CLIMATE BASELINE ASSESMENT MUNICIPALITY OF SELENICË

BUILD GREEN GROUP & MUNICIPALITY OF SELENICE

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Working Group

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This report has been prepared by Build Green Group in close collaboration with Selenica Munbicipality within the framework of the project "Resilient Selenicë Initiative" and represents an assessment of the current state of the Selenicë Municipality territory, with a particular focus on agriculture, water resources, the local economy, and construction. The report is based on field observations, local data, and other public sources, and aims to provide an analytical framework on the environmental pressures and development challenges characterizing this area. Through an interdisciplinary approach, the report contributes to the identification of practices that promote sustainability, offering recommendations for the improvement of natural resource management and territorial development planning.

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SUMMARY

This report provides a detailed analysis of the current water resources, irrigation capacity, and agricultural potential within the territory of the Municipality of Selenicë, focusing on the challenges, opportunities, and the necessary steps to ensure sustainable rural and agrarian development facing climate change and environmental pressures. The approach adopted in this report takes into account an assessment of the agricultural sector and natural resources, as well as artificial and developmental influencing factors such as energy, technological infrastructure, and digitalization, aiming to establish a comprehensive vision for the territorial development of the municipality.

During the drafting phase of this report, field visits were conducted, meetings were held with municipal relevant directorates representatives, as well as with administrators, specialists, farmers, and local stakeholders across all the administrative units. On-site observations of reservoirs, irrigation, and drainage systems were carried out alongside the collection of data on existing water sources, including major rivers (Vjosa, Shushica), irrigation canals, and auxiliary structures. Long-term climatic indicators and current water distribution capacities for irrigation were assessed, alongside the condition of infrastructure, maintenance challenges, and issues related to construction deficits stemming from a lack of technical and managerial investments.

Based on the fact that the Municipality of Selenicë is predominantly rural, the utilization of agricultural land, the analysis of currently practiced irrigation systems, and opportunities for their modernization through the adoption of advanced, high-efficiency technologies such as drip irrigation, micro-irrigation, and the use of rainwater and treated water have been taken into consideration. In an integrated approach, the relationship between water use and sustainable agricultural techniques, including planting resistant crops, organic fertilization, and crop rotation, was also analysed. In addition to agriculture, the report takes into consideration other local economic sectors dependent on the rational use of water and energy, including construction and infrastructure, processing industries, services, and renewable energy potentials, which have the potential to create new developmental synergies.

The advancement of agriculture and local production will stimulate the Municipality of Selenicë to harness its pronounced natural and landscape tourism potentials, opportunities for agrotourism development, cultural heritage assets, typical agricultural and livestock products, traditions of hospitality, and regional connections with coastal areas and southern municipalities. Recent national road developments, including the Vlorë-Borsh road extending across the entire Vlorë valley, Pojçem-Gorisht, Sevaster-Tepelenë, and Kuç-Progonat routes, have strengthened regional connectivity. Meanwhile, the presence of the Vjosa and Shushica rivers has enhanced prospects for trade cooperation, mobility, economic and social development, agriculture, and tourism.

Additionally, the potential for installing efficient energy management systems, renewable energy production such as photovoltaics, and the digitalization of agricultural services comprise a new critical pillar for comprehensive territorial development.

Within this framework, the report offers a set of practical recommendations for priority local interventions, including reservoir rehabilitation, canal cleaning, fostering farmer cooperation, and strengthening institutional capacities.

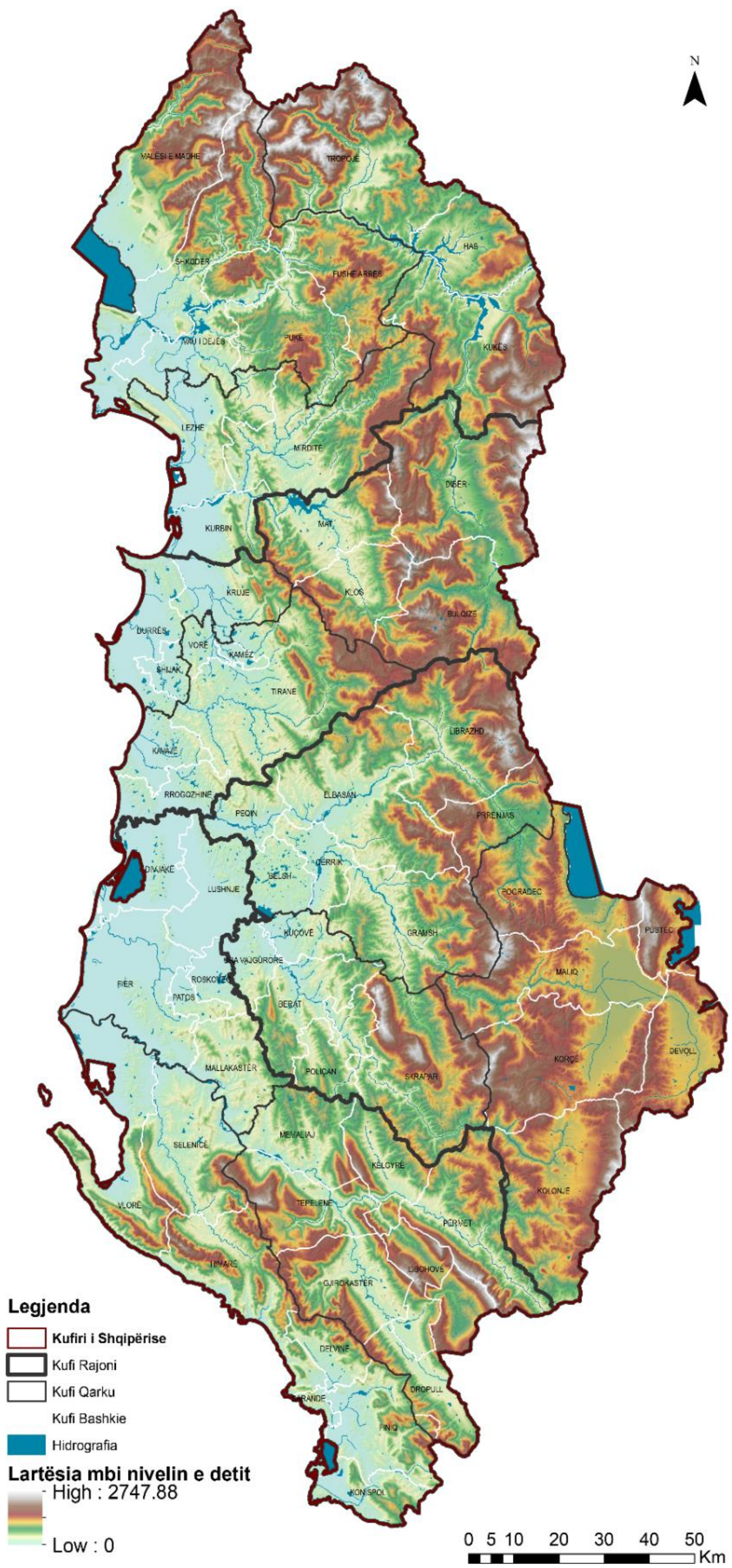
This report aims to serve not only the local authorities but also central institutions, development organizations, and rural communities to coordinate efforts toward improved water management and sustainable development of the Municipality of Selenicë, a newly established municipality with limited financial capacity but a broad range of opportunities for integrated, future-oriented development.

01
INTRODUCTION

Albania is located in the southeastern part of Europe, on the Balkan Peninsula, covering an area of approximately 28,748 km², characterized by significant morphological and ecological diversity (INSTAT, 2023). The territorial structure mainly consists of hilly and mountainous terrain, which makes up around 70% of the surface area, while lowland and coastal zones cover only a limited portion. This geographical composition has created varied conditions for economic development and population distribution at the national level, directly influencing the approach needed for territorial and natural resource management (National Territorial Planning Agency - NTPA, 2020). Population distribution in Albania is uneven, with a high demographic concentration in urban centers, especially in Tirana, Durrës, and coastal areas, whereas much of the inland and mountainous territories face demographic decline, population aging, and economic contraction. This reality results from internal and external migration, as well as a lack of adequate infrastructure, market access, and basic services in remote areas. Consequently, many rural municipalities in the southern and northeastern parts of the country have lost significant portions of their economic and social capacity, creating territories with a high risk of developmental stagnation (National Service for Habitat and Territorial Development - SKZHT, 2015).

Beyond structural and economic challenges, Albania is also highly vulnerable to the climate change effects, which have intensified over the past two decades. Prolonged droughts, intense rainfall, erosion, flooding, and gradual increases in average temperature have become increasingly frequent, significantly affecting agriculture, water supply, drainage systems, and livelihoods in rural areas. The impact of these phenomena is particularly evident in areas dependent on natural ecosystems and lacking adaptive capacity and resilience to environmental pressures (Council of Ministres, 2019) (Insitute of Geosciences - IGEO, 2022). To address this complex territorial pressure under climate change, national strategic documents emphasize the need for balanced spatial development, integration of productive sectors with renewable energy sources, as well as strengthening local capacities and sustainable resource management. The National Territorial Planning Concept (PPKT) considers the territory as a living structure where natural systems, human systems, and economic development are intertwined, aiming to create a functional network of municipalities based on self-sufficiency, social inclusion, and orientation towards technological innovation (National Territorial Planning Agency - NTPA, 2020). This approach is particularly important for municipalities with a rural profile and fragmented territorial nature, which require careful interventions aligned with local characteristics and environmental challenges.

Figure I. Topography and Water Resources in the Republic of Albania



Source: State Authority for Geospatial Information (ASIG) & CoPlan

The **Municipality of Selenicë**, is part of the Vlorë County, is one of the most representative areas of Albania in terms of the intertwining of natural heritage, rural landscape, and development challenges arising from climatic, social, and infrastructural transformations in the recent decades. This territory reflects a complex reality where natural and anthropogenic influences continuously interact, affecting land use, resource sustainability, and local development dynamics. Covering an area of 561.24 km² and a population distributed across six rural administrative units (Selenicë, Armen, Vllahinë, Kotë, Sevaster, and Brataj), the area is dominated by natural systems (51.05%) and agricultural land, with state-owned and divided agricultural land making a total area of 29.45% of the territory (Selenicë M. , 2018). The divided agricultural lands constitute 26.6%, representing a significant potential for agrarian development, yet requiring clear management mechanisms and infrastructure modernization (Selenicë M. , 2018).

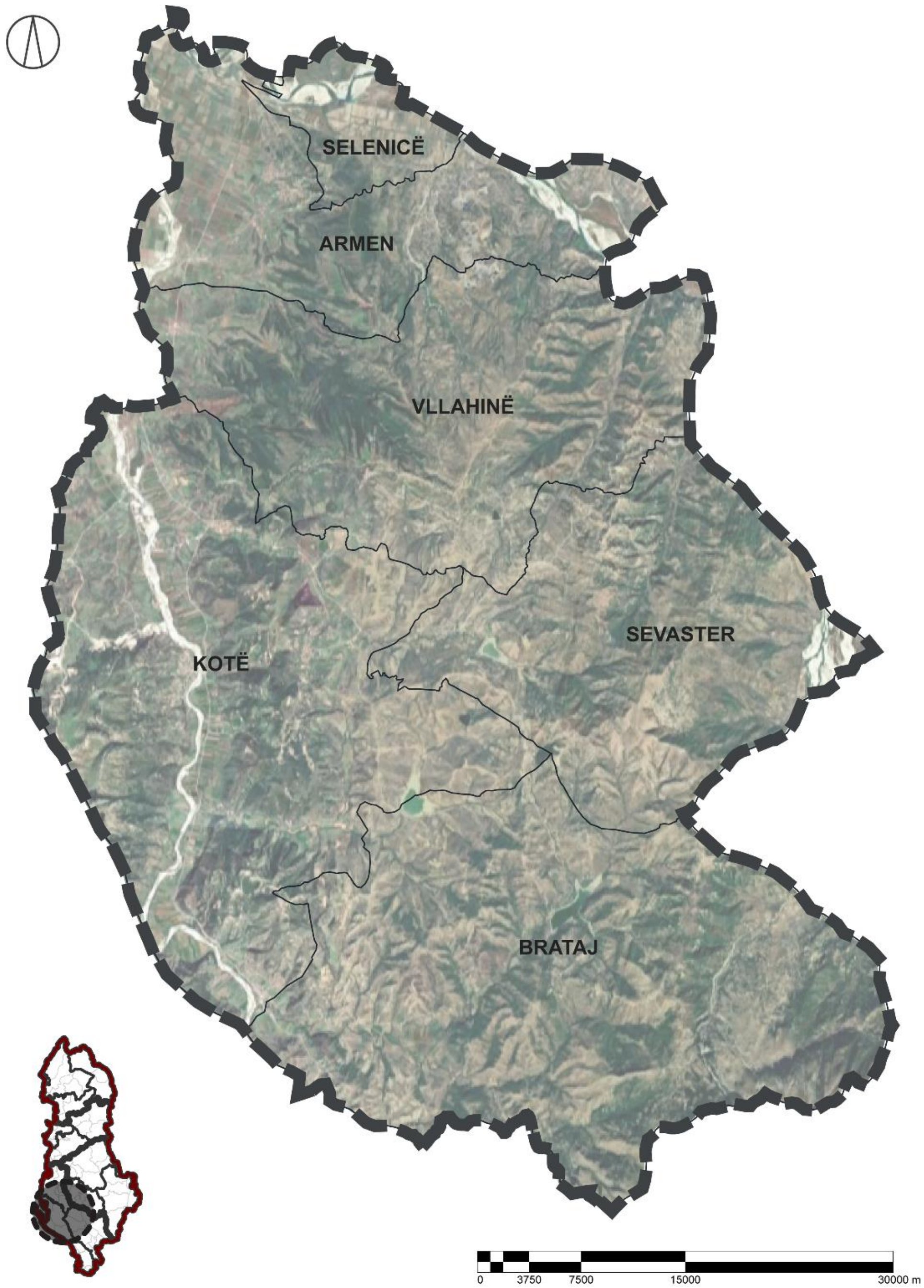
The current economic structure of Selenicë still relies on a traditional rural economy, focused on agriculture, livestock farming, and supporting activities such as agro-food processing (World Bank, 2021).

Territorial analysis shows that over 91% of the municipality's area consists of natural systems and lands dedicated to agriculture, clearly indicating rural development potential. (Selenicë M. , 2018). However, this potential remains unsupported by stable management structures and is constrained by increasing climatic impacts, land use fragmentation, and the lack of irrigation and technical infrastructure. Under current conditions, an integrated land and natural resource management approach is increasingly essential to maintain ecological functionality and enhance resilience to climate stress.

Although the agricultural sector remains the economic and social backbone of local communities, it faces significant challenges. Land fragmentation, lack of collective irrigation management mechanisms, insufficient financing, mechanization, and unequal access to inputs leave agriculture vulnerable to weather variability and production instability. I the administrative units of Kotë and Sevaster, the absence of organized irrigation networks directly affects the capacity to withstand drought periods (Selenicë M. , 2018). In Brataj, geographical isolation and the lack of transport and trade infrastructure limit integration with broader economic chains, reinforcing economic fragility and climate dependence (Ministry of Agriculture and Rural Development, 2021). In other administrative units such as Brataj, the geographic isolation and lack of investment hamper market access (USAID Albania, 2020).

In this context, this baseline climate assessment report aims to establish a clear analytical framework upon which the Municipality of Selenicë can build its adaptation and climate resilience policies, fostering sustainable development in the area.

Figure II. Administrative Map of the Municipality of Selenicë



Source: Google Earth Engine; https://earthengine.google.com

Firstly, this report provides a comprehensive hydro-climatic and biophysical profile of the territory, utilizing high-resolution satellite data series, in-situ measurements, and reanalysis products for the period 2010–2024.

Secondly, this report advances towards a deeper understanding of the impacts of climate change on the area. This enables the municipality to assess the degree of infrastructure, especially the irrigation network, rural areas, and divided agricultural lands, to prolonged droughts, intensive rainfall, and climate variability. This comprehensive approach provides the Municipality of Selenicë with a strong foundation for decision-making, improves its capacities for development of adaptation strategies oriented toward sustainable development, and to well-being of its communities. It also aligns with sectoral policies derived from the National Climate Change Strategy and the National Territorial Planning Framework (National Territorial Planning Agency - NTPA, 2020) (Council of Ministres, 2019) (Ministria e Turizmit dhe Mjedisit, 2019-2030).

This report constitutes a first step towards a broader planning and intervention process, offering a comprehensive overview of the current situation and serving as a foundation for further institutional, technical, and policy actions. Its focus aims to contribute to building a sustainable and diversified territorial development model for the Municipality of Selenicë.

02
METHODOLOGY

2.1. OBJECTIVE

The objective of this report is to establish a sustainable and integrated foundation for addressing climate change challenges in the Municipality of Selenicë, covering key aspects of rural development and natural resource management, with a particular focus on the most vulnerable and exposed sectors to climate impacts. The designed approach is built on an intersectoral analytical framework that supports local decision-making and guides investment planning toward sustainable, measurable, and evidence-based interventions. This report aims to assess the current and future climate change impacts of the Municipality of Selenicë, with a focus on the most sensitive sectors such as agriculture, water resources, and infrastructure, to support sustainable planning and strengthen local adaptive capacity.

The main report objectives are:

- To analyze the climate impact on the territory, including historical data of temperature, precipitation, and extreme events over the recent period, and their implications at the local level.
- To assess current land use, agricultural production structure, and challenges related to land degradation, droughts, and climate change.
- To examine the current condition of water resources and irrigation infrastructure, including reservoirs and distribution networks, as well as opportunities for improvement.
- To analyze rural-related construction infrastructure, such as roads, storage facilities, and agricultural buildings, in relation to structural resilience and potential for energy efficiency.
- To identify opportunities for enhancing local management and decision-making through the use of data and intersectoral coordination.

2.2. EXPECTED RESULTS

This report aims to establish a solid and sustainable foundation for improving natural resource management, enhancing adaptive capacities to climate change, and promoting sustainable rural development in the Municipality of Selenicë. These outcomes are essential for supporting local decision-making, guiding policy and investment priorities, and developing an integrated, cross-sectoral approach to addressing environmental and developmental challenges. The main report expected results are:

- Establishment of enhanced coordination mechanisms between the agriculture, energy, infrastructure, and environment sectors, supporting data-driven decision-making and building territorial resilience to face climate challenges.
- Development of a detailed and up-to-date overview of reservoir capacities, the condition of irrigation and drainage networks, and the functioning of existing systems, to serve as a basis for planning effective and prioritized interventions.
- Identification of key gaps for the efficient and sustainable use of water and other resources, including the need for systematic maintenance, infrastructure upgrades, strengthened collaboration among local stakeholders, and the modernization of technical water management practices.
- Formulation of concrete measures for the modernization of irrigation and drainage infrastructure, rehabilitation of reservoirs and existing networks, and creation of sustainable mechanisms for the management, maintenance, and regulation of water circulation to improve agricultural efficiency.
- Identification of opportunities for applying optimized water distribution systems in the agricultural lands, including rainwater use, local surface water management, and the reuse of treated wastewater for secondary purposes in areas that lack water supply.
- Development of a functional database to support the integration of simple tools for seasonal agricultural planning, monitoring of water consumption, and evaluation of the efficiency of water networks at the administrative unit level.
- Analysis of buildings, road networks, and support structures for agriculture and rural development, with a focus on their resilience and capacity to withstand climate impacts, including potential for energy efficiency and the use of renewable energy sources.
- Assessment of energy potential as a tool to reduce operational costs and improve the sustainability of rural infrastructure.

These results establish an important platform for the further implementation of strategic plans for rural development and climate change adaptation, grounded in in-depth analysis, empirical validation, and collaboration with local actors and relevant institutions.

2.3. NEEDS ANALYSIS AND GAPS IDENTIFICATION

A detailed understanding of the current water resources and irrigation infrastructure capacities has enabled the establishment of a clear picture of the functioning and physical degradation of reservoirs, irrigation canals, and flow control components. This analysis serves as the foundation for setting technical and territorial priorities for the rehabilitation of existing systems and the improvement of water use efficiency, particularly in areas highly exposed to seasonal drought. Through an in-depth assessment process, several shortcomings have been identified that negatively affect the performance of irrigation systems, including the lack of regular maintenance, network fragmentation, technical losses, and the absence of schemes for monitoring water consumption at the farm or plot level. These issues are closely linked to low agricultural productivity, land degradation, and increased dependency on unpredictable climatic factors. In this context, the need for systemic interventions has been identified, aimed at increasing hydrotechnical resilience, reorganizing network functionality based on topography and local inflows, and strengthening institutional capacities for the monitoring, oversight, and technical management of irrigation systems at both local and inter-municipal scales. This process has been accompanied by the development of a database on water resources to be periodically updated to support strategic planning and the design of integrated land and water management pathways. The database includes information on the existing capacities of reservoirs and distribution networks, the spatial distribution of irrigable plots, the ratio between natural water resources and irrigation demand, as well as risk levels. The results provide the basis for developing priority investment plans for the rehabilitation and strengthening of existing water systems, improving the institutional management of infrastructure, and enhancing local capacities to manage resources efficiently under unstable climatic conditions. The interventions stemming from this analysis are directly linked to the sustainability of the agricultural sector and the territory's ability to adapt to emerging environmental conditions.

2.4. METHODOLOGY

The methodology followed for the development of this report on the current climatic, agricultural, and infrastructural conditions of the Municipality of Selenicë is based on an analytical framework that integrates empirical field observations with the processing of official data and comparisons with reference practices at both national and international levels. This approach was designed to develop an integrated territorial analysis, serving as a foundation for defining intervention priorities to support sustainability, climate change adaptation, and evidence-based rural development.

For the climate component, meteorological and hydrological data were collected and analysed from official sources, such as the Military Meteorological Service and the Institute of Geosciences (IGJEO), over the timeframe of 1991–2020. The data were obtained as monthly and annual time series for key indicators such as maximum and minimum temperatures, precipitation, droughts, river flows, and periods of extreme events. After this data collection phase, the data were compared to the long-term averages for the area and analysed in line with regional trends identified in reports by the Copernicus Climate Change Service and the European Environment Agency. This analysis helped identify interannual deviations, map areas with increased flood and erosion risk, and delineate micro-zones with high climatic sensitivity within the territory of the Municipality of Selenicë. Simplified scenarios of exposure to seasonal droughts were also developed, based on the frequency of periods with below-average rainfall and above-threshold temperatures.

In addition to the climate component, the data collected at the local level on the capacity of existing water infrastructure, including reservoirs, irrigation canals, and drainage systems, was also analysed. These data were collected through a combination of direct site visit observations and consultations with the local stakeholders. In several areas, structured interviews were also conducted with local operators managing irrigable lands in order to assess the functionality of systems and the extent to which farmers benefit from available water resources.

For the agriculture sector, a mixed-method approach was applied, combining a desk review of the existing local government unit documents and plans, visuals, and semi-structured interviews with local stakeholders. The key strategic documents and analysed data include the General Local Plan of the Municipality of Selenicë, INSTAT statistics on agricultural land use, the percentage of uncultivated land, crop distribution, and the share of the rural population engaged in agriculture.

A field study was conducted through site visits to the administrative units of Peshkëpi, Armen, Vllahat, Brataj, and Sevaster to document the types of crops cultivated, the level of mechanization in agricultural practices, the physical conditions of greenhouses, warehouses, and the storage infrastructure of agricultural products processing.

The field study also includes photographic documentation and schematic mapping of plots with high levels of land degradation or poor water permeability.

Interviews with farmers and specialists of the Agriculture Department of the municipality were conducted, aiming to identify current needs, capacity limitations, gaps in agricultural infrastructure, and their relationship with institutional support structures.

Figure III. Data collection meetings with local stakeholders

Source: Build Green Group

Figure IV. Consultative Meeting of the Baseline Assessment Report in the Municipality of Selenicë

Source: Build Green Group

These data were analyzed by comparison with the National Strategy for Agriculture indicators and assessment of priority intervention areas at the regional level.

For the building and construction infrastructure sector, a technical inventory was carried out, focusing on the city of Selenicë, involving a representative selection of 40 different structures. These were geolocated using GPS coordinates and documented in a table of complete descriptive data. For each building, the following features were assessed: typology (single-family housing, apartment, institution, commercial), number of floors, roof shape, construction style, structural condition, and main construction materials used. A functional classification scheme was applied in line with the standards of the European Environment Agency for analyzing the built infrastructure in climate-sensitive areas. The structural condition was evaluated through visual inspection of load-bearing walls, roofs, and windows, and through interviews with residents or building caretakers in cases where the buildings were not abandoned.

Based on the energy efficiency analysis, the potential for thermal insulation interventions (facade, floor, roof), type of openings, orientation, and opportunities for applying renewable energy technologies in each building was assessed.

The data processing was carried out in an integrated manner using a GIS system for visualizing the distribution of priority interventions and constructing a climate exposure map. This allowed for the development of the analysis of the status of the agricultural sector directly linked to production system, built infrastructure, water resource management in the area, climate risks, and structural constraints. The combination of data sources, comparative approach, and empirical analysis makes this methodology a valuable tool for guiding the establishment and implementation of development policies in the Municipality of Selenicë and building scenarios for sustainable and measurable investments.

Furthermore, in line with the guidelines of the National Strategy for Energy and Energy Transition (Ministry of Infrastructure and Energy, 2021), opportunities were identified for integrating renewable energy sources into the rural sector such as the installation of solar panels for irrigation pumps and lighting, and the use of small hydraulic turbines in local reservoirs for decentralized energy generation. These measures are expected to contribute to reducing operational costs and enhancing the overall resilience of the agricultural sector to climate impacts.

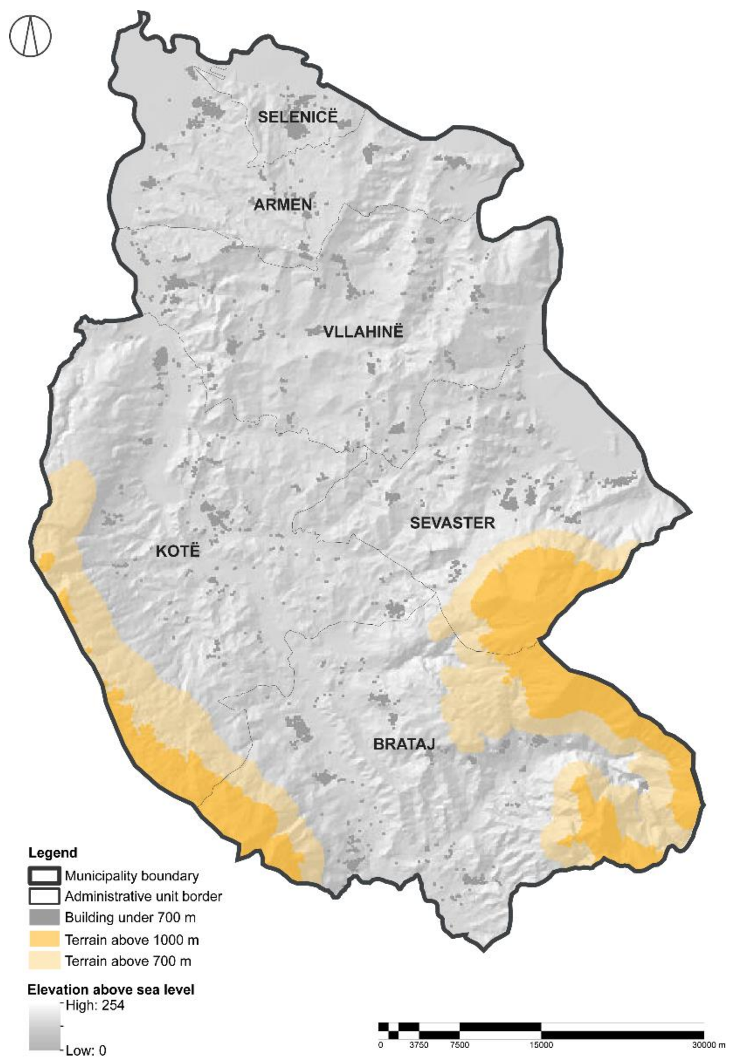
03

MUNICIPALITY OF SELENICË

3.1. SPATIAL TYPOLOGY OF THE TERRITORY

The Municipality of Selenicë is characterized by a fragmented spatial distribution, shaped by the complex morphology of the territory, which consists primarily of hilly and mountainous terrain. As illustrated in the following map, the distribution of settlements in relation to elevation above sea level, a significant portion of the territory lies above 700 meters, particularly within the administrative units of Brataj, Sevaster, and partially Kotë (Atelier 4 and Municipality of Selenicë, 2018).

Figure V. Distribution of Settlements by altitude; Municipality of Selenicë Territory



Source: State Authority for Geospatial Information (ASIG)

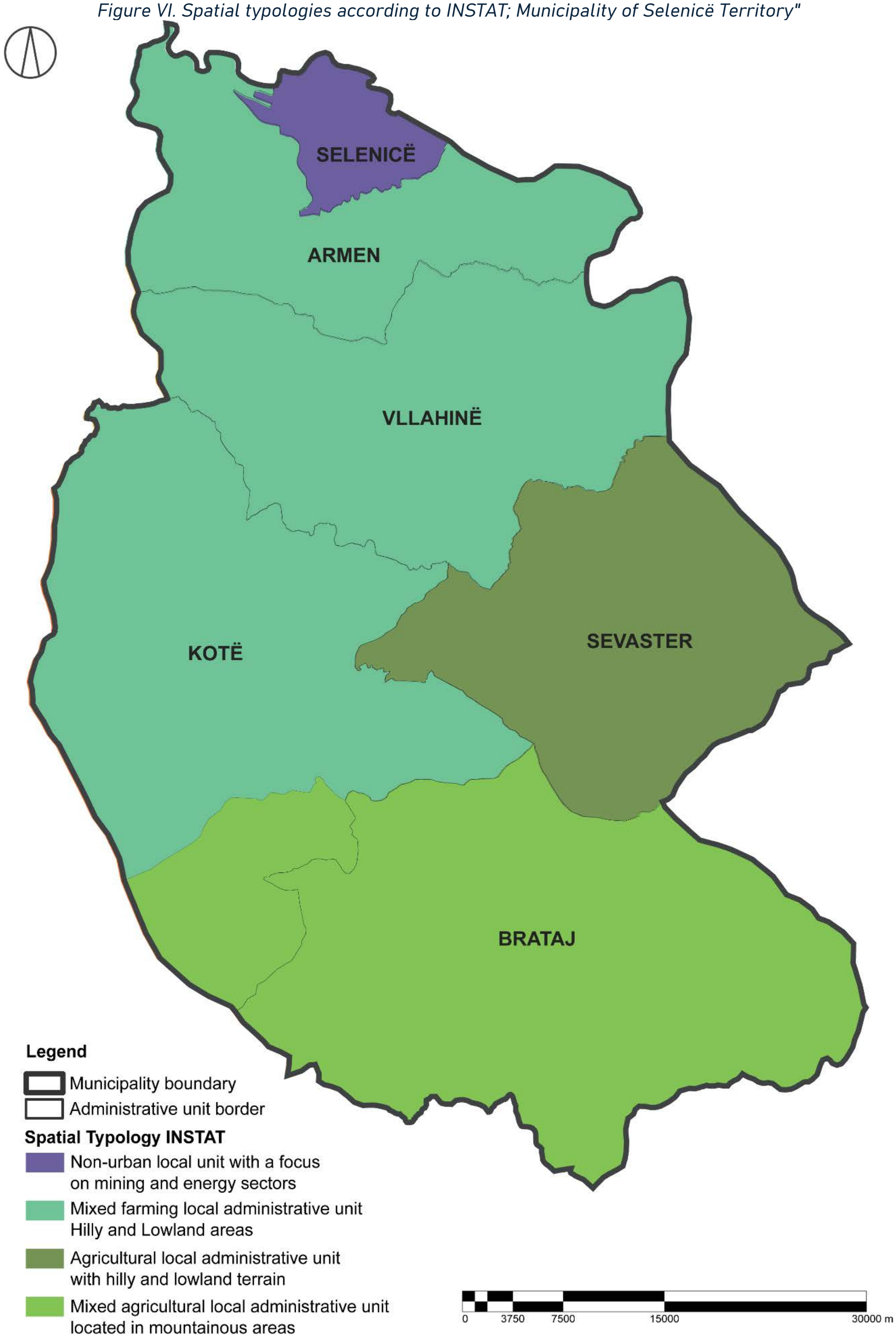
This vertical distribution of the population is reflected in the low concentration of construction in accessible areas and the formation of isolated rural micro-units. Settlements are located deep within rugged terrains, separated from one another by natural barriers and connected through limited road infrastructure, which often fails to meet the functional standards of a secondary road network.

According to data from the General Local Plan of the Municipality of Selenicë (Selenicë, GLP Selenicë, 2018), only 35% of settlements are located within a functional distance from the municipal center, indicating that the vast majority of the rural population resides outside the effective perimeter for the delivery of basic public services. This territorial division increases dependency on the urban center and creates an imbalance between existing administrative capacities and the need to extend infrastructure and logistics into remote areas. As a result, territorial management faces structural difficulties, negatively impacting territorial cohesion, the efficiency of investments, and the coverage rate of services for the most isolated communities.

In the context of spatial typology, as defined by INSTAT (Institute of Statistics, 2022), the territory of the Municipality of Selenicë is divided into a set of functional subzones that reflect pronounced socio-economic and physical differences. The administrative unit of Selenicë is categorized as a “non-urban local unit oriented towards mining and energy”, reflecting the industrial legacy linked to bitumen and energy exploitation. Meanwhile, the administrative units such as Armen, Vllahinë, and Kotë represent “mixed agricultural hilly/plain local units”, with moderate potential for agricultural activities, but constrained by the lack of concentrated rural settlements and land fragmentation. On the other hand, the administrative units of Brataj and Sevaster are classified as “mixed agricultural mountainous local units”, where the mountainous component dominates and poses a natural limitation for agricultural development and infrastructure expansion.

The territorial dynamics resulting from the interplay of altitude, construction, and spatial typology reveal a non-uniform development model that calls for a differentiated strategy for each administrative unit. In mountainous areas, where building density is low and distance from the center is significant, the development of micro-regional centers with service and rural logistics functions is necessary to improve accessibility and optimize the delivery of public services. Simultaneously, the central municipal zone should capitalize on its role as strategic point of the national transportation network and as an area of economic potential development through the diversification of its post-industrial structure.

Figure VI. Spatial typologies according to INSTAT; Municipality of Selenicë Territory"



Source: INSTAT

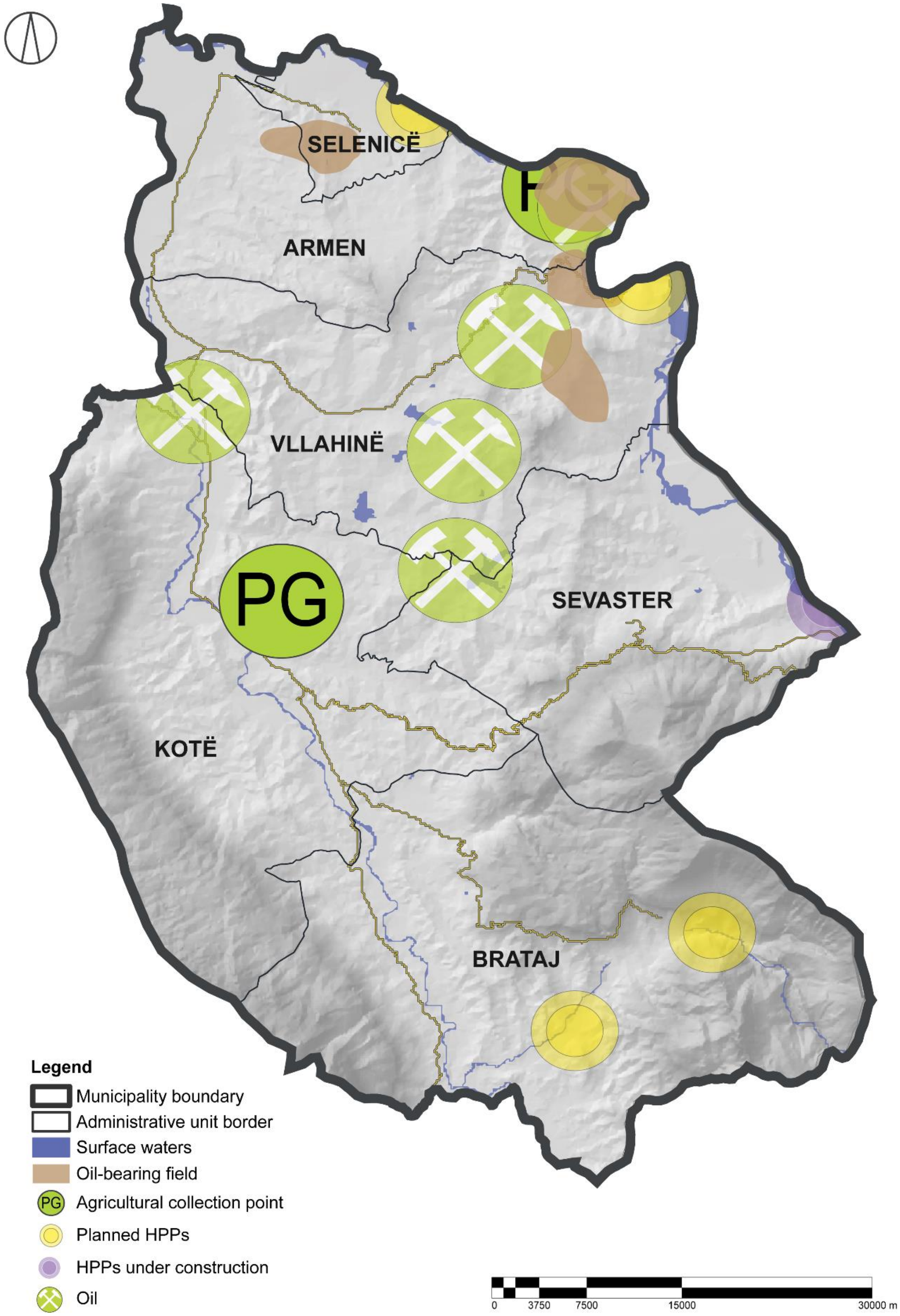
The Municipality of Selenicë is a territory with economic structure primarily based on the primary sector, in which agriculture and livestock serve as the main source of livelihood for the majority of the rural population (Selenicë, PPV Selenicë, 2018). However, the spatial distribution of the existing capacities reveals a more complex socio-economic landscape, in which natural and artificial potentials are intertwined. As evidenced by the functional map of the territory, within the municiplaity there has been identified activities related to the extraction, processing, and transport of hydrocarbons identified, including several oil-bearing fields concentrated in the administrative units of Selenicë, Vllahinë, and Sevaster (NANR, 2020).

Alongside hydrocarbon-related activities, the territory of the Municipality of Selenicë is characterized by the distribution of significant water resources and the presence of a fragmented infrastructure system, which includes collection points and agricultural production centers, such as those in the adminstrative units of Kotë and parts of Vllahinë (GIZ Albania, 2020). In this context, the map also indicates the locations of planned and under-construction hydropower plants, which aim to exploit the capacity of local rivers, such as the Shushica River, for energy production (IEEA, 2022). This further increases pressure on water resources during the dry season and highlights the need for careful management of intersectoral conflicts between energy, agriculture, and ecosystems (Vlora County Council, 2021).

Despite environmental challenges and partial industrial interventions, the municipality has a favorable geographic position and regional connections that enable sustainable economic development through the integration of agro-environmental potentials with newly developed road infrastructure networks (Selenicë M. , 2018). The Vlora–Borsh and Pocem–Gorisht corridors open up new access to southern markets and the coastal axis, turning the territory into a strategic hub for the movement of goods and people.

Furthermore, in line with green development trends and energy decentralization, Selenica represents a territory in which the application of clean technologies, micro-enterprises support in water and energy resource management, and the involvement of women and youth in these initiatives could establish a new model for rural development (Vlora County Council, 2021). The territorial dynamics of Selenicë cannot be reduced solely to the agricultural function, but rather reflect the diversification of economic sectors within the municipality.

Figure VII. Economic Activity Potential in the Municipality of Selenicë



Source: State Authority for Geospatial Information (ASIG)

3.2. LAND USE

The spatial structure of the Municipality of Selenicë reflects a clear dominance of protected natural areas and those with extensive land use, such as forests and pastures. According to available data, approximately 51% of the territory is covered by forested areas and natural pastures, reflecting the mountainous and hilly character of the municipality, as well as the limitations for intensive agricultural development.

Agricultural land occupies only **29.4%** of the total area, a significant portion of which is concentrated in hilly zones with easier access and in the lowlands surrounding the administrative unit centres such as Sevaster and Armen (Selenicë M. , 2018, p. 57). However, this land is undergoing a continuous process of fragmentation and structural degradation, due to property division following land reform and the lack of capacity for land consolidation. The absence of agricultural infrastructure, irrigation systems, and access to internal roads has made the effective use of a considerable portion of land impossible.

In the areas around Selenicë and Sevaster, slight changes in land use have been observed over the last decade, mainly involving the conversion of agricultural land into passive use or other functions, including informal construction and spontaneous greenery. These changes are also influenced by migration and the abandonment of agriculture at the local level, which have led to a decline in the utilization rate of agricultural land in some administrative units such as Brataj and Kotë. According to GLP estimates (Selenicë M. , 2018), over 45% of agricultural land is underutilized or undergoing degradation due to the lack of investment, absence of market chains, and limited rural mechanization.

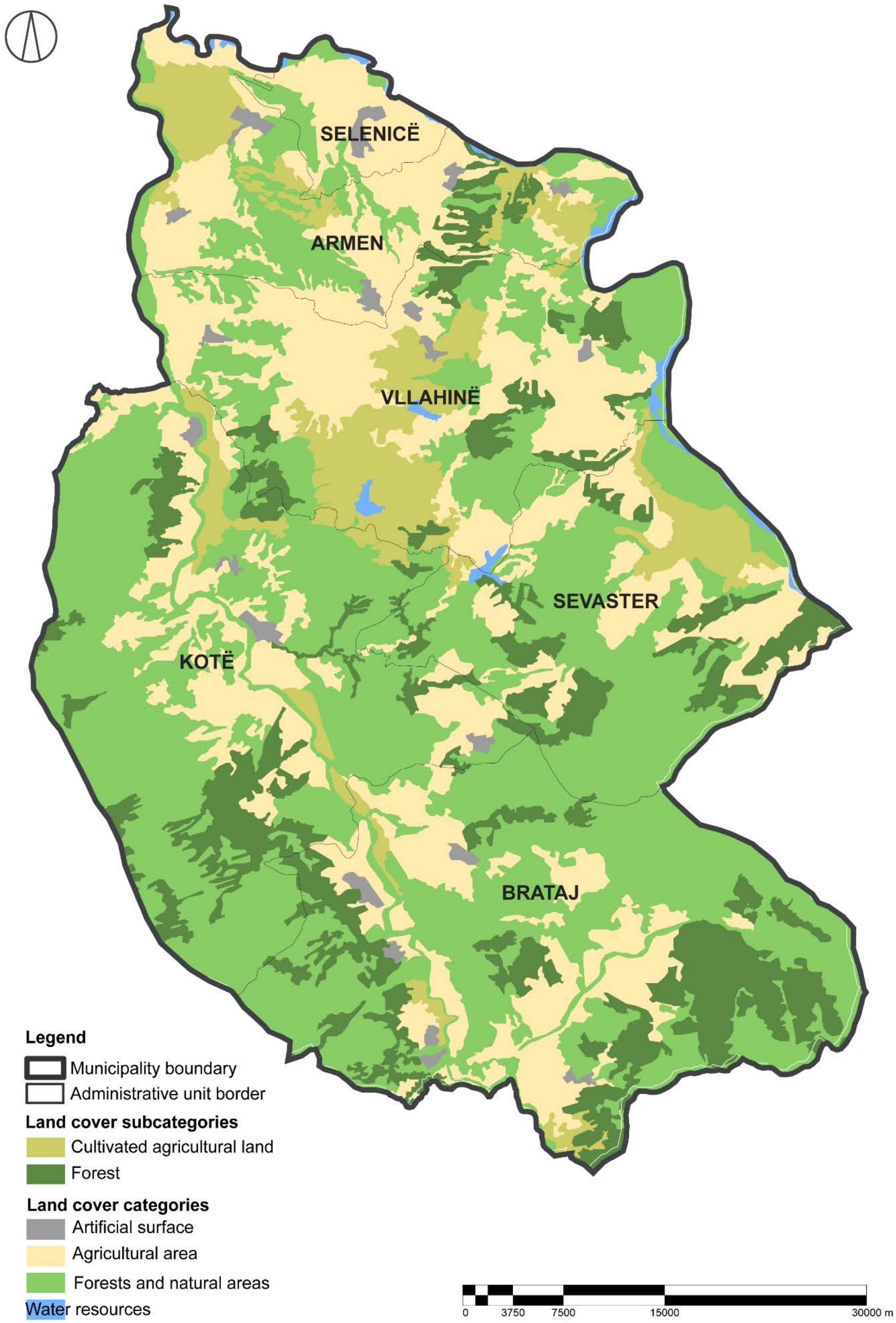
In addition to forested and agricultural areas, the remaining part of the territory includes construction land concentrated in the town of Selenicë and its surrounding areas, as well as water surfaces and other unspecified lands, which together make up a relatively low percentage (about 5–7%). This spatial distribution confirms the need for structural interventions aimed at consolidating and increasing the efficiency of land use.

Table I. Land cover structure in the Municipality of Selenicë

Land Category	Total %
Forests and Natural Pastures	51.0%
Agricultural Land	29.4%
Underutilized Agricultural Land	45% e of agricultural land
Built-up and urban area	6.1%
Other areas (unspecified)	5.5%

Source: General Local Plan; Municipality of Selenicë

Figure VIII. Land Cover; Municipality of Selenicë Territory



Source: Copernicus Land Monitoring Service; https://land.copernicus.eu/en

The irrigation systems of the Municipality are degraded, most of which built before the 1990s, that cannot face the current climate challenges. The lack of maintenance of reservoirs and canals has further degraded their functionality, forcing farmers to rely on alternative water sources that are often costly and unsustainable (EEA - European Environment Agency, 2020). This situation directly contributes to reduced agricultural production and increased production costs.

The absence of functional databases on irrigation infrastructure, soil composition and condition, and local-level energy potentials poses a major obstacle to long-term strategic planning. Balanced development requires the integration of data on energy, technical networks, and the potential for installing renewable energy systems (e.g., PV, small hydropower turbines), linking the agricultural sector with components of the energy transition.

From a climate perspective, the area faces pronounced seasonal droughts, intense rainfall, and rising average temperatures, which impact the agricultural production cycle and the quality of water resources (IGEO, 2022). The impact of heavy rainfall has also been observed in the deterioration of drainage infrastructure and increased soil erosion, which directly affects cultivated land.

In many administrative units, the absence of irrigation networks has led to reliance on unregulated sources such as the Kroi i Bardhë stream, and the Shushica and Vjosa rivers, which are not stabilized for regular use and present challenges during dry seasons. One of the most pressing issues is the informality in water use, which has generated inter-user conflicts and further deepened institutional fragmentation.

The report highlights the need for a new multisectoral approach that goes beyond the traditional focus on agriculture and natural resources. This approach should include energy efficiency, the application of digital technologies for monitoring and planning, integration with small rural industries, and the enhancement of the managerial capacities of local authorities. The digital transformation of the water sector, through data analytics, could significantly improve the capacity for integrated resource management and help plan for the mitigation of climate change impacts in the region.

3.3. THE ENVIRONMENT AND NATURAL RESOURCES

The Municipality of Selenicë faces a complex number of environmental challenges that directly impact the quality of life, land productivity, and territorial sustainability. The urban area of Selenicë and its surrounding villages have been significantly affected by bitumen mining activities, particularly during the communist period. According to data from the National Agency for Natural Resources (NANR, 2020), the area has experienced land salinization and natural landscape deformations as a result of excavations and the accumulation of inert waste.

According ton the GLP of the Municipality of Selenicë (Selenicë M. , 2018, pp. 66-67), only 23% of the municipal territory is covered by solid waste collection services. In the

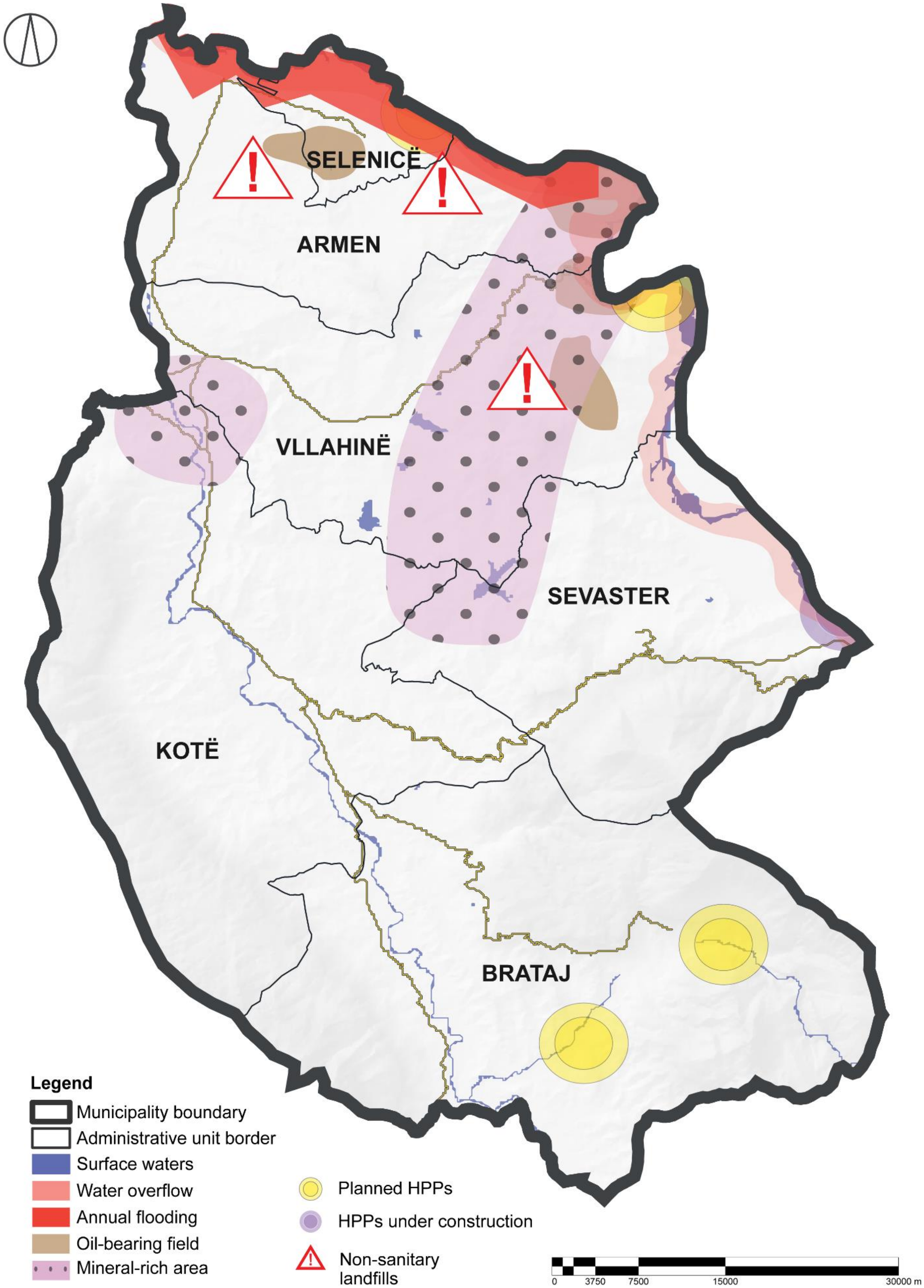
majority of the rural administrative units, waste is illegally disposed in the open environment or along waterflows, significantly increasing the risk of pollution to both water and soil resources.
Throughout all the administrative units of the Municipality of Selenicë, there is a lack wastewater treatment systems. According to the GIZ Albania report on the water sector in Vlora County (2020), wastewater is discharged directly into natural waterflows or seepage pits without any technical standards (GIZ Albania, 2020).
Erosion processes are present in a large area of the territory, particularly in the hilly areas of the administrative units of Brataj, Sevaster, and Kotë; which are exposed to it due to lack of forest cover and slope cultivation without protective measures. According to INSTAT (Insitute of Statistics - INSTAT, 2022), these areas have an average of more than 20 tons of annual soil loss, negatively affecting agricultural capacity.

Table II. Environmental Challenges in the Administrative Units of the Municipality of Selenicë

Challenges	Adminsitrative Units	Main Cause	Main Negative Effects
Industrial Pollution	Selenicë, Armen	Historical Mining Activities	Land Degradation
Unmanaged Solid Waste	Brataj, Kotë, Sevaster	Lack of Waste Collection Service and Landfill	Soil pollution and groundwater pollution risks
Lack of Wastewater Treatment	All units	Absence of Sewage Systems and Treatment Plants	Water pollution, public health risks
Erosion	Brataj, Sevaster, Kotë	Steepness, deforestation, agriculture	Loss of agricultural land, landslide risks

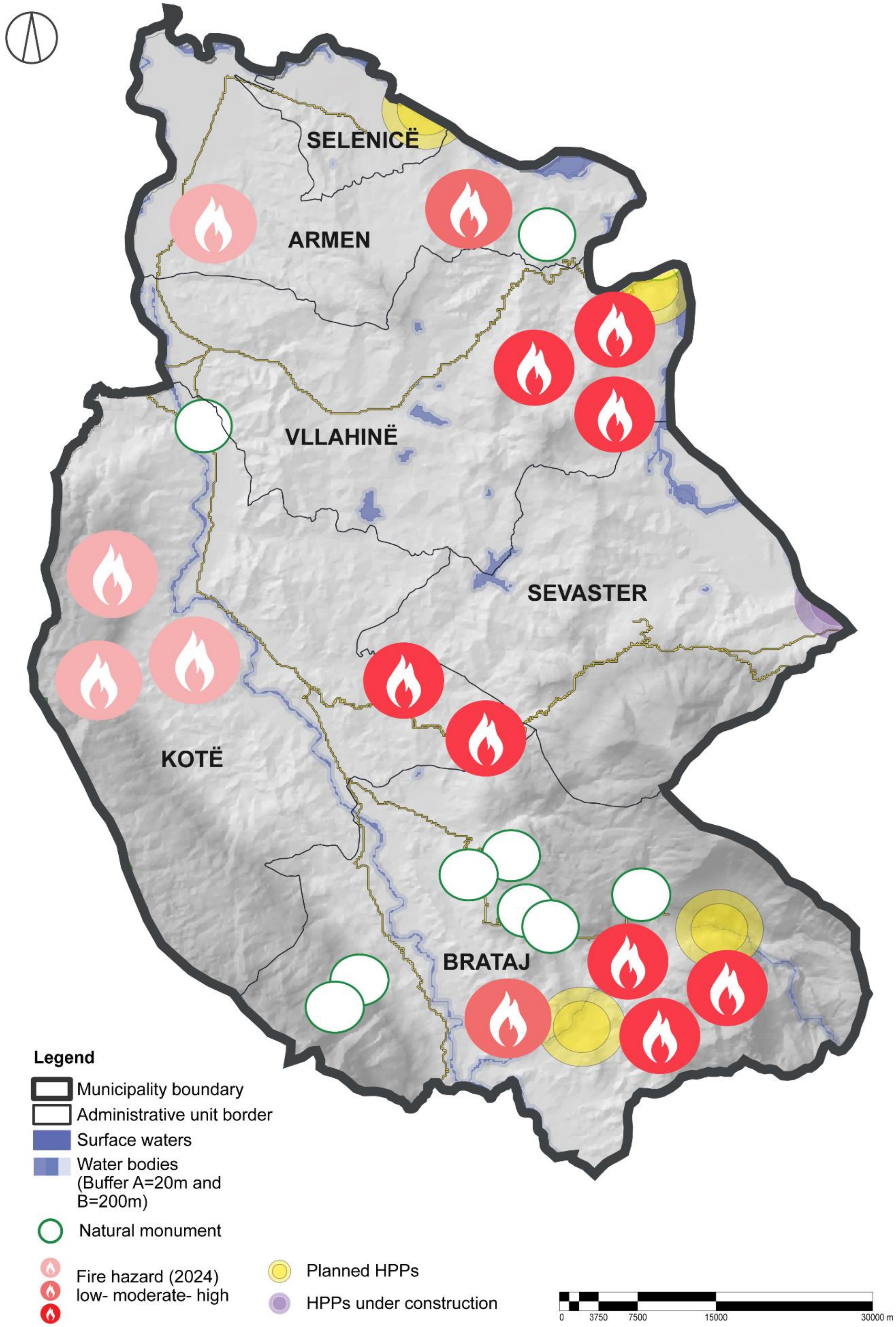
Source: Agriculture Department, Municipality of Selenicë

Figure IX. Environmental Challenges in the Municipality of Selenicë



Source: State Authority of Geospatial Information (ASIG) and National Environment Agency (AKM)

Figure X. Protected Areas Threats in the Municipality od Selenicë



Source: State Authority of Geospatial Information (ASIG) and National Environment Agency (AKM)

3.4. DRINKING WATER SUPPLY AND INTERCONNECTION NETWORKS

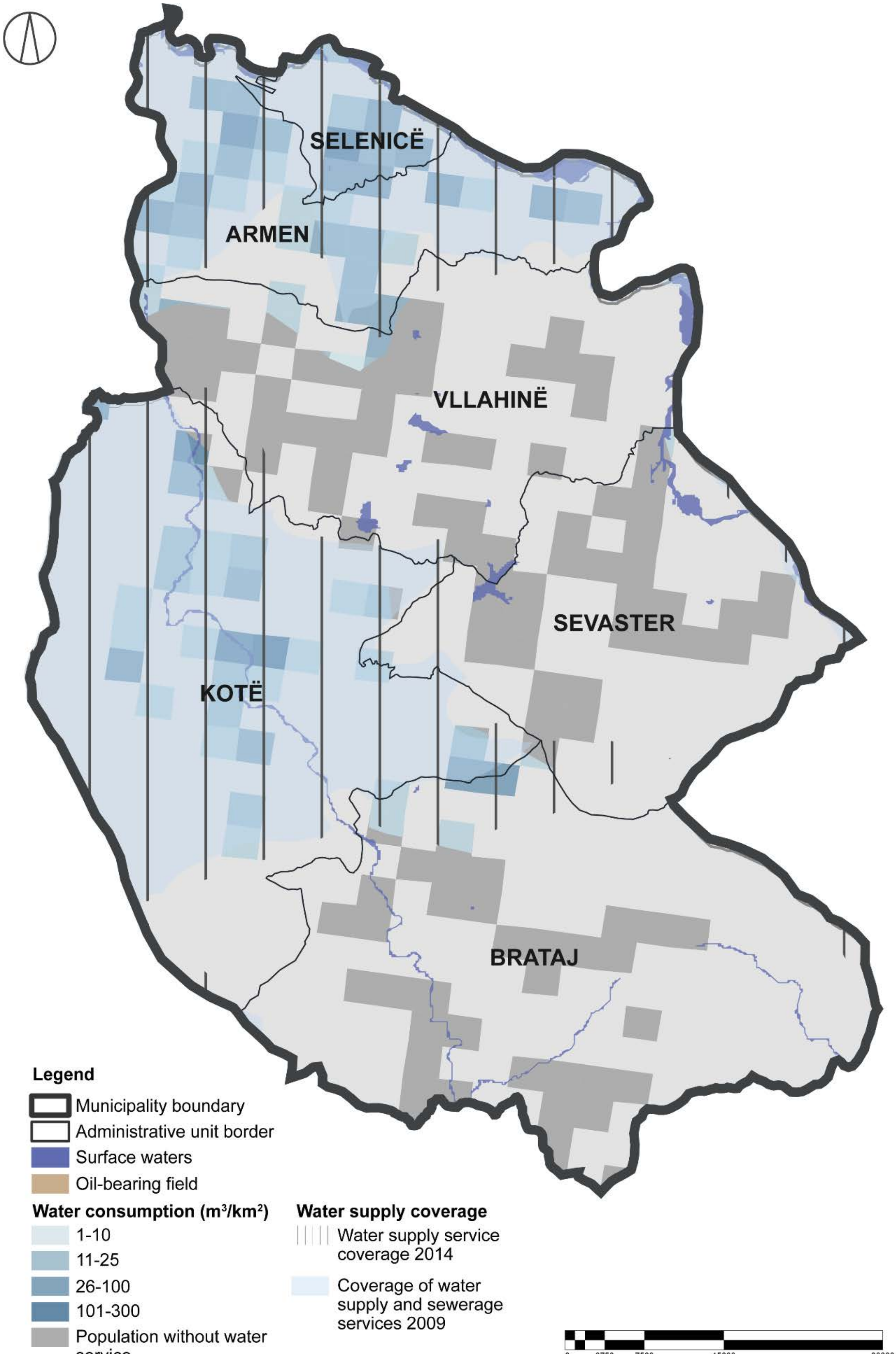
The drinking water supply service within the Municipality of Selenicë territory is fragmented and uneven, and only a limited percentage of the population has access to a permanent water supply network. According to the General Local Plan (Selenicë M. , 2018), the water supply network covers only 43% of the population, while the remaining percentage relies on alternative sources, including water delivered by water supply trucks, seasonal sources, or the use of shallow wells with no sanitary control (Selenicë M. , 2018). This disparity is particularly evident in the administrative units of Brataj and Kotë, where absence of consolidated infrastructure has resulted in a high dependence on improvised water supply forms.

From a spatial perspective, the data presented in the following functional water consumption and coverage map indicate a clear division between covered areas and those without any form of service. The highest water consumption is recorded in urban areas and in some parts of the administrative units of Selenicë, Armen, and Sevaster, where the network is more developed and consumption exceeds 101 m^3/km^2. Meanwhile, the lowest consumption (1–10 m^3/km^2) is estimated in the western and southern parts of the territory, particularly in Kotë and Brataj, where water supply coverage is almost non-existent and the area is considered “out of service” (Selenicë M. , 2018).

In terms of infrastructure, the water supply network is deteriorated in many areas and is characterized by a high rate of technical losses. The lack of standardized filtration, unequal pressure distribution, and periodic supply interruptions have been identified as common issues in several of the areas considered “covered” (Selenicë M. , 2018). Additionally, the absence of an integrated sewage network across most of the territory increases the risk of pollution to surface and groundwater resources, further degrading the overall condition of water resources and the quality of life.

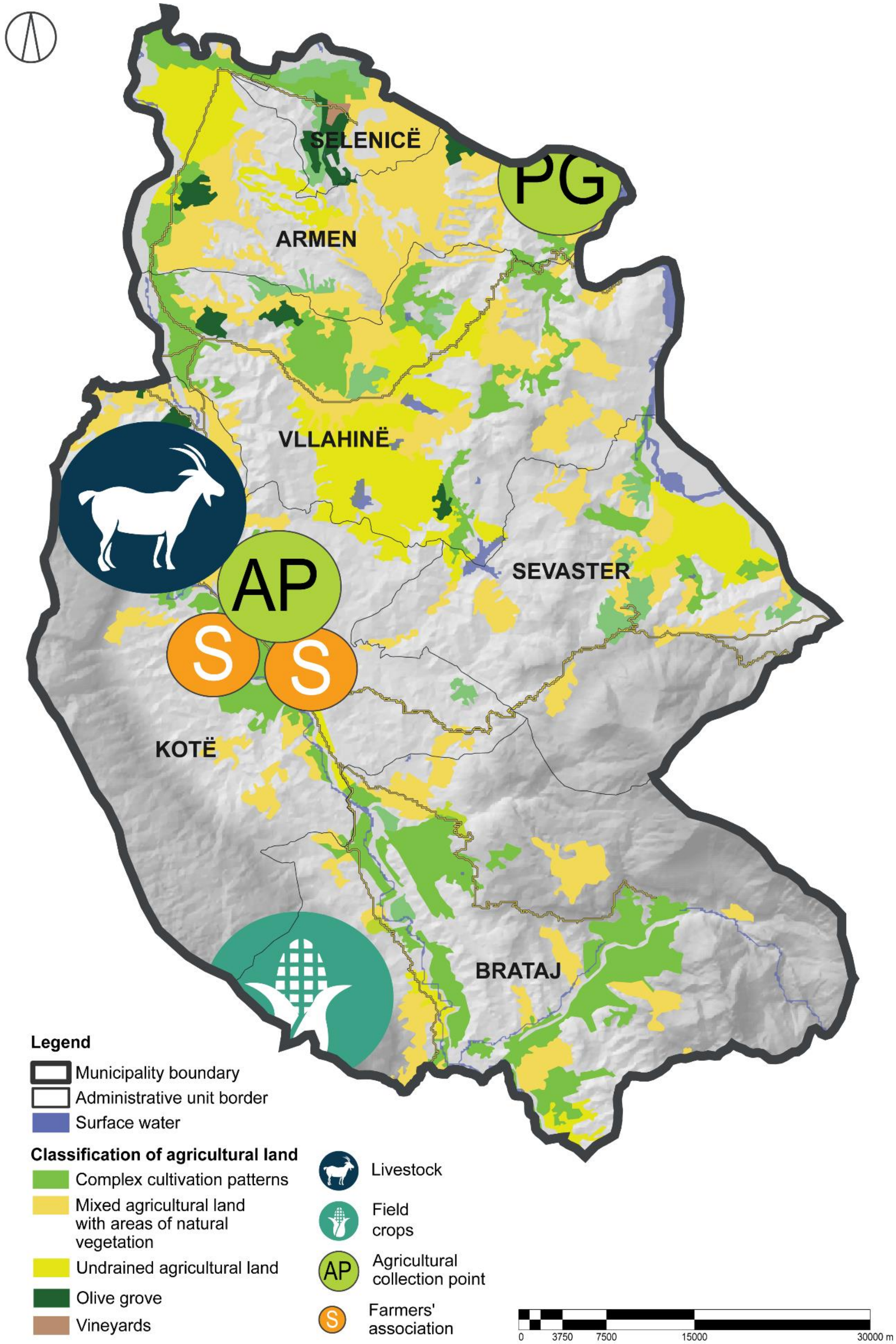
Data from the Water Supply and Sewerage Plan (Agjencia Kombëtare e Ujësjellës-Kanalizimeve (AKUK), 2014) indicate that only a small portion of urban areas is covered by an integrated water supply and sewerage network. In rural areas, while water supply services are occasionally present, the lack of a sewage system is almost total, as observed in most parts of the administrative units of Vllahinë and Brataj. In the areas in which there is a water supply network, actual household connections are fragmented, and a considerable portion of the population remains dependent on individual water management solutions.

Figure XI. Water Supply System in the Municiplaity of Selenicë



Source: National Agency of Water Supply, Sewerage and Waste Infrastructure (AKUK)

Figure XII. Agricultural and Livestock Potentias in the Municipality of Selenicë



Source: Ministry of Agriculture and Rural Development (MBZHR) and Agricultural and Rural Developemnt Agency (ARDA)

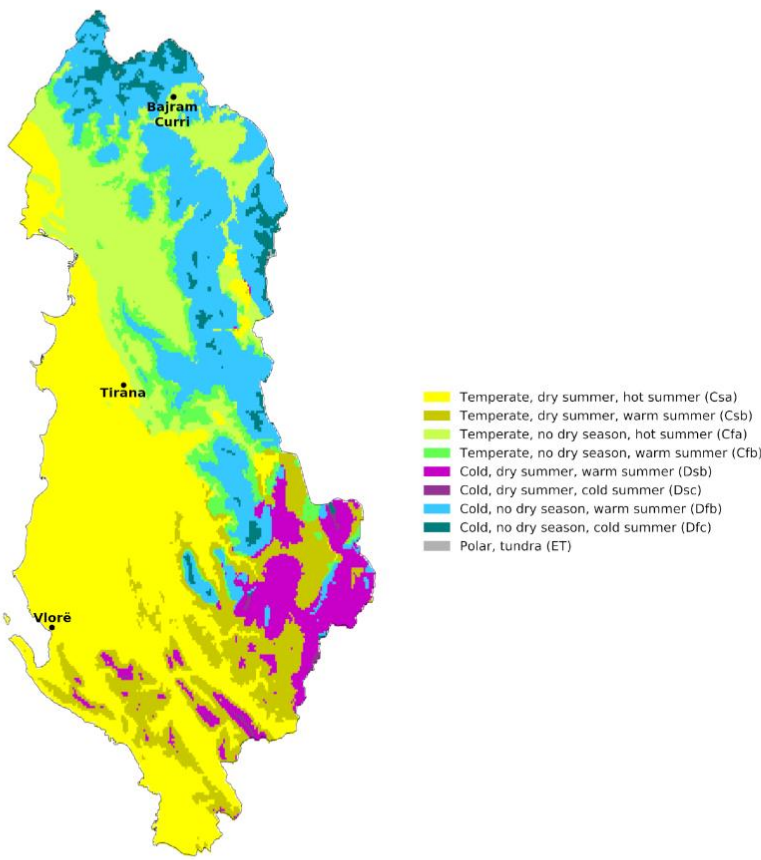
04

CLIMATE ASSESSMENT

4.1. TEMPERATURES AND PRECIPITATION IN ALBANIA

The territory of the Municipality of Selenicë is characterized by a Mediterranean climate of the Atlantic-plain and hilly-Atlantic type, with hot and dry summers and mild and wet winters (Albanian Hydrometeorology, 1985). The influence of the relief, geographical position, and altitude above sea level affects the local microclimates, especially in the valleys of the Vjosa and Shushica rivers, which have a milder climate and somewhat lower temperatures compared to other parts of the territory.

Figure XIII. Climatic Analysis of Albania Based on the Classification Köppen–Geiger



Source: Beck, H. E., Zimmermann, N. E., McVicar, T. R., Vergopolan, N., Berg, A., & Wood, E. F. (2018). Present and future Köppen–Geiger climate classification maps at 1-km resolution. Scientific Data, 5, Article 180214. https://doi.org/10.1038/sdata.2018.214.

Albania represents one of the most prominent examples in the Balkans in terms of climatic diversity, as a result of the complex interaction between its Mediterranean geographical position, pronounced mountainous relief, and various climatic influences from the Mediterranean and Continental Europe. The analysis of climatic distribution, based on the Köppen–Geiger classification system, one of the most widely used in scientific climate assessment, confirms that the Albanian territory is characterized by a variety of distinct climatic zones, which reflect specific thermal and pluviometric conditions(Beck, 2018).

The western lowland areas and most of the coastline are dominated by a Mediterranean climate with hot, dry summers (Csa), where temperatures during the summer season are high, precipitation is concentrated in the cold season, and dry periods are pronounced. This climate determines the agro-economic profile of the area, enabling the cultivation of typical Mediterranean crops such as olives, citrus fruits, and intensive viticulture. The favorable conditions of mild winters and hot summers have historically provided the foundation for agricultural and urban development in this part of the country.

In the hilly areas and interior valleys, including those of the Shkumbin and Drin rivers, the Mediterranean climate with dry and milder summers (Csb) prevails, representing a transitional climatic regime between the western lowlands and the highland areas. In these zones, the thermal amplitude is lower, precipitation is more balanced throughout the year, and summers are cooler compared to the lowlands. This provides favorable conditions for mixed farming and agro-livestock activities, making this climatic belt a high-potential area for multifunctional rural development.

The northern, northeastern, and southeastern mountainous regions, including the Albanian Alps and the highlands of Korab, are dominated by a continental climate with cool (Dfb) or cold (Dfc) summers. These areas are characterized by low annual temperatures, frequent precipitation often in the form of snow, and short, cool summers. Under these conditions, agricultural activities are limited, mainly oriented toward traditional livestock farming and forest exploitation. The marked variability of climatic conditions in these areas makes the territory particularly vulnerable to the effects of climate change, such as the reduction of snow cover and changes in precipitation regimes.

At extreme mountainous elevations, primarily above 2000 meters, a polar tundra-type climate (ET) is recorded, present mainly in the Albanian Alps and the highest peaks of Korab (Peel, 2007, pp. 53–64). This climate is characterized by very low temperatures, a very short growing season, and conditions that restrict any agricultural activity, giving these areas particular importance for the conservation of mountain biodiversity and the preservation of sensitive ecosystems.

In the intermediate hilly-mountainous belt, mainly in the eastern and southeastern parts of the country, a temperate climate without a dry season and with warm summers (Cfb) appears. This transitional climate creates a zone with mixed characteristics, suitable for combined agricultural and forestry activities, serving as an ecological buffer between the lowlands and the high mountains.

According to data from the (IGEO, 2022), he territory is divided into several agro-climatic zones, primarily defined by the distribution of annual precipitation, average seasonal temperatures, the number of dry days, and the intensity of extreme phenomena. Annual average precipitation ranges from less than 700 mm in the western lowlands to over 2,500 mm in the mountainous areas of the north and southeast, while average annual temperatures range from 7°C in alpine zones to 17°C on the southern coast (IGEO, 2020). This climatic conFiguretion results in a high sensitivity of the Albanian territory to the effects of climate change, especially in terms of frequent droughts, intense precipitation over short periods, and extreme seasonal fluctuations. Monitoring models from IGEO show a trend of increasing average annual temperature by about 0.2–0.3°C per decade over the past 30 years, as well as a gradual decrease in annual precipitation across most of the territory, particularly during the spring and summer seasons. These changes have direct consequences on water availability for agriculture, production cycles, soil degradation, and the frequency of erosion and landslide phenomena (IGEO, 2022).

The average annual temperature in the Albanian territory ranges from 7°C in the alpine areas of the north and northeast to over 17°C in the western and southern lowlands. Trends over the past decade have shown a continuous increase in temperatures, with an average of +0.2°C to +0.4°C per decade in lowland and intermediate zones. In parallel, a noticeable change has been observed in the seasonal distribution of precipitation, with a decrease in annual amounts in some regions, and an increase in precipitation intensity over shorter time periods, which raises the risk of flooding, erosion, and infrastructure damage (IGEO, 2022).

For Albania as a whole, annual precipitation ranges from less than 800 mm in the driest areas of the southeast and central regions to over 2,000 mm in the northern and southeastern mountainous areas. Meanwhile, the precipitation dynamics are characterized by high interannual and interseasonal variability, with a shift of periods with intensive rainfall toward the winter season and an extension of dry periods during the summer. This pattern has introduced new challenges for the agricultural sector and water resource management, especially in areas that rely on traditional irrigation systems.

Figure XIV. Precipitation in the Territory of Albania

LEGJENDA: ***Reshjet 24-orëshe***

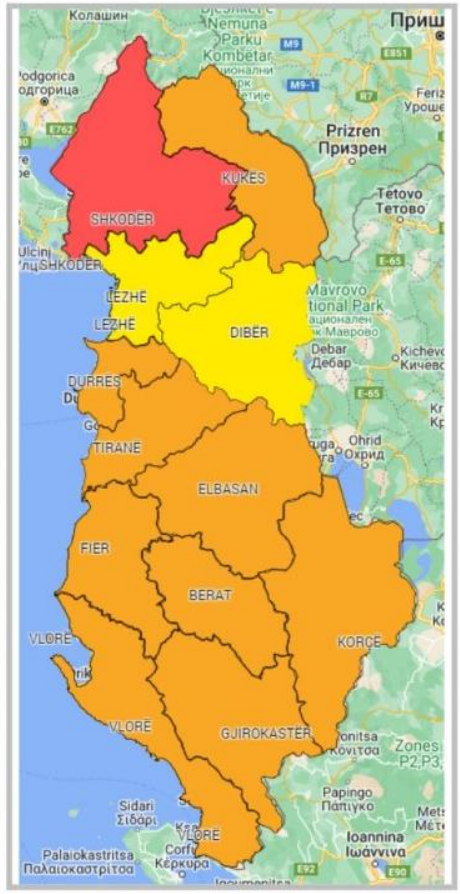
Niveli i Rrezikut	***Reshje shiu*** (mm / 24 orë)
S'KA RREZIK	të dobëta (0 – 15 mm / 24 orë) Nuk priten fenomene hidro-meteorologjike problematike.
I ULËT	mesatare (15 – 45 mm / 24 orë) Mundësi që të shfaqen fenomene hidro-meteorologjike problematike.
I MODERUAR	intensive (45 – 90 mm / 24 orë) Moti parashikohet i rrezikshëm. Parashikohen fenomene të pazakonta hidro-meteorologjike.
I LARTË	shumë intensive (> 90 mm / 24 orë) Moti është shumë i rrezikshëm. Parashikohen fenomene të pazakonshme hidro-meteorologjike mjaft intensive.

LEGJENDA: ***Zjarre në pyje***

S'KA RREZIK	Zjarret e mundshëm janë të kontrollueshëm lehtësisht.
ULËT	Barërat e thatë dhe pyjet mund të digjen lehtë. Flakët janë te mesme në pyje dhe të shpejta në zonat e ekspozuara.
I MODERUAR	Ndezja e zjarreve mund të ndodhë lehtë dhe me përhapje të shpejtë. Zjarret mund të jenë shumë të nxehtë, me kurora përhapje të vogla dhe të mesme.
I LARTË	Ndezja mund të shkaktohet edhe nga një shkëndijë. Zjarret janë shumë të nxehtë me përhapje shumë të shpejtë të flakëve si rrjedhim kontrolli i tyre është shumë i vështirë.

SIMBOLE

	Shtrëngata: reshje mbi 20 mm/3orë. Moti mund të krijojë probleme të ndryshme
	Përmbytje urbane ose nga përrenjtë dhe lumenjtë e vegjël
	Përmbytje nga lumenjtë e mesëm dhe të mëdhenj
	Rrëshqitje toke



RREZIKU MAKSIMAL I QARKUT për sot dhe nesër, dt. 25 – 26.

Source: Institute of Geosciences (IGEO)

4.2. MUNICIPALITY OF SELENICË

4.2.1. MAXIMUM AND MINIMUM TEMPERATURES

Formative climatic factors such as relief, geographical position, altitude above sea level, and land cover influence the seasonal distribution of temperatures and precipitation. Selenicë is classified as a subtropical Mediterranean climate Csa (Beck, 2018), with hot and dry summers and relatively mild and wet winters. The geographical location of the villages in valleys such as those of the Vjosa and Shushica rivers brings a moderation of the climate, with temperatures somewhat lower than the surrounding areas.

Table III. Summary of climatic data for Selenicë (1961–1990)

Parameter	Average Value / Observations
Average summer temperature	31°C (july)
Average winter temperature	4°C (january)
Temperature increase (august 2017)	+6.2°C above the 30-year average
Annual precipitation	1569 - 2025 mm
River flows in winter	43.5% - 46.8% of the annual flow
Growing season	10 months (february - december)
Solar energy (july)	7.7 kWh/m²
Average wind speed	9.8 - 12.9 km/h

Source: Institute of Geoscience (IGEO); National Agency of Natural Resources (NANR); Ministry of Agriculture and Rural Development (MARD); SolarGIS; ERA5 Copernicus

Table IV. Average monthly maximum temperatures for August at several meteorological stations in the Municipality of Selenicë and surrounding areas

No.	Meteorological Station	Average maximum temperature – August 1961–1990 (°C)	August 2017 (°C)	August 2022 (°C)	August 2023 (°C)	Increase compared to 1961–1990 (°C)
1	**Selenicë (historical)**	–	–	35.9	36.4	–
2	**Brataj**	30.0	36.2	36.5	36.9	+6.2–6.9
3	**Kuc**	28.0	34.6	34.9	35.2	+6.6–7.2
4	**Vlorë**	31.5	35.5	36.1	36.3	+4–4.8

Source: European Climate Assessment & Dataset – ECA&D

According to available local and national data, at the Brataj meteorological station, the average maximum temperature in August 2017 was 36.2°C, while the average for the same month between 1961–1990 was 30°C. In Kuc, another border station, the average maximum temperature for August 2017 was 34.6°C, marking an increase of 6.6°C above the multi-year average. The highest temperature historically recorded in Selenicë is 43.2°C, on July 18, 1973. According to long-term climatic data, average maximum summer temperatures in the Selenicë territory have shown a significant increase in recent decades. In August 2017, the average maximum temperature at the Brataj meteorological station reached 36.2°C, compared to 30°C, the average of the period 1961–1990, marking an increase of 6.2°C (IGEO, 2020). Likewise, at the Kuc meteorological station, during the same month and year, a high temperature of 34.6°C was recorded, significantly exceeding the 30-year average of 28°C for this period.

This indicator reflects significant climatic fluctuations and may serve as a signal of regional climate change.

Meanwhile, the historical temperature record for the Selenicë region is 43.2°C, recorded on July 18, 1973. This figure represents one of the highest documented temperatures in Albania and indicates the intensity of the climatic conditions that this area has experienced in the past. (IGEO, 2020).

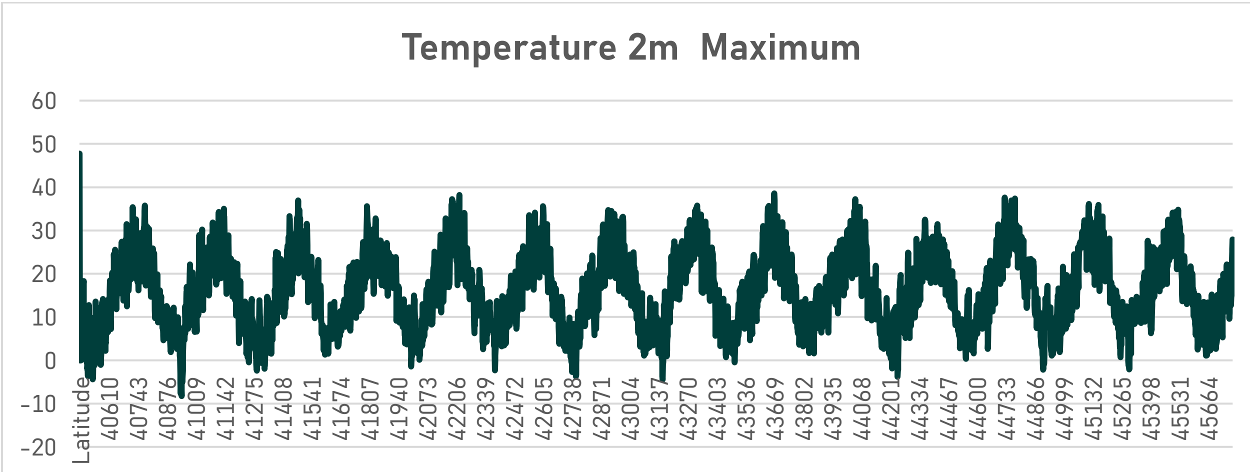
Meanwhile, from the available international satellite data, specifically the ERA5 Land series summarized by WeatherSpark (1991–2020), the following typical values are provided:

Table V. Satellite data (1991-2020)

Parameter	Average 1991-2020	Description
Average high temperature in July	31 °C	Monthly average of the daily maximum temperature
Average low temperature in January	4 °C	Monthly average of the daily minimum temperature
Recorded extreme near the area (Vlorë, 11.08.2017)	38 °C	–
Average annual precipitation	695 mm	50 % fall between November – February
Precipitation in the driest month (July)	10 mm	Typically < 1 % of the annual total
Precipitation in the wettest month (November)	109 mm	The wettest month
Diays with rain in July	2 – 3	Intensive short duration
Days with rain in November	≈ 11	Uniform distribution

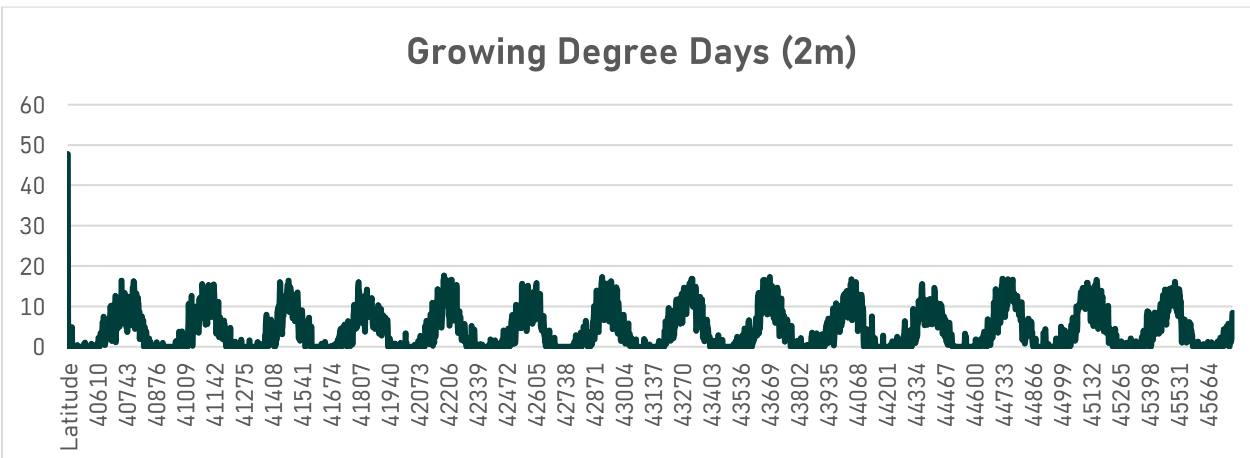
Source: Weather Spark (2025)

Graph I. Maximum temperature over the period 2011–2025; Territory of the Municipality of Selenicë



Source: MeteoBlue (2025)

Graph II. Days with temperature increase over the period 2011–2025; Territory of the Municipality of Selenicë



Source: MeteoBlue (2025)

International platform (WeatherSpark, 2024) confirms the trend of local data, reporting that average temperatures for July are around 31°C, while for January they are around 4°C (WeatherSpark, 2024). Furthermore, the global report by (Copernicus Land, 2025) Service for 2024 confirms that the average global temperature for the year was over 1.5°C higher than the pre-industrial average, marking the warmest year in history (Copernicus Land, 2025). Similarly, (WeatherSpark, 2024), the windiest estimated period is from late October to April, with an average speed of 12.9 km/h in February. Meanwhile, July has the highest solar radiation with 7.7 kWh/m².
The analysis shows a linear increase of +0.32 °C / decade for the average temperature and +0.44 °C / decade for summer maximums. The number of days with ≥ 35 °C has tripled compared to the 1981–1990 decade. The episode of August 11, 2017, with 38 °C at the coastal station of Vlorë, confirms the scale of modern heat waves (WeatherSpark, 2024).

4.2.2. ANNUAL PRECIPITATION AND RIVER FLOWS

In the Municipality of Selenicë, annual precipitation shows a decreasing trend and is unevenly distributed throughout the year, with higher amounts in winter and spring and significantly less in summer, when agricultural water demands are highest. This situation directly affects irrigation water supply and the stability of ecosystems. Selenicë experiences precipitation concentrated mainly during the winter months. For example, the Shushica River at the Vodicë station has an average flow of 22.8 m³/s, with 45% of the flow occurring during winter and only 6.5% during summer (Table 4). This uneven distribution of precipitation presents challenges for agricultural irrigation during the hot and dry months.

Table VI. Annual precipitation and average river flows of Vjosa and Shushica rivers in the area of the Municipality of Selenicë

No	Station	Annual presipitation (mm)	Average discharges (m³/s)	Discharge by seasons (%)				Comments
				Winter	Spring	Summer	Autumn	
1	**Vjosë – Dorëz**	**1569**	**155**	**43.5**	**31.8**	**10.1**	**14.6**	High discharges in winter and spring; risk of flooding in the surrounding areas.
2	**Vjosë – Mifol**	**1666**	**1530**	**—**	**—**	**—**	**—**	High water levels during heavy rainfall; possible flooding.

3	**Shushicë – Vodicë**	**2025**	**22.8**	**45.0**	**32.0**	**6.5**	**16.5**	Low discharges in summer; risk of drought and impact on agriculture.
4	**Shushicë – Drashovicë**	**1980**	**32.9**	**46.8**	**27.8**	**7.6**	**17.8**	Erosion of agricultural lands due to high discharges in winter.

Source: Institute of Geosciences (IGEO)

For precipitation, seasonal variability has amplified short wet periods with intensity > 100 mm/48 h and has extended the dry segment between June and August up to eight weeks. A reorientation of rainfall weight toward the winter months is observed at all stations around the Shushica valley. About half of the annual total precipitation falls between November and February; summer rainfall rarely exceeds 1% of the daily total, creating a water deficit during the peak phase of agricultural demand.

Annual precipitation in the municipal territory is concentrated in the November – February season; during summer, it falls below 1% of the daily total, creating a water deficit during the peak phase of the crops. The recalculation of average discharges, based on the historical series from IGEO and Poçem equalization models, gives:

- **Vjosa (Poçem section) –** long-term specific discharge around 195 m³/s; over 60% of this volume flows from December to March.
- **Shushica (Vodicë section)** – long-term discharge around 19 m³/s; only 6% in July-August, which limits irrigation supply.

The long-term trend shows a decrease in spring and summer precipitation and an increase in episodes > 100 mm/48 h in winter, adding pressure on the drainage infrastructure, which was designed for a 1-in-10-year discharge in the 1980s.

4.2.3. CLIMATE RISKS ASSESSMENT

The territory of Selenicë Municipality faces a wide range of climate risks that are intensifying as a result of climate change, directly affecting vital sectors such as agriculture, water, and the environment. According to data from the (Insitute of

Geosciences - IGEO, 2022), , his territory is characterized by a Mediterranean climate with dry and hot summers and mild winters with low, but increasing, precipitation intensity.

Heat waves and droughts

Progressive summer warming, confirmed by an average increase of +0.44 °C per decade in the daily maximum temperature, raises the frequency of days with temperatures above 35 °C. This increases thermal stress, especially affecting agriculture and crops such as corn and olives, and threatens public health in remote villages where access to healthcare is delayed.

Seasonal drought combines with the reduction of Shushica's discharges, reducing irrigated areas and forcing farmers to shorten the planting season.

The progressive rise of summer temperatures, accompanied by a reduction in rainfall during the growing season, increases the sensitivity of the agricultural sector to drought. New climate trends have led to a gradual increase in maximum temperatures, especially during July and August, where days with temperatures above 35°C are observed more frequently. These heat waves, lasting more than 4–5 consecutive days, are becoming a regular phenomenon in the territory of Selenicë, affecting plant heat stress, agricultural yields, and posing risks to public health in rural areas with dispersed populations and limited access to services.

Furthermore, the General Local Plan (GLP) of Selenicë Municipality clearly identifies that significant parts of the territory, especially in the hilly areas of the administrative units Armen and Brataj, are exposed to prolonged droughts, which affect the reduction of water inflows in reservoirs and the existing irrigation network (Atelier 4 and Municiplaity of Selenicë, 2018). This reduction is also evident in local data on water supply for agriculture, where, according to (Local Sources from the Municipality of Selenicë, 2023), the majority of irrigated areas are decreasing due to the lack of available water during critical periods of crop development.

The agronomic risk is worsened by seasonal deficits in the flow of the Shushica (~6% of the annual volume in July-August according to basin analyses), limiting irrigation supply during the critical growth period. Adaptive strategies should focus on seasonal storage (micro-reservoirs, interceptor basins), improving irrigation efficiency, and transitioning to systems with lower water consumption (UNDP, 2017).

The continental scaling of droughts (the drought impact indicator on ecosystems by EEA) shows an increasing trend of moisture deficit pressure in Europe during the last decade, including the Mediterranean basin where Albania is located; this signal supports the need for proactive soil moisture management in rural areas such as Selenicë (EEA, 2021).

Floods

Floods represent another significant risk for the territory. Episodes with rainfall > 100 mm/48 h have intensified since 2015, especially in the branches of the Shushica River passing through Plloçë, Kota, and Sevaster. The terrain lacks a well-functioning drainage network; in many sections, the canals have a capacity twelve times smaller than the 1-in-25-year design discharge, leading to floods and sediment deposition that worsen erosion and destabilize slopes with gradients > 25° in Vllahinë and Armen.

Based on flow recordings in the branches of the Shushica River and around the lowland areas of the villages Plloçë, Kotë, and Sevaster, an increase in episodes of intensive rainfall over 60 mm/day during November-December has been observed, coinciding with partial flooding of agricultural lands and damage to irrigation infrastructure (IGEO, 2022), (Selenicë).

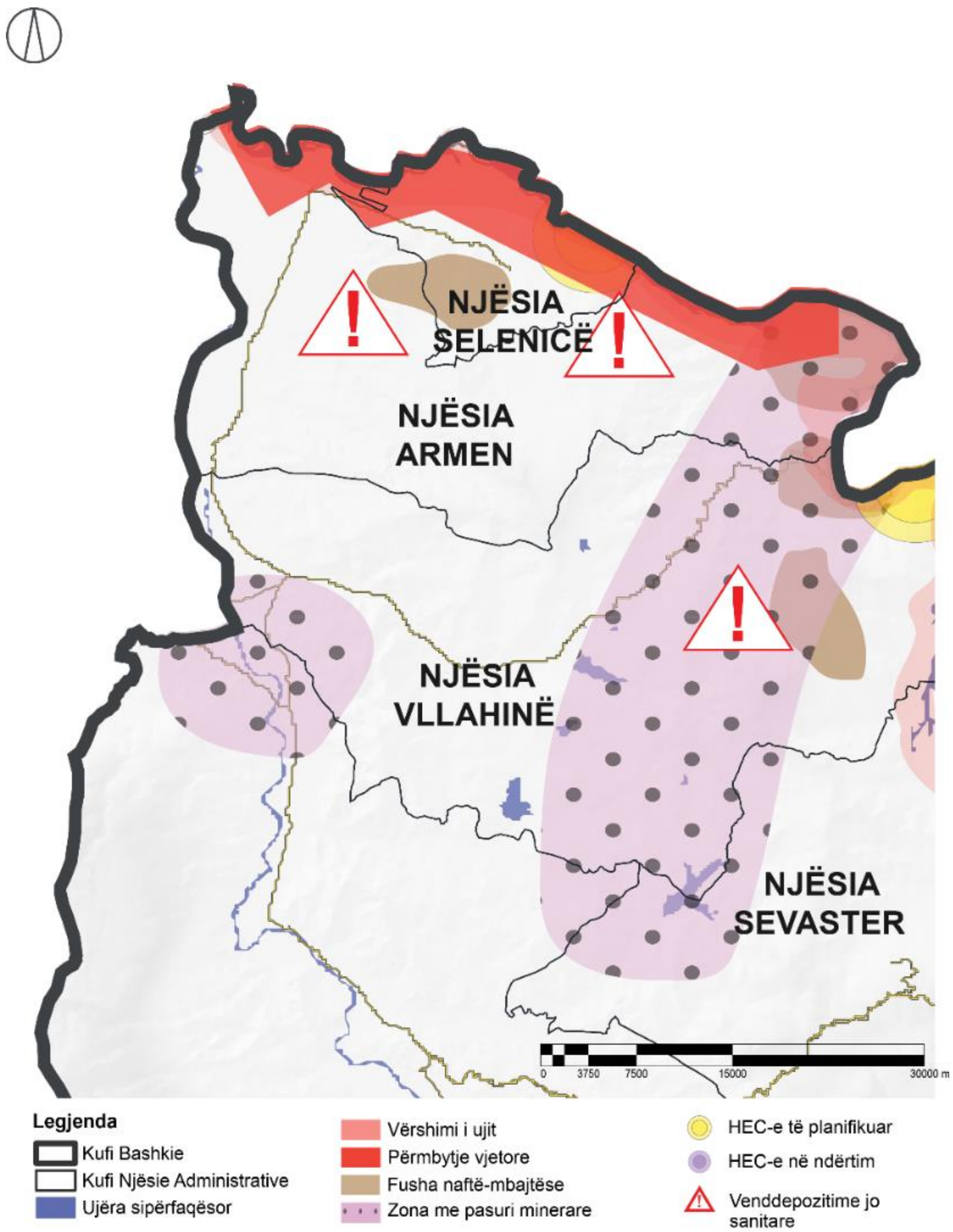
Flooding episodes with rainfall > 100 mm within 48 hours in the Shushica valleys have caused partial floods in the lands of Ulza and Sevaster.

According to the General Local Plan, the drainage infrastructure is degraded and in some cases non-functional, making the territory especially vulnerable to sudden high-intensity rainfall. These concentrated rains over a few days also increase the risk of landslides in steep areas, such as parts of the Administrative Units of Vllahinë and Armen.

Meanwhile, extreme temperatures and lack of rainfall contribute to rising soil surface temperatures, especially in bare agricultural plots or abandoned lands, where soil thermometers can reach over 45°C during the summer months. This accelerates soil degradation, reduces its capacity to retain moisture, and increases sensitivity to erosion (EEA - European Environment Agency, 2020),

From another analysis, the Vjosa at its outlet to the Adriatic averages 195 m^3/s, while the Shushica, which supplies the local irrigation network, holds only 19 m^3/s in the long-term average (United Nations Development Programme, 2017).

Figure XV. The area most affected by floods in the Municipality of Selenicë



Source: State Authority for Geospatial Information

Fires

In the territory of Selenicë Municipality, the fire situation presents an ongoing challenge for sustainable management of natural resources, especially in areas with forest and pasture cover. The geographical characteristics of the terrain, rough terrain, dry vegetation cover, and lack of access in some areas, create conditions that favor the rapid spread of flames, making timely and effective intervention by local structures difficult.

Law no. 152/2015 'On the Fire Protection and Rescue Service' clearly defines the competencies of municipalities in organizing and operating this service at the local level, but practice has shown that the human and technical capacities of municipalities, including that of Selenicë, are often insufficient to handle large-scale fire situations (General Fire Protection and Rescue Directorate, 2020).

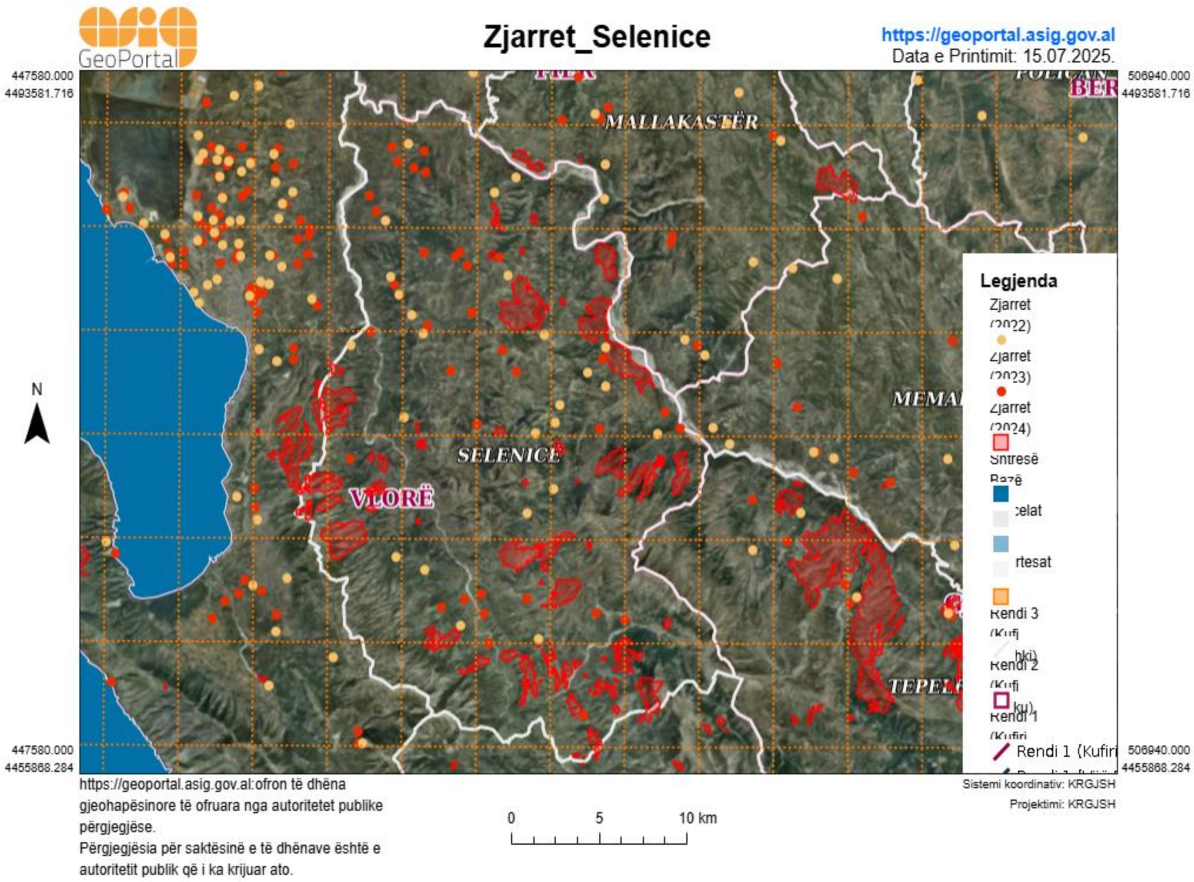
One of the fundamental problems in fire management at the local level is related to the lack of specialized equipment, monitoring networks, and forest roads that enable rapid intervention. Although the number of fire stations nationwide has increased from 39 in 2015 to 70 in 2020, an unequal distribution of them leaves some areas, including Selenicë, inadequately covered by the Fire Protection and Rescue Service (MZSH, 2021).

Fires occurring mainly during the summer months are closely linked to natural factors such as drought and high temperatures, but also to deliberate ignition or human negligence. During the summer season of 2020, 635 cases of fires in forests and pastures were reported nationwide, burning over 2,384 hectares of land and more than 10,000 olive trees (MZSH, 2021). Although the data are general at the national level, the territory of Vlorë and particularly municipalities such as Selenicë have been among the regions with a high frequency of fires.

The implementation of action plans remains one of the main weaknesses. The lack of joint inter-institutional plans, poor coordination between local and central structures, as well as the absence of ongoing training for personnel and the community, further worsen the response to fires in Selenicë and beyond (General Fire Protection and Rescue Directorate, 2020).

To increase the resilience and response capacity of Selenicë Municipality, investment is needed in early warning systems such as thermal cameras, forest roads, intervention equipment, and strong cooperation with the local community through volunteer units and awareness campaigns. Only an integrated approach supported financially by sustainable budgets can bring results in reducing burned areas and preserving local biodiversity.

Figure XVI. Fires in the Municipality of Selenicë during the period 2022–2024



Source: State Authority for Geospatial Information

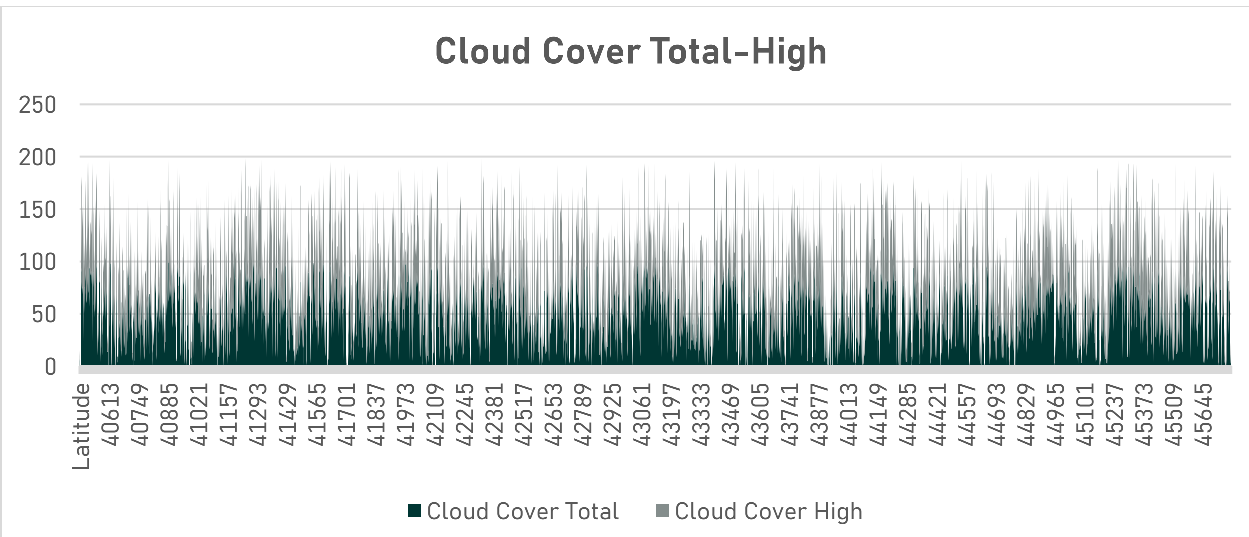
The combination of extreme temperatures, relative humidity < 25%, and northwesterly winds of 9–13 km/h creates favorable conditions for spontaneous fires in the sparsely forested hills around Lepenicë and Kotë. On average, six new fire outbreaks are recorded every summer since 2018.

Summer warming reinforces the fire risk index in hilly areas with sparse forest cover; the correlation between northwesterly winds of 9–13 km/h and relative humidity < 25% during August favors the outbreak of sporadic fire hotspots, particularly in Vllahinë and Lepenicë.

The Local Plan emphasizes that areas with sparse forest cover, especially in the hills surrounding the villages of Lepenicë, Vllahinë, and Kotë, constitute potential hotspots for fire outbreaks during the summer (Atelier 4 and Municiplaity of Selenicë, 2018). The combination of high exposure to solar radiation and the lack of protective infrastructure makes fire prevention interventions more challenging in this territory. It is worth emphasizing that in many cases there is also a lack of a functional early warning or real-time monitoring system for high temperatures and dry winds, which are key determinants for the spontaneous generation of fire outbreaks. These phenomena, also assessed in the World Bank's national report on climate and development in Albania, are

considered to be accelerating in small municipalities like Selenicë, where the interconnection between the natural system, agricultural infrastructure, and built environment is delicate and with limited adaptive capacity (World Bank, 2021).
During the timeframe between 2011 to mid-2025, there is frequent and pronounced variability in cloud cover in the upper layers of the atmosphere. The total cloud cover values, presented in the graph as the darkest intensity, show a regular and dense presence of clouds on most days, with fluctuations often reaching peak values above 150 units. In addition, the high cloud component appears more consistently widespread but with lower intensity compared to the total, suggesting that high-altitude cloud formations are common, though rarely dominant in the overall sky cover structure. Long-term trends do not show a clear increase or decrease, indicating seasonal and climatic stability in the cloud cover pattern in this area, with a high frequency of interruptions in atmospheric clarity, which may affect solar energy, natural lighting, and other atmospheric processes.

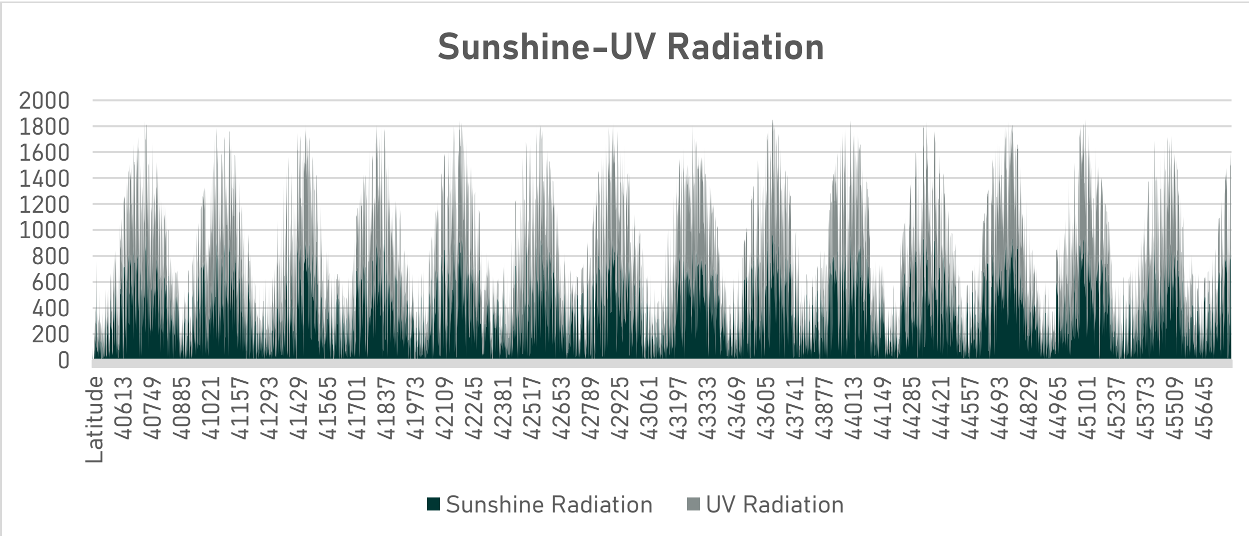
Graph III. Total cloud cover versus maximum cloud cover over the period 2011–2025; Territory of the Municipality of Selenicë



Source: MeteoBlue (2025)

The data on solar radiation and its spectral components, collected from 2011 to the end of 2024, show a regular seasonal cycle with high amplitudes in the summer months and minimum values in winter. Total solar radiation follows a clear annual pattern, peaking in mid-year and dropping to a minimum during the cold months, reflecting the direct influence of the sun's angle and day length. Within this structure, longwave radiation maintains a more stable presence throughout the year, while shortwave radiation is more sensitive to seasonal changes—rising significantly in summer and dropping sharply in winter. This recurring annual rhythm indicates high climatic stability in terms of solar energy input.

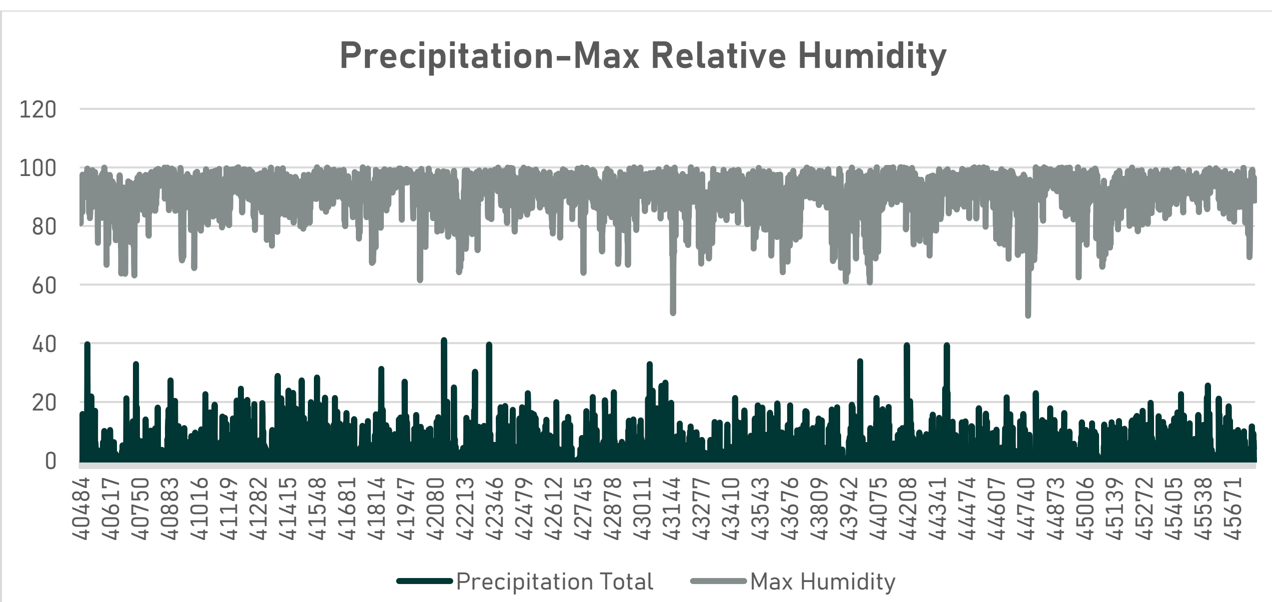
Graph IV. Radiation in the Municipality of Selenicë 2011- 2024



Source: MeteoBlue (2025)

During the period from the end of 2010 to the end of 2024, a constant presence of maximum humidity is observed, with values remaining mostly within the 80–100% range, indicating a high level of water vapor saturation in the atmosphere. Although there are some sporadic and pronounced drops, these remain isolated cases and do not represent a long-term trend. In parallel, precipitation shows an uneven distribution with regular intervals of rainfall, where intensity fluctuates at average values of 10–30 mm, but with some extreme cases exceeding 50 mm. These data signal a climate with persistent humidity and rainfall present throughout the year, reflecting an environment favorable for biological processes and vegetation growth, but also with potential for flooding in cases of high-intensity rainfall.

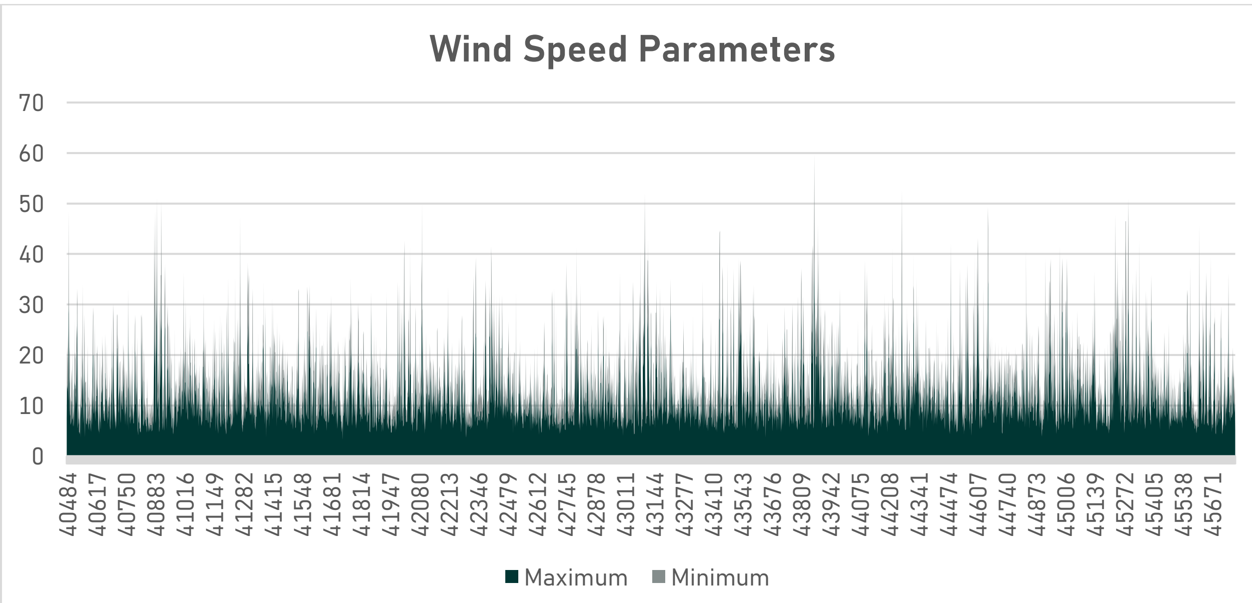
Graph V. Precipitation and Humidity in the Municipality of Selenicë 2010-2024



Source: MeteoBlue (2025)

During the time period spanning from November 2010 to November 2024, pronounced fluctuations in wind speed are observed, with a high density of moderate values interrupted by short episodes of sudden and intense increases in wind speed. The most frequent values appear to lie between 5 and 15 units, while values exceeding 30 units are occasionally recorded, indicating the presence of strong at
mospheric phenomena or storms. The frequency of these high fluctuations is unevenly distributed over the years, suggesting periods of intensified wind activity, particularly around the years 2013, 2016, and 2021–2023.

Graph VI. Wind speed in Municipality of Selenicë 2010-2024



Source: MeteoBlue (2025)

Expanding micro water storage capacities is essential to balance the summer deficit; hydrological analysis suggests that interceptor basins with a capacity of around 2 million m³ would result in a 30% reduction of the current seasonal shortfall. Furthermore, channel design standards need to be updated from the 1-in-10-year flow used in the 1980s to the 1-in-25-year flow projected for 2050, so that the infrastructure can withstand the already observed intense rainfall events.

These measures, combined with fire risk zoning and the strengthening of early warning systems, would provide the Municipality of Selenicë with a strong foundation for proactive climate adaptation.

The operational zoning of fire risk should combine the meteorological index (temperature, relative humidity <~25%, wind speed >~10 km/h), vegetation load, and distance from firefighting access infrastructure; these elements are recommended in emergency management planning practices and are adapted at the municipal level in accordance with the national legal framework.

Some Key Findings

Basic Climatological Profile (2010-2024)

The analysis of climate data for the period 2011–2024 (including temperature data; agricultural data such as: evapotranspiration levels, potential evaporation, vapor pressure deficit, soil temperature, and reference evapotranspiration according to FAO; cloud-related data such as: total cloud cover, maximum cloud cover, minimum cloud cover, and average cloud cover; geophysical potential data such as: average sea-level pressure, geopotential height at different atmospheric pressures; precipitation and humidity data; radiation-related data such as: sunshine duration, shortwave radiation, longwave radiation, UV radiation, direct shortwave radiation, diffuse shortwave radiation; soil moisture data; and wind data such as: wind speed and wind direction from the open databases Weather Sparks (2024) and MeteoBlue (2025)) clearly highlights the climatic profile of the Municipality of Selenicë as a subtropical Mediterranean zone, characterized by hot and dry summers and mild, relatively humid winters. This climatic feature exhibits strong seasonality, which appears not only in the evolution of temperature but also in key parameters such as soil moisture, solar radiation, and irrigation requirements.

Table VII. Monthly climatology/average

Month	Average Temperature (°C)	Maximum Temperature (°C)	Minimum Temperature (°C)	Soil Moisture	Available water in soil (0-100 cm)	Total Solar Radiation (kJ/m²)	Sun duration (minutes)	Wind speed at 10 m (km/h)	Reference evapotranspiration (mm)	Vapor pressure deficit(hPa)
January	3.15	13.29	-5.95	0.391	0.24	33,933.71	5,940.53	8.39	16.07	1.15
February	4	15.18	-5.62	0.388	0.237	56,925.00	7,480.53	8.47	27.16	1.77
March	7.31	20.15	-2.64	0.372	0.221	106,134.90	11,901.91	7.91	55.41	3.09
April	10.93	24.53	-0.9	0.338	0.187	141,705.10	13,167.44	7.29	80.6	4.63
May	14.86	27.92	3.67	0.318	0.167	162,753.90	14,739.28	7.12	101.14	5.57
June	19.57	33.36	8.71	0.265	0.115	173,165.80	17,137.46	6.55	121.47	8.27
July	21.25	34.94	10.41	0.215	0.067	179,553.60	18,163.51	6.51	131.6	10.34
August	20.87	34.6	10.04	0.192	0.045	154,430.10	16,524.89	5.85	112.37	9.24
September	16.7	29.75	5.49	0.196	0.048	111,090.20	12,990.36	6.35	74.49	5.82
October	11.94	23.2	2.31	0.259	0.109	70,493.36	9,410.46	6.67	41.16	2.59
November	6.73	17	-1.53	0.326	0.175	40,006.64	6,687.26	7.17	20.02	1.37
December	4.17	13.68	-4.45	0.372	0.221	27,875.64	6,085.54	8.33	13.97	1.07

Source: Weather Sparks (2024) & MeteoBlue (2025)

The average monthly temperature during this period peaks in July, with average values ranging between 27–28°C, accompanied by a parallel increase in potential evapotranspiration (ET0), which reaches its maximum between June and August. On the other hand, winters are mild, with average monthly temperatures around 6–8°C and very low ET0, indicating a period with minimal irrigation requirements.

In terms of soil moisture, the profile for the 0–100 cm depth indicates a full replenishment of water reserves during the winter–spring period, while from April onward, there is a progressive decline in soil moisture, reaching its minimum in August. This cycle is consistent with the characteristics of the Mediterranean climate and explains the water stress experienced by agricultural crops during the summer.

In terms of radiation and sunshine duration, the data confirm a progressive increase in solar energy flux, peaking in July, which coincides with the highest solar illumination of around 7.7 kWh/m²/day. This parameter is important for understanding the agro-energy potential of the area, especially for irrigation technologies that can be powered by solar energy.

Table VIII. Correlations

	Average temperature (°C)	Maximum temperature (°C)	Soil moisture (0–100 cm)	Available water in soil (0–100 cm)	Reference evapotranspiration (mm)	Vapor pressure deficit (hPa)	Wind speed at 10 m (km/h)	Sunshine duration (minuta)
Average temperature (°C)	1							
Maximum temperature (°C)	0.963	1						
Soil moisture (0-100 cm)	-0.773	-0.749	1					
Available water in soil (0–100 cm)	-0.773	-0.749	0.999	1				
Reference evapotranspiration (mm)	0.918	0.928	-0.648	-0.648	1			
Vapor pressure deficit (hPa)	0.895	0.896	-0.761	-0.756	0.941	1		

Wind speed at 10 m (km/h)	-0.486	-0.48	0.501	0.503	-0.418	-0.399	1	
Sunshine duration (minutes)	0.851	0.879	-0.627	-0.627	0.946	0.891	-0.517	1

Source: Author's calculations

The correlations between key climate variables and soil moisture and agricultural parameters are statistically strong. There is a very strong positive relationship between average temperature and ET0 ($r = 0.92$), as well as with vapor pressure deficit (VPD, $r = 0.90$), clearly indicating that rising temperatures are accompanied by increased water demand from vegetation and heightened water stress. Conversely, the relationship between temperature and soil moisture is strongly negative ($r = -0.77$), with a particularly strong one-month lagged correlation (-0.85), showing that the drying effects of high temperatures are reflected in the soil moisture profile after a 30-day period.

This interconnection is particularly important for the forecasting and management of irrigation. Moreover, **the agricultural stress index**, which combines temperatures above 30°C with low soil moisture levels (<0.2), peaks in July–August but shows a progressive increase starting as early as May and only recedes in October.

Table IX. Irrigation demand

Month	Scenario 0 – Gross volume (m³)	Scenario 1 – Gross volume (m³)	Scenario 2030 – Gross volume (m³)	Full Scenario – Gross volume (m³)
Jan	0	0	0	0
Feb	0	0	0	0
Mar	80133.13	100166.4	237728.3	459587.1
Apr	1126983	1408728	3343382	6463578
May	1499326	1874158	4448001	8599076
Jun	1896226	2370283	5625471	10875415
Jul	2113680	2642100	6270585	12122579
Aug	1800900	2251125	5342671	10328693
Sep	1144362	1430453	3394942	6563255
Oct	514940.8	643675.9	1527658	2953337
Nov	105364.8	131705.9	312582.1	604297.9
Dec	0	0	0	0

Source: Weather Sparks (2024)

Statistical modeling of average temperature and soil moisture indicates that, if historical trends continue, the next 24 months will be characterized by a further intensification of seasonality and a gradual increase in summer temperatures, thereby deepening the challenge of water resource management and agricultural adaptation.

Table X. Composite climate risk index

No.	Administrative Unit	Exposure	Sensitivity	Capacity	Risk_Index
3	**Kotë**	0.770374	0.2	0.45	52.01869
1	**Armen**	0.770374	0.18	0.4	51.71869
5	**Brataj**	0.770374	0.15	0.35	51.01869
2	**Vllahinë**	0.770374	0.17	0.5	50.31869
4	**Sevaster**	0.770374	0.15	0.55	49.01869
0	**Selenicë**	0.770374	0.15	0.7	47.51869

Source: Author's calculations

For the purpose of **constructing a composite climate risk index**, climatic exposure, soil sensitivity, and the adaptive capacity of administrative units have been combined. The results show that the units of Kotë and Armen are the most exposed, with scores close to 52 out of 100, followed by Brataj, Vllahinë, Sevaster, and central Selenica.

This ranking reflects the interplay between natural conditions and institutional and infrastructural capacities, which are more limited in peripheral areas.
The analysis of irrigation scenarios, based on the existing crop structure, highlights current deficits. Today, only 1,000 hectares of agricultural land are irrigated, while the potential capacity is up to 9,750 hectares. For the 2030 target, it is planned to irrigate an area of 4,450 hectares, which requires about 30.5 million m³ of water annually with a system efficiency of 75%. Monthly irrigation demand is minimal in December–February, but increases significantly from March, peaks in June–July, remains high in August, and decreases again in September–October. This seasonal profile calls for modernization of irrigation systems and the use of more efficient technologies to minimize losses.

Time series analyses for the period 2011–2024 clearly demonstrate an intensification of climate variability and water stress in the territory of the Municipality of Selenicë. The rise in temperatures, the decrease in soil moisture during the critical agricultural season, and limitations in irrigation infrastructure as well as fire and flood protection require a proactive approach from local policies. This includes increasing water storage capacities, rehabilitating irrigation networks, and developing early warning systems for droughts, fires, and floods, in order to ensure more sustainable and climate-resilient agriculture.

05

WATER AND AGRICULTURE

5.1. WATER RESOURCES AND WATER NEEDS

The territory of Selenicë Municipality is characterized by an Atlantic Mediterranean climate, with hot and dry summers, and mild and wet winters. Albania's Mediterranean climate shows pronounced differences in temperature and precipitation among 13 climatic subzones. Although rainfall is important for irrigation, it falls mainly during the October–March period (about 80%), while only 8–12.7% falls during the summer months (June–August), when water demand is at its highest.

July and August are the driest months, with soil water reserves at their lowest levels and evaporation at its peak. Analyses from 2023 on soil water content in the rural areas of Selenicë show that in August it reaches its lowest levels, in the range of 4.8–7.34%, compared to other seasons.

The existing irrigation schemes in Albania are designed with a norm of 4000–7000 m^3/ha, depending on crop type, climatic conditions, and soil characteristics. The irrigation deficit during the June–August period ranges from 400 to 500 mm (or 4000–5000 m^3/ha), making irrigation indispensable for sustainable production and for protecting soil from degradation.

According to literature, the water footprint for several agricultural crops in Albania is as follows: cabbage – 200 l/kg, pumpkin – 240 l/kg, corn – 900 l/kg, oranges – 460 l/kg, potato – 250–287 l/kg, tomato/cucumber – 214–280 l/kg, olives – 3025 l/kg, with an average of 336 l/kg for vegetables and 748 l/kg for fruits.

Based on current issues in irrigation infrastructure and the impacts of climate change in Selenicë Municipality, a strategic review of the existing system is necessary to increase water use efficiency. This improvement should be supported by scientific planning, including evapotranspiration indicators, meteorological parameters, and the physico-chemical characteristics of the soil.

Current irrigation practices in the country still rely on empirical experience, without accurate calculation of water needs. It is essential that irrigation planning be based on actual evapotranspiration, which represents water loss through soil evaporation and plant transpiration, dependent on temperature, wind, and plant cover.

For 2024, Selenicë Municipality has 8548 ha of uncultivated agricultural land, representing 57.3% of private agricultural land. The lack of plant cover increases soil water evaporation and worsens the water balance. Cultivating uncultivated areas could help reduce water losses by decreasing excessive transpiration and improving irrigation norms.

The calculation of water needs should include: actual evapotranspiration, useful rainfall during vegetation, soil water reserves, and crop coefficient. Additional water needs during the April–September period range from 400–700 mm. Simple formulas can also be used, which take into account soil moisture content, texture, physical characteristics of the soil profile, and the water footprint.

Currently, surface irrigation is mainly used in Selenicë Municipality within a deteriorated infrastructure, leading to high water losses and negative environmental impact.

Improving the situation requires a shift towards modern and efficient irrigation methods, such as:

- Drip irrigation Ujitja me pika
- Microsystem irrigation or controlled sprinkler irrigation
- Underground inflitration
- Use of soil moisture sensors and automated irrigation planning

The application of the above-mentioned modern techniques and systems will significantly increase water efficiency and the sustainability of agricultural production under climate change conditions.

Table XI. Main indicators for the climate situation and water resources in the Municipality of Selenica

Category	Indicator	Value/ Description
Climate and Rainfall	Seasonal distribution of precipitation	80% during the October-March period; 8–12.7% during June-August
	Average Climate	Mediterranean with dry summers and mild winters
Soil water (moisture)	% in August	4.8% – 7.34%
Irrigation systems	Type	Traditional surface systems, (canals, furrows)
	Historically designed capacity	4000–7000 m³/ha
	Actual capacity	Lower than actual needs
Irrigation deficit	Average for the vegetation period (April-September)	400–700 mm or 4000–7000 m³/ha
	For June–August period	400–500 mm
Uncultivated land	Uncultivated area in 2024	8548 ha (57.3% of private agricultural land)
Water consumption by crops	Corn	900 liters of water / kg
	Olives	3025 liters of water / kg
	Vegetables	336 liters of water / kg (approximately)

Recommended solutions	Modern irrigation systems	Drip irrigation, microsystems, automated systemes with sensors
	Management approach	Based on actual evapotranspiration , crop coefficients and water footprint.

Table XI. provides a summary of key indicators related to climate, water use, and agricultural characteristics in the territory of Selenicë Municipality. It highlights the main issues of water sustainability during the summer, shortcomings in irrigation infrastructure, and the need to implement modern practices for efficient water management. Additionally, it offers data on water consumption by different agricultural crops and the areas of uncultivated land, emphasizing the need to adapt to changing climate conditions.

5.1.1. WATER RESOURCES

Water resources for agricultural irrigation consist of reservoirs built for irrigation before 1990, the Vjosa River, the Shushica River (a branch of the Vjosa), the Velçë Stream, the Smokthina River, and the Ramicë spring.

A) The Vjosa River, an important water source for irrigating agricultural land in Selenicë Municipality (especially in the villages of the Sevaster administrative unit and potentially also for Armen if investments were made), is fed by surface and underground waters from the surrounding mountainous areas. About 69.5% of the annual flow comes from surface waters, while 30.5% is supplied by underground springs. The multi-year average flow at the river's mouth into the sea is 195 m^3/s, while the minimum flow ranges from 54 to 55 m^3/s.

In the Vjosa basin, there are several important aquifers, such as those in the areas of Buduk, Bodrisht, Vanistër, Kafaraj, Novoselë, Pish-Poro, and Uji i Ftohtë (Tepelenë), which help maintain the river's perennial character. The segment of the Vjosa that lies within the territory of Selenicë Municipality belongs to the lower course of the river (from Pocem to the river mouth), specifically to a section where the river has a wide bed with significant deposits of solid materials. These deposits contribute to the formation of surrounding agricultural lands and are also affected by the streams of Mallakastër, the Selenicë stream, and the confluence of the Shushica River into the Vjosa near Mifol. Soil erosion problems appear on the riverbanks near the confluence of the Shushica, in the villages of Varibob, Trevellazer, Frakull, and Mifol. These erosion issues extend along the segment from the confluence of the Shushica into the Vjosa River up to Mifol, as a result of unregulated exploitation of inert materials along the riverbanks on both the eastern and western sides (in the municipalities of Vlorë and Fier).

The possibility of using water from the Vjosa for agricultural irrigation exists for the Sevaster administrative unit and potentially also for the Armen administrative unit (if investments are made). Currently, the area of agricultural land irrigated from the Vjosa is low due to the partial operation of the irrigation system (irrigation canals) and the limited capacity of the mechanical lifting pumping station in Sevaster.

B) The Shushica River, is a branch of the Vjosa river, with a length of 80 kilometers. The middle course extends from the Brataj area (the southern border of Selenicë Municipality) to Drashovicë, passing through the valley plains of the Shushica: the villages of Brataj, Lepenicë, Gjorm, Gumenicë, Kotë, and Drashovicë. In this section, the river's flow can be used for irrigation, mainly through mechanical lifting systems.
In the lower course, from Drashovicë to the confluence with the Vjosa, the river flows through lowland areas such as Armen Peshkëpi, Lubonjë, a plain area with potential for agricultural production and irrigation opportunities.
The annual average rainfall in the Shushica basin is around 2,230 mm (in Kuç), while at the Vodicë station it reaches 2,258 mm; however, during the summer season, this accounts for only 7–10% of the annual rainfall.

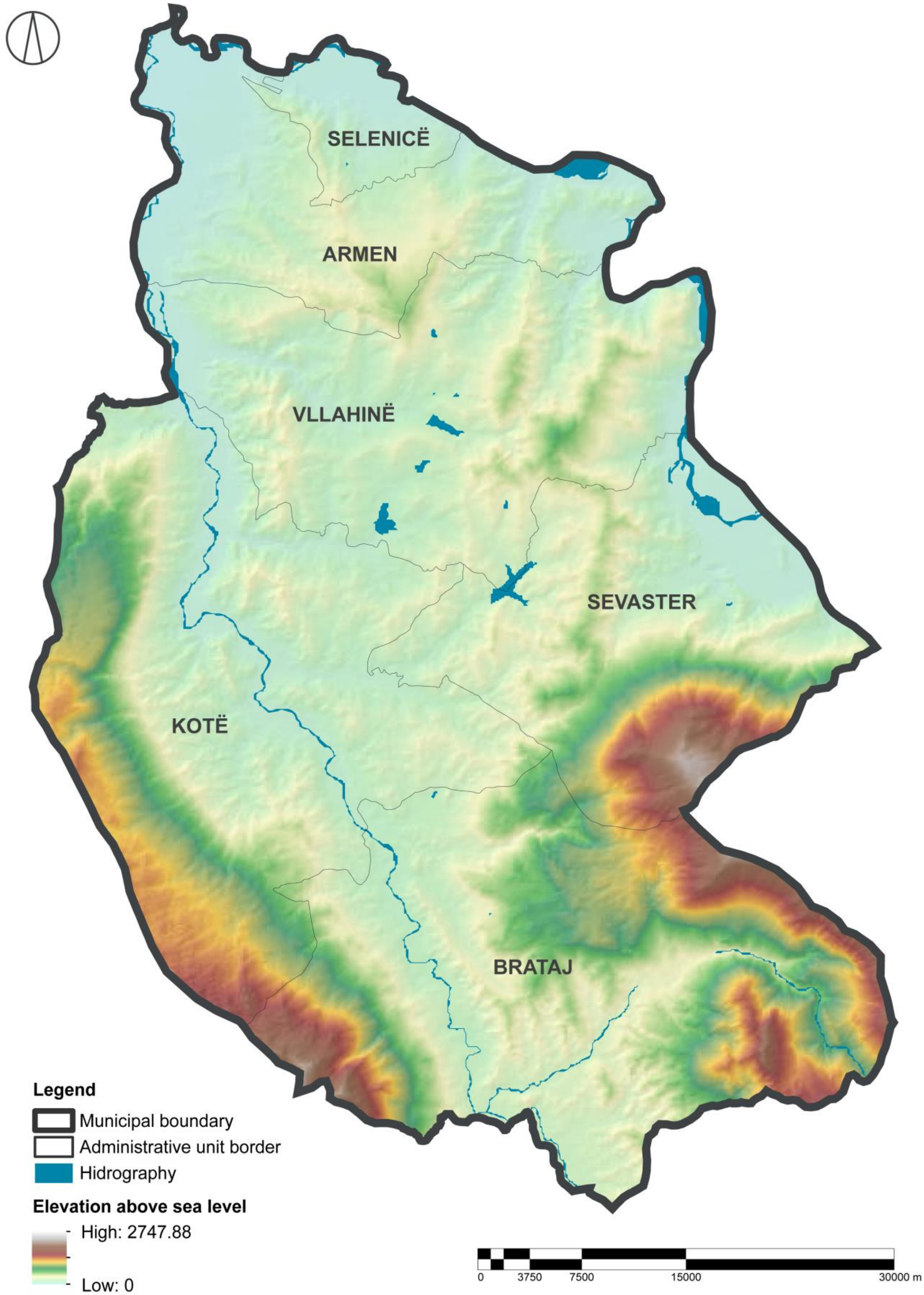
Table XII Data on rainfall and river flows in the main rivers within the territory of Selenicë Municipality

No.	River / Zone	Length (km)	Average annual rainfall (mm)	Avarage annual flow (m³/s)	Minimal flow (m³/s)	Flow modules (l/s/km²)	Comments
1	**Vjosa – River mouth**	—	—	195	54–55	—	Perennial character; surface water 69.5%, groundwater 30.5%
2	**Vjosa – Përmet**	—	—	734	—	—	Affects to later flows used for irrigation
3	**Vjosa – Dorëz**	—	—	1800	—	—	Large increase in flow from surrounding springs
4	**Vjosa – Mifol**	—	—	1530	—	—	Segment of lowland plain

5	**Shushica – Kuç**	80	2230	—	—	—	High rainfall, important source but limited during summer
6	**Shushica – Vodicë**	—	2258	4.3 (në gusht)	—	—	Only 7–10% of rainfall occurs in summer
7	**Shushica – Drashovicë**	—	—	22.8	—	32.9	Potential for irrigation through mechanical lifting systems

From the village of Brataj to Drashovicë, the river is more regulated. In the Mavrovë and Lepenicë plains, there are significant meanders. From Drashovicë to the confluence with the Vjosa River, soil erosion on the riverbanks is noticeable, especially in the lower part of the river near the villages of Peshkëpi, Armen, and near Llakatund, also due to interventions in the riverbed for the extraction of river aggregates. The main segment of aggregate extraction is concentrated in Drashovicë–Kotë.The Shushica valley near the river is crossed by fertile plains, an area that gradually widens from Kotë–Drashovicë–Armen up to the river's mouth into the Vjosa. The role of the Shushica River is significant for all the villages that bring down their farmland to the riverbank, and especially in the Kotë–Drashovicë–Armen segment. The water reserves of the Shushica decrease during the summer period, which is precisely when water demand is highest to meet needs.

Figure XVII. Topography and Main Water Resources; Territory of Selenicë Municipality



Source: State Authority for Geospatial Information

5.2. ASSESSMENT OF THE IMPACT OF CLIMATE CHANGE ON AGRICULTURE AND WATER RESOURCES IN SELENICË MUNICIPALITY

5.2.1. THREATS TO THE WATER FLOW OF THE SHUSHUCA RIVER

Shushica River faces several threads several threats to its water flow, the main ones being:

1. Diversion of water from the Kuç spring to Himarë. Current plans propose that the water sources of the river in Kuç be used to supply the municipality of Himarë, which would reduce the river's flow in the Shushica valley to very low levels, especially when considering the river's ecological flow. If this project is implemented, the river's water reserves for irrigation would become very limited..
2. Construction of small hydropower plants (HPPs). There were plans to build 3–4 small HPPs on the Shushica River, which would severely limit the irrigation of agricultural land, increase agricultural, hydrological, and environmental drought, reduce the rate of land cultivation, and cause a drop in production and income for local communities. Although construction has been suspended following the declaration of the Vjosa River as a "National Park" of category II, and the river's importance for Europe, there remains a need to strengthen management and control capacities, stop the use of aquatic environments for building HPPs, improve local governance responsibilities, and implement a monitoring plan for sustainability indicators, including erosion and increasing the number of meteorological stations and river monitoring points for data collection and database creation.
3. Lack of investment in regenerating pumping stations. If investments are not made to regenerate the mechanical water lifting pumping stations, considerable agricultural areas will not be irrigated.
4. Decline in residents' interest in agriculture. Mainly due to demographic movements of the population, this would lead to farmland being left uncultivated.

In these conditions: First, the decision regarding taking water from Kuç to Himarë should be reviewed, or the projected water volume reconsidered, so as not to compromise the irrigation needs of the valley's agricultural plains up to the river mouth; second, the decision to cancel the construction of the planned HPPs on the Shushica River should be communicated, in order to encourage farmers and institutions to invest in irrigation infrastructure; third, monitoring institutions should increase the number of water flow monitoring stations on the Shushica River and the number of measurements during the summer months..

The waters of the Shushica River, based on laboratory analyses, show that: ECW (electrical conductivity) measured at 0.685 ds/m is lower than the permissible limit and does not affect the quality of water and plant production during irrigation, the content of Sodium (Na), Chloride (Cl), Sulfates (SO_4), Calcium, Magnesium are lower than the permitted limits, the reaction value (pH of water) is 7.2–7.6. The bicarbonate content of

2.09–2.97 me/l is above the permitted limits and may reduce the commercial value of agricultural products for export. The impacts can be mitigated by using fresh organic fertilizers during surface irrigation.

5.2.2. PROLONGED DROUGHTS AND FLOODS

The Municipality of Selenicë, with a total area of 561.24 km², includes a large forest and pasture fund of 28,648 ha, of which (10,319 ha are forests, 18,124 ha are pastures) and 204 ha of non-productive area.

These conditions result in low irrigation capacity, affect the inability to meet plant water demands, and lead to a low use of land for agricultural purposes (about 43% of agricultural land allocated under Law 7501 is unused). Drought, land degradation, reduction of water reserves, and the risk of summer fires are direct consequences of these climatic conditions. (Kucaj E. L., 2024).

Table XIII. Agricultural land fund by administrative units, Municipality of Selenicë

Administrative Unit	Total ha	State agricultural land (not allocated) ha	Allocated agricultural land under the 7501 Law	Of the allocated agricultural land, area by categories ha			
				Field (ha)	Orchards (ha)	Olive groves (ha)	Vineyards (ha)
1.Selenicë	**887**	**140**	**747**	**500**	**0**	**237**	**10**
2.Armen	**3298**	**200**	**3098**	**2338**	**16**	**698**	**46**
3.Vllahinë	**4717**	**400**	**4317**	**3454**	**23**	**700**	**140**
4. Kotë	**3808**	**450**	**3358**	**3009**	**24**	**265**	**60**
5. Sevaster	**2291**	**285**	**2006**	**1901**	**2**	**90**	**13**
6. Brataj	**1531**	**125**	**1406**	**1361**	**5**	**20**	**20**
Total ha	**16532**	**1600**	**14932**	**12563**	**70**	**2010**	**289**

Source: Directorate of Agriculture, Municipality of Selenica

The Municipality of Selenicë has a land fund of 16,532 ha, of which 14,932 ha, or about 90.3%, represent private land acquired under Law no. 7501, while 9.7% remains state land. Within the area of private land, 81.4% is arable land, 13.5% is olive groves and orchards, 1.93% vineyards, and 0.47% other orchards. This structure reflects the

potential for sustainable agricultural biodiversity in the context of climate change, enabling the selection of crops suited to the environment.
About 32% of the allocated land is lowland with high productive capacity, which provides an important base for agricultural development and coping with climate challenges. Nevertheless, despite the agricultural potential, agricultural and livestock production in the municipality remains dependent on trade imports.
A series of limiting factors affect agricultural productivity, including climatic risks, droughts, and extreme rainfall. All administrative units are affected by the phenomenon of farmland abandonment, especially in Vllahinë, Sevaster, and Kotë, where hilly areas dominate without functional irrigation systems.
Irrigation is vital for increasing agricultural production, protecting land from degradation, and mitigating the impacts of climate change. Currently, the level of irrigation in the Municipality of Selenicë is very low and has worsened compared to 1991. Water resources and infrastructure are essential for restoring production and protecting against drought.

- Before 1990, in the territory of the Municipality of Selenicë, about 13,500 ha of agricultural land were irrigated.
- In the years 2023–2024, only 1,000 ha are irrigated with an irrigation coefficient of 1.78 times.
- The current potential irrigation capacity, based on existing schemes, is about 4,450 ha, but it requires rehabilitation of the irrigation network and improvement of water resources.
- With functional infrastructure in 3,000 ha in the lowlands of Armen, Lubonjë, Penkovë could be irrigated if farmers were interested in cultivation.
- The potential cultivation capacity in a second stage could reach up to 9,500–10,000 ha, including lowland and hilly land with productive potential, by maintaining and cleaning primary, secondary, and tertiary irrigation channels along existing irrigation canal routes, as well as at the pumping stations..

Table XIV. Key climatic indicators for the Municipality of Selenicë (annual average)

Climatic Indicator	Annual Average Value	Comments
Average annual temperature	15.5 – 17.0 °C	Klima mesdhetare, me verë të nxehtë dhe dimër të butë
Average temperature in July	27 – 30 °C	Muaji më i nxehtë, periudha më e ndjeshme ndaj thatësirës
Average temperature in January	6 – 9 °C	Muaji më i ftohtë

Average annual rainfall amount	900 – 1,200 mm	Kryesisht në muajt tetor – mars
Average number of rainy days	90 – 110 days/year	E përqendruar në sezonin e lagësht
Number or days with temperature > 35°C	20 – 40 days/year	Rritje progresive vitet e fundit për shkak të ndryshimeve klimatike
Droughts periods	3 – 5 months	Zakonisht nga qershori deri në shtator
Frequency of intesive rainfall	Increasing	Rrezik për erozion dhe përmbytje lokale në zona kodrinore

Source: MeteoBlue, (IGJEUM, 2020); (WMO, 2021); (Military Meteorological Service, 2020); (European Environment Agency (EEA), 2020); (National Environment Agency, 2023)

5.3. ANALYSIS OF WATER RESOURCES FOR AGRICULTURE AND IRRIGATION CAPACITY

Irrigation in agriculture is ensured through the functional irrigation system. An irrigation system is a network of irrigation canals, together with the respective hydraulic works, reservoirs, dams, diversion structures, pumping stations, roads, buildings, supplied by a primary canal or a primary water source, for irrigating a land area. The irrigation system also includes the land adjoining the irrigation canals, which has been kept under state ownership to ensure access to such canals.

The realization of irrigation is made possible by the functioning of all complex links, from water sources, canals that convey water to the parcel, and the hydraulic works that distribute the water.

The water resources used for iirigation are:

1. **Vjosa River –Sevaster Administrative Unit**

The Vjosa River is the main source of water for irrigating the lowland agricultural areas in the Sevaster Administrative Unit, mainly in the villages of Sevaster and Shkozë, as well as in smaller areas in the villages of Dushkarak and Golimbas. The potential area of agricultural land that can be irrigated reaches about 800 hectares, all with low slope (0–5%) and good productive capacity, suitable for a wide range of agricultural crops and with economic efficiency.

Irrigation is carried out through a pumping station located on the Vjosa River, with two mechanical lifts, and the water is distributed through the main irrigation canals. However, the currently irrigated area is only 210 ha, due to:

- Non-functioning of one of the main irrigation canals that is supplied by mechanical lift;
- Need for rehabilitation of the existing system of primary, secondary and tertiary canals;.
- The pumping station requires replacment with more powerful pumps.


Water intake station on the Vjosa river, Shkozë, Sevaster and the main irrigation canal


Pictures taken from the Administrative Unit Sevaster of cultivated lands and irrigation systems

Shkozë–Sevaster

Irrigation on a small surface is related to the fact that one of the main canals is out the function, the irrigation system needs complete rehabilitation, and the pumping station needs to be replaced with more powerful pumps. Potential irrigable capacity 800 ha, after the rehabilitation of the irrigation system.

1.1 **Armen Administrative Unit–irrigation scheme Drashovicë-Armen**, water source Shushicë river, the area that can be irrigated the area that can be irrigated (according to the condition of the irrigation scheme) 1500 ha

From rivers, it is the second unit, which can irrigate a considerable area of agricultural land through the irrigation scheme (Shushica) which can potentially irrigate an area of 1500 ha of flat land, equipped with irrigation systems, but which needs to be rehabilitated as well as interventions in water sources. Specifically, the villages in irrigation conditions are: Armen, Mesarak, Lubonja and Picari through the irrigation scheme:

- The irrigation scheme from Shushica through a 13 km long canal from the water intake point, which is functional and needs rehabilitation
- Another possibility applied earlier (before 1990) for the irrigation of Selenica field and the lands of the village Mesarak (Administrative Unit Armen) water was taken from the Vjosa river by gravity flow and would also bring under irrigation a considerable area of hilly lands of both units. But this project did not become functional. Currently on the ground there are traces of the main irrigation canal, while the canals in the hills do not exist. If the municipality sees it of interest, the responsible institutions may return to study it.

The rehabilitation of the irrigation system and works, which distribute water for irrigation, remains an opportunity for the utilization of the productive capacity of the flat lands of the Administrative Unit Armen and the Administrative Unit Selenicë as a pronounced agricultural potential area.

2. Shushica River–Drashovicë–Armen-Irrigation Scheme

The Shushica River, a branch of the Vjosa River, passes through the Shushica valley and flows into the Vjosa River. This river has low flows during the summer season, which affects its irrigation capacity.

Through the Drashovicë–Armen irrigation scheme, the Shushica River provides irrigation water to:

- About 1,000 ha of agricultural land in the Administrative Unit Armen.
- About 90 ha in the Administrative Unit Vllahinë.
- Limited areas in the Administrative Unit Brataj 50–55 ha.

If the complete rehabilitation of the irrigation system and pumping stations is realized, the irrigation potential from this source could reach 2,000–2,200 ha of agricultural land across all three administrative units. This makes the Shushica River a source of strategic importance for sustainable agricultural development in the area, especially in the context of climate change and water scarcity during dry periods.

3. Artificial reservoirs in the territory of Minicipality of Selenicë

The water storage reservoirs in Selenicë Municipality were mainly built before 1990, primarily in hilly areas. Over the years, these reservoirs have experienced a decrease in water storage capacity, which has directly affected the reduction of irrigated areas compared to their design capacity. The main problems are related to sedimentation, structural damages, and lack of technical maintenance.

3.1 Harval Reservoir

The Harval Reservoir was built with a design capacity of 4.4 million m³, but currently, the actual capacity is estimated at about 3 million m³, due to sedimentation and lack of maintenance.

The potential irrigation capacity of this reservoir is 500–800 ha, while currently only about 350 ha are irrigated, supplying water to the lands of the villages Kotë, Vajzë, Hysoverdhë, by gravity flow.
In 2021, an intervention was carried out on the emergency spillway to prevent leaks. However, the valves are out of function (do not open and close), while the outlet and spillway have structural damages. The dam itself is in good condition, but the entire structure requires complete rehabilitation, both for irrigation purposes and to increase dam safety.

Figure XVIII. Picture from the Harvalë reservoir, Amonicë

Souce: Build Green Group

3.2 Petë Reservoir

The reservoir is located in the village of Petë and serves to irrigate agricultural lands in the villages of Petë, Mavrovë, and Drashovicë, by gravity flow.

- The maximum water storage capacity is 1.6 million m³, while the actual capacity is calculated at around 1 million m³.
- The spillway is damaged along a length of 60 meters.
- The irrigation sluice gate is damaged and leaks with a continuous flow of 5 liters/second. Replacement of the sluice gate shaft, or the entire body together with both sluice gates, is required.

Technical data from the main Petë reservoir:

- Designed volume: 2,670,000 m³ (MBZHR)
- Area currently irrigated: 350 ha (by gravity flow)
- Dam: in good condition

- Outlet and spillway: damaged

It is foreseen that the reservoir will be rehabilitated to improve irrigation capacity and to increase the safety of the structure.

Petë 2 Reservoir

This is a smaller reservoir, with an irrigation capacity of about 20 ha, but it has lost most of its volume due to sedimentation. Currently, it is out of function, as the sluice gate is blocked.

Figure XIX. Picture from Petë reservoir (Petë village)

Source: Build Green Group

3.3 Hasomat (Velcë) Reservoir

The reservoir is located in the village of Velcë and is used for irrigating agricultural lands in Velcë and Gjorm (Brataj administrative unit).

- Designed water storage volume: 585,000 m³
- Current water storage volume: 391,000 m³
- Potential irrigation capacity: 100 ha
- Area currently irrigated: 50 ha (by gravity flow)
- The reservoir has not undergone technical interventions for over 43 years.
- The main valvue is damaged and loses about 7–10 liters of water per second.

A rehabilitation intervention is foreseen to restore the optimal functioning of the irrigation system and to improve water management for the agricultural lands of the area.

3.4 Vllahinë (Vllahinë Administrative Unit)-Reservoir

This reservoir is currently out of function due to the malfunctioning of the water conveyance canal. Technical problems began in 2015, after the transfer of ownership under the administration of the Municipality.

- Designed water storage volume: 3,000,000 m^3
- Current water storage volume: 2,024,000 m^3
- Potential irrigation capacity: 840 ha
- Area currently irrigated: 0 ha (out of function)

The rehabilitation of the system has been assessed as necessary for restoring the function of the reservoir and utilizing the irrigation potential of the area, depending on allocated funding and the conduct of a new study.

Figure XX. Vllahinë Reservoir, Vllahinë Administrative Unit

Source: Build Green Group

The reservoir has lost its irrigation function and is currently out of function due to problems with the dam and the malfunctioning of the spillway, which is damaged. The difficulties began at the time of the transfer of ownership to the administration of the municipality.

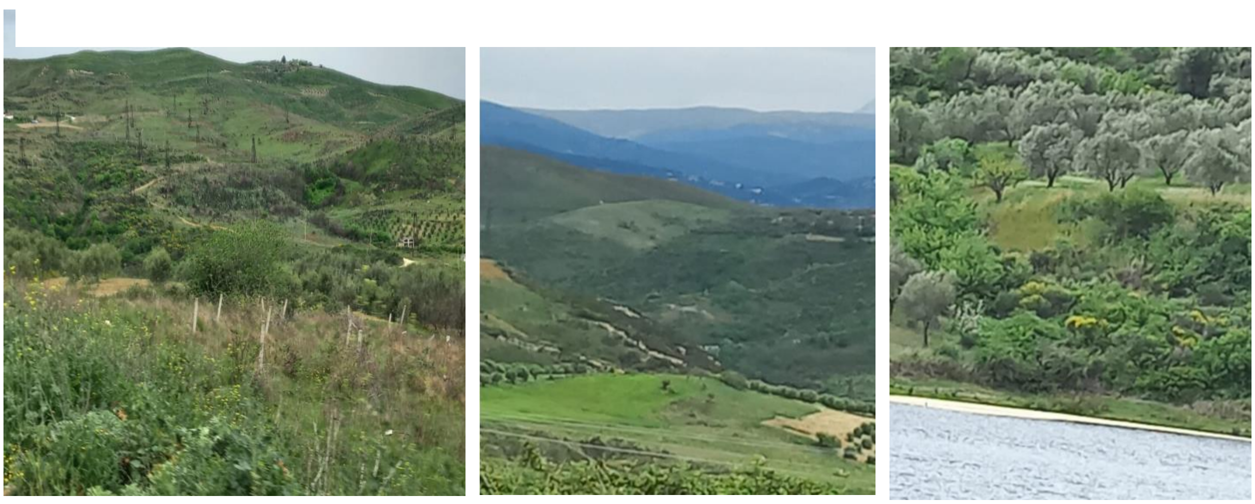
- Designed water storage volume: 180,000 m^3
- Current actual volume: 157,000 m^3
- Potential irrigation capacity: 60 ha

Rehabilitation of the dam and spillway is required to restore the function of the reservoir and to avoid further risks to the area.

Figure XXI. Kocul Reservoir, Vllahinë Administrative Unit

Source: Build Green Group

Figure XXII. Olive Trees Planted and Pastures in the Administrative nit of Kocul



Source: Build Green Group

According to previous analytical soil studies, in the oil-bearing area of Gorisht the content of Nickel (Ni) results in 415–600 ppm and the content of Lead 349–352 ppm (amounts above permitted levels), and Vanadium 79–106 mg/kg of soil (above permitted limits). The microbiological indicators of the soils, such as total microflora and physiological groups, are lower than permitted limits (Lushaj, 2005). In the oil-bearing area Kocul–Gorisht, there is a need for cooperation between the municipality and the entities exploiting, transporting, and storing oil to minimize discharges into the environment and to organize the monitoring of heavy metals in the oil-bearing area.

Table XV. Summary of water resources and irrigation agriculture capacity analysis in the Municipality of Selenicë

Water Source	Location	Irrigation Capacity (ha)	Currently Irrigated Area (ha)	Issues	Required Rehabilitation
Vjosa River (Sevaster AU)	Sevaster, Shkozë, Dushkarak, Golimbas Villages	800	210	One of the main canals is non-functional, need for system rehabilitation and pump replacement	Rehabilitation of the system and replacement of pumps
Vjosa & Shushica Rivers (Armen AU)	Armen, Mesarak, Lubonja, Picari Villages	1500	-	Irrigation from Vjosa is out of function. Need to increase irrigation capacity from Shushica	Rehabilitation of schemes and infrastructure
Shushica River (Armen AU)	Armen, Vllahinë, Brataj Villages	1500	-	Low flows during summer, need for rehabilitation of the irrigation system	Complete rehabilitation of the irrigation system
Harvalë Reservoir	Harvalë Village	1200	350-500	Sedimentation and structural damages to spillways and valves	Rehabilitation of spillways, valves, and dam maintenance
Petë Reservoir	Petë Village	350	300	Damages to spillways and valves, need to replace the valves shaft	Replacement of the gate valve and rehabilitation of the dischargers
Petë 2 Reservoir	Petë Village	20	0	Sedimentation and blockage of the valve.	Rehabilitation of valves and removal of sediment

Hasomat (Velcë) Reservoir	Velcë Village	100	50	Damage to the valve and cracking of the decanter, water losses	Rehabilitation of valves and sealing of decanter
Vllahinë Reservoir	Vllahinë Village	Jashtë funksionit	0	Malfunction of irrigation canal, technical problems since 2015	Conduct an effectiveness study by specialized institutions
Kocul Reservoir	Vllahinë Village	Jashtë funksionit	0	Damage to the dam and spillway problems with landslides	To conduct a study

Source: Monitoring of land and water use in agriculture

5.4. ASSESSMENT OF THE LIVESTOCK SECTOR, PASTURE CAPACITY AND THE IMPACT OF CLIMATE CHANGE

The Municipality of Selenicë has tradition and suitable conditions for the development of livestock farming, both cattle in the lowland area and small ruminants, mainly in the hilly area. In the total area of the territory, pastures occupy 18,124 ha, forests 10,319 ha, which enable the support of a higher number of small ruminants than the current number.

Livestock farming is an important economic sector for securing financial income, meeting family needs, and for families with a high number of heads, also selling livestock products. Organic fertilizers produced from livestock are very important for improving the productive capacity of the soil and providing nutrients for plants. Agricultural products are organic and without chemical fertilizers.

In addition to this area, uncultivated agricultural lands of about 8,550 ha are also used as feed for grazing livestock. In the administrative units Brataj, Vllahinë, Sevaster, Kotë, the uncultivated land area is at the municipal level. Forage crops (cultivated) occupy 40% of the cultivated area. The cultivated forage crops together with uncultivated agricultural lands make up 75% of the divided agricultural lands.

This should guide:

- firstly, toward care to increase the area of cultivated land and
- second, to increase the number of small ruminants in the hilly area and cows in the lowland area.
- the lowland area.

Table XVI. Number of livestock heads and livestock products by administrative units

No	Livestock type	Selenicë	Armen	Vllahinë	Kotë	Sevaster	Brataj	Total number of livestock
1	**Cow**	16	231	425	400	229	653	1954
2	**Sheep**	320	3800	5900	7400	9066	11822	38308
3	**Goat**	180	967	1250	2400	2705	6806	14308
Livestock produces TON								
Milk	**Lopë**	560	8085	14875	14000	8015	22855	68390
	Sheep	14400	171000	265500	333000	407970	531990	1761860
	Goat	9900	53185	68750	132000	148775	374330	786954
Meat	**Total**	249.6						

Source: Directorate of Agriculture; Municipality of Selenice

Brataj, Sevaster, Kotë, Administrative Units have suitable conditions for the development of small livestock farming, based on the area of pastures, forests, meadows, and grazing on uncultivated lands. The main products are sheep's milk, goat's milk, and to a lesser extent, cow's milk..

- One of the objectives for the development of livestock farming should be to increase the number of heads, as this is enabled by the terrain, the area of the territory, pastures, and other feed resources for livestock. Currently, the average number of cows per 100 ha of agricultural land at the municipal level is 13 heads, an indicator almost 1.8 times lower compared to 1990. This number can be increased especially in the lowland area where feed reserves are greater. The number of wool-producing animals (sheep) per 100 ha of agricultural land and pastures at the municipal level is 116 heads, or about 35–40% less than in 1990.

in the district of Vlorë, where the municipality of Selenicë was part. Meanwhile, the number of goats per 100 ha of forests and shrubs results to be 119 heads, or almost 3 times lower than the number of heads in 1989 in the district of Vlorë, which included Selenicë Municipality.

Processing of agricultural and livestock products:

In the Municipality of Selenicë, there are 11 dairies for milk processing, of which 4 are in the administrative unit Kotë. One of the dairies, "Shpella" in the village of Vajzë, as part of an agribusiness enterprise, is a well-developed activity, with hygiene and sanitary conditions meeting standards, advanced milk processing technology, and service. Milk processing not only meets the needs for dairy products but also increases the economic value per production unit. (Selenicë M. , 2018)

- Processing of grapes in three wine wineries. The wineries are authorized by the General Directorate of Customs and licensed for the production of alcoholic beverages. The wineries process grapes produced by the wineries' own enterprises using advanced production technology, and also collect grapes from other farms. A vineyard meeting standards is located in the village of Vajzë, Kotë administrative unit.
- Agrotourism as an activity is at its early stage, but the opportunities are great, not only because of local livestock products but also because of the beautiful nature, impressive landscape, and developed cultural heritage in the area. In this municipality, two villages (Drashovica and Amandia) as part of the "100 Tourist Villages" need support to achieve specific objectives for the development of tours in terms of tourism and to share the experience also in other villages of the municipality.
- In the framework of diversifying the rural economy, nature tourism is one of the created opportunities in this municipality, especially with the completion of the standard road Vlorë–Borsh, which crosses the Shushica valley (Vlora River) and connects to the south, beautiful nature, relief, food tradition, and hospitality. Nature tourism and agrotourism can be developed everywhere but especially in Drashovicë, Brataj, Sevaster, Vajzë, Plloce, Selenicë, Kotë. (Selenicë)

Table XVII. Number of agricultural and livestock product processing activities

Processing activity	Selenice	Armen	Vllahinë	Kotë	Sevaster	Brataj	Total
Number of vine wineries	0	0	1	2	0	0	3
Number of dairy processing business	1	1	2	4	2	1	11
Number or oil factories	1	3	2	2	0	0	8
Number of flour factories	0	2	1	0	0	0	0

Source: Directorate of Agriculture; Selenice Municipality

5.5. THE SITUATION OF OWNERSHIP, PROFESSIONAL CAPACITIES AND IRRIGATION INFRASTRUCTURE IN THE MUNICIPALITY OF SELENICA

In Selenicë Municipality, there is a lack of complete data on the documentation of the transfer of ownership of large dams to the administration of the municipality, as well as the professional capacities for their management, such as hydrotechnical engineers. These are necessary for completing the technical passports of the dams located within the municipality's territory. A detailed verification of the dams by specialized structures of the Ministry of Agriculture and Rural Development is recommended. The water sources of rivers, streams, natural lakes, reservoirs, underground waters, and the waters of irrigation and drainage systems are state property.

The main principles of managing irrigation systems, drainage systems, and flood protection works are carried out in accordance with these principles: irrigation and drainage systems operate to promote and protect the interests of all beneficiaries; irrigation and drainage systems function to regulate the water regime in the soil, balancing excess and moisture deficits, to prevent erosion and pollution, always in the interest of environmental protection; beneficiaries of irrigation, drainage systems and flood protection works cover the operating and maintenance costs themselves. (Local Sources from the Municipality of Selenicë, 2023).

From a legal prespective:

- The municipalities keep an inventory of the irrigation, drainage, and flood protection infrastructure transferred to their ownership.
- The municipality utilizes and maintains the irrigation and drainage infrastructure transferred to its ownership.

Legal duties and main responsibilities of municipalities

- The municipality utilizes and maintains the irrigation and drainage infrastructure transferred to its ownership, to meet water needs for irrigation, remove excess water, and prevent water accumulation.
- The municipality utilizes and maintains the irrigation infrastructure so that every farmer receives water at the required time and quantity within their service area:
    - cleans and maintains drainage and irrigation canals;
    - utilizes and maintains irrigation and drainage pump stations;
    - rehabilitates and reconstructs irrigation and drainage infrastructure, as well as flood protection works in populated areas;
    - supervises the safety of irrigation reservoir dams and, when necessary, carries out emergency maintenance or rehabilitation to ensure their safety;
    - takes into account the consequences of its activities on the natural balance and takes measures to prevent or minimize disturbances or damage;
    - takes measures to control the quality of irrigation water and drained water;
    - fulfills duties in accordance with legislation for the protection of the environment and water resources;
    - monitors the amount of water used during a year.

- The municipality cooperates in planning water needs for irrigation, utilization, maintenance, and rehabilitation of irrigation and drainage systems with the relevant Directorate of Irrigation and Drainage, when the latter manages the main infrastructure of these systems.

5.5.1. SUPPORTING INFRASTRUCTURE AND CURRENT IRRIGATION CAPACITY

Iririgation remains one of the most important areas for:

- Increasing agricultural produce,
- Protecting soils from drought and degradation,
- mitigating the effects of climate change.

The territory of Selenicë Municipality mainly includes hilly areas, which present difficulties for irrigation and depend on existing reservoirs, which often do not have the necessary capacity or do not function effectively.

- The current level of irrigation is low, covering only 1,000 ha with an irrigation coefficient of 1.7 times, representing:
  - 7–11.5% of the divided agricultural land area,
  - or 15.5–26.5% of the cultivated agricultural land.
- The area of cultivated land represents 42.7% of the divided agricultural land. According to the statistical yearbook of 1991, until the early 1990s, the irrigated area in the territory of Selenicë Municipality was about 13,500 ha. Currently:
- The potential area for irrigation (with designed infrastructure) is about 10,000 ha;
  - of these, about 7,000 ha improved area, but requiring rehabilitation and securing water sources;
  - about 3,000 ha are under water (with functional infrastructure) but are not irrigated as they are only partially cultivated by farmers.
  - around 1,000 ha are actually irrigated, with an irrigation coefficient of 1.7 times.
- The area of land that can be irrigated is 4,450 ha (according to the state of the irrigation schemes) specifically:
  - **Armen AU**, irrigation scheme Drashovicë-Armen, water source Shushicë River, area that can be irrigated (according to the state of the irrigation scheme) 1,500 ha,
  - **Vllahinë AU**, irrigation scheme Drashovicë-Armen, water source Shushicë River, area that can be irrigated (according to the state of the irrigation scheme) 350 ha, actually irrigated up to 90 ha.
  - **Brataj AU**, irrigation scheme Asomat, Shushicë River, water source Shushicë River/reservoir, area that can be irrigated (according to the state of the irrigation scheme) 400 ha, actually irrigated up to 57 ha.

- **Kotë AU**, irrigation scheme reservoirs Harvala and Peta, water source Harvala River, Peta, area that can be irrigated (according to the state of the irrigation scheme) 1,400 ha, actually irrigated up to 345 ha.
- **NJ. A Sevaster** irrigation scheme with mechanical lifting, water source Vjosa River, area that can be irrigated (according to the state of the irrigation scheme) 800 ha, actually irrigated up to 210–300 ha.

Even though after 2015 some interventions have been made in the reconstruction of the irrigation network, these remain insufficient to meet agricultural production needs. The level of irrigation, in relation to the land area, remains low.
However, significant improvements have been observed in flood protection, especially in the areas of Selenicë and Armen, where until 2015 a considerable part of the territory was flooded. The Municipality’s vision is that by 2030, the irrigated land area will be doubled, enabling access to irrigation for over 2,000 additional farming families.

5.5.2. CONDITION OF IRRIGATION AND DRAINAGE CANALS

5.5.2.1. IRRIGATION CANALS

For the management of irrigation and water circulation from the source to the parcel, agricultural lands are equipped with a system of irrigation canals of all categories, totaling 605 km in length.

- Primary irrigation canals (carry water from the water source to secondary canals): 226 km
- Secondary irrigation canals (carry water from primary to tertiary canals): 127 km
- Tertiary irrigation canals (distribute water within the parcel): 252 km;

Irrigation schemes in irrigable areas

Irrigation is carried out based on small schemes using water sources such as reservoirs built within the Municipality's territory, the Shushicë and Vjosa rivers, and streams that irrigate limited areas.

1. Drashivicë Armen Irrigiation Scheme, with capacity for about 1,000 ha, 1,000 m^3/second, covers the villages: Peshkëpi, Penkovë, Lubonje, Picar, and Armen.

2. Peta, Reservoir Irrigation Scheme, with volume of 1,200,000 m^3 water, covers about 350 ha in the villages: Petë, Mavrovë, and Drashovicë me volum 1 200 000 m3 ujë, mbulon rreth 350 ha,në fshatrat: Petë, Mavrovë dhe Drashovicë .

3. Asomatit Reservoir Irrigation Scheme, with 600 000 m3 water, capable of irrigating about 100 ha in the villages Velcë and Gjorm

4. Harvala Reservoir Irrigation Scheme, with 3,000,000 m^3 water, potentially irrigates about 500 ha.

5. Irrigation Scheme from the Lepenicë Hydropower Canal-Siphon, with 60 l/sec, irrigates about 60 ha in the village of Lepenicë**.**

6. Irrigation Scheme from the Smokthinë Hydropower Canal-Siphon and Ballaban canal, with 120 l/sec, irrigates about 120 ha in Mesaplik and surrounding area.

7. Irrigation Scheme from canal fed by Velçë Stream, with 80 l/sec, irrigates about 80 ha in the village Velçë

8. Irrigation Scheme for Brataj village plain, supplied by Smokthinë river, with 70 l/sec, irrigates about 60 ha in Brataj village.

9. Irrigation Scheme of the Great Stream in Velçë village, supplied from the hydropower canal and Ramicë spring, with 60 l/sec, irrigates about 60 ha in Velçë and Gjorm.

10. Irrigation scheme with pumping station in Shkozë village, with 400 l/sec, potential irrigation of about 400 ha in Shkozë.

Following Law no. 139/2015 "On local self-governance" and DCM no. 1108, dated 30.12.2015 "On the transfer from the Ministry of Agriculture, Rural Development and Water Administration to the municipalities of irrigation and drainage infrastructure, personnel and movable and immovable assets of drainage boards," the responsibility for managing water resources and irrigation and drainage canals was transferred to the municipality, except for 13.6 km of main irrigation canals (in the Drashovicë–Armen irrigation scheme) supplied by the Shushicë River by gravity. These remain under the responsibility of the Regional Directorate of Irrigation and Drainage. This canal also serves to collect floodwaters and discharges into the Shushicë. The municipality must coordinate timely cleaning works.

Out of 605 km of irrigation canals, excluding the 13.6 km of main canals, cleaning remains the responsibility of the Municipality and the farmers' community. Since 2015, the state has not provided further contributions during the transition phase for the rehabilitation of the drainage and irrigation systems.

Each year, only about 50 km of primary, secondary, and tertiary canals are put into operation at municipal level, which is insufficient for a functional irrigation system. The system requires rehabilitation because currently, due to lack of maintenance, many irrigation canals in potentially irrigable agricultural lands are out of service; reconstruction is also needed for engineering structures (water intakes, culverts, outlets, bridges, etc.) and pumping stations that are currently non-functional.

Management and administration of irrigation face several challenges: high land fragmentation makes it hard for farmers to collaborate, maintenance of the irrigation system, partially functional irrigation infrastructure, water management difficulties, lack of workforce and cleaning equipment, low water efficiency since irrigation mainly relies on gravity, administration of irrigation schemes, main and secondary canals, and intake structures, limited financial capacity as Selenicë is a new municipality.

According to Law no. 24/2017 "On the administration of irrigation and drainage," the Regional Directorate of Irrigation and Drainage, by ministerial order, may temporarily undertake the operation and maintenance of irrigation, drainage, and flood protection works transferred to the municipality, in cases of risk to dam safety.

In the context of gradually increasing institutional capacity, it would be beneficial for the Municipality to organize an irrigation and drainage unit with dedicated staff to manage irrigation systems. Also, in time, the municipality could consider alternative service provision models for irrigation, aligned with the National Irrigation and Drainage Strategy, strengthening institutional capacities to address climate issues, and integrating climate change into the strategic planning for agricultural adaptation and water resource management..

5.5.2.2. DRAINAGED CANALS

The drainage system is a network of drainage channels (built/pipes and natural channels) and related hydraulic structures, including drainage pump stations, roads, and buildings, serving to drain water from land, including agricultural land, roads, and urban areas. Cleaning and maintenance of drainage and irrigation canals remain an unresolved issue in Selenicë Municipality.

By the end of 2024, out of 380 km of drainage canals, only 131.5 km have been cleaned, removing about 70,000 m³ of silt per year through cleaning interventions. In a significant part of the agricultural land, drainage canals are out of service or even blocked.

Drainage of lands to remove water during wet seasons (winter, autumn, and spring) covers an area of 7,645 ha, through the following 7 main drainage systems:

Drainage zones/schemes, according to irrigation and drainage regulations:

1. Selenicë Plain Drainage Zone, about 400 ha

2. Armen Administrative Unit Drainage Zone, about 1,500 ha, covering villages: Armen, Mesarak, Picar, Lubanjë, Penkovë, Karbunar, Treblovë

3. Vllahinë Administrative Unit Drainage Zone, about 1,600 ha, covering villages: Vllahinë, Peshkëpi, Kocul, Vezhdanisht, Kropisht, Petë.

4. Kotë Administrative Unit Drainage Zone, about 1,760 ha, covering villages: Kotë, Drashovicë, Mavrovë, Vajzë, Gumenicë, Lapardha.

5. Brataj Administrative Unit Drainage Zone, about 1,000 ha, covering villages: Brataj, Mesaplik, Gjorm, Lepenicë, Velcë.

6. Sevaster Administrative Unit Drainage Zone, about 1,400 ha, covering villages: Sevaster, Shkozë, Golimbas, Dushkarak, Amonicë.

In addition, in Selenicë Municipality, main irrigation canals also serve to receive high water levels; at the end of the irrigation season, gates are opened, and water is discharged through secondary drainage canals into streams and rivers, which are the final receiving bodies. Maintenance interventions for high-water canals are carried out annually based on issues identified through field inspections.

The entire area is drained by gravity through a network of 380 km of drainage canals, divided by category and maintenance responsibility:

- 91 km – Main Drainage Canals (MDC),

- 113 km – Secondary Canals (SC),
- 176 km – Tertiary Canals (TC).

Tertiary canals, which make up 46% of total length, lack maintenance due to absence of workforce and necessary equipment at municipal and local community level. By law, these canals must be maintained by the Municipality and communities, but in practice, this is impossible without further support.

To improve the situation, implementing favorable policies could be considered to encourage farmers to cooperate, at least at parcel level. This is especially important to overcome difficulties from high land fragmentation.

Functional maintenance of the drainage system is essential for:

- quick circulation of rainwater,
- avoiding floods, especially in lowland areas of Selenicë, Armen, Lubonjë, etc.
- increasing agricultural production,
- protecting land from flooding and erosion,
- municipalities should maintain an inventory of irrigation, drainage, and flood protection infrastructure transferred to their ownership,
- the municipality must work on rehabilitation, reconstruction, and maintenance of irrigation and drainage infrastructure transferred to ownership,
- supervise the safety of irrigation reservoir dams,
- set and collect the annual maintenance fee for infrastructure and irrigation service for each serviced land area.

5.6. THE IMPACT OF CLIMATE CHANGE ON AGRICULTURAL YIELD AND WATER SUPPLY

The rise in temperatures and reduction of water availability directly affect agricultural yields. This phenomenon is particularly damaging to traditional crops such as cereals, forage plants, and olives, which require a stable water supply during critical stages of development.

They also form the core structure of agricultural crops in the Municipality of Selenicë. The reduction of water resources has affected:

5.6.1. REDUCTION OF IRRIGATED AREAS

The climate in the territory of the Municipality of Selenicë is characterized by hot and dry summers, where water demand is high, and evaporation from soil and vegetation increases, requiring irrigation. Experimental evidence has shown that in the absence of irrigation water, production can decrease by 50–60%, and under prolonged drought conditions, production may be completely destroyed. Projections for Albania, with the increase in temperature, indicate that the amount of water needed for irrigation may increase by up to 30%.

Meanwhile, the history of irrigation in this municipality has shown a downward trend in irrigated area. Specifically:

Until 1990, in the territory of the Municipality of Selenicë, State Agricultural Farms and agricultural cooperatives actually irrigated 13,500 ha.

- In 2023–2024, the irrigated area has decreased to 1,000 ha, irrigated 1.7 times.
- The current possible capacity for irrigation, according to irrigation schemes, for the short term (2030) is around 4,450 ha, but to achieve this, rehabilitation of the irrigation network to utilize available water resources is necessary, as well as improvement of infrastructure damaged during the transition period.
- The potential irrigation capacity could go up to 9,500–10,000 ha, but only after the rehabilitation and maintenance of the irrigation system, ensuring water supply, and improving the infrastructure for water distribution in primary, secondary, and tertiary canals as well as pumping and lifting stations from water sources into conveyance canals.

In recent years, Albania has recorded maximum and minimum temperatures higher than the 30-year average, and projections show that for the period 2030–2050, compared to the period 1980–1990, the average annual temperature tends to increase by 2 degrees, a 28% decrease in river flows, which also serve as water sources for agricultural irrigation, a reduction of rainfall by 8%, an increase in the number of consecutive dry days, the extension of the drought season, and heat waves lasting 20 days, which cause rising temperatures, a decrease in rainfall, and an increase in evaporation, reducing soil moisture. Increased temperatures, reduced rainfall, and the rise of extreme events expose the decline of agricultural production and food security. Increased risk of drought, fires, heatwaves, water scarcity, extreme events, decline of agricultural and livestock production due to the deterioration of optimal agricultural conditions, an increase in pests and diseases, and higher irrigation demands. Forecasts by the International Institute for Applied Systems Analysis for Albania predict an impact on corn yield of 10–25% by 2025 and an expansion of areas with yield reductions of more than 25–30% by 2050. The Selenicë area is mainly included in the intermediate agro-ecological zone, dominated by hilly areas affected by erosion.

5.6.2. INCREASING IN IRRIGATION COSTS

Insufficient irrigation causes a decrease in production per unit area, an increase in production costs per unit area, economic valuation with low profit or loss when expenses exceed income. Irrigation costs rise due to water loss in the network, poor management in small fragmented plots, non-functional infrastructure, and lack of cooperation among farmers within the designed agricultural parcel. Irrigation costs increase by up to 30–35% depending on the specific conditions of parcel fragmentation.

5.6.3. LIMITATION OF OPPORTUNITIES FOR DIVERSIFYING AGRICULTURAL CROPS

Lack of irrigation limits the possibility of diversifying agricultural crops, based on market demand and flexibility, in changing crops to match economic viability, such as increasing vegetables for export and the Vlora and Selenicë markets, which bring more income. Establishing a market in Selenicë for trading agricultural and livestock products. Also, expanding olive cultivation in the hilly area by mechanizing work processes and harvesting production mechanically. The lack of irrigation has increased the area of forage plants even though livestock load is not high and the pasture area is considerable. Data show that in recent years, temperatures have been higher than the multi-year average and rainfall lower. The irrigation canal system partially functions due to lack of rehabilitation and annual maintenance, lack of cooperation among farmers with properties in the same parcels, insufficient capacity of equipment for cleaning primary and secondary canals, and lack of workforce. As part of the decentralization reform, a significant part of irrigation and drainage infrastructure has been transferred to municipalities. But to make this challenge a reality, annual financing must be planned, schemes must be resolved to include as many beneficiaries as possible, municipalities must increase contributions to infrastructure maintenance, management capacities must be strengthened, and support must be provided with equipment for regional irrigation and drainage directorates.

5.6.4. CONFLICT BETWEEN WATER USERS (FARMERS, FAMILIES)

The current water resources and irrigation systems infrastructure in the Municipality of Selenicë cannot meet the needs of the vegetation cultivated in this territory. This becomes even more problematic when considering the biological needs of plants and irrigation norms for each crop. Thus, trends in temperature increase and reduction in rainfall and river flows indicate that:

- The frequency of drought periods will increase: Higher temperatures and less rainfall will cause an increase in drought periods, having a direct impact on water availability for agriculture and other needs.
- Irrigation will become more difficult and more expensive: Reduction of river flows and other water sources will decrease the capacity of irrigation systems to meet crop needs, thus increasing demand for alternative water sources and raising irrigation costs.
- Deterioration of water quality: Rising temperatures may lead to increased evaporation and concentration of harmful substances in water sources, negatively affecting water quality for agriculture and human consumption.
- Expansion of areas at risk of flooding: While rainfall will decrease, floods may become more unpredictable and sudden, creating a fragile balance between drought periods and extreme floods.
- Changing cultivation patterns: Many agricultural crops, such as wheat and vegetables, may suffer from climate change, and it may become necessary to review cultivation areas and regionalization of plants more suitable for such climatic conditions.

- Increasing irrigation demands in the coming years: With forecasts of temperature rise and rainfall decrease, irrigation demands are expected to increase by up to 30% in the coming years, including increased needs for infrastructure support for water and distribution channel management.

In one of the earliest studies, conducted by the Soil Institute, "Study of Irrigation, Drainage and Flood Protection Infrastructure" in 2004, in 10 prefectures of the country (in the current territory of the Municipality of Selenicë, which at that time was part of the Vlora district), it was found:

- The irrigated area was lower than the designed irrigation capacity. Also, the operation of drainage channels and water distribution works was problematic, causing damage to structures and problems with irrigation reservoirs that had lost their storage capacity.
- Damages to pumping stations on the Vjosa and Shushica rivers and the loss of irrigation reservoirs' storage capacity. On the Shushica River in Mesaplik, 2 irrigation pumping stations had been built, where only one was put into operation in 2022 and irrigates about 60 ha. While the other station and all the pumping stations located on the Shushica River from Mesaplik, Brataj, Lepenicë, Gjorm, Gumenicë, Lapardha Kotë, which irrigated more than 400 ha, the pumps and stations are out of operation.
- Damages to irrigation infrastructure, such as water distribution intakes in plots, cleaning of drainage channels and the functioning of irrigation channels at 35% level, as well as problems with water sources and low-scale maintenance of the drainage system.
- Drastic changes in the structure of cultivated plants and urbanization over drainage and irrigation channels.
- Damage to the protective structures of the Vjosa and Shushica rivers in the territory of the Municipality of Selenicë.
- Increase of agricultural land left uncultivated after privatization, which is gradually becoming covered with shrubs and turning into pastures.

5.7. RELATION AND INTERDEPENDENCIES BETWEEN AGRICULTURE AND WATER SECTOR

There is a close and cross-sectoral economic, social, and environmental connection between the agriculture and water sectors (Kucaj, E., & Lushaj, Sh., 2024), as they directly affect the level of agricultural production, farmers' incomes, the sustainability of rural areas, and the reduction of emigration. Agriculture is the main user of water resources in the Municipality of Selenicë. The decline in water availability, due to the incomplete functioning of irrigation infrastructure and weaknesses in the management of water resources mainly from the Vjosa and Shushica rivers and reservoirs, has highlighted the structural problems of the irrigation system. The lack of regular and efficient water distribution has created a high dependence of the agricultural sector on unstable natural resources.

5.7.1. RELATION AND INTERDEPENDENCIES BETWEEN AGRICULTURE AND WATER SECTOR

- **Low rate of agricultural land cultivation in areas without irrigation:**

Out of 14,932 ha of agricultural land distributed under law no. 7501, only 6,384 ha (45.5%) were cultivated in 2024. Lack of cultivation results in reduced agricultural production, increased risk of land degradation, desertification, and loss of water reserves due to high evaporation.

The main crops are: annual crops 63%, olives 31.5%, vineyards 4.5%, and orchards 1.1%.

- **Loss of production on non-irrigated land** reaches 50–60%, and in some cases, complete losses. Percentage of cultivated land in 2024 by administrative units:
    - Selenicë AU: 59.0%
    - Armen AU: 68.5%
    - Vllahinë AU: 36.2%
    - Kotë AU: 29.8%
    - Sevaster AU: 23.7%
    - Brataj AU: 55.5%
- **In hilly areas without irrigation systems,** lands with high production capacity are becoming overgrown with shrubs, affected by erosion and other natural factors due to lack of cultivation.
- **Areas with high agricultural potential, due to lack or insufficiency of water, fail to utilize the production capacity per unit area. High potential but non-irrigated lands include**:
    - Armen AU: Armen, Lubonjë, Mesarak, Picar
    - Selenicë AU: Selenica
    - Vllahinë AU: Vllahinë, Penkovë, Peshkëpi
    - Kotë AU: Drashovicë, Mavrovë, Kotë, Vajzë
    - Sevaster AU: Sevaster, Shkozë, Dushkarak
    - Lowland areas in Brataj AU: Brataj, Gjorm, Velcë, Lepenicë, Mesaplik
- At the municipal level, **currently about 1,000 ha of agricultural land are irrigated**, although in certain years this area reaches even more.

In this way, up to 15% of the cultivated area is irrigated, mainly lowland fields, which have high irrigation capacity and high production potential. In the Sevaster–Shkozë–Dushkarak plain, with an area of 800 ha of agricultural land with high potential, only 210 ha are irrigated, due to poor functioning of the irrigation system and the limited capacity of the pumping station that mechanically lifts water from the Vjosa river to the main irrigation canal..

- At the municipal level, **the main agricultural products are**: cereals, which occupy 27.3% of the cultivated land area; forage crops 63.51%; and vegetables–melons 4.3%. Of the perennial crops, olive groves occupy 31.48%, vineyards 4.5%, and orchards 1.09%.

The Administrative Unit Armen, which has the largest irrigated land area compared to other units, contributes 49.9% of cereal production, 33.7% of forage crops, 41.6% of vegetables–melons, and 34.7% of olive production. Vllahina contributes 48.5% of grape production. The municipality could expand olive cultivation and, in the absence of labor, increase the level of mechanization of farming and harvesting processes.

- **In the Municipality of Selenica there are no export of local agricultural produce.**

Trade of agricultural and livestock products is done individually. There is no agricultural products market. The municipality needs to conduct a study on setting up a market in Selenicë and organizing it also as a mobile market in villages on specific days.

- **Sevasteri and Brataj**, which have significant economic activity in livestock farming (about 60% of income), together produce around 39% of the municipality's milk.

The number of livestock heads is dominated by small ruminants, which also play the main role in milk production. In this municipality, with a considerable area of pastures, there is potential to expand small ruminant farming under natural conditions. However, it is necessary to build watering points near summer pastures to ensure water for livestock.

- The Municipality of Selenicë applies **technologies under low-scale agricultural mechanization conditions.**

  As a new municipality, mainly with hilly terrain, it should be supported and should also encourage entrepreneurship for the creation of mechanization companies, with equipment, machinery, efficient micro-irrigation systems suitable for small and fragmented hilly plots.

If water resources from reservoirs and the two rivers are used at the projected capacity and the irrigation system is rehabilitated to reach about 9,500–10,000 ha of potential irrigated and cultivated land, agricultural production at the municipal level could double or triple.

Table XVIII. Main interdependencies between the agriculture and water sectors in the Municipality of Selenicë

Field of Interdependency	Data / Key Facts
Total agricultural land area (7501 Law)	14,932 ha
Cultivated area in 2024	6,384 ha (45.5%)
Currently irrigated area	~1,000 ha (deri në 1,500 ha in certain years)
Potential area for irrigation	Rreth 9,500-10000 ha
Irrigable area by 2030	4450 ha

Production loss without irregation	50–60%, in some cases of total loss
Main crops	1 year old crops 63%, Olives 31.5%, Vineyards 4.5%, Orchards 1.1%
Main problems	Lack of irrigation infrastructure, poor water resource management, high evaporation.
AU with the highest % of cultivated land (2024)	Armen (68.5%), Selenicë (59.0%)
AU with the lowest % of cultivated land (2024)	Sevaster (23.7%), Kotë (29.8%)
Agricultural areas with insufficient irrigation	Sevaster–Shkozë–Dushkarak plain: only 210 ha irrigated out of 800 ha potential
Main water sources	Vjosa River, Shushica River, reservoirs
Relation with livestock farming	Sevaster & Brataj produce 39% of milk, but lack irrigation infrastructure (near pastures)
Agricultural production potential	Could **triple** if the potential irrigation capacity (9,500–10,000 ha) is reached)

Source: Agriculture Department, Municipality of Selenicë

5.7.2. USE OF IRRIGATION NORMS UNDER CLIMATE CHANGE CONDITIONS

It has been estimated that, as a result of climate change, the demand for water through surface gravity irrigation systems may increase by 35–50% during the irrigation season (National Service for Habitat and Territorial Development - SKZHT, 2015). In the Municipality of Selenicë, irrigation currently takes place on a limited area of cultivated land, mainly through the free-flow surface method, which has a low water use efficiency of around 30%.

The calculation of irrigation water needs includes several factors: climatic data (including evapotranspiration), the amount of useful rainfall during the growing season, soil water reserves at planting and during vegetation, as well as the correction coefficient of the cultivated crop (K). Based on these calculations, the amount of water required that is not covered by rainfall for the period April–September in Selenicë territory is estimated to be about 4,500–6,000 m^3/ha.

The irrigation method significantly affects water use efficiency, the level of agricultural production, and soil protection from erosion. Currently, surface irrigation in the Municipality of Selenicë is carried out under poor infrastructure conditions, with considerable water losses, low productivity, environmental damage, and lack of control over irrigation norms.

For this reason, it is necessary to promote and develop more modern irrigation methods, such as:

- automated sprinkler irrigation,

- drip irrigation,
- micro-irrigation,
- subsurface irrigation.

Although these methods require higher initial investment, they ensure significant water savings, better control of the amount used, and lower environmental impacts. These technologies are particularly suitable for lowland areas with high agricultural potential such as:

- Sevaster plain,
- Armen area,
- Shushica valley,
- and villages identified as having high-quality soils.

Priority should be given to the rehabilitation and equipping with new irrigation technologies of an area of about 4,800 ha of agricultural land in these zones. Further development of these methods can then gradually expand to other areas of the municipality.

5.7.3. NEED FOR INTERINSTITUTIONAL COORDINATION FOR WATER RESOURCE AND IRRIGATION SYSTEM MANAGEMENT

The management of water resources (reservoirs, rivers) and irrigation infrastructure requires close coordination between responsible institutions at the local and central levels. Institutional organization models and responsibilities for irrigation management have undergone continuous changes, especially after the 2015 territorial reform, when the territory was reorganized into only 61 municipalities, from the previous 60 municipalities and 309 communes.

In implementation of Law no. 139/2015 "On local self-government" and Decision of the Council of Ministers (DCM) no. 1108, dated 30.12.2015 "On the transfer from the Ministry of Agriculture to municipalities of irrigation and drainage infrastructure, as well as personnel and assets of drainage boards", a considerable part of this infrastructure has been transferred to the ownership and administration of municipalities, as part of the decentralization reform.

Supporting this process, Law no. 24/2017 "On the administration of irrigation and drainage" was approved, which clearly defines the division of responsibilities between the central government and local government. According to this law, municipalities are responsible for managing secondary and tertiary irrigation and drainage canals, while main canals, water intake works in 22 large irrigation schemes, and 7 large reservoirs remain under the responsibility of the Ministry of Agriculture and Rural Development (MARD). This ministry is also responsible for the maintenance and rehabilitation of large collectors, pumping stations, high water canals, and river protective embankments.

With Law no. 24/2017 "On the administration of irrigation and drainage" and DCM no. 437, dated 17.5.2017 "On the establishment, organization and functioning of regional irrigation and drainage directorates", four regional irrigation and drainage directorates

(Lezhë, Durrës, Fier and Korçë) were created. These replace the former regional drainage boards and perform the same tasks in the same areas: maintenance of main drainage canals, pumping stations, high water canals, 22 main canals of large irrigation schemes, 7 large reservoirs that serve more than one municipality, and flood protection works. The Municipality of Selenicë is covered by the Regional Directorate of Agriculture Fier, while all other irrigation and drainage infrastructure has been transferred to municipalities along with administration responsibilities.

5.7.4. CHALLENGES IN THE OPERATION AND MANAGMENT OF THE IRRIGATION AND DRAINAGE SYSTEM IN THE MUNICIPALITY OF SELENICË

The basic management functions of the irrigation system have been transferred from the central government to local self-governing units, including irrigation and drainage infrastructure, personnel, and movable and immovable assets of the former drainage boards. However, many municipalities, including Selenicë, have not yet created the necessary technical and institutional capacities for effective management of this system. The lack of sufficient funds, the need for training on irrigation methods and norms, and still low collection of irrigation fees remain ongoing challenges. Also, there are notable shortages of agricultural specialists and hydro-technical engineers, which affects the maintenance and rehabilitation of irrigation and drainage networks.

In the municipality, the Directorate of Agricultural Development and Management of Forests/Pastures has been established, led by an experienced professional. However, the municipality also needs to have a hydrologist to work on irrigation and climate change adaptation. Additionally, strengthening cross-sectoral capacities to address climate issues across all sectors is necessary.

The irrigation infrastructure has suffered significant damage during the transition period 1991–2020, and this condition continues to negatively impact agricultural productivity. In the Municipality of Selenicë, the operation of the irrigation and drainage system remains problematic due to the lack of equipment for cleaning and insufficient workforce. The absence of cooperative mechanisms, technical tools, and workforce continues to be a serious obstacle for the sustainable management of irrigation and drainage infrastructure.

Figure XXIII. Operation of the irrigation and drainage system in the Municipality of Selenicë

Source: Build Green Group

To make the improvement of the irrigation system a reality, it is recommended to plan regular annual funding, select schemes that include as many beneficiaries as possible, and increase the municipality's contribution to the maintenance of infrastructure. It is essential to strengthen management capacities, provide equipment support to the Regional Directorates of Irrigation and Drainage, and encourage farmers through favorable policies that promote at least minimal cooperation at the plot level, to overcome the difficulties created by the high fragmentation of land.

In the context of expected climate change impacts—rising temperatures, reduced rainfall, intensifying meteorological, hydrological and agricultural drought, and increased evaporation from soil and surface water resources—it is necessary to develop a sustainable irrigation strategy. This includes modern and efficient water distribution models, replacing traditional practices with innovative ones, and creating irrigated agriculture that is productive, profitable, and sustainable.

Furthermore, it is crucial to restore reservoirs to their designed capacities, bring potentially irrigable areas back into use, and identify and utilize new water resources.

On approximately 95% of the irrigated area in the Municipality of Selenicë, the traditional surface irrigation method is used, which has low efficiency and environmental consequences, including significant water losses. Therefore, it is necessary to limit this method and expand the use of more modern techniques, such as sprinkler irrigation, micro-irrigation, drip irrigation, and infiltration irrigation.

5.7.5. LOW LEVEL OF USE OF EFFICIENT IRRIGATION TECHNOLOGIES IN THE CONTEXT OF HIGH LAND FRAGMENTATION AND LACK OF LAND OWNERSHIP SECURITY

A major limiting factor in the implementation of irrigation technologies remains the high fragmentation of agricultural land. Until 1990, the designed parcels averaged about 12 ha in lowland areas and 3–5 ha in hilly areas, where all works, planting with the same crop, and agricultural services were unified.

With land privatization (starting from 1991), parcels were divided among many farmers, up to 15–25 farmers per block, resulting in small, scattered plots distributed among 4,318 family farms, often as separate and non-adjacent plots.

- At the municipal level, there are 4,318 family farms, of which 3,644 are general agricultural farms and 674 are specialized family farms (livestock, olive groves, vineyards, and orchards).
- In these conditions, it is very difficult to apply modern irrigation technologies, and water losses are high. In the municipality's agriculture, the predominant irrigation method (>95%) is traditional surface irrigation, initially designed with an efficiency of 70% and 30% loss. However, the actual efficiency ranges between 30–60%, and in some areas is even lower.
- Difficulties in implementing irrigation technologies are also linked to the fact that farmers do not cultivate all their parcels and plant different crops, which require irrigation at different times. Moreover, there is a lack of coordination among farmers and insufficient labor for cleaning and maintaining irrigation and drainage canals, making water use less effective.
- The supporting irrigation infrastructure and challenges with water resources, especially the poor functioning of irrigation reservoirs, further limit the irrigated land area. This situation is even more challenging in small and scattered plots, where costs of works, services, transport, and product collection have increased by 25–30%.
- To improve irrigation conditions, it is necessary to rehabilitate irrigation and drainage systems and create closer cooperation among farmers to mitigate the impacts of land fragmentation. This cooperation could be achieved through farmers' agreements to cultivate plots with the same crops, encouraging land markets for sale and lease, creating agricultural cooperation associations, and re-parcelling properties when farmers agree on land consolidation.
- Improvements in land use, irrigation technologies, and farm sustainability also require finally resolving the issue of land ownership guarantees and equipping farmers with ownership certificates—a process which remains at a very low level in the Municipality of Selenicë. The municipality does not have precise data on the percentage of farmers holding ownership certificates, but it is known to be minimal. Furthermore, in many villages, the updating of agricultural land (as a preparatory process for data collection and field verification) has not yet been carried out. Selenicë remains among the areas with the lowest levels of land

registration, issuance of ownership certificates, and even initial updating. There are conflicts, overlapping claims, discrepancies between maps and the field, and missing documents—issues that may require court proceedings.

In Armen Administrative Unit, the lands of the villages Treblovë, Mesarak, and Karbunarë have been updated, while other villages like Armen, Lubonjë, Picar, Rromës, and Karbunarë (covering an area of 3,098 ha) have not yet been updated. In these villages, leasing through informal agreements has developed. In four lowland villages, about 60% of farmers have leased out their land to 15–20 farmers, without documentation. Leasing remains an economically viable practice and helps protect land from degradation and drought.

In the Vllahinë Administrative Unit, only 10–15% of agricultural land has been certified. Meanwhile, in the Administrative Unit of Kotë, the initial registration for 2,158 ha in villages such as Mavrovë, Gumenicë, Kotë, Lapardha, Mazhar, Vodicë, and Drashovicë has not yet been completed. There are also issues with property accuracy even in some updated areas.

In the Sevaster Administrative Unit, systematic initial registration has not been carried out for the village of Shkozë, one of the villages with high agricultural potential, and there are also problems with property accuracy in other updated areas. Similarly, in the Administrative Unit of Selenicë, initial registration has not yet been carried out for the town of Selenicë and the village of Resulaj. While there has been a transfer of land from usage to ownership, a part of families still lacks ownership certificates (AMTP) because beneficiaries have not submitted survey plans. Land registration remains a major issue, limiting ownership security and preventing farmers from making investments.

5.8. ECONOMIC, SOCIAL AND ECOLOGICAL EFFECTS OF CLIMATE CHANGE ON AGRICULTURE AND WATER

5.8.1. ECONOMIC EFFECTS

Climate change, which causes rising temperatures and reduced rainfall, significantly affects agricultural production. These changes have led to reduced yield per unit of cultivated area and abandonment of uncultivated areas. Agricultural production largely depends on irrigation, as crops have specific water requirements per production unit (kg, kW, ton) and need irrigation at different growth stages. For example, the reported uncultivated area in 2024 is 8,548 ha, while the cultivated area was only 6,384 ha (with cereals, vegetables-melons, and forage crops), mainly due to lack of water (and other factors). Besides production loss, the process of land degradation intensifies.

If cultivation could cover at least 10,000 ha (adding 3,600 ha compared to 2024), assuming an average yield of about 70% of 2024's level, it would add roughly: 4,000 tons of cereals, 45,000 tons of forage, 3,000 tons of olives, 3,500 tons of vegetables and melons, and 70–80 tons of grapes. This production loss can be roughly estimated.

In the context of the Municipality of Selenicë, where irrigated land is around 1,000 ha (irrigated on average 1.7 times per year), yields on non-irrigated areas are minimally

30–40% lower than on irrigated ones. This lack of water means Selenicë has no agricultural exports, unlike other areas in the country.
There is no established or mobile market for selling agricultural and livestock products (except small dairies processing milk), which limits opportunities for enterprise growth.
Land use is planned for 10,000 ha over a 3–5 year period and an additional 6,000 ha over a longer period.

5.8.2. SOCIAL EFFECTS

Climate developments have contributed to:

- Increased food insecurity: Reduced agricultural production has lowered farmers' incomes, increased dependence on economic aid, and driven rural migration.
- Local conflicts over water use: Land fragmentation, lack of cooperation among farmers, and limited water resources have led to local disputes and inefficient water use.
- Departure of youth from agriculture: This phenomenon is widespread, but in Selenicë, due to hilly terrain and lack of mechanization, there is a need for labor which remains insufficient.

5.8.3. ECOLOGICAL AND ENVIRONMENTAL EFFECTS

- Decreased **biodiversity** in agricultural areas.
- Partial desertification of land.
- **Land damage in the oil-bearing area due to decades of oil well exploitation** in the Kocul-Gorrisht area, causing physical soil damage, surface oil spills, and pollution of land and water, with risks of contaminating groundwater.
- **Increased extreme weather events affecting agricultural areas**: higher temperatures. For example, in Brataj, an administrative unit in Selenicë, the average maximum air temperature in 2020 was 23.1°C compared to the historical average of 20°C (1961–1990), while the average minimum temperature was 9.9°C compared to 8°C. This temperature rise and rainfall deficit (761 mm) make vegetation conditions unsuitable, resulting in 50% of land left uncultivated and very low agricultural production.
- **Fires** on agricultural and forest lands.
- **Extreme temperatures**, prolonged droughts, and damage to infrastructure.
- **Flooding**: In the Vjosa River, during heavy rains and overflows, farmlands in Armen, Lubonjë, and other areas in the Vjosa valley have flooded. Although some protective measures have been implemented, unrehabilitated drainage systems remain a problem. Rehabilitating drainage canals is essential to manage rainwater and floodwaters.
- **Land degradation**: Uncultivated agricultural lands undergo drastic changes, including (i) worsening chemical and physical properties, (ii) reduced productive

and biological capacity, (iii) physical degradation through shrub encroachment and high costs to restore them—phenomena clearly seen in uncultivated lands in Selenicë.

- Fires during high temperatures and **landslides**, especially in uncultivated or previously burned areas. In 2024, 290 ha of forests and 666 ha of pastures in the Municipality of Selenicë were affected by fires.

Figura XXIV. Pictures from forest and pasture fires in Vllahinë and land erosion in Gerdec

Source: Build Green Group

Priorities for the upcoming years

- Increase the efficiency in the use of water, through investments in the modernization of the existing irrigation infrastructure and reduction of losses in the system. The expansion of advanced irrigation methods, such as drip irrigation, sprinkler irrigation, micro-irrigation, etc., is necessary to limit surface irrigation, which is currently applied on 85–90% of the area and has low efficiency.
- The modernization of irrigation infrastructure and the improvement of irrigation methods, by using rates based on the evapotranspiration of plants, soil evaporation and soil characteristics, the biological needs of plants, local trials, soil indicators and characteristics, constitute a chain of sustainable agriculture.
- The maintenance of irrigation systems needs more investments than those currently implemented.
- Strengthening the institutions charged with the management of irrigation at the municipal level and building managerial capacities are urgent. It is required to draft a new water needs balance at the municipal level and for each administrative unit, and to review the irrigation norms based on data of transpiration, soil indicators and the effects of climate change, as a mechanism

that balances the relationship between the water that leaves and the water available to the plant and the soil.

- Completing the municipal staff with a hydrologist who will lead the entire process of water administration.

5.9. ASSESSMENT OF POLICIES FOR WATER MANAGEMENT AND FARMER SUPPORT

Currently, there is a legal framework for water management, but implementation at the local level is limited. Efforts to construct dams and water distribution systems are fragmented and poorly maintained. The rural sector of the Municipality of Selenicë requires a policy environment that promotes productivity growth, investments in agriculture and non-agricultural sectors in rural areas, as well as the improvement of irrigation infrastructure.

Policies for supporting farmers include:

- Subsidy schemes for investments in irrigation systems:

The Municipality of Selenicë relies on two main sources for agricultural irrigation: reservoirs built for land irrigation and the use of water from the Vjosë and Shushicë rivers. Until 1990, these sources irrigated up to 1350 ha of land. After 1990, the irrigation system was left unmaintained and suffered many damages. The irrigation reservoirs experienced damage to discharge equipment, loss of water-holding volume, and damage to the irrigation conveying canals after water exits the reservoirs. The water from the reservoirs is partially used due to these defects, and some of the reservoirs are out of service. The problems of the reservoirs are discussed in point 1. The problems of the irrigation infrastructure are also discussed in points 1,2, and of the rivers in points 1,2..

Rehabilitation **Actions**:

- Planning of investments for the restoration of damaged reservoirs, improvement of irrigation infrastructure, and the use of mechanical equipment (excavators) for cleaning irrigation canals.
- Rehabilitation of irrigation and drainage systems for potential agricultural areas, with support from regional irrigation and drainage directorates.
- Rehabilitation of pumping stations for the use of river waters for irrigation, as well as improvement of drainage systems.
- Support for drought-resistant crops

This is a practice that many countries are working on, for the cultivation of plants that are resistant to drought, or varieties within the same crop, particularly in the hilly area, which dominates the territory of the Municipality of Selenicë. The expansion of olive groves, where traditional methods of the Albanian coastline for rainwater collection can be applied. At the same time, the crop structure can be improved with crops that are sown early and go through phases avoiding severe plant damage.

Monitoring of water resources- Regular monitoring of water resources (rivers and reservoirs) must be carried out to ensure a sustainable water supply.

Improvment of irrigation efficency- The actual irrigation of agricultural land currently in the Municipality of Selenicë is low, around 23.5% of cultivated land, or 10% of the total divided agricultural land. The irrigation methods are dominated by surface irrigation across the entire area of the Municipality of Selenicë, which is designed with 70% efficiency and 30% losses. However, the actual efficiency in practice varies at low levels of 50–60% and in particular areas even lower. The entire area is irrigated by surface irrigation, which, despite the planned 65–70%, loses water in the network and the irrigation efficiency in increasing production is low. The irrigation infrastructure, for the movement of water from the water source to the parcel, faces serious problems in the functioning of the irrigation canal systems. The main priority for the coming years will be increasing the efficiency in the use of water, through increased investments for the modernization of the existing irrigation infrastructure to reduce losses in the system, as well as the expansion of advanced irrigation methods (drip irrigation, sprinkling, micro-irrigation, etc.) and limiting surface irrigation, which is currently applied to the entire area and is a low-efficiency method.

Supporting farmers - Small farms consisting of 4318 family farms, of which 83% are agricultural family farms, 211 farms specialized in livestock, 20 farms specialized in fruit growing, 385 farms specialized in olive cultivation, and 58 in vineyards. Cooperation among farmers with agreements at least at the parcel level, where farmers come together in the rehabilitation and maintenance of irrigation canals and irrigation itself, with controlled and calculated irrigation rates based on plant evapotranspiration and soil evaporation, as well as the biological needs of plants, will improve irrigation efficiency in agricultural production. Cooperation of farmers according to production groups (agricultural farms, livestock farms, and by specialization) in production processes, irrigation, improvement of irrigation infrastructure, collection, and sale of production. A positive experience is found in Armenia, with land leasing and land cultivation.

5.10. SUMMARY & RECCOMANDATIONS FOR CLIMATE CHANGE ADAPTION IN AGRICULTURE AND WATER

The irrigation infrastructure has suffered major damages, affecting the operation of the canal network, pumping stations, and reducing irrigation capacity. There are problems with the equipment and water discharge mechanisms of the reservoirs, as well as with the water-holding capacity and maintenance of the canal system, due to lack of cleaning. Institutional capacities are limited due to lack of coordination between local and central institutions, and due to the modest staffing structure of the Municipality of Selenicë. Knowledge about climate change adaptation strategies and farmers' initiatives for adaptation measures at farm level is also limited.

- **Analytical study** of climate change in the territory of the municipality
- **Drafting of an adaptation plan to climate change,** selecting medium- and long-term alternatives, priorities, options, and responsibilities.

Adaptation to new types of crops that are drought-resistant, with lower biological water requirements per production unit, improvement of land management and technologies to retain soil moisture. Also, adaptation of sowing periods to utilize early spring rainfall amounting to 100–120 mm and the early autumn months.

Water management for irrigation through the rehabilitation of irrigation schemes, improvement of irrigation canals, and use of advanced methods such as sprinkling and micro-irrigation, increasing water use efficiency up to 70–75% under free-flow conditions and combined with advanced methods like sprinkling and micro-irrigation.

Modernization of water distribution in agricultural parcels with accurate monitoring and measurement of water use, through installed water meters. Expansion of economic irrigation techniques and use of pumping systems from rivers, use of wells for small surface areas, expansion of new and economical irrigation techniques, implementation of farm-level pumping schemes from river waters, organization of farmers into water user associations and agricultural cooperation associations, modernization of water distribution on farms through application of irrigation methods that guarantee quality and water savings.

Construction of water tanks for livestock, ventilation systems in stables to avoid heatwaves, introduction of heat-tolerant livestock breeds, local afforestation to provide shade for animals, cultivation of drought-resistant forages for animal feed. Increase in forest cover and cultivated agricultural land to reduce water evaporation from the soil to a minimum.

Agriculture is also a source of greenhouse gas emissions (35–40%), including methane (75%) from livestock and nitrous oxides from chemical fertilizers. To limit greenhouse gas emissions, proper management of nitrogen and organic fertilizers is necessary, as well as increased afforestation..

Calculation of irrigation rates based on soil and plant transpiration, and training of water users to ensure more efficient use. **Opportunities for the development of agrotourism** as a form of economic diversification are also present

From field observations and collected data on the irrigation system — starting from water sources (reservoirs and intake from the Vjosa and Shushica rivers) — it results that the irrigation and drainage infrastructure presents serious problems both in quantitative and qualitative aspects. These problems hinder the efficient use of agricultural land and do not guarantee production in line with potential capacities. The main problems of the reservoirs and drainage and irrigation systems have been described earlier in points 1 and 2.

Urgent Needs:

- **Rehabilitation of reservoirs and irrigation canals**

Water resources and irrigation infrastructure make up a cyclic network for water circulation to the parcel, based on the biological needs of vegetation, rainfall amounts, and soil moisture.

Irrigation, in the context of climate change, is becoming a "hot" issue for increasing agricultural production to meet the growing global population's needs, but also under projected climate change conditions (rising temperatures and decreasing precipitation), intensification of meteorological and agricultural drought, and increased evaporation from soil and surface waters and transpiration from plants. Water is one of the irreplaceable inputs to meet the biological needs of plants and to protect the soil from degradation.

Current state of infrastructure

- In most cases, reservoirs and irrigation canals are out of service due to lack of maintenance, damages from the transition period, insufficient investments, and water losses in the network.
- The current water-holding capacity of the reservoirs has significantly decreased compared to the initially designed capacity.

Recommendations

- The municipality should plan investments for the rehabilitation of reservoirs and canals based on specific engineering problems.
- As a first step, it is necessary to plan investments to make operational the reservoirs with the engineering issues cited, and the water conveying canals.
- The municipality needs to be equipped with mechanical tools for cleaning the canals (such as excavators), as well as closer cooperation with the Regional Directorate of Irrigation and Drainage.
- Farmers should take cooperative initiatives among themselves for the cleaning and rehabilitation of secondary and tertiary canals at the parcel level by working together.
- Rehabilitation and maintenance of agricultural irrigation infrastructure and irrigation schemes should be based on the designed system, to ensure optimal irrigation and the projected irrigation rates.

Medium term objective (3-5 years)

Under these conditions, the Municipality of Selenicë needs to irrigate about 4450 ha by the year 2030 and over a period of 7–10 years to rehabilitate the irrigation system and put into operation the reservoirs for irrigation of at least 10,000 ha of agricultural land and its cultivation.

- **Installation of modern high-effiency irrigation systems**

In the Municipality of Selenicë, alongside the limited irrigated surface, the only method currently used is surface irrigation by free flow. This method was designed with a theoretical efficiency of 70%, with about 30% water loss, but in practice, the actual efficiency varies from 50% to 60%, and in some specific areas is even lower.

To save water and increase irrigation efficiency, it is necessary to modernize the system through investments in expanding advanced technological methods, such as drip irrigation, sprinkler irrigation, micro-irrigation, and infiltration irrigation. Also, a gradual reduction of surface irrigation is recommended, which is currently the only applied method and is characterized by low efficiency.

- **Rainwater Harvesting Systems** Rainwater harvesting systems can be installed even at the household level, for the irrigation of home gardens, as well as for the construction of small water reservoirs usable in livestock farming. Additionally, special structures can be built for water collection by individual farmers or farmer groups in potential agricultural areas. The collected water can be used to irrigate plants using efficient methods such as drip or sprinkler irrigation, especially for crops like olive groves and fruit trees.
- **Laboratories for monitoring the quality of agricultural water**

The establishment of laboratories for periodic monitoring of the quality of water used for irrigation is necessary, to ensure it does not pose a risk to the soil, vegetation, or consumer health. These laboratories will assist in the assessment of physical, chemical, and biological parameters of the water, including the presence of potential pollutants.

- **Sustainable agricultural techniques**

Implementation of sustainable agricultural techniques is essential to address the challenges related to climate change, land degradation, and conservation of natural resources. Among the main recommended techniques for the Municipality of Selenicë are:

  - Cultivation of climate stress-resistant crops, such as those tolerant to drought or high temperatures, which help ensure stable yields even under unfavorable climate conditions.
  - Application of conservation agriculture through practices such as soil cover with mulch to retain moisture and reduce erosion, and crop rotation to improve soil health and reduce the need for pesticides.
  - Use of organic fertilizers and agroecological technologies to improve soil structure, increase biodiversity, and maintain its natural fertility..

These practices can contribute to the sustainable preservation of agricultural ecosystems, improvement of productivity, and strengthening the resilience of rural communities to climate and water crises.

Figure XXV. Picture from Shkozë-Sevaster plain

Source: Build Green Group

06

ASSESSMENT OF ENERGY POTENTIAL

6.1. ASSESSMENT OF RENEWABLE ENERGY POTENTIAL

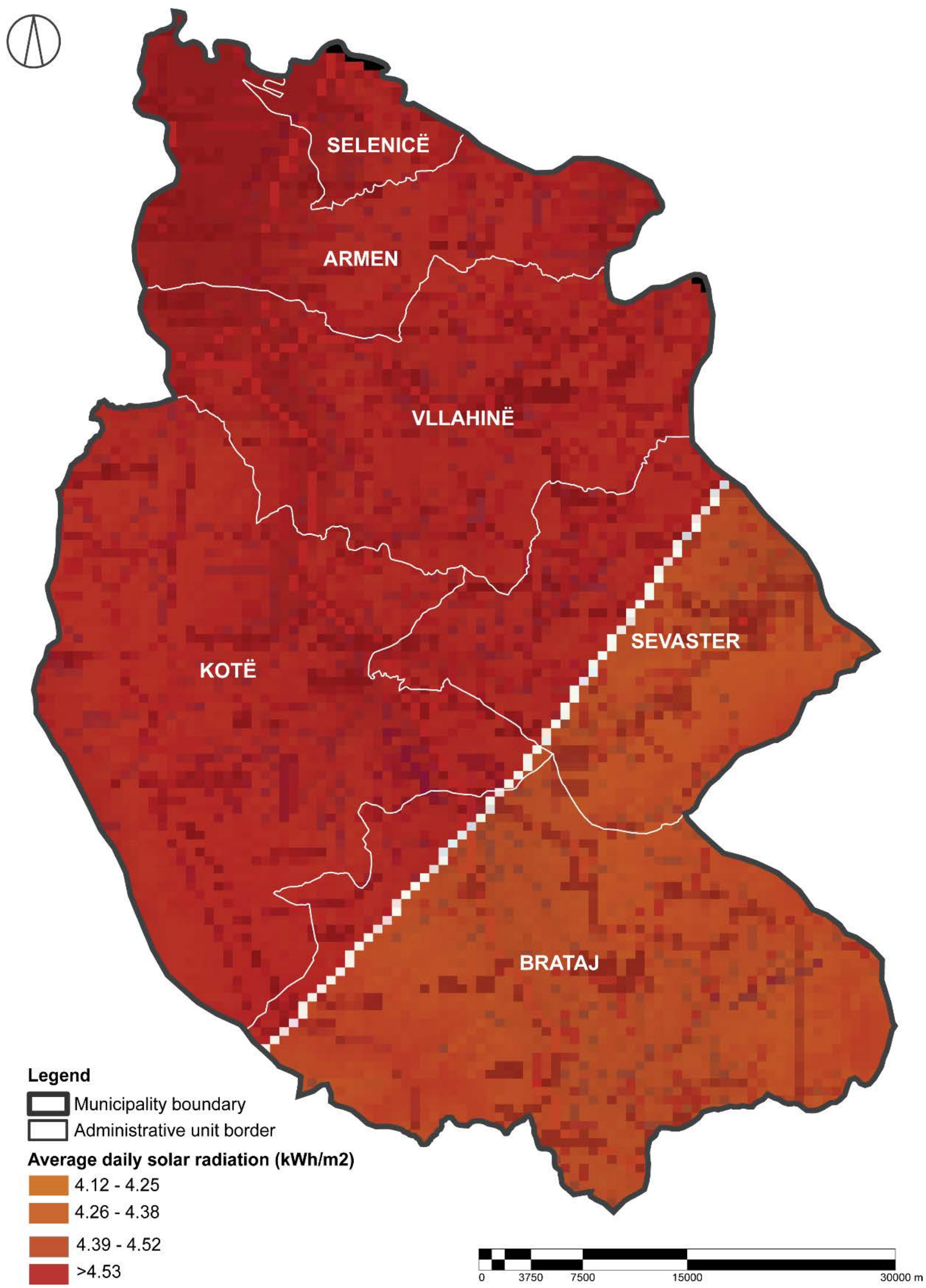
The geographic position and climatic characteristics of the Municipality of Selenicë make this territory favorable for the development of renewable energy resources, with a particular focus on solar and wind energy. As shown on the map of average daily solar radiation, almost the entire territory of the municipality has values above 4.26 kWh/m²/day, while the southeastern part (the administrative units of Brataj and partially Sevaster) reaches levels above 4.53 kWh/m²/day, which represents the highest category of solar potential according to the classification of the European Solar Radiation Atlas. This indicator signals clear opportunities for the installation of photovoltaic systems, especially on private and agricultural properties, for self-consumption and for injection into the grid, in case of the development of the supporting infrastructure.

According to the International Energy Efficiency Agency (IEEA, 2022), Albania has over 2,500 hours of sunshine per year, and this figure is confirmed for the Municipality of Selenicë through regional climate observations and field analysis. This potential is distributed steadily throughout the year, making the installation of panels on agricultural structures, municipal buildings, and low-rise constructions suitable. Harnessing solar energy under these conditions is not only economically justified but also recommended by national decarbonization policies and the 2030 energy transition strategy (Ministry of Insfrastucture and Energy - MIE, 2021).

Besides solar energy, considerable potential also exists for wind energy, especially in the exposed areas of Armen and Brataj, as well as in the northeastern part of the Sevaster unit. According to data from the National Agency of Natural Resources (NANR, 2020), these areas record average wind speeds above 4 m/s for more than 250 days per year, which constitutes a sufficient technical threshold for small-scale wind turbines at the community level or for agricultural use. The area of Armen, due to its hilly position and northeastern exposure, presents a microclimate that promotes air circulation, particularly during seasonal transition periods.

However, structural challenges in the territory and the absence of an electricity distribution network in peripheral areas have limited the actual capacity to implement clean energy projects. The lack of distribution substations, energy storage systems, and technical support for autonomous off-grid systems hinders the expansion of solar and wind energy at the local level. In this context, the existing potential remains underutilized, while strategic intervention is needed to improve infrastructure and to encourage public or public-private partnership investments in the renewable energy sector.

Figure XXVI. Average daily solar radiation; Territory of the Municipality of Selenicë



Source: Global Solar Atlas; https://globalsolaratlas.info/

Figure XXVII. Windy hours; Territory of the Municipality of Selenicë

Source: Copernicus Climate Data Store; https://cds.climate.copernicus.eu

07

CURRENT STATE OF BUILDINGS INFRASTRUCTURE AND ENERGY EFFICIENCY POTENTIAL

7.1. EXISTING BUILDINGS AND THE STATE OF BUILT INFRASTRUCTURE

During field inspections, a significant number of residential structures and service buildings were identified in rural areas and in the centers of the administrative units of the Municipality of Selenicë. According to the data from the General Local Plan (Selenicë M. , 2018), over 60% of residential buildings were constructed before 1990, primarily using traditional or semi-prefabricated methods, and have not undergone significant interventions for structural improvement or energy efficiency (GLP, pg. 52). This represents a direct challenge to urban sustainability and the structural risk resilience in the event of natural disasters.

The structural analysis focused on the main building components such as foundations, load-bearing walls, columns, beams, concrete, and roofs, with the aim of identifying signs of damage, cracks, deformations, or weaknesses related to the age of the construction materials. Another important aspect of the assessment was the urban integration of buildings, which relates to their level of connection to road infrastructure, water and energy supply networks, as well as access to green spaces. In many rural areas, buildings are dispersed, creating functional gaps and obstacles to the efficient delivery of public services. This reflects a lack of integrated planning at the micro-urban scale and highlights the need for interventions aimed at functional reorganization.

The assessment also included the needs for conservation and restoration, especially in cases where buildings have architectural or historical value. Several structures representing traditional building typologies of the area were identified, which require interventions for preservation and inclusion in cultural heritage policies.

The comparative analysis between modern buildings, traditional ones, and those constructed using prefabrication techniques revealed significant differences in durability, usability, and adaptation to changing urban conditions. Modern structures have benefited from construction based on better technical standards and are better prepared for energy efficiency improvements. In contrast, older buildings face recurring issues such as material erosion, lack of reinforcements, structural moisture, and poor insulation.

From an environmental and energy perspective, many of the existing buildings do not meet basic standards for thermal insulation or natural ventilation, negatively affecting energy consumption and the thermal comfort of residents. The analysis considered factors such as building orientation, the use of thermally efficient materials, and the potential for integrating sustainable technologies (such as solar panels or passive lighting systems).

Table XIX. Building analysis; Territory Center – City of Selenicë

No.	Latitude	Longitude	Building Type	No. of floors	Roof type	Style	Condition	Materials
1	40,536 04	19,636 97	Apartment	5	Flat	Post 1990 apartment building	Moderate	Brick and concrete
2	40,536 22	19,636 83	Abandoned home	1	Tiled	Old	Abandoned / ruined	Wood and brick
3	40,536 99	19,637 00	High school	3	Flat	Post modern	Good	Brick and metal
4	40,535 44	19,636 79	Apartment	5	Flat	Post communism	Good	Brick
5	40,535 59	19,636 59	Abandoned house	1	Tiled	Old	Bad	Raw/Earth
6	40,534 95	19,636 31	House	4	Flat	Socialist	Moderate	Concrete, brick and stone
7	40,535 19	19,636 41	House	4	Flat	Socialist	Moderate	Concrete, brick and stone
8	40,534 10	19,635 96	Apartment	3	Flat	Post communism	Moderate	Brick, concrete and stone
9	40,533 46	19,636 20	Apartment	4	Flat	Pre Fabrication	Moderate	Concrete

10	40,53 3 34	19,63 5 90	House (Apartment)	4	Flat	Comunist	Good	Concrete and brick
11	40,53 3 03	19,63 6 04	Abandoned house	1	Tiled	Old	Bad	Brick
12	40,53 3 80	19,63 5 48	Apartment	2	Tiled	Italian	Moderate	Concrete and tiles
13	40,53 3 40	19,63 5 64	House	1	Tiled	Old	Bad	Brick
14	40,53 3 32	19,63 5 32	House	1	Flat	Traditional albanian	Moderate	Concrete , blocks
15	40,53 3 20	19,63 5 63	Abandoned house	1	Tiled	Old	Bad	Raw/Ear th
16	40,53 2 61	19,63 6 34	Coffee, market, house	2	Tiled	Traditional albanian	Good	Bricks and concrete
17	40,53 2 29	19,63 6 60	Apartment	2	Tiled	Comunists	Moderate	Bricks, concrete and metal
18	40,53 1 85	19,63 6 79	House	2	Sloppe d	Traditional albanian house	Abandon ed / ruined	Concrete , brick, stone and wood
19	40,53 1 59	19,63 7 16	Condominiu m	4	Flat	Socialism	Moderate	Concrete , brick, stone and wood
20	40,53 0 97	19,63 7 27	Commercial	2	Sloppe d	Post communis m	Good	Concrete , brick, stone and wood
21	40,53 2 39	19,63 5 82	House	1	Flat	Ruined	Abandon ed	Concrete

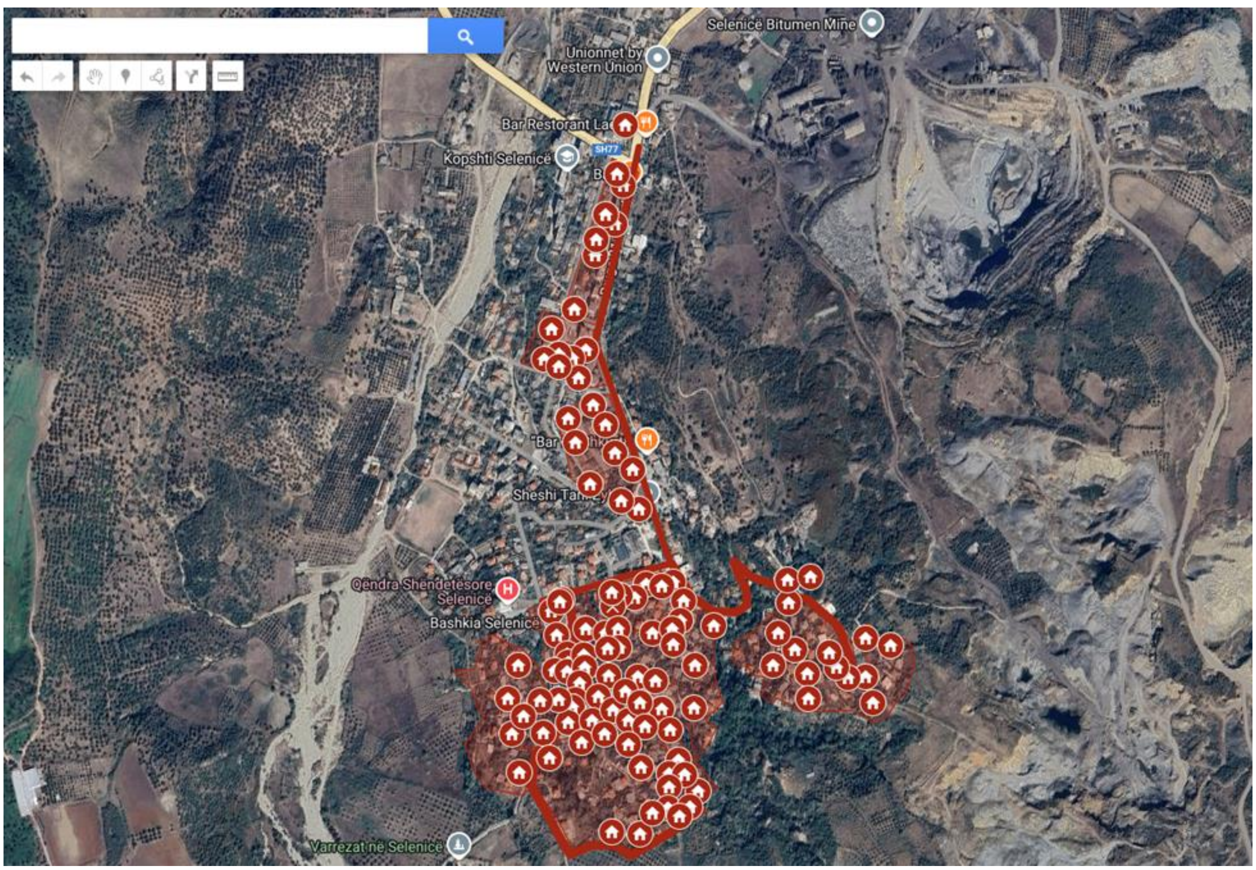
22	40,532 02	19,635 98	House	1	Slopped	Local	Abandoned	Concrete, brick, stone and wood
23	40,531 36	19,636 27	House	1	Slopped	Local	Good	Concrete, brick, stone and wood
24	40,531 10	19,636 93	House	2	Slopped	Traditional albanian house	Good	Concrete, brick, stone and wood
25	40,529 79	19,637 44	House	2	Slopped	Local	Good	Concrete, brick, stone, metal and wood
26	40,529 82	19,637 99	House	2	Slopped	Traditional albanian house	Moderate	Concrete, brick, stone and wood
27	40,529 59	19,637 19	House	1	Slopped	Traditional albanian house	Good	Concrete, brick, stone, metal and wood
28	40,529 53	19,638 20	House	2	Slopped	Traditional albanian house	Good	Concrete, brick and metal

29	40,52 9 76	19,63 7 76	House	1	Slopped	Traditional albanian house	Good	Concrete, brick, stone and wood
30	40,52 9 61	19,63 6 90	House	2	Slopped	Traditional albanian house	Good	Concrete, brick and stone
31	40,52 9 46	19,63 6 74	Abandoned Restaurant	1	Metal sheet	/	Bad	Concrete and stone
32	40,52 9 67	19,63 6 74	House	2	Flat	Local	Moderate	Concrete, brick, stone, metal and wood
33	40,52 9 38	19,63 5 49	Abandoned ruined building	3	Flat	Post communism	Abandoned	Concrete, brick and stone
34	40,52 8 99	19,63 5 60	Institutional building	1	Flat	Post communism	Good	Concrete, brick and stone
35	40,52 9 56	19,63 5 70	House	1	Slopped	Traditional albanian house	Moderate	Concrete, brick and stone
36	40,52 9 52	19,63 5 65	House	1	Slopped	Traditional albanian house	Moderate	Concrete, brick and stone
37	40,52 8 70	19,63 5 81	House	1	Slopped	Vernacular	Moderate	Concrete and brick
38	40,52 8 44	19,63 5 54	House	1	Slopped	Traditional albanian house	Good	Concrete, brick

								and stone
39	40,52 8 57	19,63 5 82	Abandoned building	1	Sloppe d	Local	Abandon ed	Concrete , stone, metal and wood
40	40,52 8 42	19,63 5 80	House	1	Sloppe d	Traditional albanian house	Good	Concrete , brick, stone

Source: Site Visits Build Green Group

Figure XXVIII. Study map of building analysis in the field; Territory Center – City of Selenicë



Source: Google My Maps Platform

The inventory of buildings in the city of Selenicë provides a clear overview of the construction characteristics and the overall condition of the housing stock, enabling a direct analysis of intervention opportunities aimed at energy efficiency and the integration of renewable resources. A considerable portion of the buildings is constructed with traditional materials such as concrete, brick, and stone, featuring a morphology that includes both tall apartment buildings and low individual houses with pitched roofs. In this context, two distinct groups of structures are clearly identified: collective buildings with flat roofs built after the 1960s, and a broad stock of traditional Albanian houses with low volume and a combined concrete, stone, and wood structure.

The physical condition of the buildings shows that a large portion of them is in moderate or poor condition, which implies a low level of thermal insulation and noticeable deficiencies in terms of energy comfort. This is especially evident in traditional individual houses, most of which are not equipped with modern heating or ventilation systems, while their pitched roofs partially limit the application of technologies such as photovoltaic panels but offer good potential for integrating solar thermal systems for hot water production. On the other hand, apartment buildings with flat roofs represent a more direct potential for the application of solar panels, especially if interventions are combined with improvements in the thermal envelope system and the replacement of old windows with high-efficiency systems.

The construction style encompassing buildings from the communist and post-communist eras has influenced the structural typology and the use of building materials, resulting in building masses with high thermal inertia but lacking insulating elements. This is further reinforced by the fact that many of these buildings have exposed facades and lack systems for controlling natural lighting or airflow. Under these conditions, the most appropriate interventions to improve energy performance include insulating exterior walls with contact systems or ventilated facades, insulating ceilings and roofs with rock wool or polyurethane, and installing double- or triple-glazed windows with thermal break frames to reduce thermal losses through transparent surfaces. Similarly, the use of thermal systems based on heat pumps for heating and cooling offers higher efficiency compared to open-fire stoves or traditional air conditioners.

In buildings with limited space for large installations, passive technologies are essential. These include optimal orientation of openings for natural lighting and heating during winter, the use of sun protection elements such as horizontal shading devices on south-facing facades, and natural ventilation to improve indoor air quality. For residences in good structural condition but lacking energy improvements, the application of compact systems for heating and hot water—such as boilers with solar collectors and radiators with thermostatic valves—is recommended. In the case of collective housing, more efficient solutions include shared energy systems, such as common roof collectors, centralized inverters for photovoltaic energy, and centralized energy consumption management through smart metering systems.

Abandoned or degraded buildings pose a distinct challenge, as they require full rehabilitation investments; however, they also represent an opportunity for recovery through “deep retrofit” projects that envisage reconstruction with new energy standards and functional transformation in line with community needs. Integration of renewable energy sources in these buildings is possible but must be preceded by structural analysis. Supporting this assessment, the analysis of 40 buildings identified through GPS coordinates within the territory of the Municipality of Selenicë reveals a considerable variety of building typologies, both in function and style, materials, and physical condition. The dominant structure is individual houses with 1–2 floors, featuring pitched roofs, built in traditional Albanian style, especially in peripheral areas. These buildings are primarily constructed with mixed materials such as concrete, brick, stone, and wood, reflecting traditional techniques and local construction practices. About 30% of the buildings are found to be abandoned or severely damaged, showing clear signs of wear and tear on materials and load-bearing structures. Among them, the use of raw earth, wood, and unfired bricks is common in abandoned buildings, exposing these structures to the risk of collapse or further damage. On the other hand, institutional and educational buildings, such as schools or administrative offices, are built with more durable materials (concrete, brick, and metal) and are generally in good condition. Overall, around 20% of the buildings have been assessed as being in “good” condition, including some residential structures built after 1990 with better construction standards. Most buildings are equipped with pitched roofs covered with tiles or metal sheets, reflecting an adaptation to the local climate and the need for natural ventilation. This represents a functional value, but in many cases, issues with thermal insulation have been identified, particularly in old and uninhabited buildings.

This typological and functional fragmentation negatively affects urban integration and creates the need for a differentiated intervention strategy that combines heritage preservation, structural improvement, and energy efficiency measures. In this context, the approach should be based on specific analyses for each building group, including gradual interventions starting with buildings in moderate condition that have high potential for rehabilitation. To ensure long-term sustainability and investment efficiency, it is essential that every measure is accompanied by an assessment of the potential for integrating renewable energy sources.

Figure XXIX. Digitalization of buildings in the city of Selenicë within a 600m radius in relation to the assessment of renewable energy potential

Source: Build Green Group

7.2. QUANTITATIVE ASSESSMENT OF BUILDING CONDITIONS AND POTENTIAL FOR ENERGY IMPROVEMENT

The building inventory carried out in the city of Selenicë identified 40 structures, distributed across various building typologies, architectural styles, and differing physical and structural conditions. The analysis revealed the following composition:

- 20% of the buildings (8 structures) are in good condition, with high potential for integrating energy efficiency measures.
- 40% (16 structures) are in moderate condition, requiring interventions for thermal insulation and structural component improvements.
- 30% (12 structures) are worn out or abandoned, needing deep rehabilitation or reconstruction.
- 10% are in unsafe or partial condition, requiring further inspection.

According to field assessments, the total roof area that can be utilized for installing solar panels is:

Table XX. Quantitative assessment of building conditions

Type of building	Number	Average roof area	Total area
Collective building	10	200 m²	2,000 m²
Individual house	25	100 m²	2,500 m²
TOTAL			4,500 m²

Source: Author's calculations

Taking an average annual solar radiation of 5 kWh/m²/day for Selenicë, the annual energy potential is:

4,500 m² × 5 kWh/m²/day × 365 days = ~8,212,500 kWh/year

This volume of energy represents a strategic capacity to reduce dependence on conventional sources and support the energy consumption of the urban community.
In buildings constructed before 1990, the lack of insulation standards results in average energy losses of 60–70% for heating/cooling. For an average consumption of 10,000 kWh/year per housing unit, this results in:

28 buildings (70% e fondit) × 7,000 kWh loss = 196,000 kWh/year of lost energy

The implementation of measures such as wall and ceiling insulation, installation of thermal-insulating windows, and improvement of heating systems can ensure:

28 buildings × 10,000 kWh × 50% = 140,000 kWh energy savings per year

These savings translate into a direct reduction of household expenses, lower CO_2 emissions, and improved indoor comfort.

Table XXI. Summary of Findings

Parameter	Value
Total number of buildings assessed	40
Persentage in good condition	20% (8 buildings)
Persantage in moderate condition	40% (16 buildings)
Persentage degraded/abandoned	30% (12 buildings)
Potential for solar rooftops	4,500 m²
Potential annual energy production	~8.2 milion kWh/year
Current energy losses for heating	~196,000 kWh/year
Energy savings from interventions	~140,000 kWh/year

Source: Author's average calculations

Based on the analysis of existing buildings in the territory of Selenica, interventions aimed at improving energy efficiency should guide their approach by respecting the characteristics of each construction category and the physical condition of the structures. In this context, buildings that are in good condition and those in moderate condition represent the most suitable basis for immediate intervention. These structures, which represent approximately 60% of the total analyzed, can directly benefit from standard measures to improve energy performance. The most recommended practices include the insulation of external walls to significantly reduce thermal losses, the insulation of ceilings and roofs, which are critical zones for the loss of heat or cooling, as well as the replacement of old windows and doors with high thermal efficiency equipment. These measures not only result in a reduction of energy consumption but also significantly improve the comfort of the residents and reduce energy costs.

Another strategic dimension is the integration of renewable energy sources, primarily through the installation of photovoltaic panels on the roofs of collective buildings and individual homes that offer suitable surface areas. These investments increase the energy autonomy of the buildings and contribute to reducing carbon emissions, in line with national objectives for decarbonization and clean energy. Additionally, the application of solar thermal collectors for hot water production presents a profitable and feasible alternative, especially in individual houses with pitched roofs.

On the other hand, abandoned and deteriorated buildings, which represent approximately 30% of the existing stock, cannot simply benefit from standard efficiency measures. For these structures, the only sustainable approach is deep rehabilitation, which entails not only structural interventions to restore the building's stability but also their functional transformation. Reconstruction according to new energy standards would enable the creation of new residential or service spaces capable of meeting energy classification parameters of class A. This process not only rehabilitates the architectural heritage of the area but also restores to use an important part of the currently underutilized urban space.

These interventions should be part of an integrated urban and energy plan that accompanies the rehabilitation process of the building stock with long-term projections for sustainable development. This plan must be harmonized with national policies on sustainable development and climate neutrality, enabling not only the city of Selenicë but also the surrounding administrative units to be included in a progressive trajectory of energy and urban transformation. Only such an integrated approach ensures not only economic and energy efficiency but also guarantees urban regeneration in accordance with contemporary construction and living standards.

08

CONCLUSIONS AND RECOMMENDATIONS

8.1. CONCLUSIONS AND RECOMMENDATIONS ON CLIMATE RISKS TO AGRICULTURE AND WATER RESOURCES

The analysis carried out on the state of water resources and irrigation infrastructure in the Municipality of Selenicë, as well as on the challenges of agricultural development, highlights a problematic situation, but also a considerable potential for strategic interventions and sustainable development. The data collected in the field, combined with institutional information and technical analysis, clearly show that despite interventions in the rehabilitation and improvement of the irrigation and drainage system and the agricultural system after 2015 with the organization of the Municipality of Selenicë, the current irrigation system is in a deteriorated state. The lack of investments, structural damages, and inefficient functioning of reservoirs and irrigation canals have significantly reduced the irrigation capacity of the area and the cultivated land surface.

The Municipality of Selenicë possesses 16,532 ha of agricultural land, of which 14,932 ha are distributed under Law 7501 "On Land" and 1600 ha are available state land. From the distributed land, in 2024, 6384 ha were cultivated and 8548 ha left uncultivated. These indicators directly affect the decrease of agricultural productivity and the abandonment of cultivated land.

Climate change, which is becoming increasingly evident in Albania as well, has intensified existing challenges through the increase of drought periods, reduction in rainfall, rise in temperatures, and increased evaporation from soils and vegetation. In this context, agriculture without secured irrigation remains fragile and unsustainable. Meanwhile, the lack of cooperation among farmers, as well as limited institutional capacities and lack of maintenance tools for infrastructure, further deepen the problem.

The Municipality of Selenicë, as a newly formed municipality with limited financial resources, following the transfer of irrigation and drainage infrastructure, has carried out some interventions to improve irrigation and drainage systems, but has not managed to improve them to a level that ensures the volumes necessary to guarantee the expected production and utilization of the land.

The irrigation system currently applied to most of the land is surface irrigation by free flow, which, although originally designed with an efficiency of 70%, in practice shows low levels of efficiency, with significant water losses exceeding 50%. This method is not only inappropriate for current climate conditions but also fails to meet water-saving requirements and the objectives of sustainable agricultural production.

Beyond this, the lack of mechanical tools and farmer participation in canal cleaning, the operation of only three reservoirs while the others face engineering problems and non-

functioning irrigation canals, and the damage to pumping stations on the Shushica River have resulted in only 1000 ha of agricultural land being irrigated each year compared to 13,500 ha before 1990. The low level of irrigation, besides being related to the system's functionality and infrastructure, is also linked to the low cultivation rate, small farms, and highly fragmented land parcels.
Faced with this situation, recommendations must focus on concrete and integrated interventions. First, it is essential to develop and implement a medium-term 3–5-year plan for the rehabilitation of the irrigation system and reactivation of irrigation reservoirs, aiming to cover at least 4450 ha of potential agricultural land by 2030, and in the longer term, up to 10,000 ha of irrigated and cultivated agricultural land. This must be accompanied by equipping the municipality with mechanical tools for maintenance and canal cleaning, as well as continuous support from the Regional Directorate of Irrigation and Drainage.
Secondly, investment in advanced high-efficiency irrigation technologies—such as drip irrigation, micro-irrigation, and infiltration—should be promoted and supported, in order to reduce losses and improve agricultural yields. At the same time, local farmer cooperation should be encouraged for the cleaning of secondary and tertiary canals and for the joint maintenance of existing systems, including initiatives to form agricultural cooperation associations to jointly produce, market, and consolidate land parcels.

Providing farmers with ownership certificates as documents guaranteeing property rights, and the process of updating initial registration in many villages, is problematic and at low levels, and requires urgent resolution. Engagement from ASHK, the Municipality, and all responsible institutions is needed to change the situation and provide farmers with ownership certificates to guarantee land rights, encourage investment, protect land from degradation, stimulate the land market, and promote land cultivation.

- Areas with high agricultural potential, due to lack or insufficiency of water, are unable to utilize their production capacity per unit area. Highly potential lands, but either not irrigated or only partially irrigated, include:
    - **Armen AU:** Armen, Lubonjë, Mesarak, Picar
    - **Selenicë AU:** Selenica
    - **Vllahinë AU:** Vllahinë, Penkovë, Peshkëpi
    - **Kotë AU:** Drashovicë, Mavrovë, Kotë, Vajzë
    - **Sevaster AU:** Sevaster, Shkozë, Dushkarak
    - **Brataj AU** (in the lowland areas): Brataj, Gjorm, Velcë, Lepenicë, Mesaplik

These zones, which are mainly part of the 4800 ha of potential flat agricultural land, should be prioritized in the rehabilitation of the irrigation and drainage systems, improvement of irrigation infrastructure, and cultivation efforts.

Thirdly, the promotion of sustainable agricultural techniques and adaptation to climate change—including infrastructure adaptation for crops—is vital. These include the use of organic fertilizers, planting of climate-resilient varieties, implementation of conservation agriculture (mulching, crop rotation), and use of treated wastewater. The installation of rainwater harvesting systems on family farms and for livestock would strengthen resilience and provide a valuable resource during drought conditions.

The Municipality of Selenicë covers a wide territory where agricultural lands, forests, and pastures total around 45,000 ha and are suitable for livestock farming, increasing herd size, boosting production, market access, and organizing a local market for agricultural and livestock products in the city of Selenicë. The number of livestock, especially small ruminants, is low relative to the natural grazing resources.

Increased mechanized work in operations, services, collection of production, and processing is needed to cope with labor shortages, by encouraging entrepreneurs to acquire motorized equipment.

Protection of water reserves of the Vjosa River and its Shushica tributary and their sustainable management should be based on drafting and implementing a management plan and efficient water use during the summer months, aiming to meet the irrigation needs of agriculture, the needs of livestock, the needs of residential centers in terms of economic growth and social improvements, ensuring ecological flows to mitigate climate change impacts and adaptation to climate change. In particular, the Shushica, as a main tributary of the Vjosa, which irrigates a considerable surface of flat agricultural lands in the Shushica valley, needs restoration of irrigation infrastructure and pumping stations with mechanical lifting, which have not functioned since 1990.

The regional connections of the Municipality of Selenicë with the coastal area and with several southern municipalities of the country—via national road infrastructure developed in recent years such as the Vlorë–Borsh road, which passes along the Vlorë River, the Pocem–Gorisht road, the Sevaster–Tepelenë road, and Kuc–Progonat—strengthen regional connectivity. The presence of the Vjosa and Shushica rivers has increased opportunities for trade cooperation, circulation, economic development, agriculture, and tourism in the Municipality of Selenicë. Agricultural development and local products will encourage the municipality to exploit its highlighted natural and scenic tourism potential, opportunities for agrotourism development, cultural heritage potential, typical local agricultural and livestock products, and hospitality traditions.

Only through an integrated and coordinated approach, combining infrastructure improvement with technology, education, and efficient management, can the Municipality of Selenicë ensure sustainable agricultural development and address the growing challenges of climate and natural resources. This vision requires long-term commitment and support from all decision-making levels, as well as from the agricultural community itself.

The findings regarding agricultural development and the protection of water resources, the improvement of irrigation systems and infrastructure, and climate change adaptation in this municipality will also be reflected in a strategy of adaptation measures to climate change.

8.2. CONCLUSIONS AND RECOMMENDATIONS ON THE GEOGRAPHICAL AREA, INFRASTRUCTURE AND SUSTAINABLE DEVELOPMENT POTENTIAL

The Municipality of Selenicë is characterized by an economy primarily based on the primary sector, with agriculture and livestock serving as the main sources of income for the majority of its residents. This dependence on traditional activities limits the potential for more sustainable and diversified economic development. The current state of infrastructure and the lack of modern technologies at agricultural collection points result in considerable quality losses of produce and difficulties in accessing broader markets. For this reason, planned investments are needed to modernize existing collection points, including the construction of thermally insulated storage facilities and humidity control systems. These investments will facilitate the storage of products under optimal conditions and extend their shelf life, resulting in a significant improvement in quality and market competitiveness

A key element for economic development in this area remains the road infrastructure, which is currently fragmented and inadequate for the transportation of agricultural goods. The lack of maintained roads and stable connections between administrative units and collection points limits the possibility of efficient transport to regional and national markets. For this reason, the reconstruction and asphalting of connecting roads should be the main priority of infrastructure investments. The use of sustainable construction materials and techniques that ensure longevity and minimize maintenance costs will help establish a functional and reliable road network. This will create a safe and efficient route for the transportation of goods, reducing losses during transit and improving the connection of the Municipality of Selenicë with key markets.

Water supply at collection points and agricultural areas is another technical aspect that requires immediate attention. The existing water supply network is limited and in many areas does not guarantee a stable and sufficient supply to meet production and storage needs. Improving this network, including the repair and expansion of pipelines, installation of high-efficiency pumps, and automatic devices for monitoring water level and quality, will directly impact the increase in agricultural production capacity and the quality of stored products. This will reduce the risk of losses and improve storage conditions at collection points..

Waste management at collection points and in agricultural areas is another challenge that requires technical and operational solutions. Currently, there are no organized systems for the separation, collection, and treatment of organic and non-organic waste, which causes environmental pollution and deteriorates working conditions. Implementing a simple system for waste separation and treatment, including local composting of organic waste, will reduce pollution and create opportunities for further benefits through the use of compost in agriculture. This system should be supported by training and guidance for the staff operating in the collection points, to ensure efficiency and compliance with environmental standards.

To increase efficiency and transparency in the management of collection points, it is recommended to implement a simple information system. This system will enable real-time tracking of the quantity and type of products passing through these points, assist in planning logistical needs, and reduce losses. Furthermore, the information system will facilitate reporting and monitoring of activity, enabling informed decision-making for further investments and development.

Sustainable financing for the maintenance and modernization of collection points is essential for their continuity. The municipality should create mechanisms that enable access to various funding sources, including local funds, national programs, and European Union funds. This requires detailed financial planning and rigorous monitoring of resource use, to ensure that investments are effective and serve their long-term purpose.

In the medium term, the integration of cold chain logistics systems in the transport and storage of fresh products, such as vegetables and high-market-value fruits, should be planned. This will significantly improve the quality of distributed products and expand opportunities for export and trade in regional and international markets. Investment in refrigeration equipment and automated controls will be a necessary step to achieve this goal.

Improvements to road infrastructure, the water supply network, and equipment at collection points should be accompanied by professional training for technical staff and operators managing these services. This will ensure the optimal use of new technologies and proper maintenance of infrastructure, prolonging the lifespan of equipment and improving service quality.

Regarding residential buildings and housing structures within the territory of the Municipality of Selenicë, it is essential that every intervention is carried out by following high energy efficiency standards. This includes the use of thermal insulation materials for walls and roofs, the installation of double or triple-glazed windows with high thermal performance, and the use of efficient heating and cooling systems with reduced energy consumption. Moreover, renewable energy practices are encouraged, such as solar panels for water heating or electricity production for household use. These measures will contribute to lower energy bills for families, improved thermal comfort in homes, and reduced environmental impact of the housing sector in the area.

To increase technical capacities, it is recommended to equip collection points with machinery for cleaning, classifying, and packaging products. This will increase market value and reduce losses during the initial stages of product handling, making the supply chain more efficient.

The use of drip irrigation technologies and automatic soil moisture monitoring systems should be integrated into the agricultural practices of the area. This will increase water-use efficiency and improve production without raising costs.

Storage and transport safety must be improved to withstand climatic and seasonal conditions. The construction of facilities with moisture-resistant structures and climate-controlled transport equipment is necessary for maintaining product quality.

A system for monitoring and technical auditing of infrastructure and processes at collection points should be established, to ensure compliance with standards and identify timely intervention needs.

Infrastructure projects should include measures for resilience to climate change and natural disasters, using sustainable materials and efficient drainage systems to ensure that investments are long-lasting and environmentally friendly.

In accordance with the current capacities and resources of the Municipality of Selenicë, these recommendations are achievable in the short and medium term and can bring noticeable improvements in the efficiency of the collection, storage, and marketing system for agricultural products. Furthermore, these investments will boost the local economy and reduce losses by improving the well-being of residents.

In conclusion, a clear focus on the technical and infrastructural improvement of collection points, roads, and the water supply network, along with the implementation of energy efficiency standards in construction, will lay the foundation for sustainable and competitive economic development of the Municipality of Selenicë. These measures will significantly improve product quality and enable market expansion, contributing to sustainable income growth and improved well-being of the local community.

09
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