly those provided by civil society organizations and community initiatives.

Community leaders and community members must cooperate to develop response mechanisms appropriate to the unique needs of each community in Anenii Noi Raion, though these strategies can be further informed with the analyses of the ABRA.

Figure 1.3.2 Multi-Hazard Risk Index



2.1 HAZARD - WILDFIRES

Hazard Description

Wildfire and urban fires are a major hazard to the environment, populations, and infrastructure in Anenii Noi Raion. Triggered by both natural and anthropogenic activities, they can lead to direct (e.g.: severe burn, smoke inhalation) and indirect mortality, and destroy large swaths of natural habitat and manmade structures (e.g.: houses, factories, or utility infrastructure). As temperatures are rising (**Figure 2.4**) and drought risks are increased, there is the potential for more spontaneous wildfires that put the environment and population.

This review consists of data in Anenii Noi Raion from two sources: Visible Infrared Imaging Radiometer Suite (VIIRS) and the European Space Agency's WorldCover 10,m. Presumed vegetation fires were extracted.

The VIIRS dataset is based on satellite observations of thermal anomalies, and includes data regarding the time, location, and intensity of fires. This dataset excludes fires on industrial land use to avoid conflating the numbers with heat signatures related to industrial processes, solely showing Presumed Vegetation (PV) fires.

Map 2.1 shows wildfires in Anenii Noi Raion from the Visible Infrared Imaging Radiometer Suite (VIIRS), between 2012 and 2022, and **Figure 2.1.1 and 2.1.2** show the frequency of PV fires by year and month, respectively. According to the European Space Agency's WorldCover (2020-2021) dataset, cropland is the predominant land cover type, with 52% of land being classified this way. Grass land and forest cover are both 21% of Anenii Noi raion's landcover types. Notably, few fires were recorded in protected areas in Hîrbovăț, despite high-intensity fires occurring on cropland surrounding the forest.

64% of presumed vegetation fires were on cropland, 25% were on grassland, and 9% on tree cover (**Table 2.1**). There was no significant difference between fires during the day and at night, though 86% of fires occurred during the day.

Cropland fires may be related to stubble-burning, which is restricted and punishable by law: Articles 115 and 154 in the Criminal Code, and Article 62 in the Law on Environmental Protection. However, this practice may continue regardless. Wildfires destroy surface vegetation and some root structure, and decrease soil moisture, overall increasing the risk of topsoil erosion.

This dataset does not take into account wind speed or direction, which can have significant effects on the destructive power of a wildfire and promote the spread of smoke, which can have detrimental effects on human health.

Wildfire risk can also be compounded by rising temperatures, drought, and waste management practices.

Map 2.1 Intensity of Presumed Vegetation Fires (2012-2022), Landcover Type (2020-2021), Anenii Noi Raion

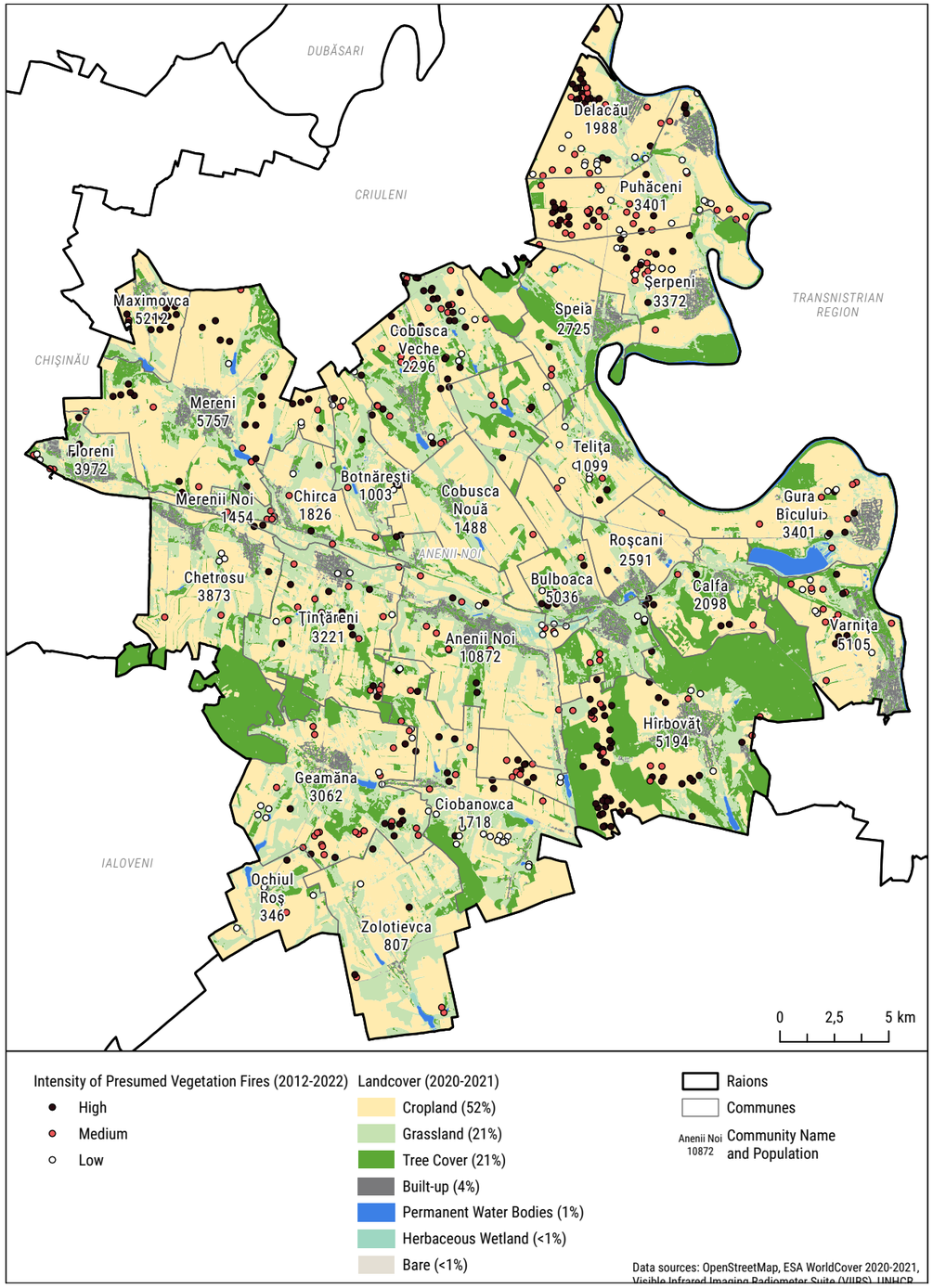


Figure 2.1.1 Number of PV Fires per Year (2012-2022)

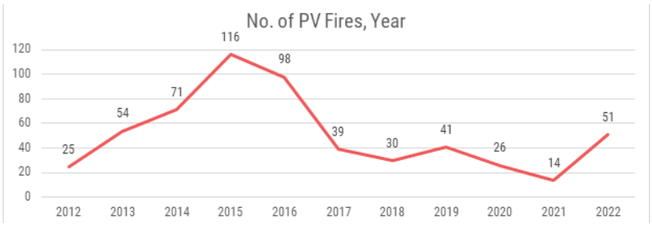
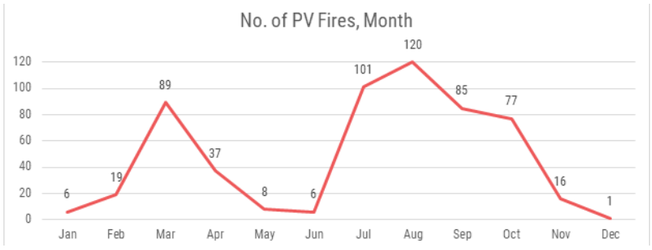


Figure 2.1.2 Number of PV Fires per Month (2012-2022)



Recommended action:

1. Support for farmers for weed and pest control to reduce agricultural stubble burning.
2. Restoration of forest belts and high-moisture native flora as firebreaks to reduce the spread and intensity of fires.
3. Inclusion of considerations for wildfires, their prevention, and responses to them in the Environmental Strategy in development for 2024.

Table 2.1 Presumed Vegetation (PV) Fires by Land Type and Time

Landcover (ESA WorldCover Land Type 2021)	No. of PV Fires (Day)	No. of PV Fires (Night)	% of PV Fires (Day)	% of PV Fires (Night)	% of Total
Cropland	309	54	64%	64%	64%
Grassland	117	23	24%	27%	25%
Tree Cover	44	6	9%	7%	9%
Built-up	7	0	1%	0%	1%
Herbaceous Wetland	3	0	1%	0%	1%
Bare	1	0	0%	0%	0%
Permanent Water Bodies	0	1	0%	1%	0%

2.2 HAZARD - DROUGHT

Hazard Description

Drought is a recurrent issue in Moldova: 3 of 10 years are affected by drought[10], and since 2021, Moldova has been experiencing a severe drought[6]. Since 1901, the average monthly amount of precipitation has somewhat increased in the colder months, but has reduced in the summer months, which can compound the effects of drought (**Figure 2.4**). Aridity is expected to increase[11].

This analysis, shown in **Map 2.2**, was performed by masking out non-agricultural land from ESA WorldCover 2021, and averaging the vegetation condition index (VCI) from MODIS NDVI (MOD13A1 V6.1) from the years 2000 to 2022.The index was normalized to the area of interest (AOI) to determine areas of "higher" and "lower" severity relative to the AOI.[19]

Anenii Noi Raion is around 52% active cropland and relies heavily on agriculture. In part due to the drought, the raion has seen a severe (50-75%) drop in yield in sunflower and maize; a moderate (25-50%) drop in wheat, peas, and plums, a minor (15-25%) drop in potatoes and alfalfa, and a very minor (5-15%) drop in barley and apples[2]. However, there has been a moderate (15-25%) increase in both table and wine grapes[3].

This change in yield is in conjunction with rising costs of food products: inflation was estimated at 36.2%[3]. As most farms across Moldova are smallholders, the costs of harvesting and selling produce can directly impact livelihoods and have greater effects.

Drought also affects soil health, further impacting agriculture. Nitrogen, phosphorus, and sulfur may increase during droughts, and become concentrated in the topsoil[20]. Erosion of this topsoil can cause significant nutrient loss, which may lead to overapplication of fertilizers. Soil salinity also may be increased, and hardened soils can make it difficult for roots to penetrate to the depth required for crop production[21].

Dry soil has reduced microbiology, which reduces the health and diversity of organisms which live in the soil as well as those which grow from the soil, increasing the risk of decaying root structures and subsequent erosion[21].

With drought also comes an increased risk of wildfires and flooding. Drier conditions of vegetation can increase the frequency and severity of vegetation wildfires[22], and dry soil can harden, preventing rainfall absorption. Heavy rainfall can create flash floods, which are dangerous and unpredictable, with rapid onset[23]. These are particularly dangerous in densely-populated areas, where the lack of absorptive surfaces can produce strong currents and sweep people, automobiles, and detritus into narrow passages or into barriers, resulting in property damage and personal injuries or deaths[24].

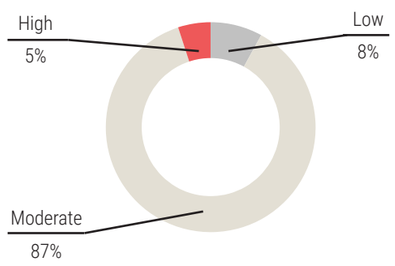
Along with rainfall and floods, drought can affect water levels in surface and underground water sources. Anenii Noi Raion is in the Dniester River basin (68km is within the territory), and the Bâc River subbasin (42km is within the territory). It also contains several dozen small rivers and streams, which may dry out in the warm period of the year, shifting water use to other water bodies, increasing pressure on their ecosystems. There are also 57 artificial aquatic objects with a total area of about 1000 hectares[25]. These can be used for multiple purposes, from irrigation to tourism to sanitation, and are affected by changes in precipitation.

The Bâc River is used for both agricultural (45%) and household (40%) purposes[26]. These uses are discussed in greater detail in **Section 3.1: Hydrography** and **Section 3.3: Wastewater and Waste Management**. Intense droughts can lower water tables and affect wells and pumping, particularly those which are for personal use. As around 50% of the population of Moldova relies on shallow wells as a main source of water, drought can threaten water supply for a significant portion of the population[27]. Dry wells can also contribute to overheating of submersible pumps and damage to PVC piping, and low water tables can bring in sediment or detritus from cloudy water into the system[28].

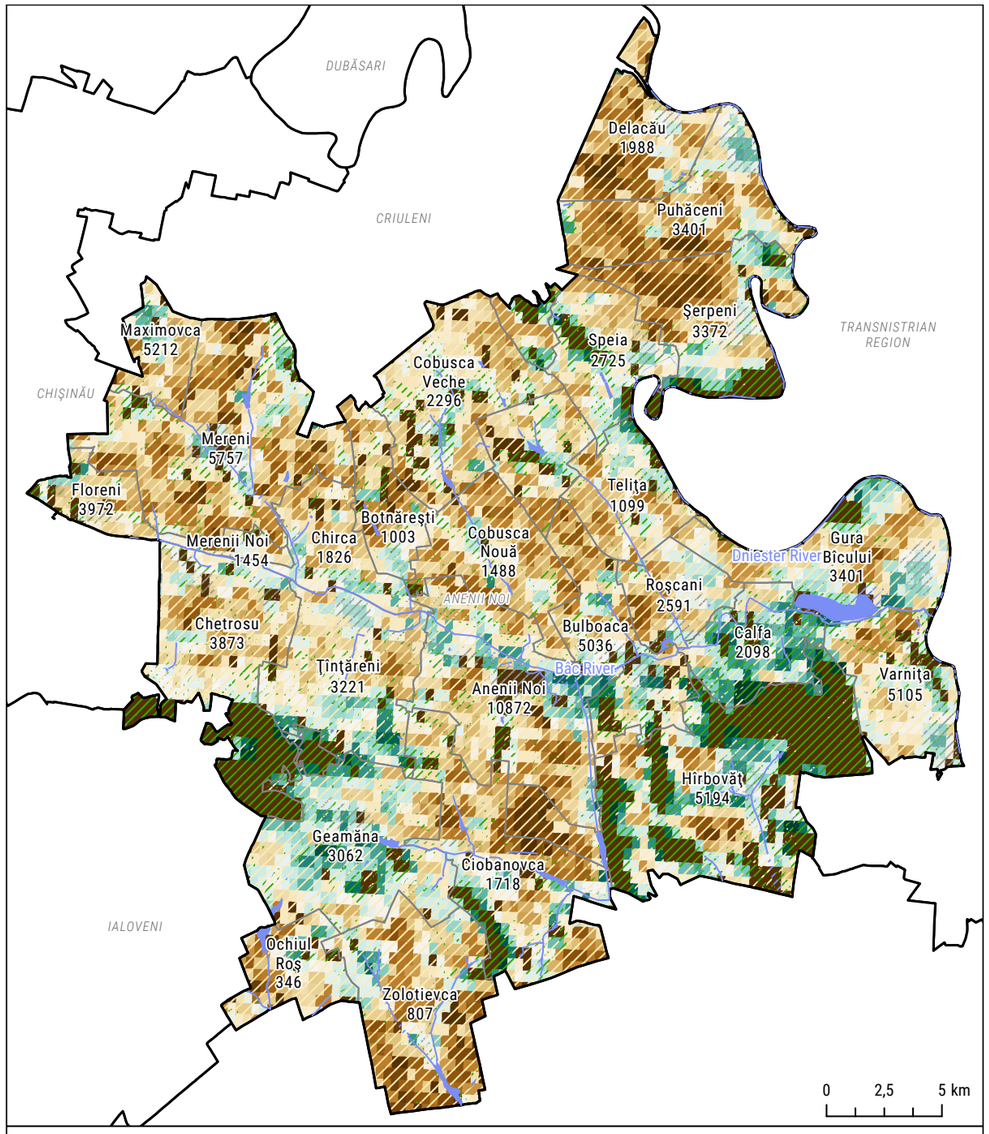
Recommended action:

1. Determination of drought resistance and vulnerability of crops of interest in Anenii Noi, and support to small-scale farmers who are growing drought-sensitive crops.
2. Maintenance of ground cover and stubble appropriate to crop rotation and soil type, with testing of soil nutrient profiles to reduce unnecessary fertilizer use, which can pollute waterways and reduce future crop yields.
3. Public safety campaigns about personal exposure for drought, such as the availability of potable water or water for irrigation when affected by low rains.
4. Development and promotion of low water-loss irrigation techniques at accessible cost to smallholder farms.

Figure 2.2 Severity of Drought on Agricultural Land (2001-2022) (MOD13A1 V6.1)



Map 2.2 Drought Severity (2001-2022) on Agricultural Land (2020-2021), Anenii Noi Raion



2.3 HAZARD - EXTREME TEMPERATURES: HEAT WAVES

Hazard Description

Prolonged periods of extreme heat are referred to as heatwaves[29]. The exact definition varies by country, but heatwaves are usually defined by a significant and prolonged deviation from the long-term average temperature.

Heatwaves are a leading cause of disaster-related deaths. More than 166,000 people have died du to extreme temperatures between 1998 and 2017, particularly affecting susceptible groups [30]. The frequency and severity of heatwaves are increasing and will become increasingly difficult to address as infrastructure continues to age and less able to cope with demands[31].

Moldova's average temperatures have been rising over the last 100 years, with record-breaking heat becoming more common in the last 20 years[32]. The average air temperature in 2019 exceeded the norm by 2.1 - 3.2°C, and across the territory of the country, daily high temperature records were broken[33]. According to SM Chişinău data, which has data across a time period of 125 years, the average annual air temperature was 2.7°C higher than normal. Average monthly temperatures have overall risen since 1901 (**Figure 2.4**), and average monthly precipitation is slightly lower in the summer months.

Data on abnormally high land surface temperatures in Anenii Noi Raion and adjacent territories was acquired from MODIS Land Surface Temperature and Emissivity (MOD11)[34], using temperature observations in June, July, August, and September from 2012 to 2022. +35°C was determined as the lower limit of "hot" days, as this tempeature exceeds the 30°C limit of "tropical days"[31, 34], and the limit the government considers to exceed monthly average temperatures in the summer months, enacting a "Code Yellow" warning[35]. A "Code Yellow" warning can also be enacted at lower temperatures, depending on other conditions.

"Code Yellow" is part of the four-color system enacted in 2010, which is a weather alert system used throughout Moldova: "green" is no danger, "yellow" is potential danger, "orange" is moderate danger, and "red" is severe danger[35].

Land Surface Temperature (LST) and emissivity daily data are estimated from land cover types, atmospheric column water vapor and lower boundary air surface temperature are separated into tractable sub-ranges for optimal retrieval.

Several heatwave hotspots are visible on **Map 2.3**, with "cooler" spots corresponding directly to the Dniester River on the eastern border of the raion, the Bâc River through the center of the raion, and patches of forest in Chetrosu and Hîrbovăț, including protected areas.

Another concern is that of the electric grid: higher temperatures can reduce the thermal capacity of transmission lines, as well as being linked to higher electric demand for cooling[36]. Exceeding a peak load may lead to damage to the power system or a complete shutdown, or "blackout". This can leave vulnerable populations at a higher risk of heatstroke or cardiac arrest.

Higher energy use for cooling may also lead to increased cost of living for residents, and as Moldova has experienced the increases in energy costs, this may create additional financial stress on residents[3].Too high of costs can make energy use inaccessible or prompt the use of unsustainable coping methods[37].

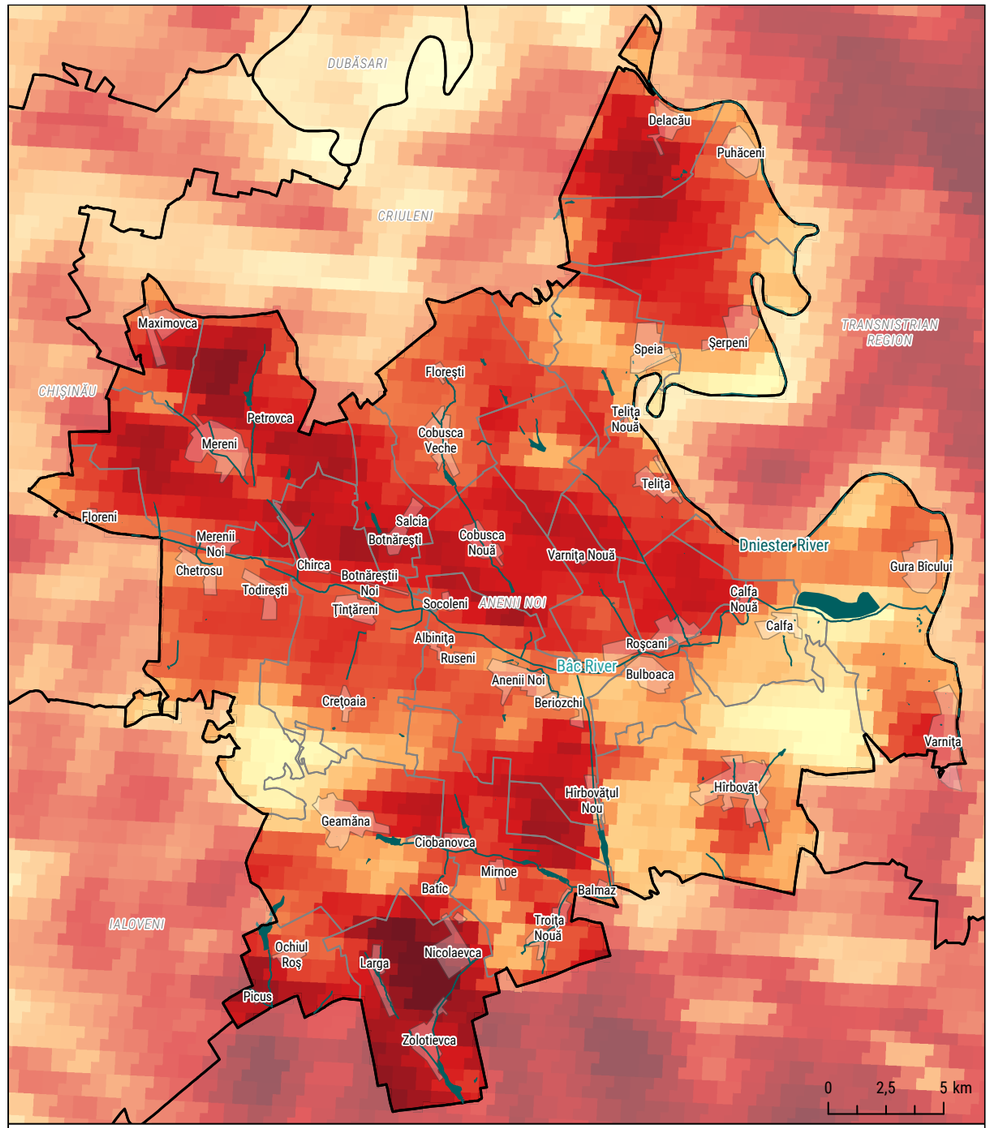
Heat waves and droughts are often interlinked and extreme temperatures can exacerbate drought impacts. This has lasting effects on various sectors, including agriculture, as rainfall patterns and amounts may change in drought conditions, requiring increased water usage for irrigation.

Drought conditions can dry out vegetation, increasing the risk of vegetation wildfires[36]. Exceedingly dry soil can also increase the risks of flash floods, especially if precipitation is heavy[6].

Additionally, there may be different risks to exposure of disease, as changing climate may make new territory hospitable to new pests and disease vectors that did not previously have acceptable conditions for survival[38]. This can be both anthropogenic and zoonotic[38,39].

The use of land surface temperature products such as MODIS help authorities identify areas in which high temperatures may affect resident health, and can support preparedness and response mechanisms. Coupled with data on vulnerable groups, particularly those who are more susceptible to heatwaves, authorities can better target risk reduction initiatives within communities that see more frequent exposure to abnormally high temperatures.

Map 2.3 Percentage of Days in Summer Season with Temperature > 35°C (2012-2022), Anenii Noi Raion



Recommended action:

1. Assess heat mortality risks for local communities, with considerations to current and future technologies and resources in medical facilities, such as distance to rural communities, rural telecommunications, and humidity indices, all of which can exacerbate heat-related illnesses and compound the severity of symptoms.
2. Communication and education for community members about the risks of heat, particularly for children, with continued clear instructions about what four-color code recommendations are for high temperatures.
3. Encouragement of nature-based solutions, such as urban greening, gardens, or public parks, with water and shade resources, especially near well-traveled areas or areas that cater to families.
4. Diversification of energy resources to cope with a higher demand with concerns about rising costs, such as evaluation for solar, wind, or biogas energy.

2.4 HAZARD - EXTREME TEMPERATURES: COLD WAVES

Hazard Description

Extreme cold or cold waves are weather conditions defined by either a rapid drop in air temperature or a sustained period of excessively cold weather[40]. Severe cold is a threat to human health, as prolonged exposure can lead to hypothermia, frostbite, and cardiac arrests, all of which contribute to increased mortality[41]. Residents may also attempt to heat shelters with ovens or fires, which can results in carbon monoxide poisoning.

Deterioration in transport conditions also leads to higher instance of road accidents[42] and affects utility networks such as water and heating systems[43]. In addition, extreme cold can damage crops and their root systems, affecting food production and livelihoods[44].

Moldova experienced a cold wave in January of 2019, in which temperatures registered "low temperatures", defined as -5°C and below, with temperatures reaching -11°C. Between 30 md 190mm of snow fell throughout the country, with most of it in the central and northern parts of the Republic. On 11-12 January, the roads were closed for any movement, but after 24 hours cleaned and opened again. 14 communities in 5 districts were left without electricity for one day. Out of 5,460 affected people, 2,912 needed Red Cross assistance[45].

Information about abnormally low temperatures in Anenii Noi Raion and adjacent territories was calculated using MOD11[15], based on temperature observations in December, January and February between 2012 and 2022. **Map 2.4** shows the percentage of days with temperatures below -10°C during the study period. This temperature was chosen as the lower limit as the government considers it to exceed the monthly average values and enacts a "Code Yellow" at this temperature for the winter months[35]. A "Code Yellow" can also be enacted at higher temperatures throughout the year, depending on conditions.

As with heatwaves, the presence of the Dniester and Bâc Rivers have a mitigating effect on extreme weather, though the forested areas of Chetrosu and Hîrbovăț do not offer the same protection against cold as they do for heat.

In **Figure 2.4,** a continuous gradual increase temperature is observed across the last 120 years for all of Moldova, though precipitation is only increased in colder months, and decreased in warmer months.

While a range of infrastructure can be affected, the most exposed to low temperatures are water and heating infrastructures. Freezing of water pipes, damage to power lines, and failure of heating systems can cause lasting damage to water access, power, and heating supplies, putting populations at further risk of exposure.

Map 2.4 Percentage of Days in Winter Season with Temperature < -10°C (2012-2022), Anenii Noi Raion

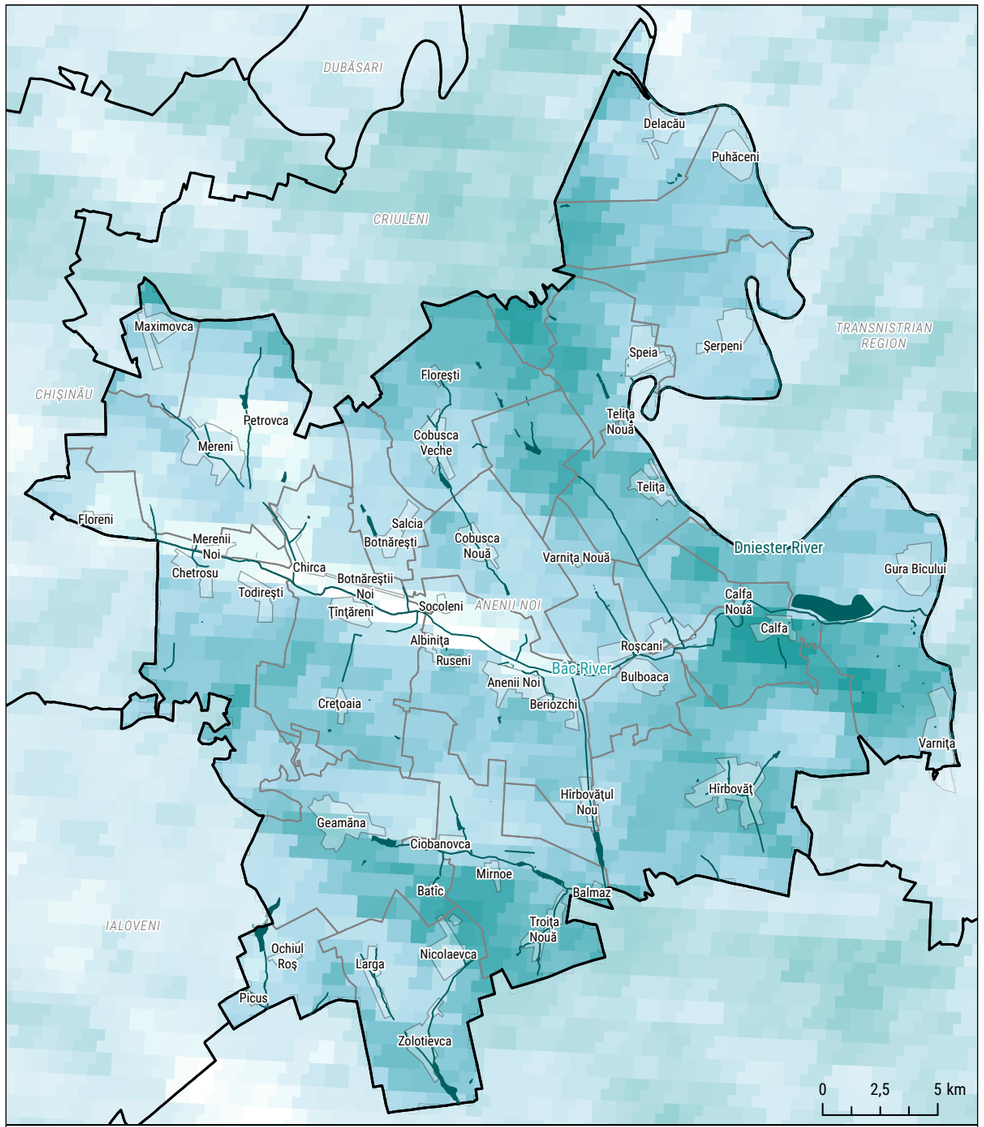
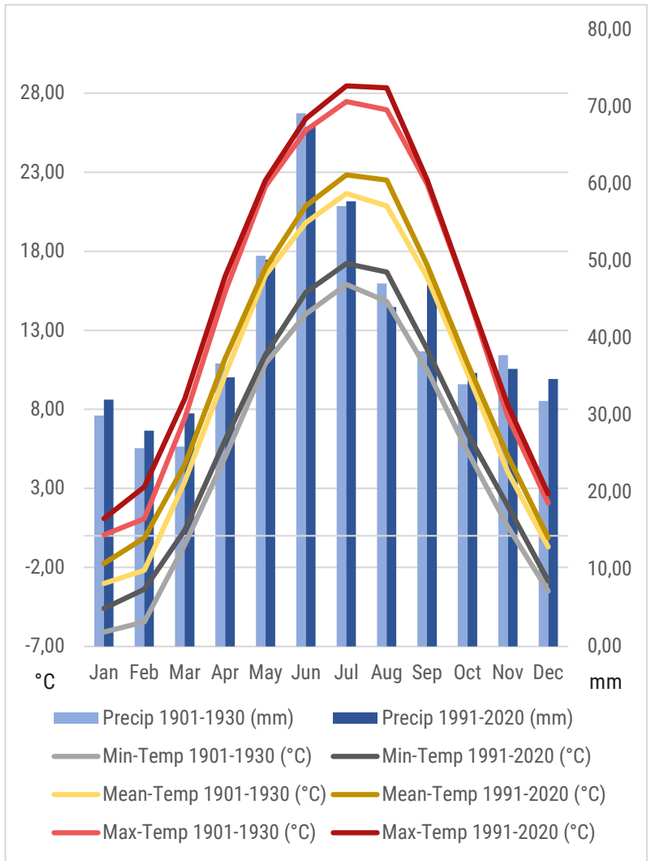


Figure 2.4 Averaged Monthly Precipitation and Temperature Trends for Moldova, 1901-1930 and 1991-2020[46]



Recommended action:

1. Ensure vulnerable groups in areas that experience the most extreme weather can access financial or material support to cover basic expenses for heating, such as providing firewood or reduced costs for gas and electricity as was done in 2022[37].
2. Continued clear use of the four-color system, with instructions as to the dangers of cold and resources for those in need, including warnings about the dangers of carbon monoxide from using improper heating elements in a domestic setting.
3. Assess vulnerability with local responders and develop support and contingency plans for those most vulnerable (the elderly, those with disabilities or chronic illnesses, or young children).

2.5 HAZARD - CLIMATE CHANGE TRENDS

Hazard Description

The potential impacts of climate change on water resources in the coming decades can manifested by changing the hydrological regime of the rivers by reducing flow and loss of water quality with increased chemical and biological substances, requiring a more intensive water treatment regime, impacting costs[47]. IPCC Sixth Assessment Report puts Moldova as "medium" human vulnerability to climate change.

While aspects of the global climate fluctuate naturally, dramatic changes in temperature, precipitation, and extreme weather in recent years are impacted to human activity. Burning of fossil fuels, deforestation, and livestock farming lead to emissions of "greenhouse gases," (GHGs) such as carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Influx of these gases into the atmosphere is leading to increased global warming and extreme weather events[48].

Moldova's greenhouse gas emissions (GHG) have remained approximately the same since 2010 at around 14.1 $MtCO_2$-eq (including landuse, landuse change, and forestry (LULUCF)), which is around 0.04% of the world's current emissions. This number represents a drop of 69,5% from 1990, which exceeded the initial goal and nearly meets the updated goal of the Long-Term Low Emissions Development Strategy of reducing its GHG emissions by 70% below its 1990 level in 2030[49].

In 2019, the total GHG per capita emissions were 35% lower than the world's average: 4.4t CO_2 equivalent per capita compared to 6.8t CO_2 equivalent per capita[49].

In 2020, Moldova emitted 3.3t of CO_2/capita, which is below the EU average 5.5t/capita, and shows an upward trend for 2.9 t/capita in 2010[50]. The primary source of emissions was the transport sector, at 43% of the total, and the residential sector at 20%, which has remained stable since 2010[50].

CO_2 contributed to 68% of total GHG emissions in 2019, CH_4 represented 19%, and NO_2 represented 12%, while fluorinated gases (F-gases) only represented 1.6%[50]. GHG are explored in greater detail in **Section 2.10**.

A number of bioclimatic variables from WorldClim Coupled Model Intercomparison Project 6 (CMIP6) were analysed to estimate selected projected bioclimactic variables for temperature and precipitation changes from the baseline (1970-2000) to the near future (2041-2060) in Anenii Noi Raion (**Table. 2.5**). The GFDL's ESM2 model was chosen in part because of its complexity and emphasis on the carbon cycle[52].

In this model, some of the most significant changes (**Table 2.5**) are a rise of annual mean temperatures of 1,5°C, a potential shifting in precipitation with the summer months becoming the driest months, and a greater variation in maximum and minimum temperature and precipitations.

Recommended action:

1. Incorporate RCP scenarios in resilience planning for agriculture and public safety, particularly rising temperatures, with localized climate adaptation plan using nature-based solutions.
2. Monitoring of subterranean and surface water, its domestic use, and safety planning for flash-flooding related to changes in precipitation.

Figure 2.5 Observed Annual Mean Temperatures of Moldova for 1901-2021[51]

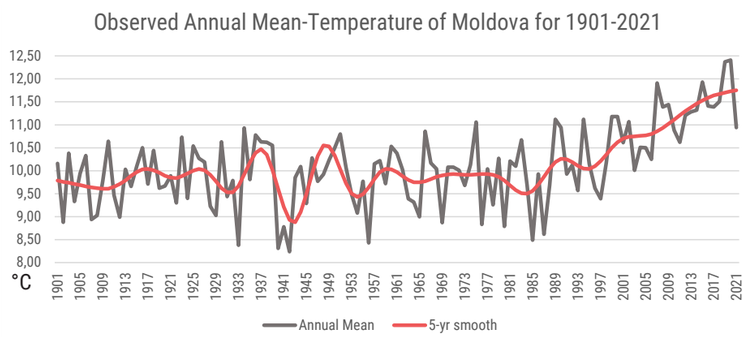
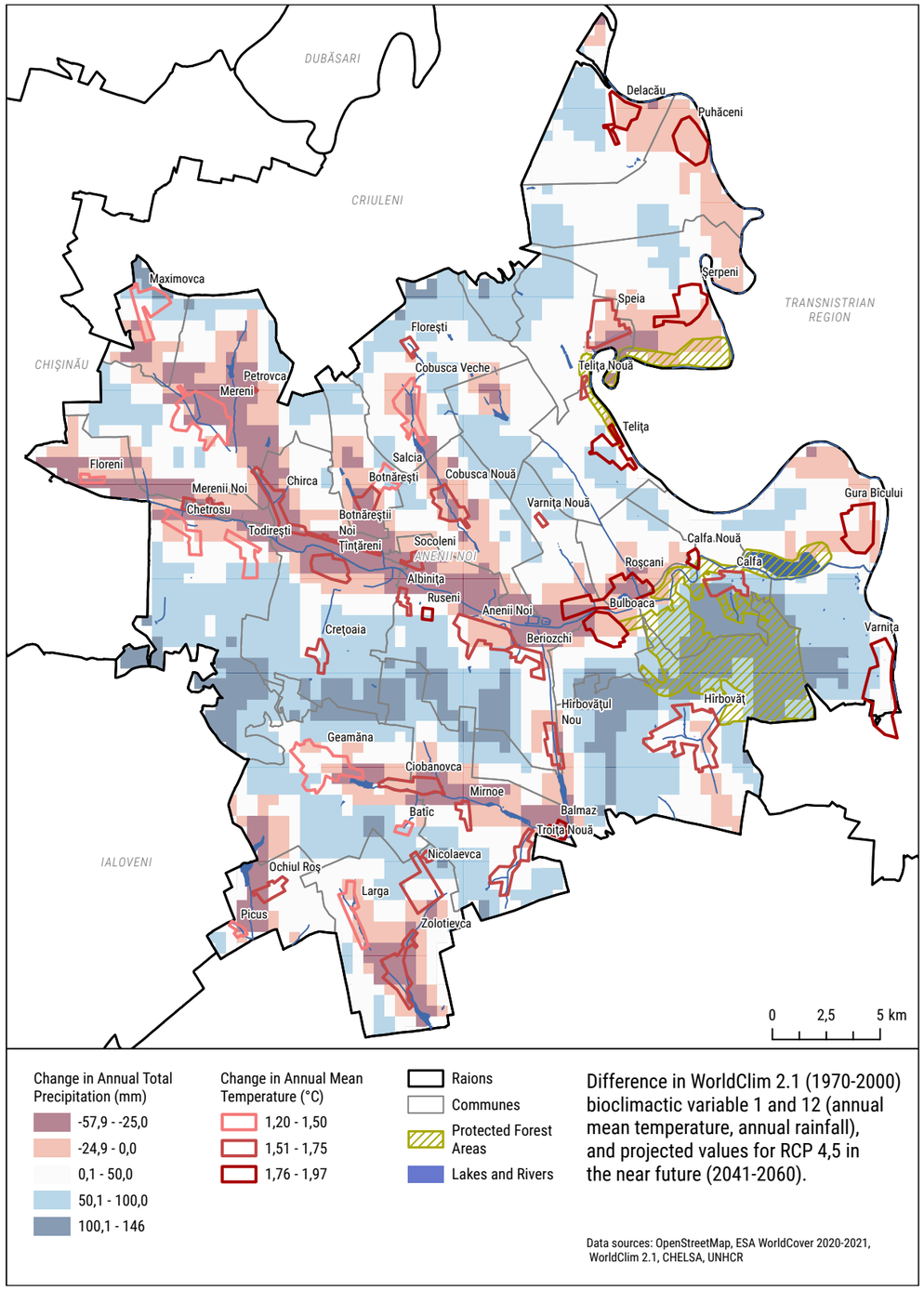


Table 2.5 Change in WorldClim 2.1 bioclimactic variables (1970-2000) in RCP 4.5 (2021-2046)[53, 54]

Bioclimactic Variable	Average (RCP 4.5)	Change in Average
BIO1 = Annual Mean Temperature	11,15	1,55
BIO2 = Mean Diurnal Range	8,9	0,65
BIO3 = Isothermality	28	0,35
BIO4 = Temperature Seasonality	864,9	-17,9
BIO5 = Max Temp. of Warmest Month	28,3	2,65
BIO6 = Min Temp. of Coldest Month	-3,4	2
BIO7 = Temperature Annual Range	31,65	0,5
BIO8 = Mean Temp. of Wettest Quarter	19,65	1
BIO9 = Mean Temp. of Driest Quarter	13,95	11,95
BIO10 = Mean Temp. of Warmest Quarter	22,85	2,7
BIO11 = Mean Temp. of Coldest Quarter	0,5	1,875
BIO12 = Annual Precipitation	578	51,5
BIO13 = Precipitation of Wettest Month	85	14,5
BIO14 = Precipitation of Driest Month	23	-5,5
BIO15 = Precipitation Seasonality	39	8,65
BIO16 = Precipitation of Wettest Quarter	229,5	38,5
BIO17 = Precipitation of Driest Quarter	73	-28,5
BIO18 = Precipitation of Warmest Quarter	217	31,5
BIO19 = Precipitation of Coldest Quarter	108,5	0,5

Map 2.5 Climate change trends in Anenii Noi Raion



2.6 HAZARD - DEFORESTATION

Hazard Description

While it is forbidden to reduce the area of forest lands, from 2001 to 2022, Anenii Noi Raion lost a total of 432 ha, which is a 5.4% decrease in tree cover since 2000[26, 55]. 6 ha of tree cover loss resulted from fires, and 426 ha resulted from all other drivers of loss, including deforestation due to logging and natural die-off[54]. The year with the most tree cover loss due to fires during this period was 2022 with 2 ha lost to fires — 2.7% of all tree cover loss for that year[55]. However, from 2000 to 2022, there was also a 591 ha gain of tree cover, making a net change of 427 ha[55].

Notably, some of this forest cover reduction occurred in protected areas (**Map 2.6**), and increased loss in forest area is correlated with increasing CO_2 emissions (**Figure 2.6**). The greatest tree cover loss was experienced in 2020, with an estimated 1412 m^2 of loss, and estimated losses have seen an upward trend since 2014[56, 55]. The biggest losses are visible in the southern and southeastern parts of the raion, including protected areas.

While reforestation can address forest fragmentation and increase biodiversity, some reforestation comes from the introduction of non-native species, such as the ***Robinia pseudoacacia*** (Black locust tree), acacias, and ***Acer negundo*** (Box elder), which can be affiliated with monocultures and ideal intermediary host for pests that threaten local native biodiversity[57].

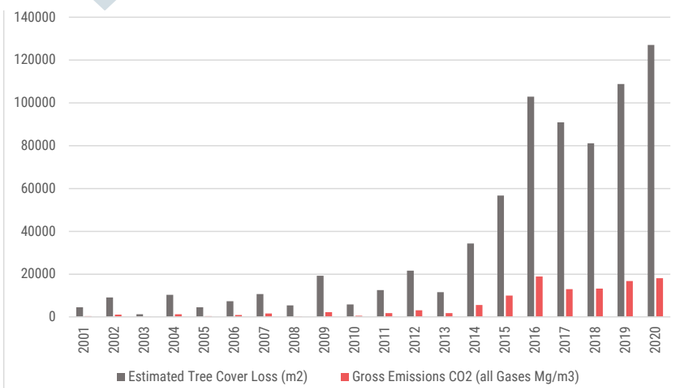
Tree cover was estimated from the ESA WorldCover 2020-2021 global dataset, while tree gain and loss were estimated from Global Land Analysis & Discovery's (GLAD) "Global Forest Change" dataset. Water cover dynamics were estimated from GLAD's "Global Surface Water Dynamics" dataset.

Grassland cover used for livestock has also been reduced: 8483.4 ha (9.56% of the district's territory) in 2005 to 7719.95 ha or 8.7% of the territory in 2015[10, 26]. Livestock (cattle, sheep, and goats) required more territory: 2 times more in 2005, 1.55 times more in 2008, 1.39 times more in 2012, and 1.28 times more in 2015[26, 2]. Despite the increase in demand for grazing territory, the number of cattle reduced from 11.5 to 6 thousand, and sheep and goats were reduced from 15 to 13.6 thousand[26]. Pigs increased in number, and though they do not graze, they may have contributed to landcover change by their living space requirements[26]. The quality of pastureland for grazing was found to be low, and national legislation has banned grazing from 8 October 2021 to 6 May 2022[2].

The dynamic of changing. landcover can produce changes in the genetic-population structure and biodiversity of flora and fauna in natural and built habitats, as well as the soil[26]. This is discussed in more detail in **Sections 2.7** and **2.8**.

With the changes in temperature and rainfall from climate change (**Section 2.5**), both surface and subterranean water is affected.

Figure 2.6 Estimated loss in forest area and carbon emissions in Anenii Noi Raion (2001 - 2022)[55,56]



Map 2.6 Deforestation in Anenii Noi Raion (2000-2022)

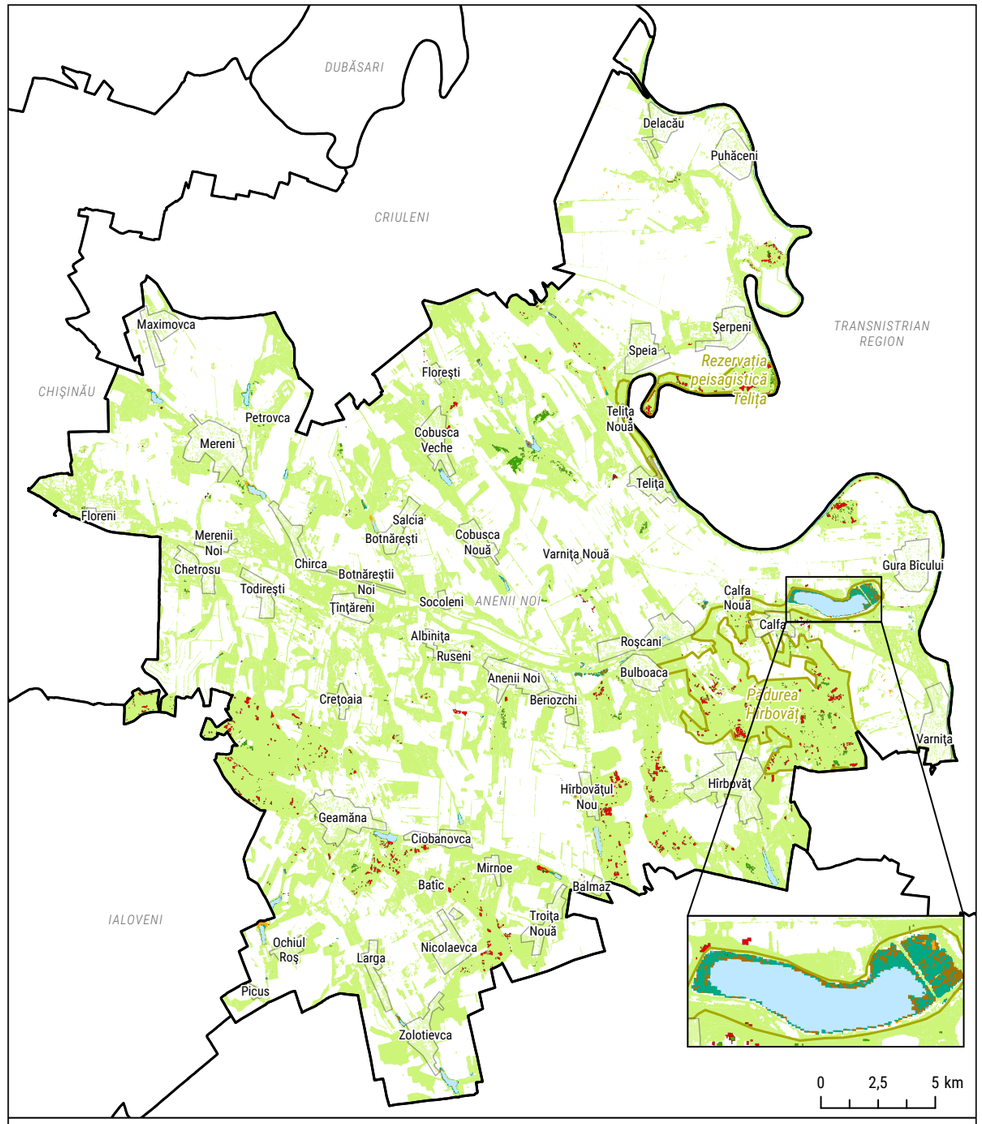


Table 2.6 Change in water area (1999-2020)[58]

Water Area Type	% of Total
Permanent water	40,57
Stable seasonal	20,24
Probable permanent land	11,75
High frequency change	11,69
Water loss	7,05
Water gain	1,26

Of surface water change from 1999 to 2021, 84% was water loss[57]. From 2001-2022, the greatest change categories were from water into probable permanent land (11,75%) and high-frequency change (11,69%) (**Table 2.6**).

"Probable permanent land" refers to areas that have dried out, and are unlikely to be flooded or become surface water again[58].

"High-frequency change" refers to the rapid cycling of dry land and flooded land outside of the normal range of "dry period" and "wet period" waters, which can result in unpredictable water access resources[58].

"Stable seasonal" is land that experiences seasonal flooding and drying, but in a predictable pattern[58].

Recommended action:

1. Introduction of a "set-aside program" for lands that serve as buffer strips and buffer zones for protecting water sources, as on steep slopes and to help protect watershed integrity.
2. An increase in monitoring and enforcement capacity for forest resource protection, as well as adaptive plans for changing water regimes and carbon policy and monitoring.

2.7 HAZARD - BIODIVERSITY LOSS

Hazard Description

Forest areas have functions of water, soil and land protection, protection against harmful climatic and industrial factors and recreation, such as medicinal plants or hunting[10]. The fragmentation or degradation of forests can lead to the loss of various species and a reduction in biodiversity, reducing a biome's resilience capacity and increasing the risk of extinction for flora and fauna[59].

Moldova is situated at the intersection of three biogeographic zones: the Central-European zone, the EuroAsiatic zone, and the Mediterranean zone, and many species typical for each of these zones are at the limit of their natural range in Moldova[60]. This makes Moldova particularly sensitive to changing landcover and climate.

The majority of Moldovan forests were partially or completely cleared three times in the 20th century, and the majority of current stands grew from plantations or from stump or root sprouts, resulting in the majority of mature forest stands lacking the genetic and species composition of healthy forest ecosystems[61]. Around 90 percent of natural steppe habitats have been affected by agricultural expansion[61].

The forests of the Dniester basin, which includes Anenii Noi Raion, are populated by 172 species of terrestrial vertebrates, which represent 47.8% of the total number of species distributed in the country, and a number of invertebrates, whose diversity is still little studied[47]. Important native tree species include *Quercus pubescens* and *robur* (fluffy and English oaks), *Fraxinus excelsior* (European ash), *Acer platanoides* and *pseudoplatanus* (Norway and Sycamore maples), *Tilia cordata* and *tomentosa* (Littleleaf and silver lindens)[61]. *Quercus pubescens* is of particular concern[62].

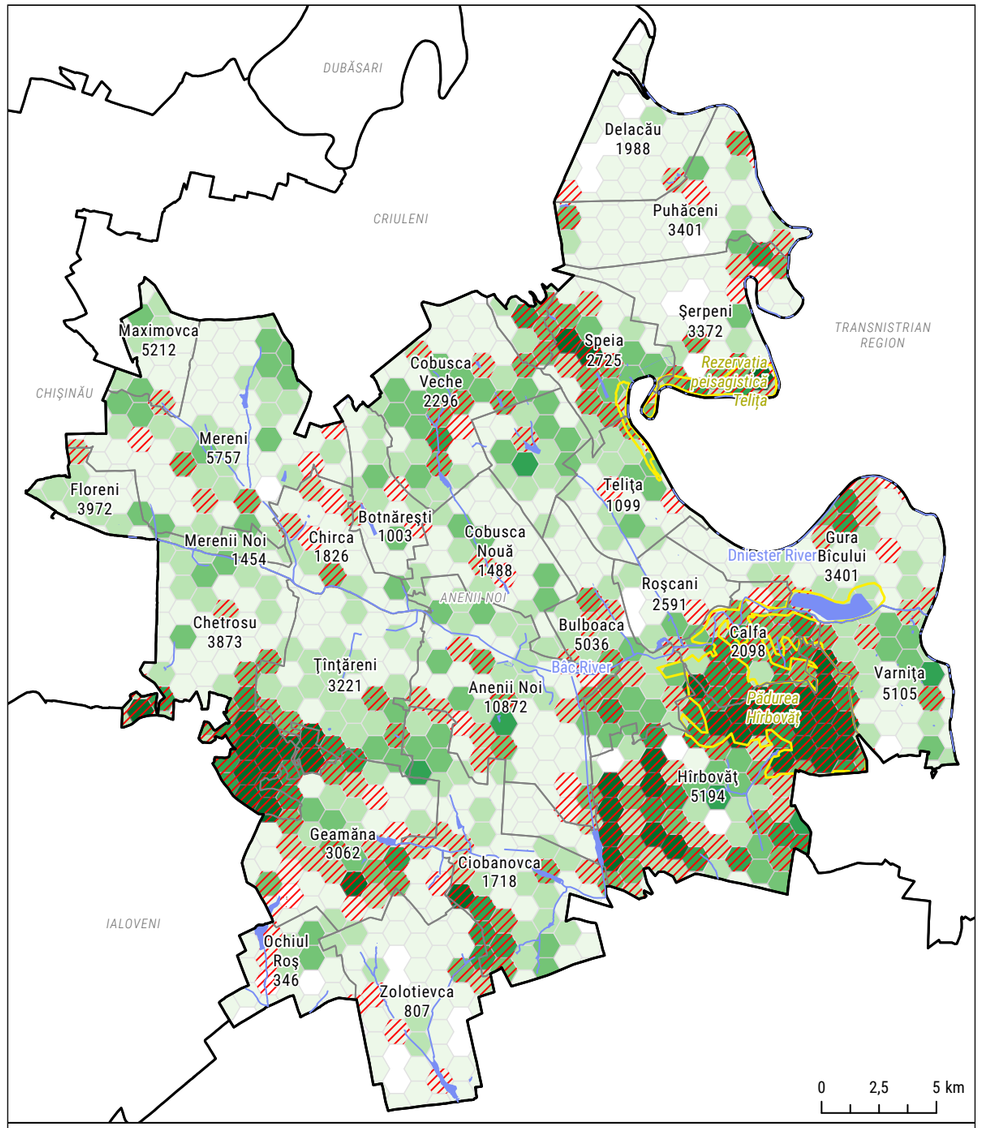
Aquatic and marsh species in particular are threatened by anthropogenic activity in the basins, such as the discharge of wastewater and the operation of hydrotechnical nodes[63]. Rising temperatures and reduced rainfall could heavily impact reptile and amphibian species, which are less able to expand their range, and thus at a higher risk of extinction in the region[38].

The International Union for Conservation of Nature's Red List of Threatened Species identifies 783 species on the territory of Moldova, with 37 vulnerable species, 6 endangered species, and 6 critically-endangered species[63,64]. Anenii Noi is in the resident, breeding, or passage territory of 14 vulnerable species, 4 endangered species, 3 critically-endangered species, and 3 species extinct on the territory[64]. The majority of these species are vertebrates, both terrestrial and aquatic, and all endangered and critically-endangered species fit into this category[64]. Two of three extinct species on the territory are aquatic (sturgeons), and the last terrestrial (European mink)[64].

These species are protected from collection and hunting, though there are no recorded sightings of any near-threatened, endangered, or critically endangered species in the IUCN database[65, 64]. A lack of sightings does not necessarily mean the species no longer exist, but rather that there may not be sufficient monitoring in the region.

There are two landscape reserves in Anenii Noi Raion: Pădurea Hîrbovăț (2,218 ha, established 1958) and Rezervația peisagistică Telița (124 ha) (**Map 2.7**)[66]. Both sites are part of the Emerald Network of Areas of Special Conservation Interest, a network of Areas of Special Conservation Interest to conserve wild flora and fauna and their natural habitats of Europe[67]. Pădurea Hîrbovăț contains 514 distinct species of flora, and of the 1774 forested ha, only 27% are fundamental natural trees[62]. There are also 20 rare species of plants, including the only known tree of *Pyrus elaeagrifolia* (Dobrogea pear)[62].

Map 2.7 Forest Cover Percentage (2020-2021) in Anenii Noi Raion



Moldova now has only one third of the bees that existed in the 1980s, potentially due to changing climate, disease, pesticides, and reduction of spontaneous flora[68, 69]. As bees are essential for pollinating crops and plants, including around one-third of crops, this decrease affects both Moldovan honey production and agriculture[70]. However, the Beeprotect.md system has been developed to increase communication between registered beekeepers and farmers to coordinate with the application of pesticides and bee protection measures[71]. Around 7,000 beekeepers are registered in Moldova[69].

Addressing these biodiversity issues may also have economic impacts: biodiversity conservation activities in forest ecosystems could have a 12 million Moldovan lei contribution to the national economy over the next 25 years[57]. These could be in the realms of tourism, ecotourism, and other forestry activities.

Recommended action:

1. Continued adherence to Articles 58-66 in Law 1515[65] to establish protected areas, buffer zones, and species-specific protection for flora and fauna, such as *Pyrus elaeagrifolia*.
2. Cooperation with IUCN Red List to identify at-risk species in the region and maintenance of habitats, and incentives for wetland and flood zone protection at the village level.
3. Support to farmers to use Climate-Smart Agriculture methodology, such as hail nets, multi-cropping practices to reduce pests instead of pesticides, etc.
4. Strengthen environmentally-related governmental bodies to investigate and enforce environmental protection laws and promote awareness among the public.

2.8 HAZARD - SOIL EROSION

Hazard Description

The relief of Anenii Noi Raion represents a hilly plain, intersected by multiple gullies and ravines. Erosional processes and landslides have conditioned the formation of "hârtops", which have amphitheater-shapes recesses in soft stone, similar to a land slump. The east of the raion is located in the meadow of the Dniester River and has a less fragmented plain relief, on the Southern Moldavian Plain[72]. The Bâc river cuts through the center of the raion.

During 1954–1960, most slopes of a >10° incline were cultivated, and watersides and swamps were drained, but strips of forests were planted along the boundaries of fields and roads, but these were cleared in the 1970s and replaced with nut trees. Soil was more likely to be eroded or salinized, as it lacked protection[72].

Pesticides were also widely used: every hectare reportedly used 5.2 kg of pesticides, and by 1990, the Institute of Experimental Meteorology determined that 60% of the arable area of Moldova was affected by pesticides, which had a concentration 50 times higher than permissible. Since 2004, over 3000 tons of pesticides have been evacuated from the territory of the Republic of Moldova with the support of NATO and other international institutions[72].

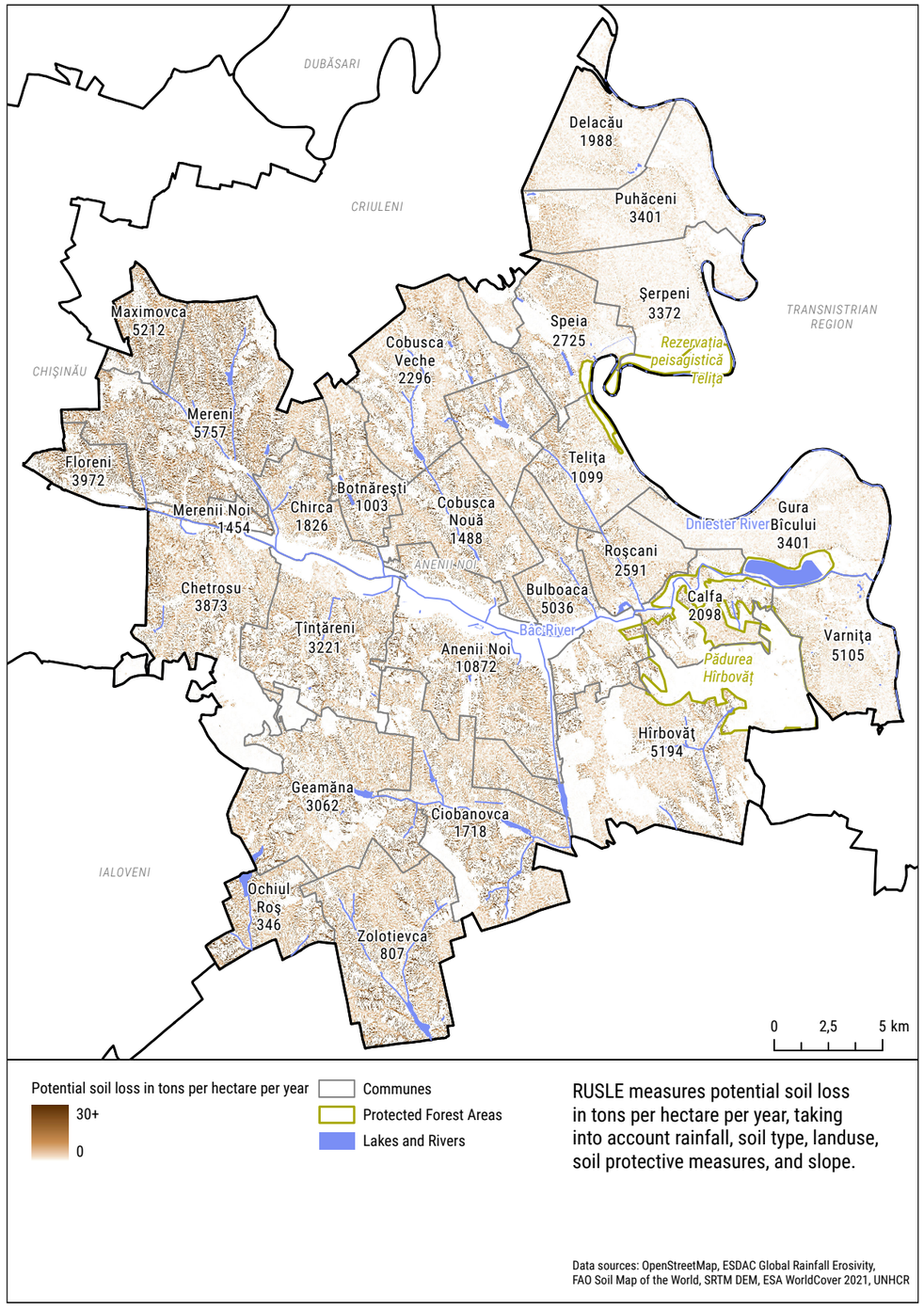
In the late 1990s, the "Land" program was implemented, in which farmers became landowners, receiving documents on their land shares. The average size of one land share was 1.38 ha. There are approximately 1.2 million citizens that possess the right to the allocation of a land share, and this led to fragmentation in land management policy and application[73]. Currently, there are varied issues in soil fertility, durability, and agricultural production: 62% are "slightly eroded", 26% "moderately eroded" and 12% "heavily eroded status"[10, 74].

Around 2% of the surface area of the Bâc River basin is composed of landslides, and these areas are more vulnerable to collapse in heavy rains, which may pool in uneven landscapes[48].

Table 2.8 Soil types in Anenii Noi Raion by Percentage[78]

Soil Type	Percent of Area
Luvic chernozems	29,99%
Calcic chernozems	28,67%
Haplic chernozems	15,75%
Calcaric fluvisols	10,29%
Haplic kastanozems	5,67%
Eutric fluvisols	4,47%
Mollic gleysols	2,90%
Orthic luvisols	2,20%
Haplic phaeozems	0,04%

Map 2.8 Potential topsoil erosion in tons per hectare per year in Anenii Noi Raion in 2023



Landslides can also affect water quality, increasing turbidity and chemical compositions.

Soil is protected in Moldova, under Chapter V, Section 1, Articles 33-43, which promotes maintaining soil health with sustainable agriculture and reduced fertilizers and pesticides, and the goal of less than 5 tons of topsoil erosion per hectare per year to maintain a positive balance of humus[65]. The loss of topsoil can cause soil acidification, reduced available nutrient loads, and contamination of water sources[74].

Soil erosion can reach as high as 30 tons ha^{-1} $year^{-1}$ across the country, including Anenii Noi Raion. The Revised Universal Soil Loss Equation (RUSLE) shows the geographic distribution of potential topsoil erosion, with the highest potential loss in the western part of the region and the lowest potential loss in areas with forest cover, such as Pădurea Hîrbovăț in the southeast (**Map 2.8**).

RUSLE uses six factors to determine potential topsoil erosion risk: rainfall intensity, soil erodibility, length and slope, cover management, and conservation practices[75]. The primary drivers of erosion in Anenii Noi are slope and landcover: higher slopes and unprotected soil are significantly more likely to experience erosion. Torrential rain affects around 80% of agricultural land, and is of concern in the warm months[72], and topsoil erosion can be affected by prior drought.

The majority of topsoil in Anenii Noi Raion is a chernozem type (74,51%), with luvic, calcic, and haplic subtypes (**Table 2.8**). Chernozems are nutrient-rich soils that are well-regarded for agricultural purposes, and every 100 tons erosion results in humus losses, with their nitrogen, phosphorus, manganese, boron, cuprum, zinc, molybdenum, and other trace elements[76]. In eroded chernozems, these substances' losses make 25-75% from their initial proportion, resulting in degraded soils and potentially affecting crop yield and ecosystem resilience.

Recommended action:

1. Continued adherence to Articles 34 and 35 in Law 1515 to improve degraded land, use a single subsystem for soil quality monitoring, reduce fertilizer and pesticide use, determine appropriate crop rotation, and the establishment of protective forest curtains with support for smallholder farms from the National Environmental Fund[65].
2. Support to farming associations and local NGOs to promote community participation and capacity-building, particularly with soil conservation and low-cost protection measures that are appropriate to crop rotation for the region.
3. Collaboration with the Moldova Soil Conservation Project and Staţiunea Didactică Experimentală „Chetrosu" for soil and agricultural information targeted towards Anenii Noi Raion in particular.

2.9 HAZARD - FLOOD

Hazard Description

Moldova experiences semi-regular flooding, and is classified as "high" risk for urban floods by GFDRR's Think Hazard tool. The history of flooding in the Dniester has been chronicled since 1146, starting in the Hypatian chronicle, and severe floods have seen a sharp upward trend since 1947[78]. Floods have increased from 1 in 16 years in the 12th century to 1 in 10 years, with an increased likelihood of catastrophic floods since 1980[78].

Following a severe drought in 2007, Moldova saw significant flooding the following year, affecting predominantly the Prut and Dniester River[79,80]. Across Ukraine and Moldova, this caused over $120 million USD in damages, flooded 7,500 ha of agricultural land, resulted in 40 deaths and displaced 30,000 people[79,81]. Another heavy flood occurred in 2010, affecting over 1,600 families[82]. As average annual rainfall has been variable over the previous 120 years, with a slight trending increase in the 5-year mean (**Figure 2.9.1**), this could increase the risk of catastrophic and deadly floods.

Figure 2.9.1 Observed Average Annual Precipitation of Moldova (1901-2021)[51]

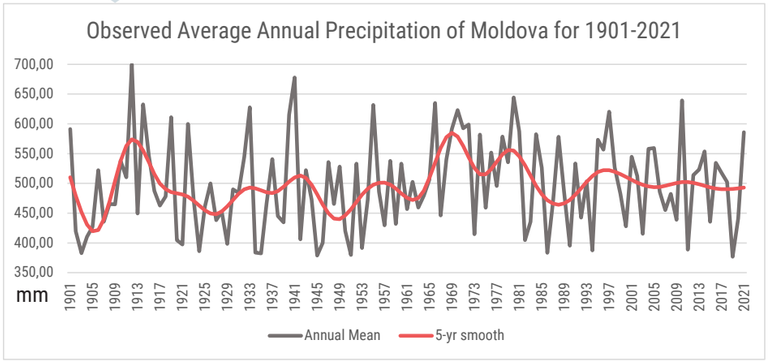
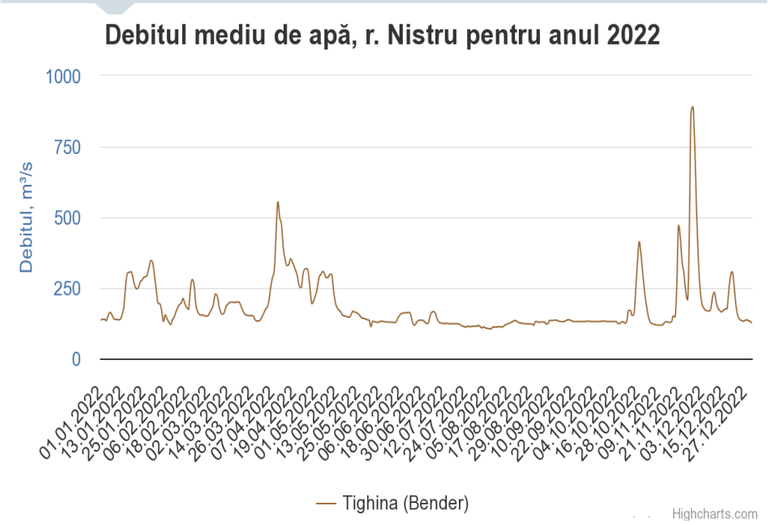


Figure 2.9.2 Median flow of water in the Dniester river at Tighina (Bender) Water Monitoring Station (2022)[33]



Flood risk in Anenii Noi Raion (**Map 2.9**) was determined by using a weighted combination of global rainfall, slope, landcover, and river flow data[83]. High rainfall is known to be a factor in historical flooding, and average precipitation is around 450-550mm per year[78,10].

The highest risk drivers of floods in the area of interest are the proximity to rivers, such as the Dniester River to the east and the Bâc river through the center of the raion; lowlands, such as Gura Bîcului; and areas with high rainfall, such as Zolotievca. As the Bâc flows into the Dniester, communities to the south and east in Anenii Noi are more at-risk of floods, particularly seasonal ones, such as following snowmelt in the spring, though late-autumn can also see higher-than-average river flows (**Figure 2.9.2**).

Anenii Noi Raion has approximately 7,4% of its territory vulnerable to regular flooding by runoff, and the same is at risk of regular flooding from river overflow[84]. The most at-risk areas are the Bâc River basin and Gura Bîcului, though change in rainfall patterns may also change risk profiles.

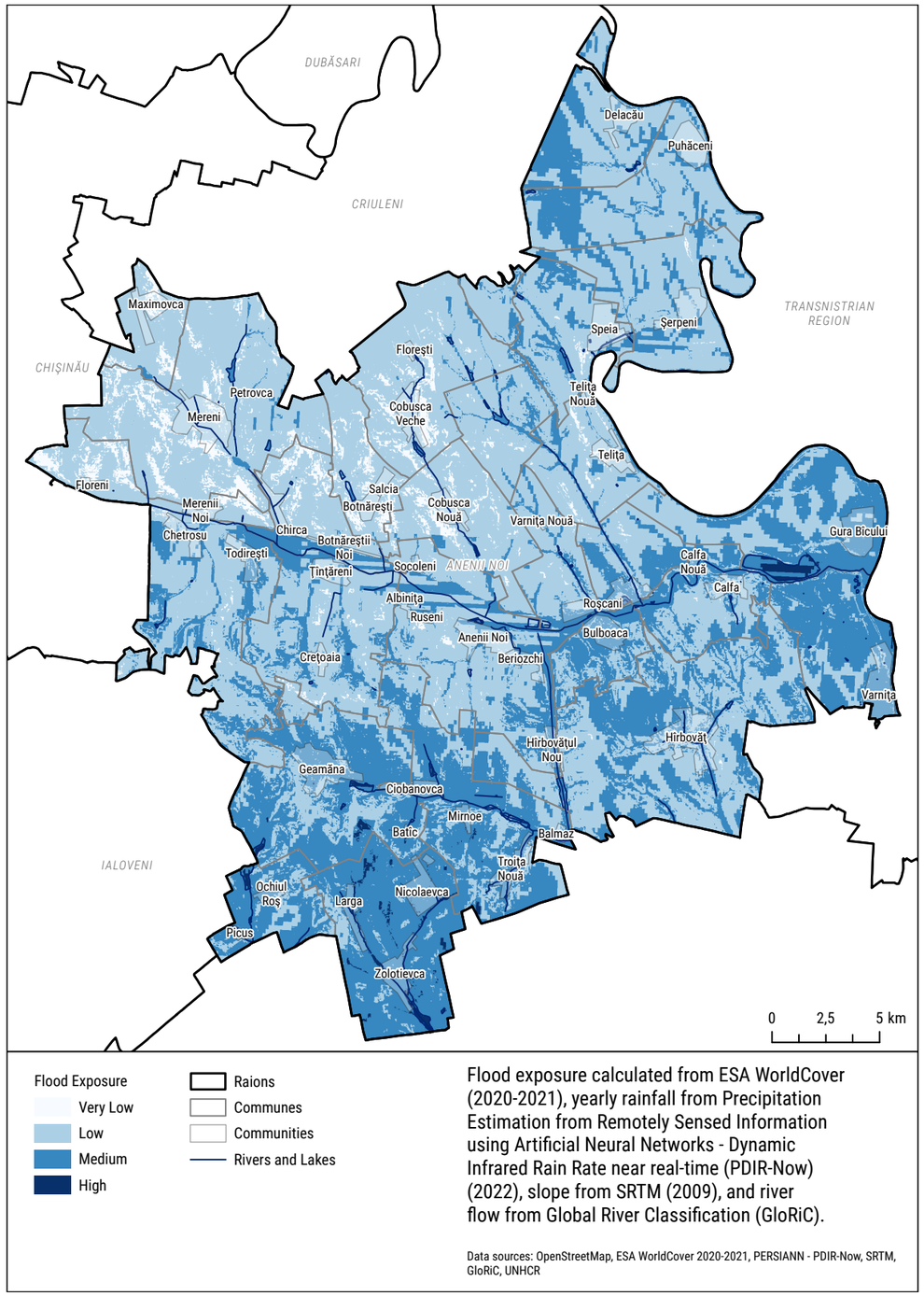
Seasonal floods are somewhat predictable, but flash floods are particularly dangerous, as they have rapid onset and unpredictable currents. As little as 15cm of water can push over an adult, and 30cm of water can carry a small car[2]. Low visibility conditions, such as low light or heavy rain, can conceal the depth and flow of water, and increase risk of injury or death.

Floods can also carry sewage, pesticides, and other runoff pollutants, contaminating groundwater and soils. These can then affect the quality of water for household and industrial uses, including potable water.

Recommended action:

1. Public awareness campaigns to inform citizens of flood safety measures, such as avoiding driving through water and contaminants in floodwater.
2. Continued monitoring of river levels and speed, early warning systems for potential floods using the four-color system and Proiectul Suport de Asistență Tehnică și Management în vederea Protecției împotriva Inundațiilor a teritoriului Republicii Moldova (SATMPI) maps[35].
3. Inspections of flood protection measures, such as the dike in Șerpeni[46], and nature-based solutions for flood risk mitigation.

Map 2.9 Flood Exposure Index (2022), Anenii Noi Raion



1.10 HAZARD - AIR POLLUTION

Hazard Description

Moldova as a whole has acceptable air quality, with lower levels of air pollution than its neighbors. The country has 17 monitoring stations for measuring air quality, and the highest concentrations of pollutants are around the capital, Chișinău, and areas with power plants, such as the Cuciurgan power plant, which is in the south[85].

Currently, there are no reliable sources of data on carbon emissions from public buildings, and discussions are underway to develop a strategy of measurement and mitigation.

Air pollution is generated both by anthropogenic and natural processes. Sources include gases (e.g. ammonia, carbon monoxide, sulfur dioxide, nitrous oxide, methane, CFCs); particulates, and biological molecules.

Air pollution poses a major threat to health and climate, causing around seven million premature deaths annually, primarily due to stroke, heart disease, chronic obstructive pulmonary disease, lung cancer, and acute respiratory infections[86].

Since July 2018, the European Space Agency Sentinel-5P satellite mission has been collecting global atmospheric data on carbon monoxide (C), nitrogen dioxide (NO_2), formaldehyde (HCHO), sulfur dioxide (SO_2), and aerosol concentrations in the atmospheric column. Data from Sentinel 5-P was averaged across the study area from January to December 2022.

Windspeed was also evaluated, but did not display a significant spatial pattern in Anenii Noi Raion. The average windspeed was between 5,79 and 5,92 m/s, determined by averaging data from FLDAS: Famine Early Warning Systems Network (FEWS NET) Land Data Assimilation System across the study area. The slightly higher value was observed in the northwest and the slightly lower value was observed in the southeast.

Carbon monoxide is a byproduct of incomplete combustion of fuels, such as coal, wood, and gas[85]. This may come from vehicles, heating, coal power plants, waste disposal, and biomass burning. Approximately 40% of CO comes from natural sources like volcanic eruptions, emission of natural gases and forest fires, and 60% comes from human activities[86].

Levels of carbon monoxide in Anenii Noi Raion are higher in the northeast (**Map 2.10.1**), which may partially be attributed to the higher overall levels of carbon monoxide in the Transnistrian region, particularly the industry-heavy Tiraspol.

Monthly patterns of CO rise and fall are similar in Anenii Noi Raion as the mean for all of Moldova (**Figure 2.10.1**), but at slightly higher levels.

Long-term exposure to higher levels of CO can result in memory problems, flu-like symptoms, heart disease, and breathing problems[87]. CO can also contaminate soils, affect the upper layers of water and algae production, and reduce the oxidative ability of

Figure 2.10.1 Monthly dynamics of CO concentration in the air from May 2018 to July 2020[85]

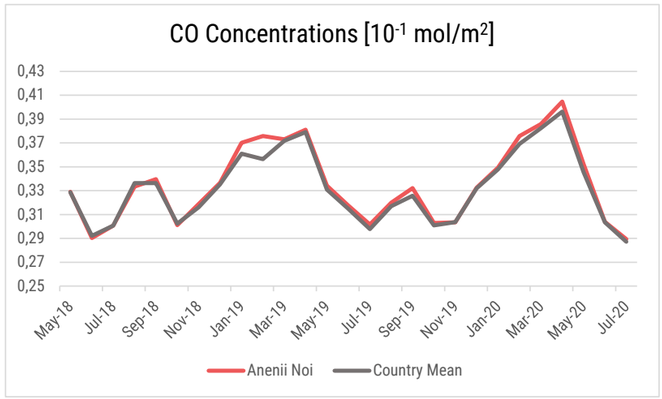


Figure 2.10.2 Monthly dynamics of NO_2 concentration in the air from May 2018 to July 2020[85]

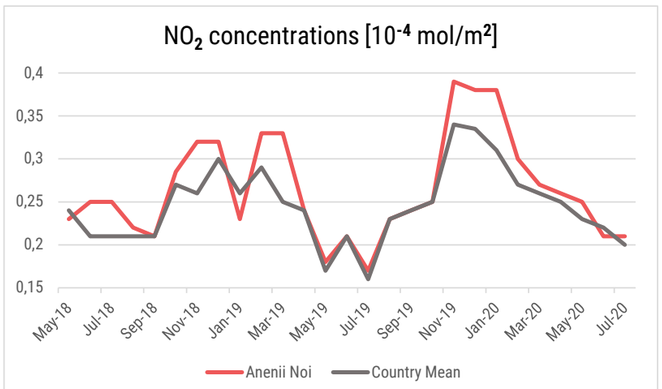
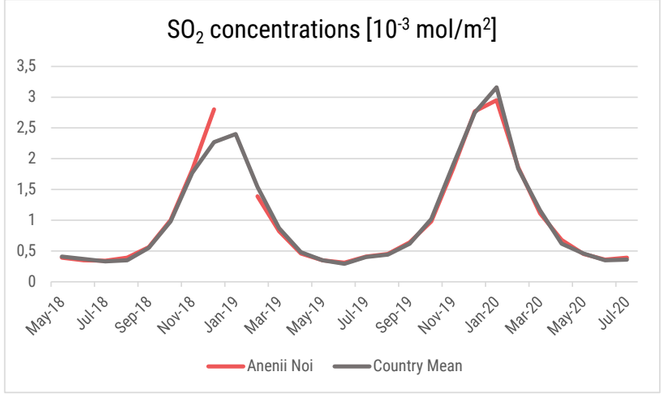
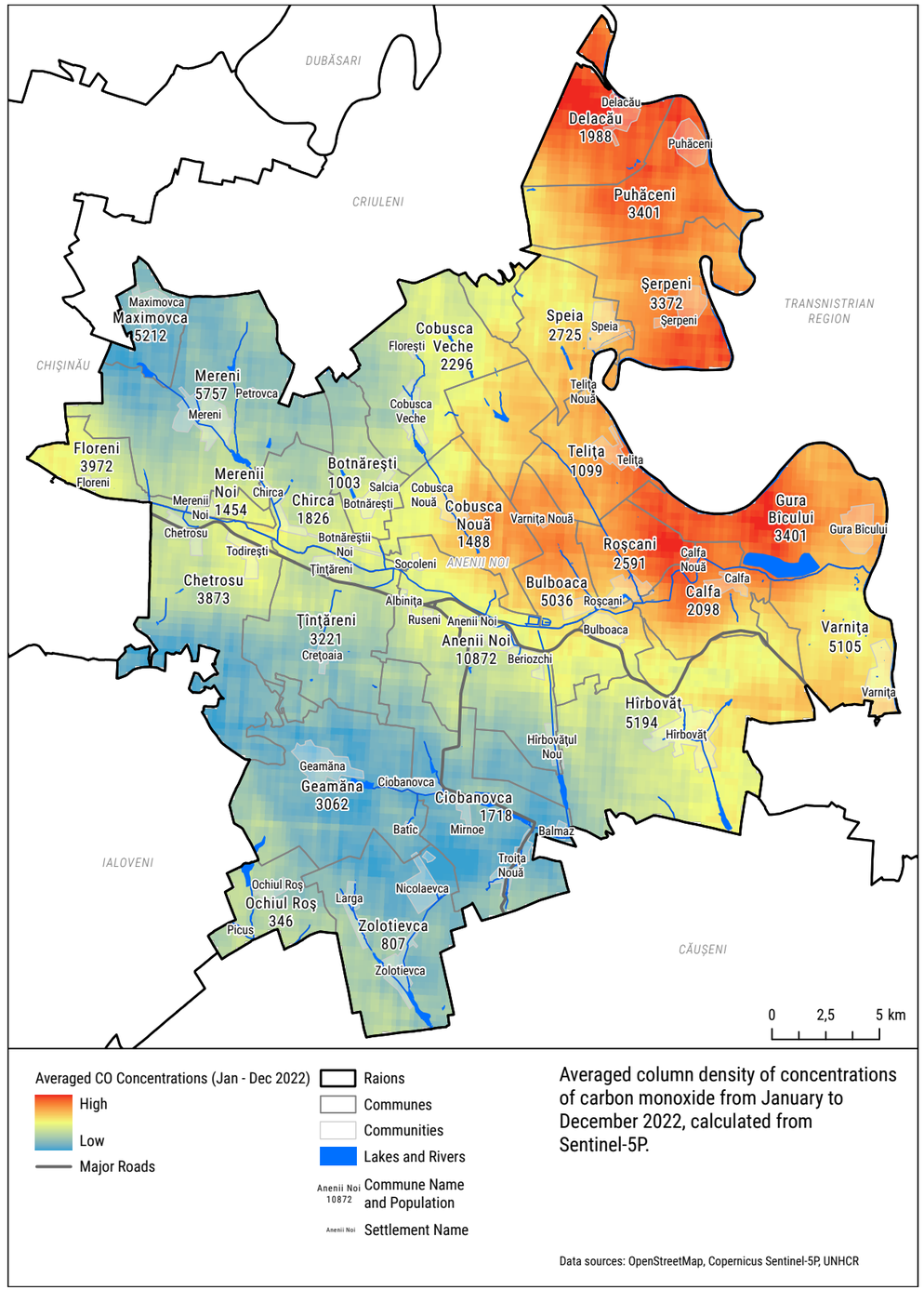


Figure 2.10.3 Monthly dynamics of SO_2 concentration in the air from May 2018 to July 2020[85]

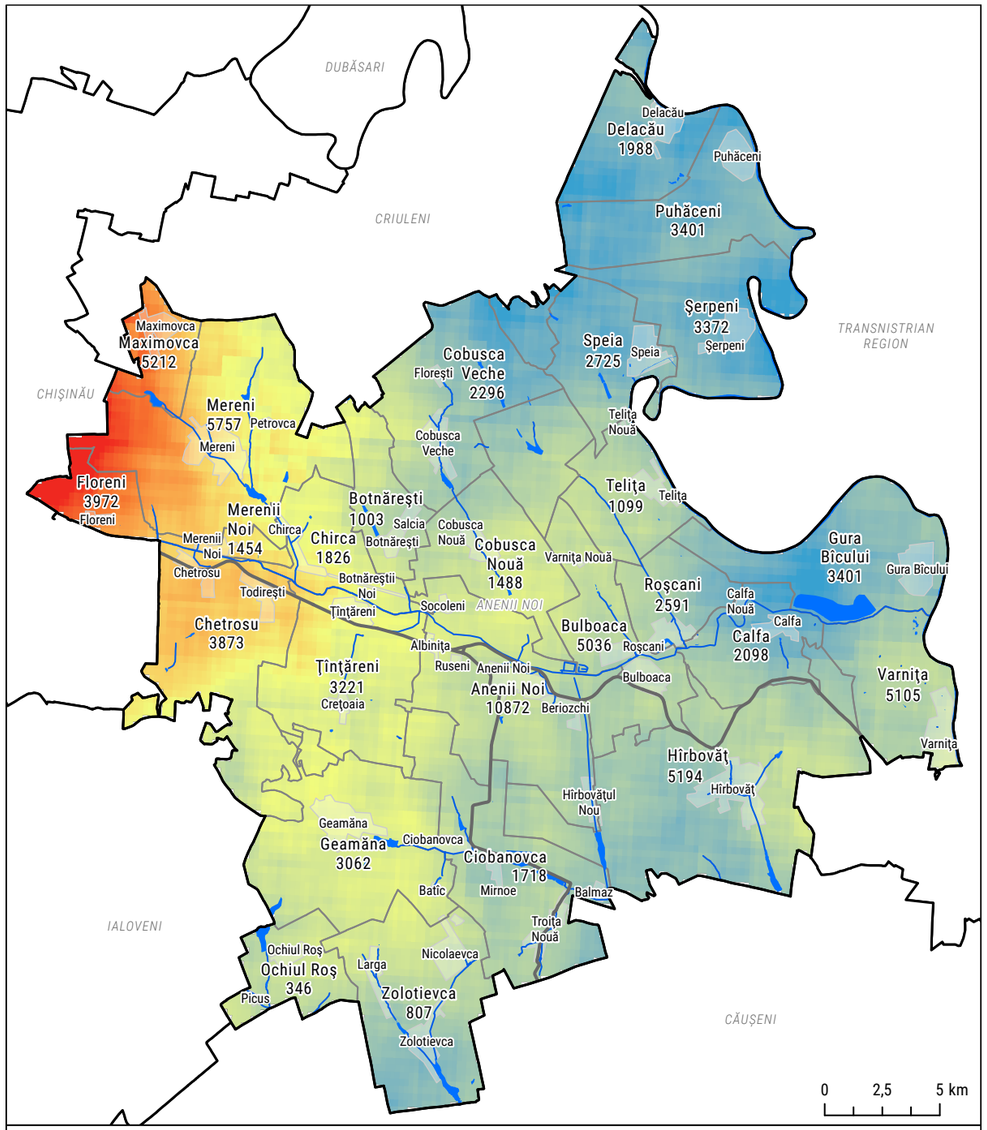


Map 2.10.1 CO column density concentration in Anenii Noi Raion (January - December 2022)



2.10 HAZARD - AIR POLLUTION: NO_2 AND HCHO

Map 2.10.2 NO_2 column density concentrations in Anenii Noi Raion (2000-2022)



Averaged NO_2 Concentrations (Jan - Dec 2022)
High
Low
Major Roads

Raions
Communes
Communities
Lakes and Rivers
Anenii Noi 10872 Commune Name and Population
Anenii Noi Settlement Name

Averaged column density of concentrations of nitrogen dioxide from January to December 2022, calculated from Sentinel-5P.

Data sources: OpenStreetMap, Copernicus Sentinel-5P, UNHCR

the atmosphere[88].

Nitrogen dioxide (NO_2) is mainly produced by vehicle exhausts, petrol and metal refining, electricity generation from coal-fired power stations, and other manufacturing industries and food processing. According to UNDP, Anenii Noi Raion is within the top five highest average NO_2 pollution levels. This is likely partially due to its proximity of the capital, Chişinău, which may account for the higher levels of NO_2 in Maximovca and Floreni (**Map 2.10.2**). Slightly elevated levels in Varniţa may be accounted for by higher levels of NO_2 in Tiraspol.

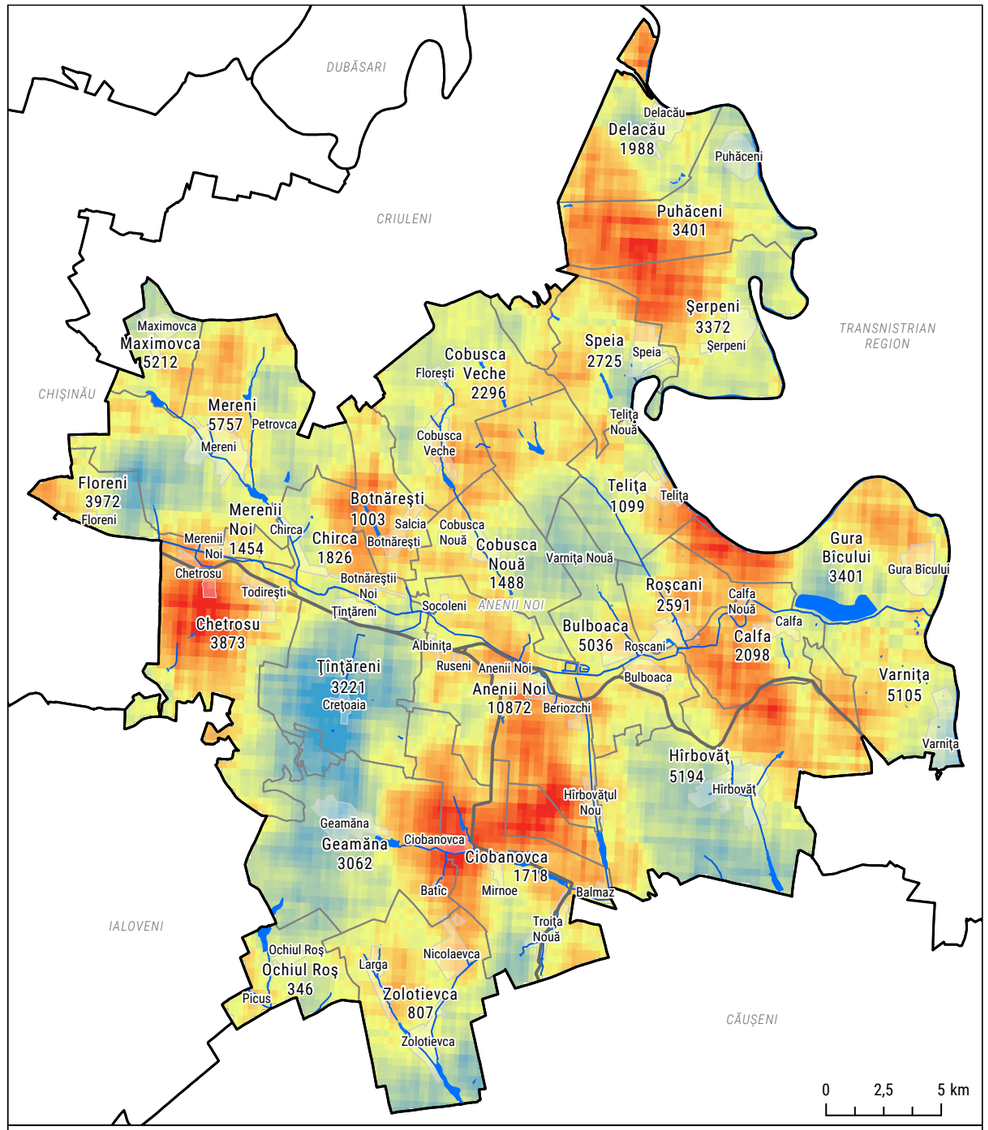
NO_2 concentrations for Moldova follow a similar pattern as the mean for the country (**Figure 2.10.2**), but at overall higher levels, except for January of 2019. Levels of NO_2 are also higher in the winter months, where it may as much double the summer levels.

Long-term exposure to NO_2 can contribute to the development of asthma and respiratory infections, as well as promote the development of acid rain and pollute coastal and inland waters[89].

Formaldehyde (HCHO) can be produced from burning fuels as well as vehicle exhaust. There is not a strong spatial pattern for the distribution of concentrations of HCHO, though some higher concentrations can be seen in Chetrosu, Ciobanovca, Puhăceni, and Şerpeni (**Map 2.10.3**).

The toxicity distance for HCHO is presented in **Table 2.10.1**. and is most hazardous for humans up 5km from the source, but may also have environmental effects, such as contaminating soils and water within 10km of the source. However, HCHO does not accumulate in the human body or environment, being quickly metabolized.

Map 2.10.3 HCHO column density concentration in Anenii Noi Raion (January - December 2022)



Averaged HCHO Concentrations (Jan - Dec 2022)
High
Low
Major Roads

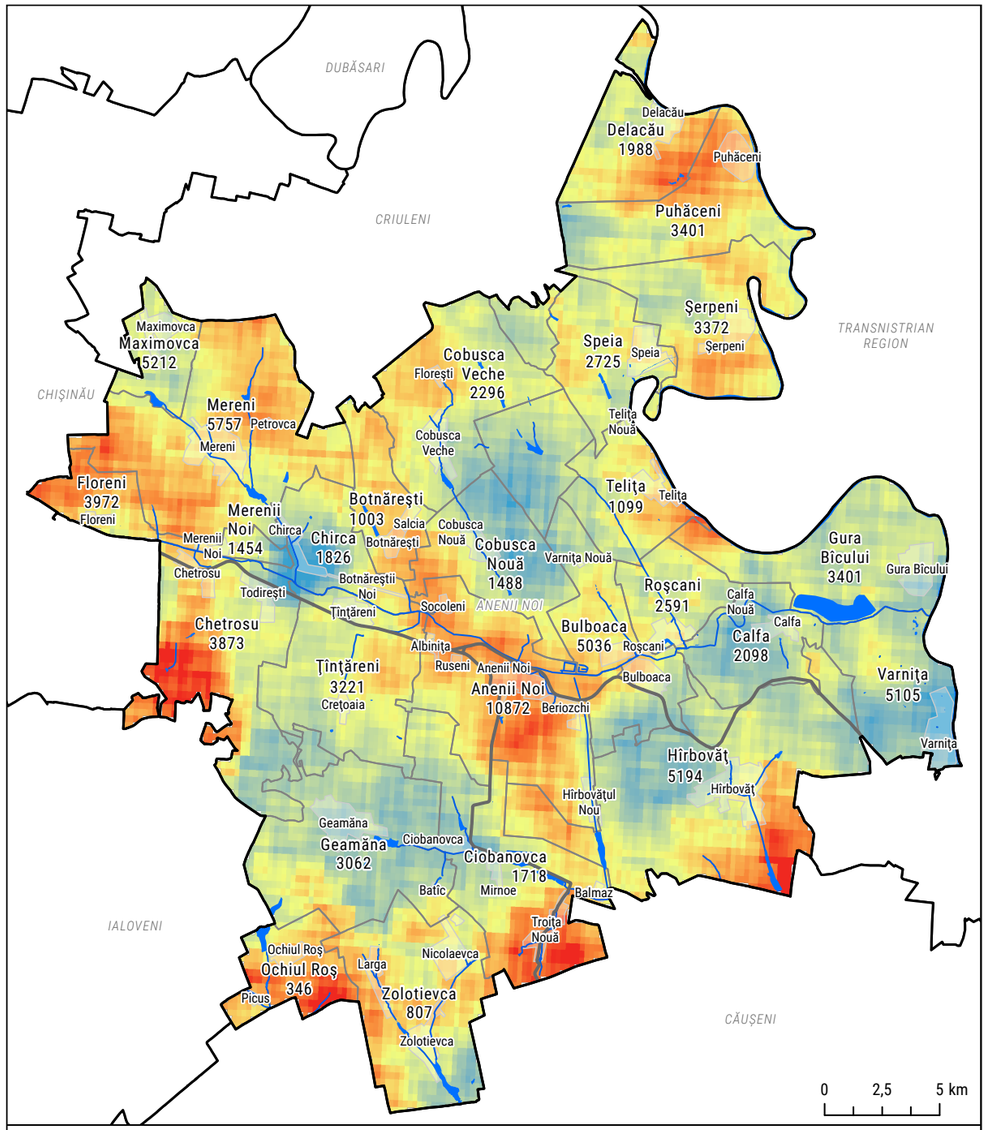
Raions
Communes
Communities
Lakes and Rivers
Anenii Noi 10872 Commune Name and Population
Anenii Noi Settlement Name

Averaged column density of concentrations of formaldehyde from January to December 2022, calculated from Sentinel-5P.

Data sources: OpenStreetMap, Copernicus Sentinel-5P, UNHCR

2.10 HAZARD - AIR POLLUTION: SO_2 AND AEROSOLS

Map 2.10.4 SO_2 column density concentration in Anenii Noi Raion (January - December 2022)



There are no strong SO_2 hotspots across Anenii Noi Raion (**Map 2.10.4**), but higher levels are seen in the west and south.

As with other pollutants, SO_2 in Anenii Noi Raion follow a very similar pattern as the rest of the country, with a notable data gap in January of 2019, where data was not correctly collected (**Figure 2.10.3**).

SO_2 can harm the respiratory system as well as damage foliage and reduce plant growth, and can remain in the environment, acidifying water and result in acid rains[90].

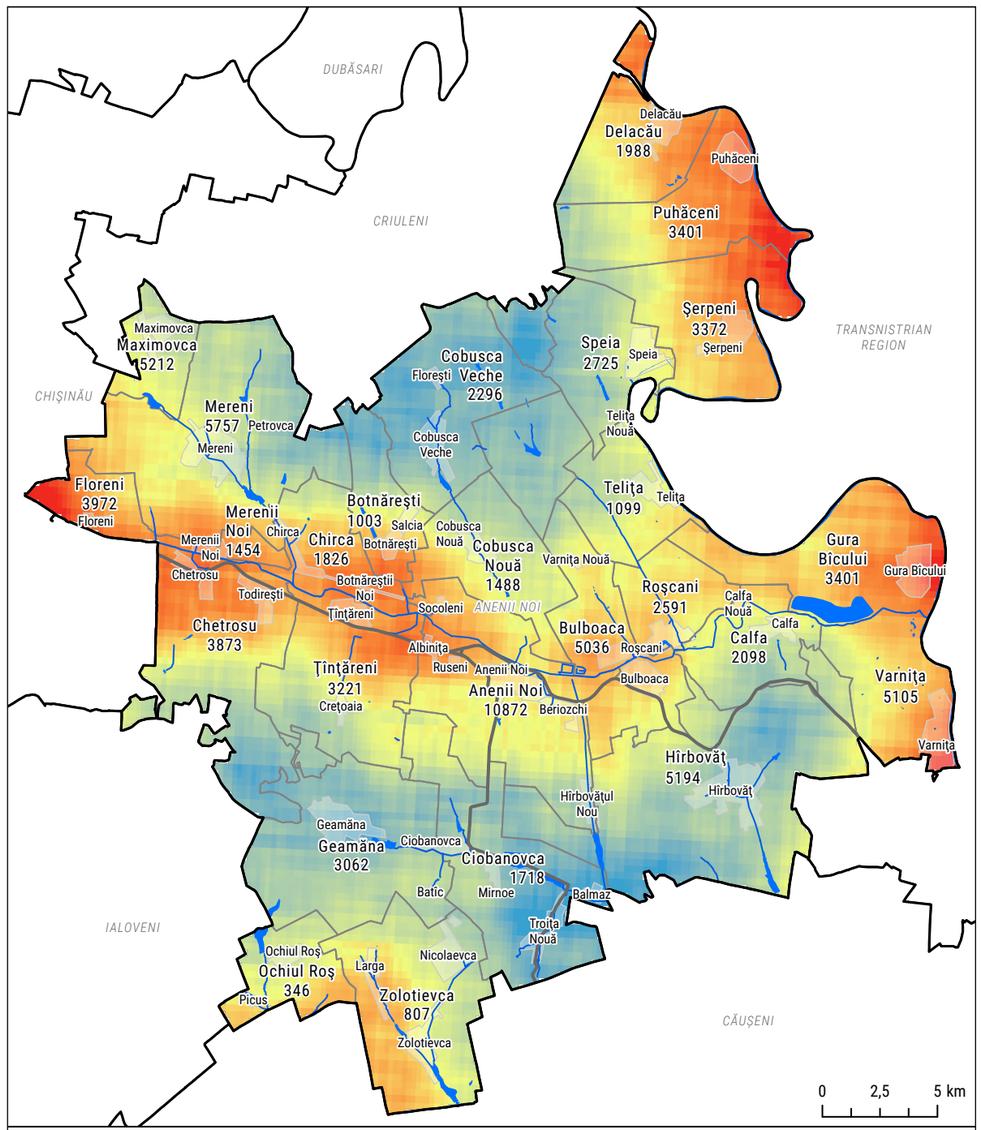
Aerosols are the suspension of fine solid or liquid particles in air[91]. concentrations are highest through the center of Anenii Noi, along the Bâc River, in the west and south (**Map 2.10.5**). Aerosol particles that are smaller than 10 µm effective diameter can enter the bronchi and irritate the lungs[92]. The content of these aerosols is not identified in Sentinel-5P data, but may be dust, ash, or other biomass.

Storm winds can trigger the dispersion of aerosol pollutants across a wider area. Above wind speeds of 5 m/s, dust and ash from bare and degraded land can become disturbed through wind erosion (deflation), potentially polluting nearby soils and water bodies[92].

Wind direction and speed are important aspects of understanding the path of travel for air pollutants. Dominant winds in Anenii Noi Raion are North-West and South-East, at about 3-4 m/sec[10]. According to data from FLDAS: Famine Early Warning Systems Network (FEWS NET) Land Data Assimilation System, there is not a significant difference in windspeed across the raion. However, more granular data may present a clearer model of dispersement and concentrations relevant to individual communities.

Methane (CH_4) is a hydrocarbon that

Map 2.10.5 Aerosols column density concentration in Anenii Noi Raion (January - December 2022)



2.10 HAZARD - AIR POLLUTION

is a primary component of natural gas[48]. It is also a GHG, so its presence in the atmosphere can affect the earth's temperature and climate. CH_4 is the second most abundant anthropogenic GHG after carbon dioxide (CO_2): it is approximately 20 percent of global emissions, and is more than 25 times as potent as carbon dioxide at trapping heat in the atmosphere, making it a major concern for meeting climate goals[48].

CH_4 is emitted from landfills, oil and natural gas systems, agricultural activities, coal mining, stationary and mobile combustion, wastewater treatment, and certain industrial processes[48].

The highest concentrations of CH_4 are in the northeast and southwest of Anenii Noi Raion (**Map 2.10.6**). Concerns over CH_4 and other emissions from the Ţînţăreni landfill may be at too small a scale to appear on these map, though emissions and processing are described in greater detail in **Section 2.12**.

CH_4 emissions in Moldova have dropped considerably from 1990: 550 kt of CO_2 equivalent in 1990 to 3287 kt of CO_2 equivalent in 2020[46].

While concentrations of air pollutants in Moldova are generally acceptable, there are risks of continual exposure to pollutants such as HCHO and CH_4. According to FEAT methodology, HCHO as a gas represents a significant exposure threat to both human life and the surrounding environment, with 11 hazard classifications appropriate to HCHO (**Table 2.10.1**). CH_4 is evaluated as a gas and liquid (**Table 2.10.2**), and predominantly as a threat to human health. Both HCHO and CH_4 can represent long-term threats to the environment, which is not the focus of FEAT methodology, and not represented in the exposure tables.

Recommended action:

1. Continuation of air quality announcements using the color-coded system, with consideration for access to different messaging platforms, public information campaigns for grassroots efforts to lower GHGs and safety risks, as well as first-aid treatment for contact.
2. Analysis of emissions from public buildings and processes for more targeted reductions, with attention to the widespread use of biomass burning for energy use (consider **Figure 3.3**)
3. Strategize for both mitigation and removal approaches: diverse forest stands, building with biomass and low-carbon concrete, reduced reliance on plastics and petroleum products for packaging and storage, investment in wind and solar energies, updating manufacturing process and plants, etc. Nature-based solutions should be prioritized.
4. Continued use of the four-color warning system to alert residents of air quality issues and to take safety measures[36].

Map 2.10.6 CH_4 column density concentration in Anenii Noi Raion (January - December 2022)

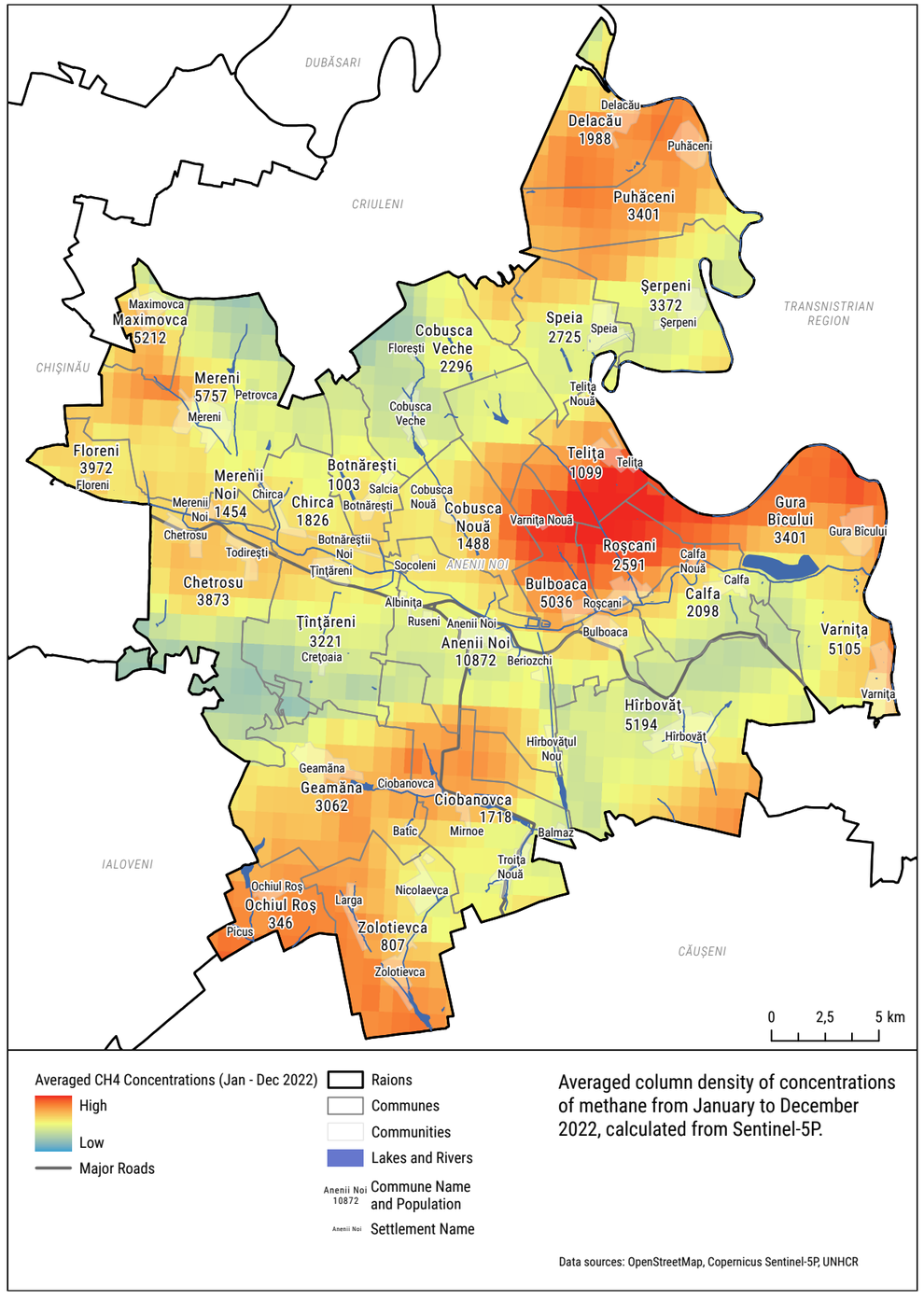


Table 2.10.1 Potential impacts of HCHO (gas)[123]

Hazard		Hazard Impact				
Hazard Classification	Explanation	Human		Environment		
		Lethal (km)	Health (km)	Soil (km)	Lake (km)	River (km)
Acute Tox. 2	Fatal/toxic when inhaled	< 0,1	0,8			
		< 0,1	1			
		0,1	2			
		0,2	3			
Acute Tox. 3	Toxic when inhaled	< 0,1	0,5			
		0,1	0,7			
		0,1	1			
		0,2	1,7			
Carc. 1A, Carc. 2, Muta. 2	May cause carcinogenic, mutagenic, repotoxic mutation	> 5	> 5	> 10	> 4,5	> 10
Resp. Sens. 1	Induces hypersensitivity of the airways	> 5	> 5	> 10	> 4,5	> 10
Skin Corr. 1B, Skin Corr. 1C	Corrosive for skin	contact	contact	1,3 (1 -1,5)	0,2 (0,2 - 0,2)	2 (1,3 - 2,7)
Skin Sens. 1	Irreversible damage to skin	contact	contact	> 10	1,8 (1,5 - 2,1)	> 10
STOT SE1, STOT RE1	Significant health effects	> 5	> 5	> 10	> 4,5	> 10
STOT SE 2	Temporary adverse effect	> 0,1	0,3	0,7 (0,6 - >10)	0,1 (0,1 - 7,3)	0,6 (0,5 - >10)
Flam. Gas 1	Extremely flammable	0.2	0,3			
Liq. Gas	Refridgerated, pressurized, liquified	0.2	0,3			
Met. Corr	Corrosive for metal					

Table 2.10.2 Potential impacts of CH_4 (gas and liquid)[123]

Hazard		Hazard Impact				
Hazard Classification	Explanation	Human		Environment		
		Lethal (km)	Health (km)	Soil (km)	Lake (km)	River (km)
Flam. Gas 1	Extremely flammable	0,2	0,3			
Liq. Gas, Ref. Liq. Gas	Refridgerated, pressurized liquified gas	0,2	0,3			

1.11 HAZARD - MINOR HAZARDS

Hazard Description

Other hazards exist across Anenii Noi Raion, but do not have a distinct geographic distribution or do not pose a major hazard that can be analyzed and mapped due to insufficient or incomplete data.

Seismic Risk

All of Anenii Noi Raion lies in a zone of middle seismic risk, with earthquakes potentially reaching Intensity VII in the Medvedev–Sponheuer–Karnik (MSK64) scale[93,94]. MSK64 is a macroseismic intensity scale used to evaluate the severity of ground shaking on the basis of observed effects in an area where an earthquake transpires.

Intensity VII is "very strong": "most people are frightened and try to run outdoors. Furniture is shifted and may be overturned. Objects fall from shelves. Water splashes from containers. Serious damage to older buildings, masonry chimneys collapse. Small landslides."[95].

Seismic activity is monitored through 7 seismic stations in Moldova, located in Chişinău, Cahul, Leova, Soroca, Giurgiuleşti, Mileştii Mici, and Purcari[96]. The station in Chişinău has been active since 1949, and the newest station is Purcari, built in 2013. These stations work in cooperation with The Common Seismic Monitoring System Romania-Moldova.

Since 1790, 24 earthquakes stronger than 5.0M_w (Richter scale) have been recorded on the territory of Moldova, which is roughly equivalent to MSK64 V to MSK64 V[97,98]. The highest magnitude was 8,0M_w, and has occurred up to 7 times, with the final occurring in 1934[97]. On average, strong earthquakes of magnitude M ≥ VI occur ten times or more per century[96].

Recommended action:

- Continue monitoring, with regular public awareness campaigns about emergency safety procedures for civilians, practice drills for public buildings, and well-marked and visible signage for emergency assistance in the circumstances of a dangerous seismic event.
- Regular training for emergency response personnel, including demographics that may have specialized needs in an emergency. Consider reinforcement for critical infrastructure to prevent chemical leakage.

Severe Weather Events

According to the European Severe Storms Laboratory, Anenii Noi Raion has only experienced 21 severe weather events since data collection began in 2010[99]:

- Hail (9): Hailstones that have a diameter (in the longest direction) of at least 2,0 centimetres, *or* hailstones that form a layer of 2,0 cm thickness or more on flat parts of the earth's surface
- Strong wind (7)*: A severe wind gust is a gust measured to have a speed of at least 25 m/s *or* one doing such damage that a wind speed of 25 m/s or higher is likely to have occurred.
- Lightning (2): Any lightning phenomenon which has caused important damage to aircraft, vehicles, ships or structures, or which has injured or killed people or animals. Any “exceptional lightning phenomenon” which has caused - or is capable of causing – important damage.
- Heavy rain (2): Heavy rain defined here as rain falling in such large amounts, that significant damage is caused, or no damage is known, but exceptionally high (as determined by Wossow (1922) and Nachtnebel (2003)) precipitation amounts have been observed within a period of at most 24 hours.
- Heavy snow (1): Snowfall (or snow grains) and/or snowstorm in an amount that causes important disruptions of daily life and/or considerable material or economic damage.

In comparison, the whole of Moldova has experienced 726 severe weather events since data collection began in 2006, with around half being "hail" events[99].

**Anenii Noi Raion does not display significant spatial differences in wind speed (in 2022: average of 5,9 m/s in the north, average of 5,7 m/s in the south, according to FEWS NET.)*

Recommended action:

- Continue monitoring, with regular public awareness campaigns about emergency safety procedures, practice drills for public buildings, and well-marked signage for emergency escape routes and assistance for a severe weather event.
- Continue the use of the four-color system to indicate severity of risk and broadcasting changing information on media platforms (e.g.: television, Facebook, Telegram/WhatsApp/Viber groups, etc.) with consideration for vulnerable groups and access to various platforms.

Diseases and pandemics

As patterns of temperatures and precipitation change, so too can patterns for vegetation and vector-borne disease[5]. Increased temperature or precipitation can extend the warm and humid seasons, which are ideal conditions for breeding for some insect species, such as mosquitoes[38], ticks[100], and sand flies[101].This could increase risks of diseases such as malaria, Lyme disease, and leishmaniasis, should temperatures and precipitation trend upwards as predicted in multiple RCP scenarios.

Both zoonotic and anthropogenic illnesses can be affected by these changes in climate, which may be an important consideration for vaccination campaigns for livestock farmers and businesses that process animal-based products.

Recommended action:

- Incorporating training for potential "new" diseases to the region for medical personnel to aid in detection and treatment, and as public awareness campaigns for potential disease vectors and their territories, such as mosquitoes and ticks.
- Cooperation with building standards to improve the protection of the public from pests and disease vectors, such as the use of nets or ecologically-safe control measures. Revisit protocols put in place during the COVID-19 pandemic and evaluate effectiveness in the population to strategize for increased effectiveness in pandemic planning.

Human health

In comparison with all raions in Moldova, Anenii Noi Raion does not have a strong vulnerability in terms of life expectancy: it has comparatively medium-high life expectancy (66,2 years for males, 73,4 years for females) and a low infant mortality rate (663-859 deaths per 100,000 people for less than one year) and a medium-low mortality rate for youths (32-49 deaths per 100,000 people for ages 1 to 19 years)[102].

However, Anenii Noi has a higher rate of neoplasm mortality than average, with men (271-300 per 100,000) being more affected than women (160-184 per 100,000). It is important to note that not all neoplasms are cancerous, and the term in this case for all new growths, both benign and malignant, but neoplasms are used as indicators of cancers, listed in the below table[102] for death rates per type and risk compared to other raions in Moldova.

Neoplasms (Cancer)	Rate per 100,000	Risk
Digestive	70,50 - 84,90	Medium-low
Respiratory	42,20 - 48.25	Medium-high
Breast	18,92 - 21,85	Medium-high
Genitourinary	38,88 - 46,20	High
Other	37,12 - 41,07	High

Environmental management strategies from decades ago may still have lasting effects: for example, Speia village in Anenii Noi district, has a comparatively very high rate of cancer, which is suspected to be related to the use of pesticides: 46 cases registered in 2020, with a village population of 2800[73].

The impact of soil pollution with tons of pesticides has been documented, which may contribute to the higher rates of neoplasms and cancer[72].

Recommended action:

- Improved campaigns to address dangerous chemical contaminants, such as pesticides, with information campaigns for medical personnel and the public to understand exposure risks and effects.

Landmines and ordnance

Moldova is affected by unexploded objects (UXO), mainly ammunition left over from World War II, and remaining UXO may exist in areas in some regions on the side of the Dniester River where the Transnistrian armed conflict took place in 1992[103]. Despite their potential age, all UXO should be considered dangerous and potentially unstable, due to degradation of the materials used as safeguards against explosion[104].

However, in July of 2020, a total of 120 explosive objects were neutralized across the European nation, including 75 anti-infantry mines found in Teliţa village, in Anenii Noi Raion[105].

Recommended action:

- Continued training for mine detection and demining activities, cooperation with international bodies to identify ordnance and hazards from conflicts past and collaboration with security and environmental groups for the safest methods of disposal.

2.12 ŢÎNȚĂRENI LANDFILL CASE STUDY

Facility Description

In Moldova, there are around 1139 landfills, covering 1224 ha, but fewer than 50 authorized dumps for domestic waste neutralization[106,107]. The amount of solid household waste is has increased: from 2172,8 thousand m^3 in 2008 to 3043.1 thousand m^3 in 2018[106].

The Ţînțăreni landfill is the primary landfill for use for Anenii Noi as well as Chișinău and surrounding areas. It was designed and built between 1984 and 1991, in accordance with Soviet standards, and became operational in 1991. The landfill area is 24.7 hectares, is fenced, and has a single access point for vehicles and personnel[109].

More than 22 million m^3 of solid waste are buried at the municipal landfill, which is approximately half the landfill's capacity and around 600-700 tons of waste are transported daily from the capital[109]. The expected lifespan of the landfill from July 2021 is to December 2032[110].

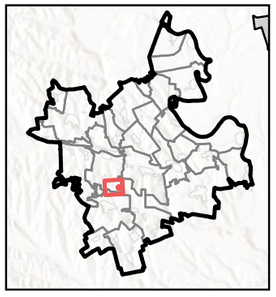
The contract ensuring the storage of garbage from Chișinăun municipality was renewed in December 2021, extending the landuse for three years. It was closed briefly from 2010 to 2017, and waste from the capital was taken to a landfill in Bubueci[109].

The landfill is considered to be a major polluter in the region, but also an essential public service. GHGs, such as CH_4, N_2O, and CO_2, are produced from the aerobic and anaerobic biodegradation of municipal solid waste, with the largest source of GHGs being CH_4 from landfills[109]. Bubbling has been reported on water surfaces, suggesting the production of gases[107]. FEAT methodology showing the distance toxicity for HCHO and CH_4 can be found in **Section 2.10**.

CH_4 is produced when garbage breaks down, and risks spontaneously igniting: a fire broke out in July 2020, when waste began to burn[107,109]. Residents from nearby Crețoaia and other villages complain of the smell of garbage as well as lower water quality, and have staged protests against the continued use of the landfill, blocking the access road in 2017[109].

No landfill gas has been collected and treated, but there is a landfill gas collection and utilisation system on part of the site, which was installed and has been operated by JSK BioGasInter since 2008[94]. It comprises 56 gas collection wells, of which 30 were previously reported to be extracting landfill gas to three substations, from which there is a single pipe that feeds the landfill gas utilization plant to generate electrical energy that is fed into the grid[94]. There is also a flare for backup purposes or to burn any residual gas which is not used by the utilisation plant[91]. The contract between the Chișinău Mayoralty and BioGasInter and their Italian partners (Unendo Energia EpA) to construct and operate the plant for the collection of landfill gas was signed in 2004 and reportedly expires in December 2023[94],

Map 2.12.1 2.8-km buffer area around the Ţînțăreni landfill



0,3-km Distance

Țînțăreni Municipal Waste Facility

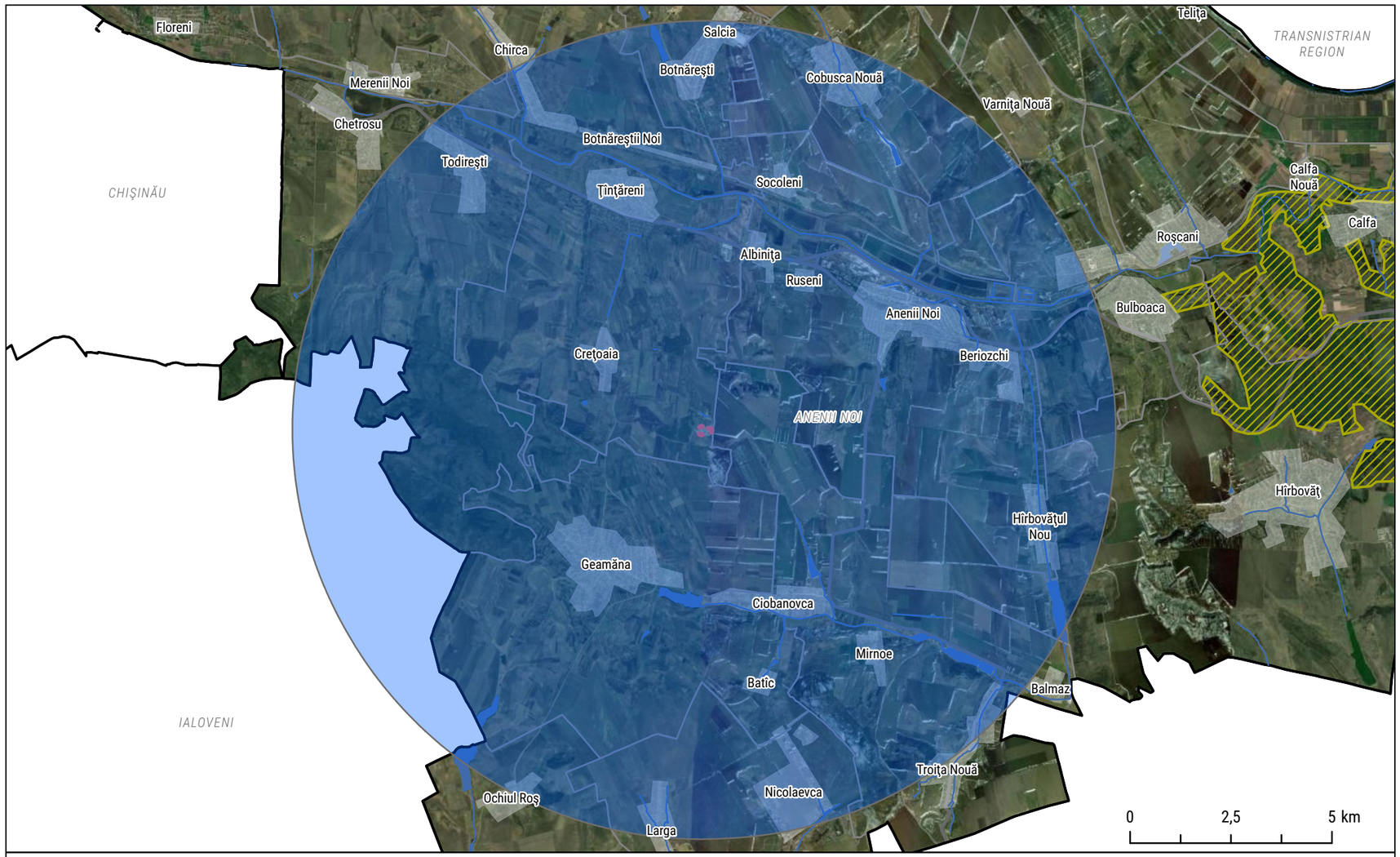
Communities

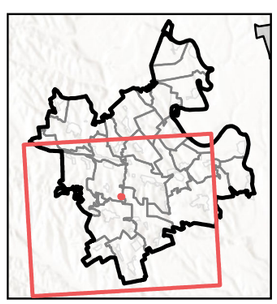
0,3-km buffer shown for the potential health contamination zone for CH4 (methane).

Data sources: OpenStreetMap, UNHCR, ESRI, Maxar, Earthstar Geographics

2.12 ŢÎNŢĂRENI LANDFILL CASE STUDY

Map 2.12.2 10-km buffer zone around the Ţînţăreni landfill





10-km Distance

Ţînţăreni Municipal Waste Facility

Communities

Protected Forest Areas

Rivers

10-km buffer shown for the potential health contamination zone for HCHO (formaldehyde).

Data sources: OpenStreetMap, UNHCR, ESRI, Maxar, Earthstar Geographics

which is approximately 9 years before the expected end of the landfill's lifespan in 2032.

There is a leachate treatment plant as of 2020: leachate was previously collected and stored in six underground tanks with a capacity of 330 m^3, then recirculated by collection from the underground tanks into road tankers with the contents emptied at the top of the landfill[94]. However, now the treated leachate is used for wheel-washing and road-cleaning activities, reducing the leachate returned to the landfill by 60%, but altering chemical runoff risk profiles[94].

The landfill is located on old alluvial formations of the hills on sandy clays, with two small streams that do not have a constant flow of water, and groundwater that can reach as deep as 11m, but the average level is at a depth of 8.5-9.5m[94]. This depth makes the risk of pollution caused by site activities very small, and investigations have not found significant contamination in groundwater[107,94]. There is a low-permeability compacted clay liner with a thickness of 100 cm at the base of landfill, which serves as protection from potential leachate, though discussions on developing a more durable or effective leachate drainage layer as of 2022[107,94,110].

The geologic structure under the landfill is stable, and while leaching was not observed, seismic activity in the area could alter the landscape and risk profiles[94].

The landfill performs an important and essential civil service, but also poses a threat and an inconvenience to those living near it. Residents of nearby villages complain of contaminated water and soils, unpleasant odor, and health problems they believe to be related to the landfill[109].

Recommended action:

1. Continue development of the landfill site to increase protection for leachate and potential soil and groundwater contamination.
2. Conduct detailed hydrological and geological analysis, such as taking groundwater samples of household wells and soil samples from potential contamination zones.
3. Monitor biogas collection and reinforce safety standards such as the flare, and investigate methods of mitigation for nearby communities, predominantly Creţoaia.
4. Discussion with local residents about mitigation measures to improve their quality of everyday life.
5. Public awareness of solid waste processing and plans for the lifespan of the landfill, which is believed to be at approximately half capacity[108,109].

3.1 RESOURCES - HYDROGRAPHY

Description

Anenii Noi Raion is located in the Dniester River basin and the Bâc river sub-basin: the Dniester basin is the largest in Moldova, representing 56.4% of the area and 54% of the total water resources of Moldova, and the Bâc representing 6.2% of the total water resources[63]. The Dniester basin serves 2,1 million inhabitants[63]. The surface water of the Dniester has been classified as appropriate for farming minnows and carps, recreational purposes, and irrigation, but nearly all tributaries, including the stretch of the Bâc River that cuts through the center of Anenii Noi Raion, are classified as "very polluted" (Class V), and water should only be used for electricity generation and transport unless treated[47].

The Bâc river flows at approximately 3 m/s[2] and is used for irrigation, though complaints have been raised about the quality of the water[111]. The basin is 2,150km[2] [47].

Lacul Sălaş, the third-largest natural lake in Moldova, has an area of 3.7 km² and is located in Gura Bîcului, in the east of Anenii Noi Raion[18].

Figure 3.1.1 Average volumes of water in Dniester River (outer ring) and Bâc Rivers (inner ring) (2007-2016 mln.m³)[112]

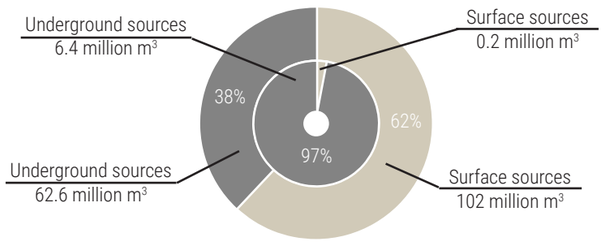
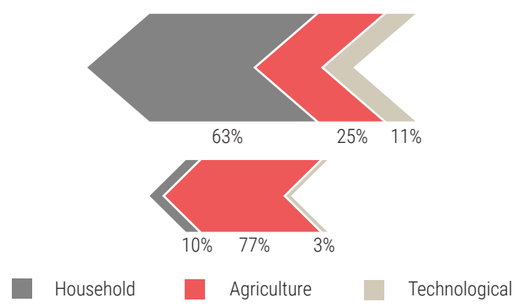
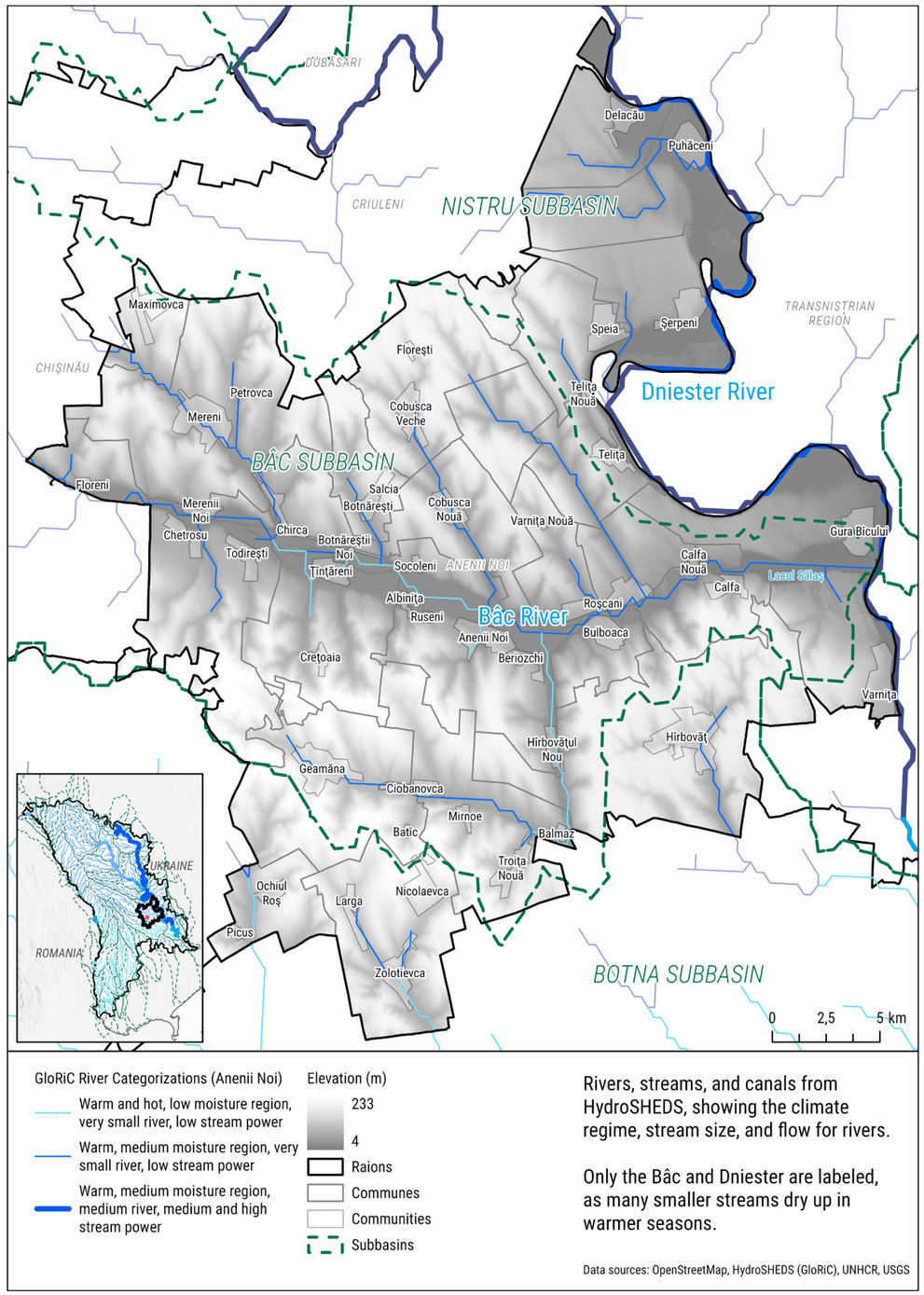


Figure 3.1.2. Water usage in Moldova (top) and Anenii Noi Raion (bottom) (2020)[113]



Map 3.1 River Basins and Primary Rivers and Streams, Anenii Noi Raion



There are three public dams in Anenii Noi: Puhăceni - Şerpeni, Şerpeni - Speia, and Gura Bîcului. As of 2020, all three were in "satisfactory" condition, but the dam in Gura Bîcului is marked as one of the most dangerous for potential rupture or flooding [63,47]. There may be numerous small, private dams and dikes that are not accounted for. These may add additional protection or threat to local households, depending on their maintenance and efficacy.

There are 33 stations across Moldova, with 3 in Anenii Noi, to monitor surface water, managed by Serviciul Hydrometeorologic de Stat (SHS), and 170 wells for monitoring subterranean water[114,47]. The first station was installed in 1960, and monitoring of water level and temperature is done from 1 to 10 time per month, depending on the station, and chemical analysis is done 1 to 2 times per year[114].

Anenii Noi is in the limestone-based Badenian-Sarmatian (N1b-S1) aquifer system, which is covered from Ocnița Raion in the north to Ştefan Vodă Raion in the south, with its western limit at the Prut river basin[110]. This aquifer system is considered to have a "good" general quality of water, though the large size of the aquifer system can mean varying quality throughout[47]. This system represents 90% of potable water resources in Moldova, though in the Bîc hydrographic basin, there has been a loss of volume equal to 15% of the average annual volume of the river discharge[47].

Water usage in the country has also changed: household (55 to 40 million m³) and agriculture (25 to 18 million m³) use has decreased from 2007 to 2017, but has seen a slight increase in technological usage (8 to 11 m³)[113,10]. The source has also changed: surface use has dropped from 70 to 57 million m³, and underground sources have increased from 19 million m³ to 20 million m³ in the same period[113]. This may be related to costs of operation or declining population in the raion.

Recommended action:

1. Continuation of monitoring, with centralized data across the SHS system for comparison and evaluation. Data on unauthorized or unregistered wells and pumps to better understand use of reservoirs and subterranean water use.
2. Database of potential point pollution and critical infrastructure facilities, using the FEAT methodology to evaluate impact on the environment and human populations in appropriate distances, reinforcing safety and operational mechanisms to avoid chemical contamination.
3. Maintenance of dry riverbeds and artificial ponds, which may have higher concentrations of pollutants in their soils, with considerations to the affordability of mitigation measures for private land owners.

3.2 RESOURCES - WASTEWATER AND WASTE MANAGEMENT

Description

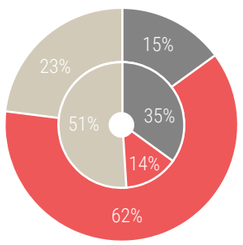
The Dniester River basin discharges an average of 1212,6 thousand m^3 of wastewater annually: around 13% is sufficiently purified, and around 2% is considered insufficiently purified, with the remainder being untreated[47]. This wastewater can come from a variety of sources, and the largest amounts of production waste are generated from the construction materials extraction industry, livestock sector, and food industry[47]. A number of treatment plants, internal and external, are non-operational, and both the Dniester and the Bâc are considered heavily polluted[115].

The primary pollutants in the Dniester (including the Bâc tributary) are pharmaceuticals (42%), pesticides (41%), and industrial chemicals (10%)[112]. The juncture of the Bâc and Dniester Rivers in Gura Bîcului contain the highest cumulative concentration of contaminants, including sewerage[116,117].

Anenii Noi City has extremely low access to the centralized sewerage system for residents of individual houses, with only 4.29% of homes connected to the public sewer network, but 78% of apartments are connected to sewage[118]. In comparison, the national average is 14% (**Figure 3.2**).

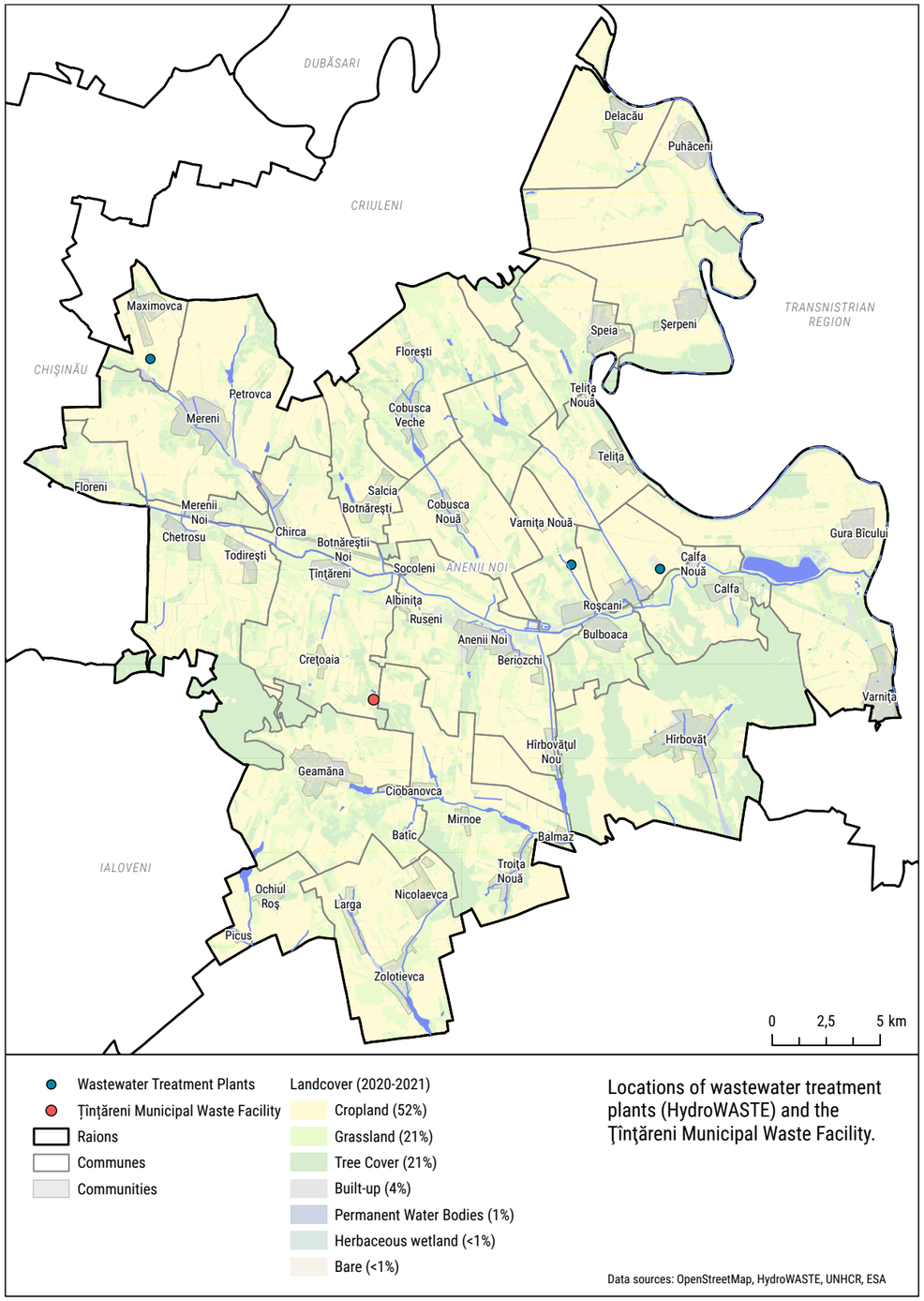
This means that households may rely on open or pit toilets, which may leach contaminants into the soil or into groundwater, and can also be difficult or dangerous to use for young children or persons with disabilities. They also must be covered and redug periodically, as the pits will fill with waste.

Figure 3.2 Households in Moldova with Access to Water Supply System (outer ring) and Sewerage System (inner ring)[18]



Around 79% of residents of the city have facilities connected to the public network: this is comprised of 100% of apartments, and less than 70% of indiviual houses[118]. In comparison, the national average is 62% (**Figure 3.2**). Additionally, Anenii Noi Raion has one of the highest tariffs for public water supply and sewerage services, but the operator covers about 80% of the operational cost for water and about 72% of wastewater collection and treatment[46,114].

Map 3.2 Wastewater Treatment Facilities and Municipal Waste Facility Locations in Anenii Noi Raion



Moldova has 1139 authorized landfills available for domestic waste, though collection may not be accessible in rural areas: in 2010, only 12% of rural localities in Moldova have waste collection and storage[102,46]. The household solid waste generation index is approximately 0,7 kg and 0.5 kg/capita per day for urban and rural areas, respectively, with a rate average annual growth of 1,5%[47].

Anenii Noi Raion has three major wastewater treatment plants (**Map 3.2**) and a major municipal landfill in Ţînţăreni, which is described in greater detail in **Section 2.12**. There are about 140 artesian wells, 130 of which are active[119]. Much of the wastewater infrastructure is old and requires maintenance such as the SEB IM "GLC Speia" and SEB SRL "Merencon", both of which are non-functional, but GLC Speia has undergone some renovations [10,119].

Two of the wastewater treatment plants are only active during parts of the year, predominantly for private agricultural use[119]. SEB IMDP "Apă-canal Anenii Noi" is of regional importance and serves Anenii Noi, ss. Ruseni, Beriozchi, Bulboaca, and Roşcani to provide water for homes and businesses[119].

11 local community stations for capturing and purifying specifically contaminated stormwater are also in operation, as well as one local wastewater treatment station[119].

Rural localities may have another issue with waste: approximately 4.8 tons per year of manure waste is produced, which is only partly composted and used as fertilizer, and the remainder is stored in unauthorized places, and can compose 60% of the volume of waste stored in rural areas[47]. There is currently no collection method for this waste.

Hazardous waste makes up less than 1% of total accumulated waste in Moldova, but there are no facilities for safe storage [47,115]. In 2017, there was 1045,4 tons of hazardous waste, of which 20,6 tons were in Anenii Noi, predominantly related to pesticides[47].

Recommended action:

1. Prioritize connection to water and wastewater services for individual houses and rural areas, with considerations to renovation and maintenance costs to low-income households.
2. Repair and inspection of wastewater processing facilities, both private and public, with routine water quality testing to identify point pollution sources and mitigate environmental impacts using FEAT methodology for potential contaminants.
3. Expand routine waste collection to rural areas to discourage dangerous dumping of waste, and promote public knowledge of scheduling and access.
4. Continuing bids for projects with development programs, such as UNDP, for small-scale renovations, such as wastewater treatment stations, and following OECD recommendations for rural sanitation[120].

3.3 RESOURCES - GAS AND OIL SUPPLY INFRASTRUCTURE

Description

Moldova has been in an energy crisis since October of 2021, with prices increasing after the pandemic, and again after the invasion of Ukraine in 2022, seeing gas price increases that could reach three times the pre-war price[121]. Increasing energy costs affect the public: 60% of Moldova's population live in energy poverty, spending more than 10% of their budgets on energy bills, with 49% of residential energy consumption coming from biofuels, 23% from natural gas, and 4% from oil[121,47].

In 2020, Moldova imported around 1.1 bcm of gas, an -11.1% decrease since 2010[50]. There is a total of 817 km of main/transit pipelines and 1106 km of gas service connection pipelines, with 96 gas delivery stations[50]. Gas distribution networks have a total length of about 25.000 km and supply more than 760.000 residential and non-residential consumers[50].

Around 90% of electricity is generated from natural gas, and most natural gas is used for electricity and heat generation, making up around 30% of the total energy supply of Moldova[123,50].

Moldova has no significant domestic sources of gas, and therefore, all gas is imported. Up until the end of 2014, all gas used in Moldova was imported from Russia via Ukraine[123]. In 2015, this was supplemented with the Iași-Ungheni gas interconnecter between Romania and Moldova, which was extended to Chișinău in 2020[123,50]. As of 2023, due to disputes over debts to Russian-owned Gazprom, Moldova has secured energy from European sources such as Slovakia and the Trans-Balkan pipeline[124].

This is a major change, and may heavily impact the costs of buying gas from Romania, which has smaller pipelines connected to the system and may require support to supply the level of gas that Moldova requires[123].

Moldova also does not have the capacity to store gas, and as of 2023, there are discussions with its western neighbor, Romania, to be stored on this territory[125].

The Tiraspol Transgaz line passes through the northern part of Anenii Noi Raion (**Map 3.3**) This portion is the Chișinău-Râbnița (ChR), which stretches 91,1 km and carries 1,5 billion m^3/year.

Moldova also has no significant domestic sources of oil, and imports more than 99% of its oil, mainly from Romania, which represents 34% of the total energy supply in 2020[50]. In order to diversify energy sources, Moldovan authorities signed a 50-year concession agreement in 2016 with Frontera Resources for the exclusive exploration and development of hydrocarbon resources in the Dobrogea Basin in southern Moldova[50].

Transport is the biggest consumer of oil (71%), followed by industry (12%) and agriculture (12%)[49]. Domestic use is only 5% of the market[50].

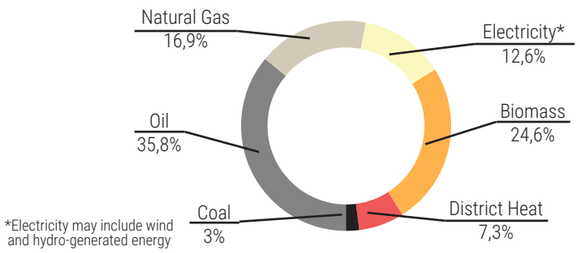
The average consumption per year for domestic users in Anenii Noi Raion has seen a downward trend from 2020 to 2022 (**Map 3.3**). This is potentially related to the energy crisis that began in 2021, and was worsened in 2022: costs have increased, and some residents have reported using less fuel or alternating their fuel sources to control costs[126]. The biggest increases are seen in east and south, with only three communities with increases above 10%: Balmaz (41%), and Hîrbovăț (31%), and Florești (12%). The greatest decrease was Larga (-52%).

According to FEAT methodology, both natural gas and oil transfer through pipelines represent flammable threat as well as threats to human health and the environment[127].

Recommended action:

1. Continue to diversify gas supply routes with Autoritatea Națională de Reglementare în Domeniul Energiei (ANRE) and sector entities, as well as support for low-income households
2. Monitoring stations along pipelines to identify possible ruptures and contingency plans for leakage, including potential

Figure 3.3 Sources of consumed energy for Moldova in 2020[122]



Map 3.3 Gas and Oil Pipeline Network and Change in Usage, Anenii Noi Raion (2020-2022)

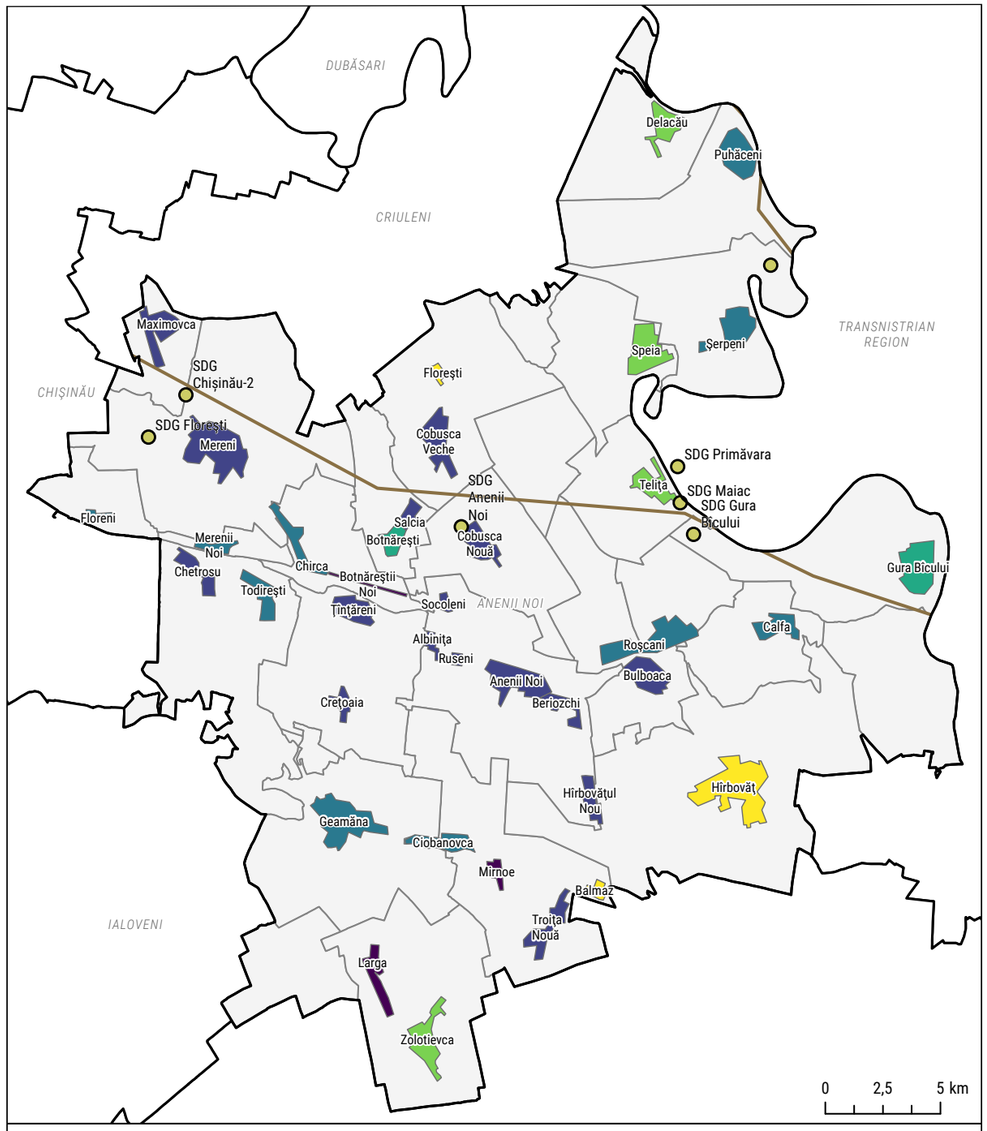


Table 3.3 Potential environmental effects of gas and oil in pipelines[127]

Hazard		Priority Hazard				
Hazard Classification	Explanation	Human		Environment		
		Lethal (km)	Health (km)	Soil (km)	Lake (km)	River (km)
Flam. Gas 1	Extremely flammable	0,2	0,3			
Liq. Gas, Ref. Liq. Gas	Refridgerated, pressurized liquified gas	0,2	0,3			
Aquatic Chronic 3	Reversible adverse effects to aquatic organisms			0.5 km (0.3 - >10)	0.1 km (0 - 3.3)	0.1 km (0 - >10)
Asp. Tox. 1	Severe acute effects	> 5	> 5	> 10	> 4,5	> 10
Flam. Liq 1	Flashpoint < 23 °C	0,4	0,6			

3.4 RESOURCES - ELECTRICITY NETWORK

Description

Moldova joined the Energy Community and has updated its National Energy Strategy for 2030 with objectives to ensure the security of energy supply, develop competitive markets, and ensure sustainability[128]. The country's overall consumption per capita is approximately half the European average at 1.5 tonnes of oil equivalent, 3 billion cubic meters (bcm) of natural gas, and 2,000 KWh of power annually, consuming around 4590 GW total per year[129].

Currently, Moldova's energy self-sufficiency is among the lowest in the world: around 20% of its energy demand is covered by domestic production: two combined heat and power (CHP) plants in Chișinău and Bălți, along with eight small CHP plants, and the hydroelectric plant in Costești[123]. Up until November 2022, the MGRES gas-fired power plant in Transnistria covered the remainder[124].

Moldova's electricity system operates synchronously with Ukraine's, and the neighbouring systems are interconnected by 11 lines of 110 kV and 7 lines of 330 kV, with smaller lines serving communities and residential areas[123]. Previously, the systems between Moldova and Romania, were not operated in parallel, but could function together in "island mode", with 1 line of 400 kV and 4 lines of 110 kV[123,131]. This is currently changing, as Moldova is working towards full synchronization with the European Network of Transmission System Operators for Electricity (ENTSO-E), with a synchronous interconnection in March of 2022[123,122].

Moldova aims to eliminate fluorinated gases by 2050[121], and there are active discussions on making Moldova carbon-neutral by 2035[129]. This could lead to significant change in the energy sector, as Moldova no longer purcahses Russian gas[124], and has experienced interruptions in its international transmission lines.

The Isaccea-Vulcănești-Moldovan (Cuciurgan) Power Plant high-voltage transmission line briefly stopped functioning in November 2022, causing major blackout across Moldova, impacting public transportation and mobile communications as well[124]. The reason for this interruption in function was a dispute over bills, and no damage to the lines was sustained. Electricity returned in a matter of hours, though exact times varied across the country[124].

Another blackout occurred in May of 2023, when the Cuciurgan and the Bălți - CHE Denostrovsk high-voltage line was disconnected[133].

The hydroelectric plant in Dubăsari is vulnerable to extended drought: the possible volume of the reservoir has reduced 63% since 1954[46]. Further reduction could impact operability and energy production.

Moldova also has renewable energy source (RES) stations: a 1.1 MW wind power station near Brătușeni, Edineț; a 320 kW power station on municipal solid waste landfill farm in Ţînțăreni, Anenii Noi; and a 2 MW power station using biogas in Drochia, Drochia Raion[130].

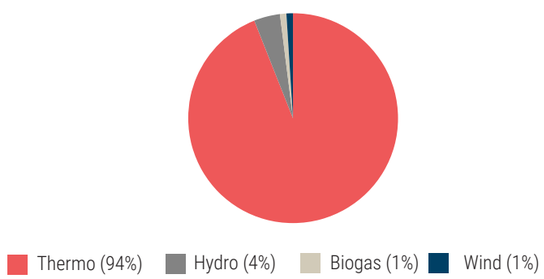
Electricity use in Anenii Noi Raion has largely increased (**Map 3.4**), with 76% of reported communities experiencing an increase in Kw usage from 2020 to 2022. These communities are more represented in the west of the raion, with Batîc in the south experiencing an increase of 117%, followed by nearby Mirnoe with a 73% increase. Calfa Nouă saw the greatest drop at -36%.

As temperatures are expected to continue to increase (**Figure 2.5**), and higher temperatures can reduce the thermal capacity of transmission lines, consideration for reliable, affordable energy is a major concern[36].

Recommended action:

1. Investment in green energy as outlined in the Moldovan Energy Strategy such as wind and biogas can reduce Moldova's reliance of imported electricity and potentially reduce expenses from energy generated from gas and oil.
2. Updating or replacing worn or out-of-date parts of the electric grid, particularly those which have lower thermal tolerance.
3. Support for public building switching to "green" energy sources, incentives from international actors to offset the costs of adapting to new technology.

Figure 3.4 Production and sources of electricity (2023)[127]



Map 3.4 Electricity Network and Change in Usage, Anenii Noi Raion (2020-2022)

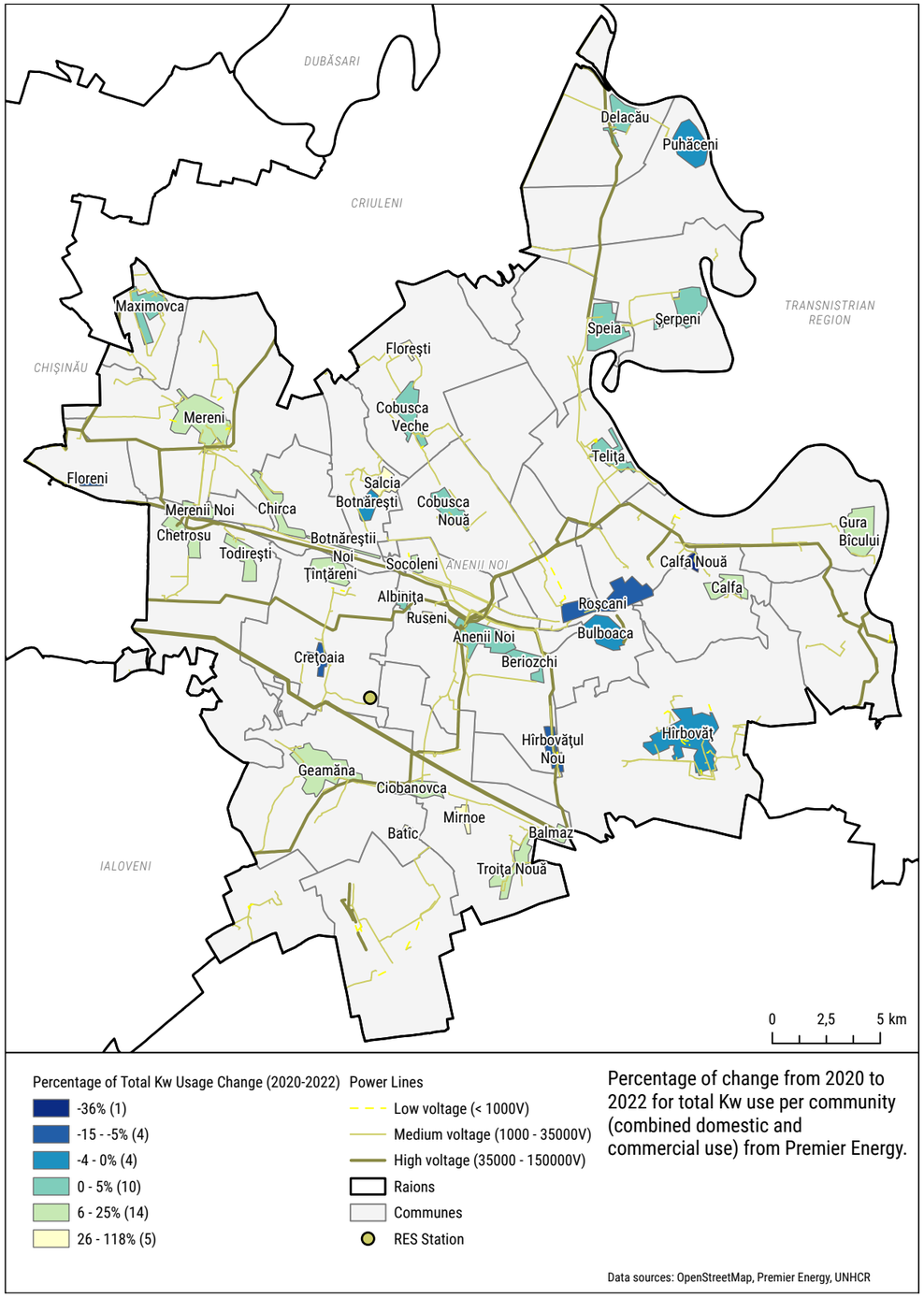


Table 3.4 Renewable Energy Potental[132]

Technology	Technical Potential (GW)
Wind	20,9
Solar PV	4,6
Biomass	0,9
Hydropower	0,8

4.1 NATURAL MULTI-HAZARD EXPOSURE

Natural Multi-Hazard Exposure

The natural multi-hazard exposure analysis was calculated from the combination of hazard indicators 2.1 Wildfires, 2.2 Drought, 2.3 Extreme Temperatures: Heat Waves, 2.4 Extreme Temperatures: Cold Wave, and 2.9 Flood. These were intended to model the most immediate and direct risks that affect the human population, though less-immidiate threats such as biodiversity or soil loss are relevant and should still be considered in adaptation planning.

Values from each hazard were averaged to the boundaries of the settlement, or in the case of wildfires, within a buffer of 580m, which is the range that a vegetation fire could potentially move in an hour, based on average windspeed[134].

These values were then normalized to a 0 to 1 scale in order to compare the relative risk across different hazards. These values were then added together and divided by 5, giving an equal weight of 0,2 to each hazard. **Map 4.1** shows the relative level of hazard per settlement, both in individual hazards (0 - 1) and total exposure by combined hazard index (0 - 1).

Tables 4.1.1-4.1.5 present lists of settlements that show the highest exposure to these selected risks. The most common threat overall was heatwaves, with 70 percent of communities with exposure scores above 0,5. However, the risk with the highest intensity was flood risk, with 36% of communities having exposure scores above 0,75 (**Figure 4.1**).

The southern communities of Batîc, Mirnoe, Larga, and Ciobanovca displayed the highest levels of combined risk, with scores above 0,6. A complete breakdown of communities and individual risks can be seen in **Table 4.1.6**. These communities are considered to be "rural: "Rural" was defined as settlements that had fewer than 1500 people per square kilometer, and settlements above this threshold were defined as "urban". Rural communities are generally assumed to be more isolated from medical assistance and potential breaks in the communication network, potentially increasing the vulnerability to a natural hazard. This is explored in greater detail in **Maps 4.2** and **4.3**.

Overall, communities in the south and center of Anenii Noi saw the highest risk factors, with the exception of Maximovca in the northwest.

Batîc, Mirnoe, and Larga displayed the highest combined scores, but are among the smaller communities in Anenii Noi. This lower population may compound vulnerability, as smaller, rural communities are less likely to be targeted for emergency infrastructure development, which tends to be centralized in larger communities for the widest impact[135]. Rural communities are also more likely to have populations aged 60 and over: 11,5% of the rural population in the country fits within this category[136].

Changes in infrastructure and planning can help to lower the exposure to hazards for communities: forest belt restoration, climate-smart agriculture for land management and irrigation, increased urban green space, insulation for homes and power infrastructure, and dikes and barriers can all help reduce the impact of natural hazards on a population.

*Flood exposure is measured from 1,0 to 4,0, with 1 being "very low" and 4,0 being "high" (**Section 2.9**).

Map 4.1 Natural Multi-Hazard Exposure by Settlements

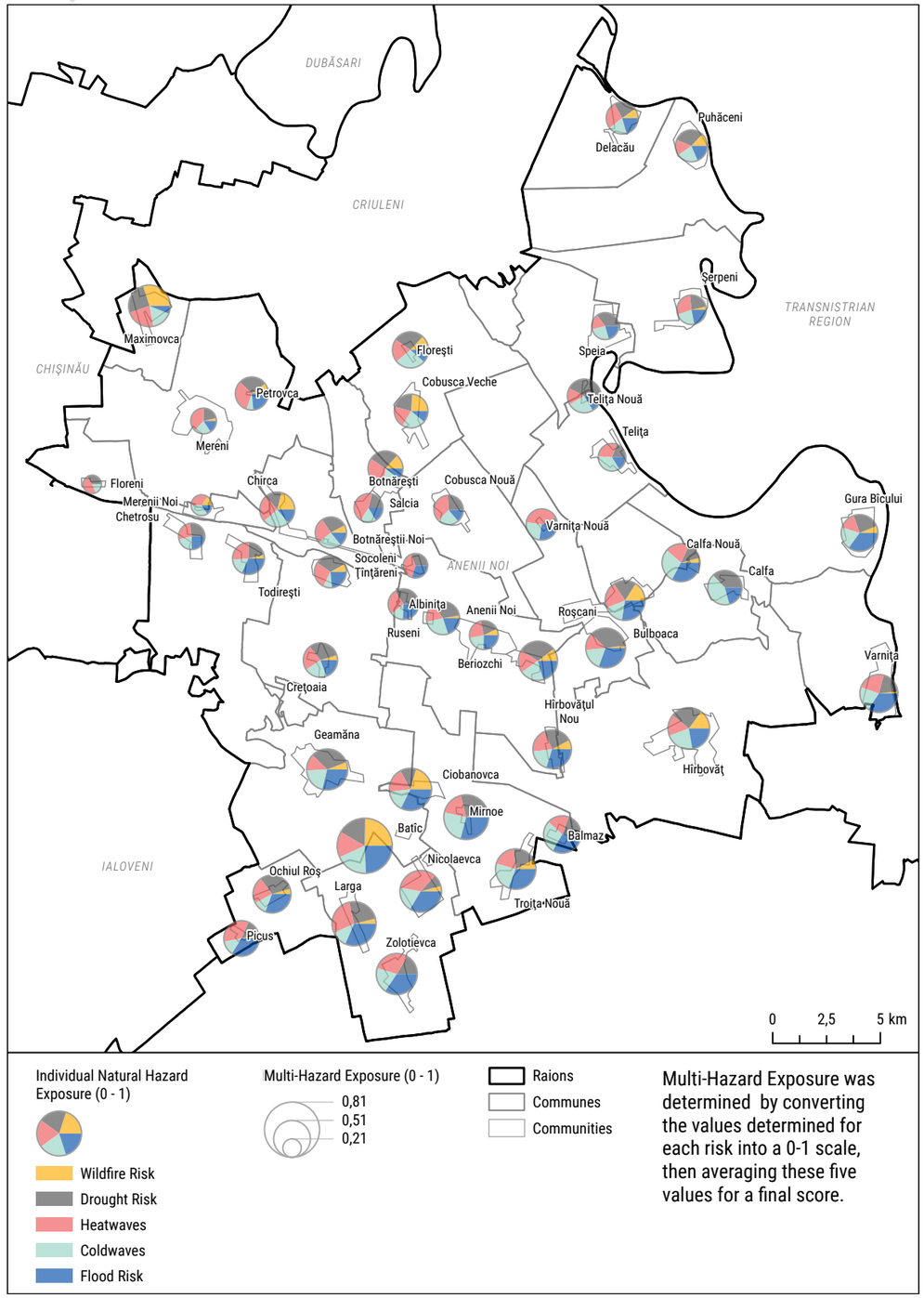


Table 4.1.1 Settlements with Highest Observed Wildfires (2012-2022)

	Settlement	Total number of fires
1	Maximovca	9
2	Batîc	8
3	Chirca	7
4	Cobusca Veche	6
5	Roşcani	6

Table 4.1.2 Settlements with Highest Drought Exposure

	Settlement	VCI (9,4 - 15,8)
1	Bulboaca	15,8
2	Teliţa Nouă	15,6
3	Geamăna	15,4
4	Calfa	15,1
5	Beriozchi	14,8

Table 4.1.3 Settlements with Highest Percentage of Days Above 35°C (°C, 2000-2022)

	Settlement	% of Days Above 35°C
1	Nicolaevca	24,9%
2	Picus	24,5%
3	Larga	23,2%
4	Varniţa Nouă	22,3%
5	Botnăreşti	22,2%

Table 4.1.4 Settlements with Highest Percentage of Days Below -10°C (°C, 2000-2022)

	Settlement	% of Days Below -10°C
1	Calfa	1,6%
2	Mirnoe	1,3%
3	Calfa Nouă	1,3%
4	Batîc	1,3%
5	Balmaz	1,3%

Table 4.1.5 Settlements with Highest Estimated Flood Exposure

	Settlement	Flood Exposure (2,2 -4,0)*
1	Zolotievca	4,0
2	Larga	4,0
3	Nicolaevca	4,0
4	Batîc	4,0
5	Ciobanovca	3,9

4.1 NATURAL MULTI-HAZARD EXPOSURE

Table 4.1.6: Natural Multi-Hazard Exposure Indices

Settlement	Pop. (2004)	Fire	Drought	Heat Waves	Cold Waves	Flood	Multi-Hazard Exposure
Batîc	32	1,00	0,68	0,61	0,76	0,98	0,81
Mirnoe	205	0,22	0,71	0,57	0,78	0,93	0,64
Larga	311	0,12	0,78	0,90	0,37	1,00	0,63
Ciobanovca	1072	0,62	0,36	0,57	0,47	0,97	0,60
Maximovca	1783	0,89	0,75	0,68	0,47	0,18	0,59
Hîrbovăţ	5447	0,44	0,72	0,49	0,65	0,66	0,59
Nicolaevca	104	0,12	0,27	1,00	0,56	0,99	0,59
Geamăna	3401	0,17	0,93	0,38	0,59	0,84	0,58
Zolotievca	585	0,00	0,48	0,84	0,59	1,00	0,58
Troiţa Nouă	493	0,22	0,54	0,55	0,68	0,88	0,57
Bulboaca	**5095**	**0,06**	**1,00**	**0,39**	**0,50**	**0,86**	**0,56**
Roşcani	2563	0,45	0,51	0,61	0,46	0,77	0,56
Beriozchi	647	0,28	0,85	0,51	0,54	0,56	0,55
Hîrbovăţul Nou	484	0,21	0,64	0,54	0,49	0,80	0,54
Calfa Nouă	197	0,11	0,38	0,55	0,76	0,88	0,53
Ochiul Roş	376	0,12	0,81	0,60	0,30	0,81	0,53
Varniţa	4210	0,05	0,50	0,63	0,56	0,90	0,53
Balmaz	163	0,00	0,50	0,49	0,74	0,87	0,52
Gura Bîcului	**3427**	**0,16**	**0,61**	**0,38**	**0,50**	**0,89**	**0,51**
Floreşti	216	0,33	0,68	0,52	0,69	0,29	0,50
Picus	101	0,11	0,04	0,98	0,37	0,97	0,49
Chirca	1668	0,66	0,47	0,79	0,08	0,43	0,48
Salcia	194	0,32	0,65	0,79	0,39	0,23	0,48
Calfa	1600	0,00	0,88	0,00	1,00	0,49	0,47
Creţoaia	458	0,11	0,72	0,55	0,50	0,45	0,47
Teliţa Nouă	19	0,00	0,98	0,37	0,58	0,38	0,46
Cobusca Veche	2079	0,55	0,50	0,47	0,51	0,25	0,46
Petrovca	--	0,25	0,66	0,78	0,02	0,57	0,45
Ruseni	1090	0,06	0,72	0,43	0,59	0,45	0,45
Todireşti	1843	0,08	0,46	0,58	0,37	0,69	0,43
Delacău	2240	0,21	0,50	0,60	0,40	0,44	0,43
Puhăceni	3775	0,28	0,67	0,34	0,46	0,40	0,43
Ţînţăreni	2867	0,17	0,69	0,58	0,19	0,50	0,43
Botnăreştii Noi	142	0,22	0,73	0,72	0,07	0,39	0,42
Varniţa Nouă	--	0,00	0,16	0,84	0,52	0,58	0,42
Albiniţa	370	0,00	0,71	0,55	0,28	0,53	0,41
Cobusca Nouă	1701	0,00	0,50	0,72	0,46	0,27	0,39
Şerpeni	3585	0,07	0,45	0,56	0,44	0,43	0,39
Anenii Noi City	**8358**	**0,14**	**0,40**	**0,47**	**0,40**	**0,48**	**0,38**
Botnăreşti	898	0,00	0,40	0,84	0,33	0,31	0,38
Teliţa	1187	0,00	0,35	0,54	0,63	0,29	0,36
Speia	2837	0,00	0,62	0,33	0,45	0,36	0,35
Chetrosu	1974	0,00	0,46	0,44	0,36	0,42	0,34
Mereni	6174	0,06	0,35	0,63	0,34	0,26	0,33
Socoleni	514	0,00	0,47	0,61	0,00	0,46	0,31
Mereni Noi	1512	0,28	0,00	0,64	0,06	0,29	0,25
Floreni	**3713**	**0,00**	**0,35**	**0,48**	**0,19**	**0,00**	**0,21**
Total	81710		--	--	--	--	--

Some hazards may also play an important role in the local ecosystem, such as regular small fires reducing the probability of a large, high-intensity fire[137] or seasonal flooding increasing the available nitrogen, phosphorus, and organic material[138]. The role of natural hazards in the larger ecosystem should be considered alongside their impact on human populations and activities.

The relationships of these hazards are dynamic, and can exacerbate or mitigate different aspects depending on the temporal distribution of intensity. As climate change affects the patterns of rainfall and seasonality, the risk profiles may alter, sometimes dramatically, and have interactions or implications that are not modeled in this profile.

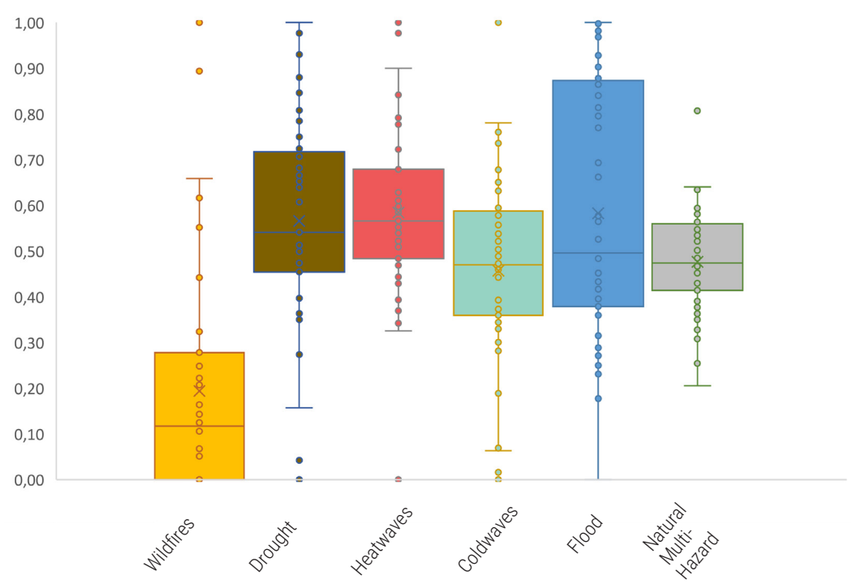
Different demographics have unique vulnerability profiles for each of these natural hazards, and planning should consider the needs of an individual community and its members, adapting mitigation recommendations and measures to the abilities and resources appropriate to each community and its needs.

Bolded in **Table 4.1.6** are the communities that were selected for the Area-Based Assessment. Data from this assessment was used in analyzing the Susceptibility and Coping Capacity of communities based on demographic data and distance from emergency and community services, which is examined in **Section 4.2**.

Recommended action:

1. Further investigation into each community and the population's needs, such as families with young children, persons with disabilities, and elderly populations.
2. Prioritizing nature-based, sustainable solutions to reduce the impact of hazards while considering their wider role in the ecosystem and crop life cycles.

Figure 4.1 Distribution of Exposure Index Values per Natural Hazard



4.2 VULNERABILITY - SUSCEPTIBILITY AND LACK OF COPING CAPACITY

Susceptibility

Based on indicators derived from the ABA, rural communities were more susceptible than urban communities, and refugee households (HHs) were more susceptible than host households, which is explored in detail in the ABA[139]. For this analysis, the community was considered as a single unit with both refugee and host responses, and was also not disaggregated based on an urban/rural divide. However, it should be noted that refugee households are likely to increase a community's overall susceptibility, such as with persons with disabilities (PWDs) or single parents, and this should be considered in community safety planning.

The gender distribution in the respondents was representative of the distribution across the raion (**Figure 4.2.1**). Around half of respondents were classed as "urban" and half were "rural", with "rural" respondents being divided between three communities (**Figure 4.2.2**)[37]. "Rural" was defined as settlements that had fewer than 1500 people per square kilometer, and settlements above this threshold were defined as "urban".

Without including "refugee" status, around 57% of host HHs and 92% of refugee HHs experienced at least one susceptibility indicator, with many HHs experiencing more than one (**Figure 4.2.3**).

The most common vulnerability in combined figures was a vulnerable HoH (single parent or female HoH) (**Figure 4.2.4**), followed by HHs with Members 60+. This was true for both Host and Refugee HHs, though in different proportions and severity: Host HHs for female HoH was 26,3% compared to Refugee HH's 54,5%, and Host HHs with Members 60+ was 40,2% and Refugee HH's was 52,3%. Refugee HHs were also more likely to report HHs with PWDs at 29,5%, whereas Host HHs only reported at 10,5%.

Due to the smaller populations interviewed, these findings should not be considered representative of all refugee or host HHs across Moldova, but are representative of households in Anenii Noi Raion.

Indicators for both dependency and economic capacity susceptibility and their justification are described in greater detail in **Section 1.3 Methodology: Risk Indicators**.

Susceptibility was based on two factors: dependency and economic capacity. Each indicator was applied to the entirety of the household if a single member of the household met the criteria (e.g.: if one member of the household is a person with a disability, then the household is counted among "HHs with a PWD"). No distinction was made for redundancy within a category at this level, though this may be of interest at a community planning level, as these households may require additional accommodation in emergency response.

For dependency, a HH was considered susceptible if any of the following demographics were present in the household: refugees, a head of household that was either a female or a single parent, three or more children, a person over 60 years of age, or a person with disabilities.

For economic capacity, a HH was considered susceptible if: an adult member of working age (18-60) was unemployed, a HH made a total of 3400 MDL or less in the previous month, or if the HH was reliant on agriculture.

Community breakdowns for each indicator are visible in **Table 4.2.2** and **Map 4.2.1**. A higher number indicates a greater susceptibility . The most prominent dependency susceptibilities were HHs with members who were 60+ years old (40,3%) and in the makeup of the HoH (32,3%). There may also be overlap within these groups, compounding the susceptibility to the hazards. Gura Bîcului had the highest rate of vulnerable HoHs, though HHs with elderly members did not see a significant difference between communities.

Regarding these susceptibilities, the number of pensioners is expected to increase: by 2050, it is forecast that every third person in the Republic of Moldova will be older than 60[136], and the "elderly" dependency ratio (number of people 60 years of age and older per 100 individuals of working age) is projected to triple in the next 45 years[136]. This may be of particular interest in contingency planning and community development.

Gura Bîcului also saw a higher incidence of HHs with refugees as well as HHs with PWDs, but the same relationship was not seen in Anenii Noi City. Bulboaca and Floreni did not have a significant population of refugees.

HHs that had a higher incidence of HoH with vulnerabilities were more likely in communities that had refugees. This may be related, as the martial law in Ukraine does not allow all able-bodied men from 18–60 years old were not allowed to leave the country as the country began a general mobilization of all reserve force, with exceptions made for disability, childcare, or other unique circumstances[140].

Economic capacity susceptibility did not see significant differences in the raion average, with both unemployment and agricultural dependency affecting around 45% of respondent HHs. Unemployment may also coincide with HHs with dependent children, as a parent may remain in the home for childcare. Agricultural dependency was notably smaller in Floreni, at nearly half the rate as other communities (**Table 4.2.2**).

Unemployment and low-income HHs were overall correlated, with the exception of Gura Bîcului, which saw a higher rate of low-income HHs compared to the reported HHs with an adult member who was not employed.

While adults who are unemployed were counted as an economic susceptibility, they may be providing important social and domestic support, such as providing child or elder care, or performing household tasks that can alter the coping capacity profile.

Notably, labor migration has affected both the male population and the rural environment across the whole of Moldova: of people who left and returned, 67,6% were male, and 75% were from a rural environment[136].

With increasing costs of living[3] and some refugee HHs reporting barriers to employment[126], patterns of movement related to livelihoods may also be of interest in a community's economic development, as HHs may employ different coping techniques to ensure that all the HH needs are met.

The model for the HHs lack of coping capacity is explored in **Table 4.2.3**, prioritizing a community's proximity to public assistance, which included barriers to healthcare, distance from shelters, and distance from emergency services (**Table 4.2.1**), as well as the HHs ability to respond in the home, which included insufficient heating during the winter and insufficient water in the past 30 days.

Figure 4.2.1 Gender Distribution in Anenii Noi Raion (2022) and Total Assessed Individuals (ABA)

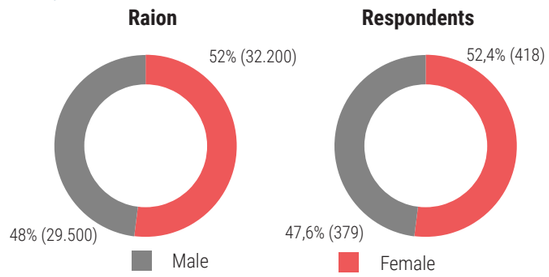


Figure 4.2.2 Percent of Interviewed Host HHs by Community

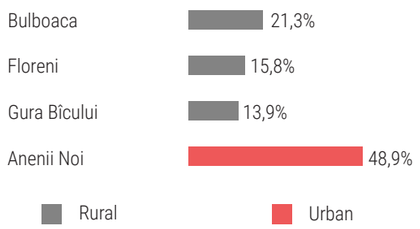


Figure 4.2.3 Percent of Households with at Least One Susceptibility Indicator (without Refugee indicator)

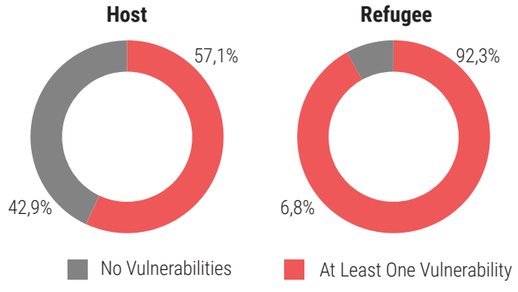


Figure 4.2.4 Most Common Types of Susceptibility by HH

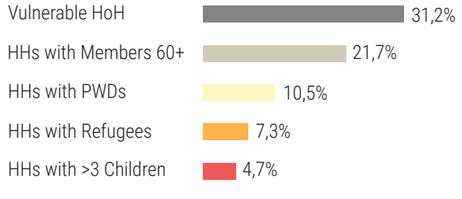


Table 4.2.1 Traveling Distance from Emergency Services

Community	<5 Minutes	<10 Minutes	<15 Minutes	<20 Minutes	>20 Minutes
Bulboaca	0%	35%	65%	0%	0%
Gura Bîcului	0%	0%	0%	11%	89%
Anenii Noi City	99%	1%	0%	0%	0%
Floreni	0%	57%	22%	20%	0%

4.2 VULNERABILITY - SUSCEPTIBILITY AND LACK OF COPING CAPACITY

Lack of Coping Capacity

Lack of coping capacity was based on five factors: HHs that reported barriers to access to healthcare, distance from emergency shelters, distance from emergency services, access to sufficient heating during cold months, and access to water. Community breakdowns for each indicator are visible in **Table 4.2.2** and **Map 4.2.2**.

Gura Bîcului and Floreni had the highest percentage of HHs that reported barriers to accessing healthcare, with the most common complaint being that specific medicines or treatments were not available (60,3%), a long waiting time for the service (59,5%), or being unable to afford the cost of the consultation (39,7%)[139]. No HHs identified distance from a health facility as a barrier, suggesting that access within communities is good[139]. Refugee HHs were more likely to report barriers to access[139].

Anenii Noi Raion has 23 shelters, which is above the average number of shelters per raion at 20 (excluding the outlier of Chișinău, which has 316)[141]. Shelters are located in Anenii Noi City, Cobusca Nouă, Bulboaca, Roșcani, and Hîrbovăț. 17 shelters are Public Shelters, and 5 are from the Housing Fund, the latter of which are all located in Anenii Noi City.

As the average number of vehicles per household in the assessed communities is between 0,41 and 0,63[139], walking was chosen as the preferred modality to determine distance from shelters. Walking distance in minutes was derived from an assumed walking speed of 120cm/s, resulting in a distance of 1080m[142].

Information on road quality and walking paths were not available at this level, and therefore were not considered in this analysis. Broken pavement, a lack of sidewalks, insufficient lighting, and physical barriers, such as gates, may result in a road being unwalkable, and therefore the shelter may be inaccessible, despite being within an acceptable distance[143].

As there are no public shelters in Gura Bîcului or Floreni, the entirety of the population was considered to be vulnerable. However, there may be community buildings that serve as shelter or a meeting place in an emergency, such as churches, schools, the town hall, or other well-known and central buildings that were not accounted for, as the official Inspectoratul General Pentru Situații de Urgență shelter dataset did not include them.

Anenii Noi Raion has 4 active Emergency Service stations, which is above the average number of emergency stations per raion at 3[144]. There is one Secția Situații Excepționale (USP Anenii Noi), one Post Pompieri Benevoli 24/24 (Depozit Anenii Noi), and two Post Pompieri Benevoli (PSPTv Mereni and PSPTv Speia). Two stations have closed: PSP Bulboaca and PSPT Zolotievca. There are no hydrants in Anenii Noi Raion[145].

As the 112 Emergency Service is national, and there are no barriers to crossing between the neighboring raions of Chișinău, Criuleni, Ialoveni, and Căușeni, emergency services located in these raions were included in the analysis. Calls received at the national 112 Emergency Service line are directed to the relevant nearest emergency response location, which may be outside of a raion for communities close to raion borders[146].

Distance from service was determined based on a speed limit of 20km/h for residential (community) roads[142]. Regional roads were considered to have speed limits of 50 km/h and 90km/h was applied to public roads[147]. Vehicles were presumed to travel at maximum speed.

Residential buildings were considered to be within the "service network" (≤10 minutes driving time) if they were within 100 meters of a road (**Table 4.2.1**). Fluid conditions, such as road surface conditions, traffic, blockages for construction or accidents, and weather conditions that make roads unsafe, were not accounted for in this analysis, but are of utmost importance in an emergency and should be considered in further investigations.

Both shelter and emergency response stations were weighted equally in their respective categories in terms of access and response capacity for this analysis, though physical access, available equipment, and staffing may alter the community's coping capacity profile and should be considered in safety assessments for communities.

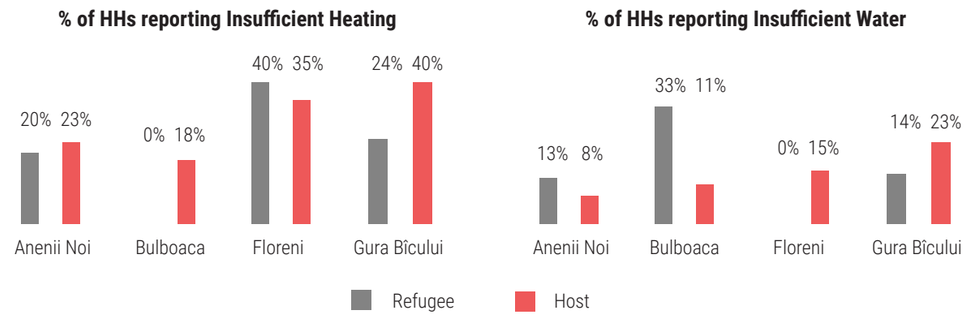
Table 4.2.2 Breakdown of Susceptibility Indices for Interviewed Communities

Settlement	HHs with Refugees	Vulnerable HoH	HHs with >3 Children	HHs with Members 60+	HHs with PWDs	HHs with at least 1 adult unemployed	Low-income HHs (<3400 MDL per month)	HHs reliant on agriculture	Susceptibility Index
Bulboaca	32,4%	44,7%	2,1%	40,4%	20,6%	35,3%	50,0%	58,8%	**0,36**
Gura Bîcului	9,8%	28,3%	4,3%	45,7%	23,5%	60,0%	47,1%	21,6%	**0,31**
Anenii Noi City	21,8%	30,3%	2,6%	37,4%	8,8%	49,2%	35,3%	43,5%	**0,29**
Floreni	4,3%	25,8%	1,5%	37,9%	7,2%	37,5%	26,1%	56,5%	**0,25**

Table 4.2.3 Breakdown of Lack of Coping Capacity Indices for Interviewed Communities

Settlement	HHs with Barriers to Healthcare Access	> 15 Minutes from Shelters	> 10 Minutes from Emergency Services	Insufficient Heating for Nov. 2022- Mar. 2023	Insufficient Water in the Past 30 Days	Lack of Coping Capacity Index
Gura Bîcului	18,6%	100,0%	100,0%	35,3%	23,4%	**0,67**
Floreni	8,1%	100,0%	43,0%	34,8%	15,2%	**0,50**
Bulboaca	3,0%	0,0%	65,0%	17,4%	10,6%	**0,25**
Anenii Noi City	2,3%	0,0%	0,0%	22,9%	8,4%	**0,13**

Figure 4.2.5 Utility Indicators by Refugee and Host HH



Rural communities were more likely to report insufficient heating for the winter months of November 2022 to March 2023. For all communities except for Floreni, host HHs also reported higher rates of insufficient heating[139] (**Figure 4.2.5**).

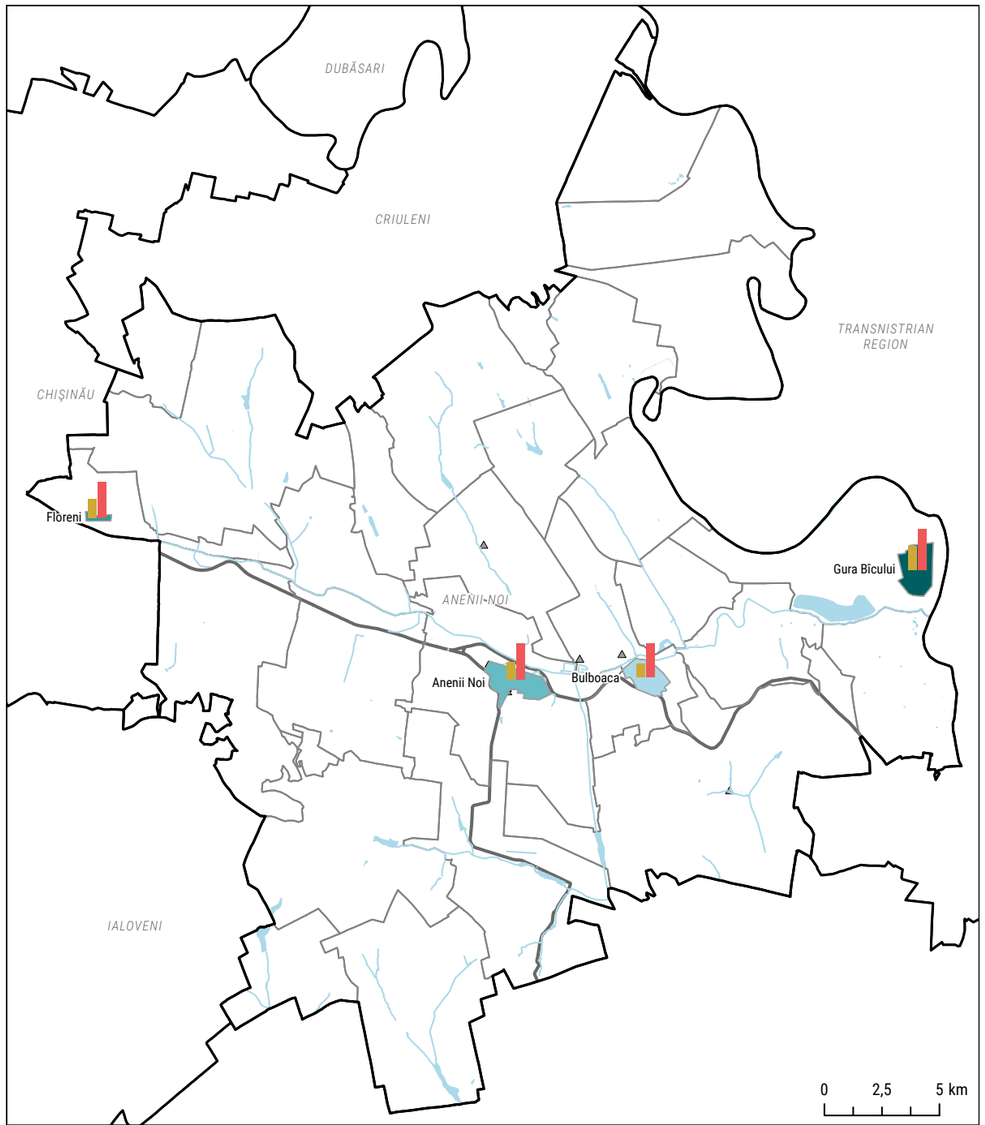
All four communities had a decrease in gas usage from 2020 to 2002: Gura Bîcului had the smallest decrease at -2,5%, whereas Floreni, Anenii Noi City, and Bulboaca ranged from -13,3 to -18,6%. This can be seen in greater detail in **Map 3.3**. This change in usage may be related to cost-saving measures of using less gas or an increased reliance on wood to heat the home, and behaviors related to gas usage may continue to change, due to the change in imports of Russian gas and access to pipelines in Ukraine[123].

Two communities saw an increase in Kw usage from 2020 to 2022: Anenii Noi City (4,6%) and Gura Bîcului (6,9%), while Bulboaca (-3,9%) and Floreni (-13,5%) saw a decrease (**Map 3.4**). The majority of communities (76%) showed an increase in Kw usage, whereas the majority of communities (84%) showed a trend of decreasing gas consumption in communities.

Rural communities were also more likely to report insufficient water in the past 30 days (**Figure 4.2.5**). The most common problems were that water was not safe for consumption or that the water supply was interrupted, but some HHs reported that water points did not function at all or that water points were too far to access[139]. The quality of drinking water was reported to be low, with HHs reporting that the taste and smell were not good[139]. Additionally, 9,5% of refugee HHs in Gura Bîcului reported that sanitation facilities were too far.

4.2 VULNERABILITY - SUSCEPTIBILITY AND COPING CAPACITY

Map 4.2.1 Susceptibility of Interviewed Communities



Susceptibility Index by Community
- 0.25
- 0.29
- 0.31
- 0.36

Susceptibility Index by Dependency and Economic Capacity
- Dependency
- Economic Capacity
- 0,5
- 0,25
- 0

- Raions
- Communes
- Water

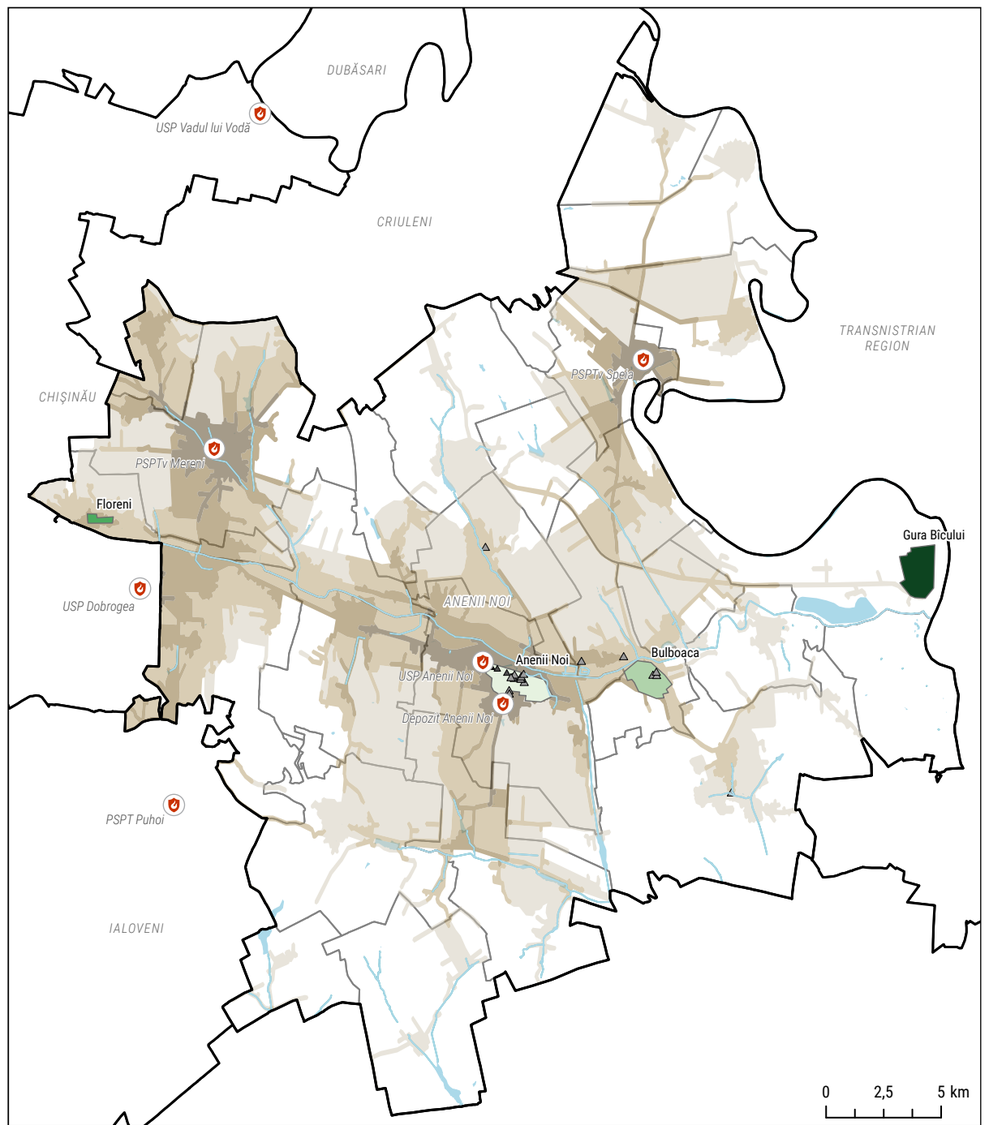
Susceptibility was determined by determining the percentage of households in the community that had social and economic vulnerabilities:
refugees, vulnerable head of household, more than three children, a person over 60 years old, a person with disabilities, an unemployed adult (18-60), received less than 3400 MDL in the last month, or was reliant on agriculture.
A higher score indicates greater susceptibility.

Data sources: OpenStreetMap, REACH, UNHCR, ESA

Recommended action:

1. Assessment of the physical condition, capacity limits, and accessibility of shelters for communities. Communities without shelters should be assessed for suitability of their construction. Discussions with community members should be organized to understand their knowledge of the community, as well as safeguards in the community, such as a church or town hall, that may be a preferred shelter.
2. Inventory and assessment of emergency response capacities, such as equipment and staffing, evaluation of the road network for estimation of response times and routing, and widespread use of the the National Public Security Inspectorate (INSP) and the State Road Administration's (ASD) roadmap of accidents and road conditions (https://harta.asd.md/).
3. Assessment of a community's energy and water needs and financial capacity to ensure continued access to utilities. Inspections of water lines and aging infrastructure to ensure that the quality of water in residences is acceptable.
4. Considerations for vulnerabilities described in **Section 4.1**: HHs with small children, PWDs, or elderly members may not match the models used for walking accessibility, which was generalized. Communication about emergencies should continue to be communicated across multiple platforms, such as community Telegram groups, sirens, television and radio announcements to ensure information saturation across communities.

Map 4.2.2 Lack of Coping Capacity of Interviewed Communities



Lack of Coping Capacity Index by Community
- 0.129
- 0.248
- 0.502
- 0.672

Time from Emergency Response Stations
- < 5 Minutes
- 5-10 Minutes
- 10-15 Minutes
- 15-20 Minutes

- Raions
- Communes
- Rivers and Lakes
- Emergency Response Stations
- Public Shelters
- Shelters from the Housing Fund

Lack of Coping Capacity was determined from the percentage of households in a community who:
reported barriers to healthcare access,
greater than 15 minutes from a shelter (walking),
greater than 10 minutes emergency services (driving), insufficient heating from Nov. 2022 - Mar.2023, or insufficient water in the past 30 days.
A higher score indicates greater vulnerability.

Data sources: OpenStreetMap, REACH, UNHCR, IGSU

4.3 COMBINED RISK INDEX: CONCLUSIONS

Combined Risk Index

The Multi-Hazard Risk Index was developed from the Natural Hazard Exposure Index (**Table 4.1.6**) and the Vulnerability Indices (Susceptibility (**Table 4.2.2**) and Lack of Coping Capacity (**Table 4.2.3**)) to give a total Multi-Hazard Risk Index (**Table 4.2.4**).

The Natural Hazard Exposure Index was developed for all communities, and these scores were retained for the Multi-Hazard Risk Index.

Vulnerability Indices were developed only for the four communities assessed in the Area-Based Risk Assessment[139], and these scores are relative to this assessment, and should not be generalized to the whole of Moldova.

Higher scores indicate a greater proportion of households were vulnerable to the given indicator.

The urban community of Anenii Noi City had the lowest score, indicating that the community was the least at-risk of the four communities, with all indicators in the "lower" to "medium" category of risk (**Map 4.3**).

Gura Bîcului displayed the highest score in the Index at 0,51. As a rural community, particularly one far from the capital of Chișinău or the raion center of Anenii Noi City, Gura Bîcului may be farther from centralized resources for communities, which better serve the rural communities of Floreni and Bulboaca respectively.

Major drivers for community vulnerability were natural hazards, particularly flood risk and heat waves, and lack of coping capacity indicators, predominantly distance from shelters and distance from emergency services. These drivers are developed from models, whose simplified nature may not capture the complexity or entirety of the community and its exposure or vulnerability. Evaluation at a community level is necessary to develop more comprehensive models that reflect the priorities of the community.

Recommended action:

1. Community-level assessments, particularly in vulnerable communities such as Gura Bîcului, to identify the impact of hazards and vulnerabilities on quality of life and coping capacities.

2 Comparison studies on similar urban and rural communities across Moldova, identifying short-, medium-, and long-term development goals tailored to local economic, social, and natural needs. Rural development may represent particular challenges, particularly in isolated, low-population communities, despite their comparatively higher vulnerability to hazards.

3. Public information dissemination on development planning, consultations with community leaders who can more accurately liaise with government officials and local CSOs.

Map 4.3 Multi-Hazard Risk By Settlements

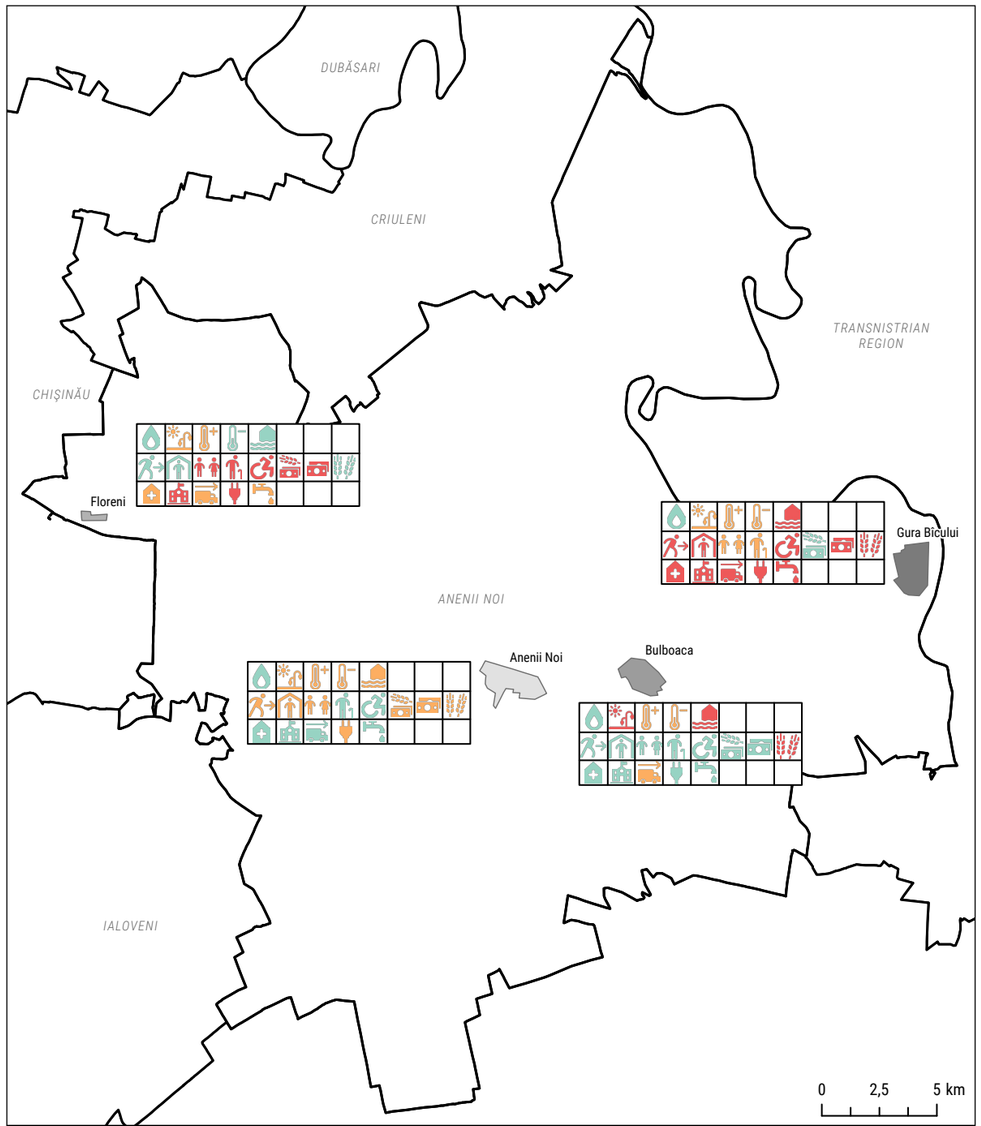


Table 4.2.4 Risk Indices by Community

Settlement	Natural Hazard Ex. Index	Susceptibility Index	Lack of Coping Cap. Index	Multi-Hazard Risk Index
Gura Bîcului	0,51	0,36	0,67	**0,51**
Bulboaca	0,56	0,25	0,25	**0,35**
Floreni	0,21	0,31	0,50	**0,34**
Anenii Noi City	0,38	0,29	0,13	**0,27**

Conclusions

This ABRA for Anenii Noi Raion aimed to analyze hazard exposure and community vulnerability to assess both natural and anthropogenic risks for the raion as a whole and selected settlements in the area.

This was done using a combination of socioeconomic assessments based on a 2023 ABA undertaken by REACH and geospatial data analysis.

It is expected that the ABRA will be used by the communities and local authorities as a background for risk management plan development that will address the local communities' vulnerability and needs to prepare and respond effectively to a range of hazards.

The study has been conducted at the sub-regional level, and relies on both locally available data, global datasets, and satellite imagery. Most of these datasets are open-access and continually updated, and may be used to reproduce the analysis for other areas or time periods. Thus, this ABRA also serves as a demonstration tool for environmental and industrial risk at a local settlement level.

Community prioritization according to the level of hazard exposure and vulnerability is important for increasing the awareness about the actual risks and an essential step in building capacity to the exposed hazards.

This ABRA should not be viewed as a prescriptive document: more exploration is needed to understand the dynamics of natural hazards, their spatial distribution and seasonal abnormalities, economic impacts, and socially-appropriate mitigation measures in specific development initiatives.

As the new Moldovan Environmental Strategy and its Action Plan is set to begin in 2024, Anenii Noi Raion may begin to play an important national and subnational role in addressing environmental hazards and their impacts at the community level, introducing strategies for waste management, climate-smart agriculture[148], and forestry management that address the unique needs of its residents.

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ANNEX 1: DATA SOURCES AND PROCESSING BY MAP

Map 1.2: Overview map for Anenii Noi Raion

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Map 2.2 Drought Risk (2001-2022) on Agricultural Land (2020-2021), Anenii Noi Raion

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Map 2.7 Forest Cover Percentage (2020-2021) in Anenii Noi Raion

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