International Journal of Agriculture and Environmental Research

ISSN: 2455-6939

Volume: 11, Issue: 01 "January-February 2025"

ANALYSIS OF THE QUALITIES OF THE CLIMATIC, LAND AND WATER ENVIRONMENT FOR THE CULTIVATION OF MEDICINAL AND AROMATIC PLANTS IN THE KOPLIK AREA, MALËSI E MADHE

Adrian Doko[1*], Adri Erebara[1] , Simir Krasniqi[2], Albert Kopali[1]

[1]Department of Environment and Natural Resources, Agricultural University of Tirana, Albania.

[2]Department of Vocational Education, Prizren, Kosovo.

*Corresponding Author

DOI: https://doi.org/10.51193/IJAER.2025.11107

Received: 21 Jan. 2025 / Accepted: 28 Jan. 2025 / Published: 08 Feb. 2025

ABSTRACT

Medicinal and aromatic plants are one of the most interesting advantages for Albanian agriculture and this is due to the fact that in Albania there are hundreds of medicinal and aromatic plants that grow naturally around the country, becoming a source of income for thousands of farming families, but on the other hand also with a high demand for these kind of plants in the world market. These types of plants find use in the pharmaceutical, food and cosmetic industries, while the process of their preparation goes through different stages starting from natural collection, or in plots where they are cultivated, drying in special environments, their selection from unnecessary waste and finally packaging in special bags for their preservation until sale or export. Albania has about 330 different species of medicinal plants that are possible for export with the destination of use in the food, cosmetics and pharmaceuticals industry. The study for qualities of the climatic, land and water environment for the cultivation of medicinal and aromatic plants took place in the Koplik area, Malësi e Madhe, which is located on north of Albania well known for the cultivation of medicinal plants, where sage and lavender are mostly cultivated and other plants in smaller quantities such as rosemary, thyme, etc. The study aims to assess the climatic and physic-chemical parameters of the soil and water in the Malësi e Madhe area and to identify their impact on medicinal plants and to create a more effective management of the area for this kind of plant production.

Keywords: *Medicinal and aromatic plants, ecosystem, climatic parameters, physico-chemical parameters*

ISSN: 2455-6939

Volume: 11, Issue: 01 "January-February 2025"

1. INTRODUCTION

Albania is a country with a geographical extension along the Adriatic and Ionian Seas in the Mediterranean and is composed of a relatively rugged relief that extends throughout its territory (Bernet & Kazazi, 2011). Albania, due to its geographical position, as well as the favorable physical-geographical conditions (geological structure, variety of relief forms, diverse climate, rich hydrographic network, diverse soil types) is ranked among the first European countries for floristic wealth diversity. About 47% of the plant species of the Balkans and 30% of the plant species of Europe grow in Albania (Vangjeli et al., 1997). Its flora includes about 3250 different plant species belonging to 165 families and 910 genera. About 1.1% or 28 species and 150 subspecies are endemic. About 300 species are medicinal and aromatic plants and about 10% of the Albanian flora is occupied by rare species, species at risk of extinction and relict species (Vangjeli et al., 1997). The origin of the Albanian flora is from different places, but the spread is more related to the northern regions than the southern ones. This is also evidenced by the fact that about 25% of them have Mediterranean origin, 22% Balkan origin, 18% European origin, 14% Eurasian origin, 5.5% of the plants are cultivated, 4.5% are cosmopolitan, 4% Euro-Siberian (Ibraliu & Lipman, 2009).

The Shkodra region, the northern part of which is Malesia e Madhe, lies in the northern Mediterranean lowland, northern Mediterranean hilly and northern Mediterranean mountainous climatic zones. Its lowland zone is distinguished by mild winters, while the part of the territory that lies in the Mediterranean mountainous zone is characterized by high levels of precipitation. The Mediterranean lowland zone has an average annual temperature of about 11.1^0C, the Mediterranean hilly zone about 9.3^0C and the Mediterranean mountainous zone, which includes the Albanian Alps, has an average annual temperature of about 5.3^0C. Regarding the precipitation regime, the lowland part (Mediterranean lowland zone) is characterized by a precipitation amount of about 1750 mm, the Mediterranean hilly zone about 1950 mm per year and the Mediterranean mountainous zone with about 2530 mm per year. In the lower area (Shkodra Lake basin) annual rainfall ranges from 1750-2500 mm. In particular years in the lake area, it goes up to 3000 mm per year. The average annual amount of rainfall in the Shkodra area is about 2065 mm. The Shkodra area has a high level of sunny hours, about 2450-2650 hours.

The geographical region of the Malesia e Madhe lies in the northwestern part of Albania. This region is characterized by a stony terrestrial environment, mainly dominated by limestone rocks, dry and bare and influenced by a relatively low level of precipitation. The geographical region of the Malesia e Madhe is protected from the cold winds of the Albanian Alps by the mountain complex that crosses it. This region is located on the shores of Lake Shkodra and the influence of this water mass significantly affects this area to have a climate with hot and dry summers and mild winters accompanied by abundant precipitation.

ISSN: 2455-6939

Volume: 11, Issue: 01 "January-February 2025"

The climate of the Malesia e Madhe is determined by the variety of lowlands, hills, foothills and mountains, by the proximity to the Adriatic Sea and Lake Shkodra. It is characterized by a Mediterranean climate with mild, wet winters and hot, dry summers. On average, 2500 mm of rain falls per year, making it one of the wettest areas of Albania. The coldest month of the year is January, while the hottest month of the year is July. Snowfall is rare, while frosts are usually recorded at the end of the year.

A very important grouping of Albanian vegetation is the aromatic medicinal plants (MAPs) defining them in two groups, aromatic and medicinal, although this division is made more for research purposes as there is no clear boundary between them since there are plants that can be both aromatic and medicinal at the same time (Kutrolli.F. et al) and 90% of aromatic medicinal plants in Albania grow naturally (Papathopuli G., 1976). MAPs make a considerable potential for Albania due to the fact that they have a high ecological, economic, landscape importance and their rational and sustainable use constitutes a natural economic source for the employment of the local population (Pazari, F., 2014).

Figure 1: Location of Malesia e Madhe

The MAPs processing industry in Albania has received special attention during the period 1945-1990, which is reflected in the figures of economic benefits generated by their export. Albania is

ISSN: 2455-6939

Volume: 11, Issue: 01 "January-February 2025"

one of the most important exporters of aromatic and medicinal plants in Europe (Asllani, 2004) and is a major international factor for several products such as sage, oregano and thyme. In some specific markets and market segments, Albanian products are market leaders, as in the case of sage in the USA and thyme in Germany (USAID-AAC). The main part of the MAPs business is realized from wild products. MAPs are found everywhere throughout the country but their collection is more organized in some areas such as Malësia e Madhe, Shkodër, Skrapar, Elbasan, Korçë, Berat, Përmet and Durrës (USAID-AAC). Many wild medicinal and essential oil plants that grow in Albania end up in the French and Italian markets or beyond for the production of perfumes, the German market for the production of creams, and in Great Britain for popular alcoholic beverages (Asllani, 2004).

Hundreds of hectares of cultivated area with MAPs make Albania a leading country in the production and export of these natural resources. The rich biodiversity in Albania represents a significant potential for the development of the MAPs sector which generates around 18 million Euros from exports, listed as the second largest agricultural export sector, accounting for 19% of the country's total exports (INSTAT, 2022). The international market prefers Albania's wild natural plants, which are considered to have exceptional medicinal values. According to data, more than 95% of the MAPs collected or produced in Albania are wild. Their exports have reached over 10 thousand tons, reaching almost 20% of Albania's total agricultural exports (INSTAT, 2022). A small but exponentially growing flow of essential oils has also been recorded. Currently, Albania produces 35-40 tons per year of essential oils, mainly sage, juniper, oregano, thyme and sage (Agroweb, 6 mars 2019).

In some areas of northern Albania (Malësi e Madhe, Kukës and Dibër), the collection and cultivation of MAPs accounts for about 30% - 40% of the income of rural families. Albania is considered the second largest exporter of MAPs in Southeastern Europe, after Bulgaria (Kathe et al., 2000).

Climate is a vital factor for biodiversity. Factors that influence the formation of climate such as latitude, altitude, exposure to the sun, proximity to seas or lakes, affect the content of active ingredients in plants, since the same type of plant can be found in different climatic zones, but their behavior is different (Papathopuli G.,1976). This change in the biological cycle of these plants, depending on climatic factors, also affects the active ingredients they contain, therefore their behavior towards differentiated environmental conditions is different. In general, MAPs in hot areas and at high temperatures are richer in active ingredients than those in countries with cold climates (Papathopuli G.,1976). This usually occurs as a result of a secondary metabolism that is closely related to the plant's survival strategy under stress conditions, which comes as a result of high exposure to UV radiation (Kreft et al., 2002).

ISSN: 2455-6939

Volume: 11, Issue: 01 "January-February 2025"

In some areas of northern Albania (Malësi e Madhe, Kukës and Dibër), the collection and cultivation of MAPs accounts for about 30% - 40% of the income of rural households. Albania is considered the second largest exporter of MAPs in Southeastern Europe, after Bulgaria (Kathe et al., 2000).

It is a very important actor, being the 16th largest exporter of MAPs internationally for 2016. It is also an important supplier in the form of raw material or partially processed for many EU and US industries in different sectors. Almost 3/4 of the sage imported from the US originates from Albania (Skreli & Imami, 2019).

Soil quality is another important factor that affects the growth of MAPs. For most of them, when the active substances are located in underground organs, it is impossible or difficult to cultivate in soils that are considered 'heavy', including clay and rocky soils. Likewise, soils that have a low drainage level and high-water content are soils that make the production of active substances difficult for many plants (Chittendon,1956). Soil composition is a factor that changes the nature and quantity of active plant compounds, this is automatically related to the growth and spread of vegetation types. Permeability, humidity, capillarity and porosity affect soil fertility and productivity (Papathopuli G.,1976). Albania is a country characterized by a variety of soils, which has also influenced the growth of a very large variety of medicinal and aromatic plants, which find suitable conditions for their growth depending on the types of soils they require. Some plants require alluvial soils (nettle), others clay-limestone soils (sage), limestone soils (poppy, blackberry, etc.), stony soils (Spiny Restharrow) etc. (Papathopuli G.,1976).

Essential oil and aromatic medicinal plants constitute the largest part after forage crops in the overall structure of the agricultural area in the territory of the Malësia e Madhe Municipality. They occupy 30% of the agricultural area under cultivation. MAPs are cultivated on about 3,571 ha, spread widely in the Qendër Commune (Koplik lowland) and in the Kastrat Commune. There are about 2 thousand farmers working in this important sector for Albanian exports. The main type of MAPs in Malësia e Madhe has traditionally been cultivated sage. Another autochthonous type of the area is helicrithius, while the climatic conditions are also favorable for the growth of lavender and rosemary.

The MAPs produced in the Malësia e Madhe area are known on the foreign market. Demand is particularly high for traditional sage - valued for its very good quality, thanks to its high content of essential oils; in recent years, demand has also been increasing for mugwort *(Artemisia vulgaris).* The main medicinal and aromatic plants cultivated in the Koplik area are: Sage *(Salvia officinalis L.),* Lavender *(Lavandula angustifolia Mill.),* Helichrysum *(Helichrysum italicum (Roth) Don.),* Oregano *(Origanum heracleoticum L.),* Rosemary *(Rosmarinus officinalis L.).*

ISSN: 2455-6939

Volume: 11, Issue: 01 "January-February 2025"

2. MATERIALS AND METHOD

2.1 Study area

The study area is located in the Mehaj neighborhood on Koplik administrative unit of Malësi e Madhe district which is located at coordinates 42º13'07.9" N / 19 º 26'35.5" E. The total area of the farm is about 10 ha. It is a small business which is known as "Salvia Nord". Its main activity is the production of MAPs, chain (seed-seedling) and products that come from these kind plants. It mainly cultivates sage (6 ha); lavender (1 ha); about 0.8 ha is cultivated with helichrysum italicum and the rest is a nursery and MAPs seed production.

Figure 2: View of the study area

2.2 Analysis of climatic and soil conditions

The necessary climatic data were obtained from the Koplik meteorological station and three main meteorological parameters were analyzed: (a) temperature (average, maximum and minimum), (b) amount of precipitation and (c) sunshine (photoperiod). These climatic parameters are with a determining influence on the quantity and quality of MAPs production. Their performance was compared with the requirements of medicinal plants in this area and mainly with those of sage as the dominant plant cultivation on this area.

Sampling in soil and water

The soil sample was taken at a depth of 0-30 cm from a dark skeletal stony soil, which was planted with sage. After the soil was collected according to the soil sampling procedures, it was dried and later processed and sieved into a fraction <0.5 cm, to be suitable for analyzing physico-chemical parameters.

ISSN: 2455-6939

Volume: 11, Issue: 01 "January-February 2025"

While the water sample was taken from one of the two wells located in the study area, in accordance with the ISO 5667-4 standard. The sample was taken with a polyethylene bottle (1.5 liters). The following information is placed on the bottle: sample code (sample type and number) and the date of sampling. Sample storage and transportation were carried out in accordance with the ISO-5667-3 standard. The sample was sent to the laboratory in a portable refrigerator at 4^{o}C.

2.3 Description of analytical methods used for the laboratory analyses

Soil and water laboratory analyses of the physicochemical parameters were carried out at the Scientific Research Laboratory of the Department of Environment and Natural Resources, Faculty of Agriculture and Environment, Agricultural University of Tirana, Albania.

Methods of analysis of physicochemical parameters in water

Determination of COD-PI: The method specifies the boiling of the sample with a known amount of potassium permanganate with sulfuric acid for a specified period of time, reducing a portion of the permanganate from the oxidizing materials in the sample and determining the consumed permanganate by the addition of oxalic acid, followed by titration with permanganate. This method is applicable to waters having a chloride ion concentration of less than 300 mg/L. Samples having a permanganate index above 10 mg/L should be diluted before analysis.

Determination of pH: For pH measurement, a constant potential reference electrode is placed next to the glass electrode and the potential difference is measured via a potentiometric circuit. The potentiometric apparatus converts the measured potential value into the pH value of the solution. The pH meter also enables the measurement of the electrode potential in the solution in mV.

Determination of N-NH_4: Spectrometric measurement at a wavelength of 655 nm, of the blue compound formed by the action of ammonium with salicylate and hypochlorite ions in the presence of sodium nitrosopentacyanoferrate. Hypochlorite ions are formed in situ by alkaline hydrolysis of N, N'- dichloro – 1,3,5- triazine – 2,4,6- trione, sodium salt. The reaction of chloramine with sodium salicylate takes place at pH= 12.6, in the presence of sodium nitroprusside. Any chloramine present in the sample is determined quantitatively. Sodium citrate is added to the reagent to prevent interferences of cations, mainly calcium and magnesium.

Determination of N-NO_3: Measurement of UV absorption at 220 nm allows a rapid determination of NO_3. Given that dissolved organic matter can absorb at 220 nm and NO_3 does not absorb at 275, a second measurement at 275 nm is performed to correct the NO_3 value. The application of this empirical correction is related to the nature and concentration of the organic matter and may vary in different water samples. The correction factor for organic matter is determined by the addition

ISSN: 2455-6939

Volume: 11, Issue: 01 "January-February 2025"

method combined with the analysis of the NO_3 content by another method. Filtration of the sample is performed to avoid the influence of the matter in suspension.

Determination of P-Total: This method determines the content of total phosphorus in the form of orthophosphates. In a sulfuric solution, orthophosphate ions form molybdate ions of phosphomolybdic acid. This is reduced by ascorbic acid to phosphomolybdenum blue (PMB) which is measured in a spectrophotometer at λ= 880 nm.

Determination of P-PO_4: (ISO 6878, 2004). Ammonium molybdate and potassium antimonyl tartrate react in an acidic medium with orthophosphate ions and form phosphomolybdic acid which is reduced to blue molybdenum under the action of ascorbic acid. The absorbance is measured within 10-30 min at a wavelength of 880 nm and the concentration of orthophosphates present is determined.

Methods of analysis for physicochemical parameters in soil

Determination of dry weight and moisture: (prEN 15935, 2010). The dry weight of the soil and the water content are determined as follows: the soil sample is dried at 105°C ± 5°C for 24 h. Then the sample is quickly placed in a glass desiccator for cooling to avoid moisture. After cooling, it is weighed at room temperature to obtain the dry weight.

Determination of pH: The pH is measured in the suspension of the test portion which is prepared in the ratio 1 to 5 in water or 0.01M $CaCl_2$ solution.

Determination of organic matter: In the soil it was carried out by the method (Walkley A, & Black IA). The method is based on the oxidation of organic matter by potassium dichromate ($K_2Cr_2O_7$) in a mixture with sulfuric acid H_2SO_4 followed by oxidation of ammonium ferrous sulfate (Fe $(NH_4)2(SO_4)2$ x $6H_2O$.

Determination of N-total: (DIN EN 16169, 2011-2012). Most of the organic matter is oxidized by H_2O_2 at relatively low temperatures. After decomposition of excess H_2O_2 and evaporation of water, the combustion is completed with H_2SO_4. At about 330°C under the action of a catalyst.

Determination of NO_3-: (Keeney DR, & Nelson DW). Nitrates were determined with a spectrophotometer after extraction of NO_3- from the soil by means through the potassium chloride KCL.

Determination of P-Total: (Taylor & Francis Group). After microwave combustion in the presence of nitric acid (HNO_3), it was analyzed in a spectrophotometer using the colorimetric method.

3. RESULTS AND DISCUSSIONS

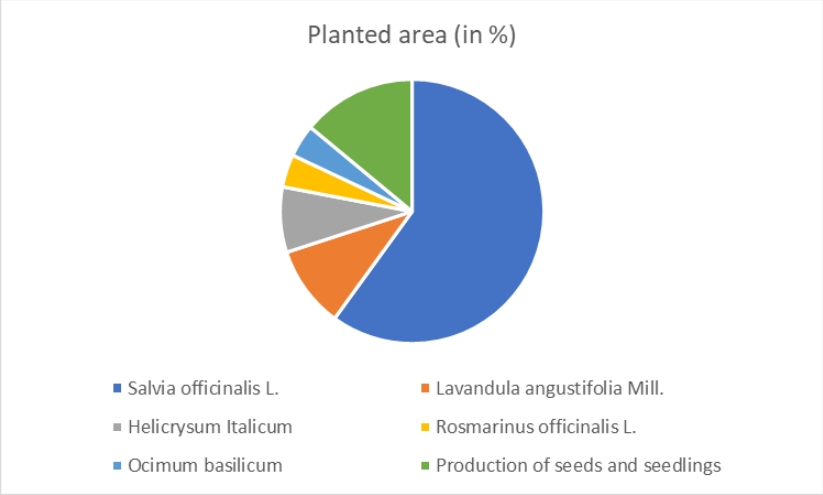
ISSN: 2455-6939

Volume: 11, Issue: 01 "January-February 2025"

3.1 Cultivation of medicinal and aromatic plants in the Koplik area (Malësi e Madhe)

Although the number of MAPs that are naturally collected and cultivated has increased in recent years, despite the fluctuation in prices in recent years, the area of cultivated sage *(Salvia officinalis L.)* has stabilized at 2000-2300 ha since the demand for it in the international market has not decreased at any time. However, in recent years, helichrysum *(Helicrysum Italicum)* has become widespread in this area, which resembles the nightshade of our areas, but which originates from the Sardinia area in Italy with very high essential oil values (neryl acetate).

In the Malësia e Madhe area, it is evident that the largest part of the land surface is used for the cultivation of MAPs, where sage *(Salvia officinalis L.)* occupies the main place with 60%, then followed by lavender *(Lavandula angustifolia Mill.)* with 10%, helicristium *(Helichrysum italicum)* with 8%, other plants such as rosemary *(Rosmarinus officinalis L.)* with 4%, basil *(Ocimum basilicum)* with 4%, and 14% of the surface is used for the production of MAPs seeds and seedlings.



Graph 1: Medicinal and aromatic plants according to the percentages they occupy in the Malesia Madhe area

3.2 Climatic, land and water conditions of the study area

3.2.1 Climatic characterization of the Malësia e Madhe area

The Malësia e Madhe area, since it has a relatively considerable extension, from a climatic point of view it is divided into several subzones such as the Mediterranean lowland zone, the Mediterranean hilly zone, the Mediterranean pre-mountainous zone and the Mediterranean mountainous zone. From a climatic study point of view, regarding the cultivation of MAPs, the

ISSN: 2455-6939

Volume: 11, Issue: 01 "January-February 2025"

greatest interest is the Mediterranean lowland zone where their cultivation is also more concentrated. Other areas are of interest for the collection of MAPs in nature. The Koplik area is part of the north-eastern region of the country with a generally hilly-mountainous relief. It lies in the north of Albania, bordered to the east by Shkodra and Lake Shkodra and the rest by Montenegro. The region is located at the following geographical coordinates: Latitude 42° 13' 28" and Longitude 19° 28' 6", and the altitude above sea level is 146 m.

Mediterranean Lowland Zone. It is one of the climatic zones that extends from the coast of the Adriatic Sea and continues along the entire eastern shore of Lake Shkodra. It is divided into two subzones:

(i) The Velipoja Valley subzone which has an altitude of 1-35 m, with typical sandy soils and a generally mild climate in winter with average temperatures ranging from 12 - 13 ºC, while in summer 26-28 ºC. In this area, about 1400 mm of precipitation falls per year, mainly concentrated in the second half of autumn and winter.

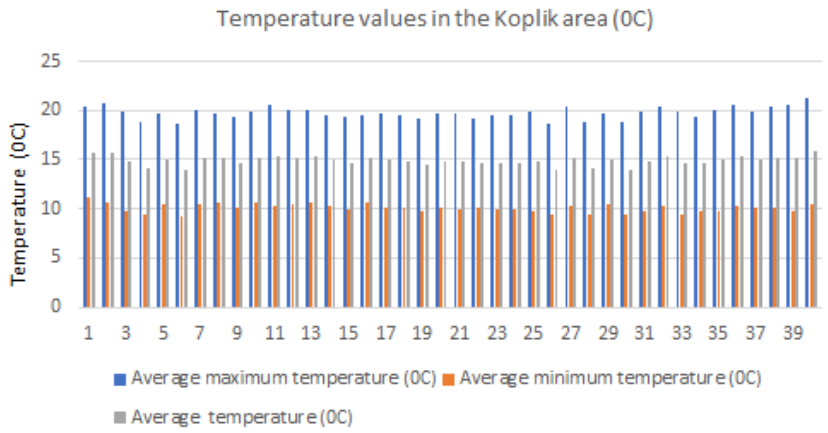
(ii) The second sub-zone extends north of the Velipoja valley and along the entire eastern shore of Lake Shkodra. It has an altitude of 35-595 m above sea level, culminating in Mount Tarabosh at 595 m. It consists of limestone and dolomite rocks. The soils are alkaline in pH (7.8-8.2). Average temperatures in the coldest months of the year are not lower than 10-11ºC, while in the summer months 24-27 ºC. Average annual rainfall is over 1600 mm of rain per year. Sunshine reaches over 2000 hours per year following the temperature curve. This area presents the greatest climatic suitability for the cultivation of sage, but also other medicinal plants with a smaller spread.

In order to have the most representative data, multi-year data on the average maximum monthly temperatures, the average minimum monthly temperatures, the average monthly temperatures, the minimum and maximum temperatures recorded for each month for the last 40 years were taken into analysis. The analysis results that temperatures show a gradual increase, reaching a maximum during the months of July and August of each year and a gradual decrease towards the winter months. It is precisely during the summer months and especially during July-August that it is also accompanied by minimal precipitation.

During this multi-year period (40 years), the lowest temperature was recorded -12 ^{O}C on January 8, 2017, as well as the maximum temperature +42.2 ^{O}C on August 8, 2012. The number of frost days for the 40 years is 30.5 days on average per year, of which over 70% of them were observed during the months of January-February of those years. Average maximum temperatures above 30°C are recorded during the months of June-July-August-September with their peak usually reached in July at 37.6°C.

ISSN: 2455-6939

Volume: 11, Issue: 01 "January-February 2025"



Graph 2: rend of average maximum, minimum and average temperature in the Koplik area

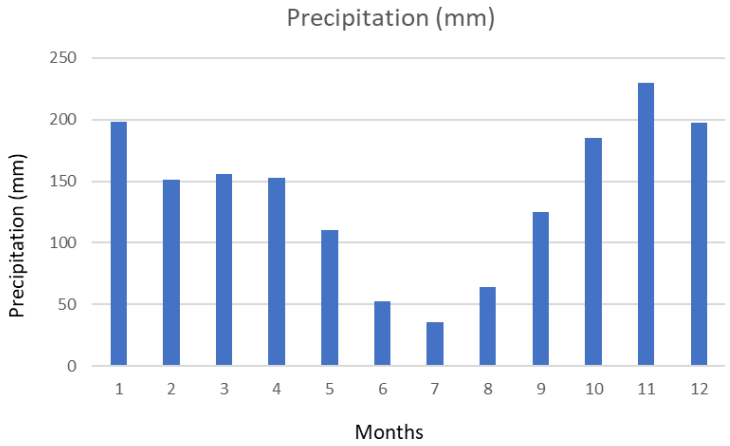
The average maximum temperatures go up to +39.5^{0}C, while the average monthly minimum temperatures drop to +1.3^{0}C in July and December, respectively. The lowest minimum temperature recorded throughout the year is -6.1^{0}C verified in January, but there have been special years when temperatures have dropped to -12^{0}C in January, while the highest maximum temperature is +39.8^{0}C. But there are also years with a high number of frost days that go up to 41 days. These data that come from the analysis of the climatic regime of the Koplik area should be taken into account in the technologies of MAP cultivation.

Rainfall precipitation is one of the most important factors in the cultivation of a crop in a certain area and when it comes to the cultivation of MAPs, they take on special importance since they are plants that are generally not irrigated. During the months of the year there are fluctuations in the amount of precipitation, during the months of July and August of each year these values are in most cases almost 0 mm of precipitation.

The average precipitation for the multi-year period is 1764.2 mm, this average value of the 40 years under consideration, with months without precipitation or even with 444 mm of rain recorded in a single month. But there are also years with a minimum amount of annual precipitation where e.g. in 2015 only 934.7 mm were recorded, or years with maximum precipitation (2010) with an amount of 2366.5 mm or 2.5 times more precipitation compared to the year with less precipitation. This would be enough to understand that there is a distribution that goes in the opposite direction to the needs of the plants.

ISSN: 2455-6939

Volume: 11, Issue: 01 "January-February 2025"



Graph 3: Multi-year average monthly rainfall in the Koplik area

The number of hours of sunshine during a year is over 2227 hours. January and December are the months with the lowest sunshine with 84.8 and 79.5 hours of sunshine respectively, while immediately afterwards, starting from February, the hours of sunshine increase, reaching their peak in July with 322.4 hours. Although it follows the temperature trend from one month to the next, reaching its peak in July-August, the sunshine is not high. It does not always favor the normal growth of sage plants and other medicinal plants.

Lands with a southern and southwestern orientation, the plants are more developed and have a higher content of essence. The opposite occurs in hilly areas facing north and northeast where in any case, according to observations and data from farmers, s observed a lower development and lower flowering and fruiting of different MAPs. Therefore, it is preferable to plant MAPs where the sun exposure is mainly better and more direct and with a high degree of exposure.

3.2.2 Soil conditions

The study was conducted on stony soils (with 10% to 30% stones) in Koplik, Shkodër, an area in which MAPs have been cultivated since the 1960s, mainly lavender, thyme and sage.

There are shallow soils with stone content and drainage. Only the area near the lake has fresh and wet soils that often cause the thinning of the sage plant due to the humidity that the soil has for a long period. The soils on which the experiment was set up, however, are typical stony soils of Pustopoja field. They contain 10 – 30% stones. In the field in which the sampling was carried out, soil samples were taken at several points, diagonally, separately in the 0-10 cm, 11-20 cm and 21-30 cm layers.

Results of the analysis of the terrestrial and aquatic environment in the Koplik area

ISSN: 2455-6939

Volume: 11, Issue: 01 "January-February 2025"

From the analysis of the soil samples, taken according to the established methodology, the values of the physico-chemical parameters result as follows.

Table 1. Results of the physico-chemical parameters in the terrestrial environment

Code	pH	$N\text{-}NO_3$	$N\text{-}NH_4$	N tot	P tot	Organic Matter
	pH unit	mg/Kg	mg/Kg	mg/kg	mg/kg	%
T1	8.08	4.92	5.34	1514.2	1231	3

From the analysis of laboratory results of soil samples results that the pH level is sub-basic (8.08) and is around normal values with a tendency to increase its values. Knowing that pH is an important indicator that affects the mobility of chemical elements in the soil, it is verified that it has little impact from the technologies of cultivation of MAPs such as sage, lavender, oregano, etc.

Electrical conductivity is at average values.

Regarding nitrogen and phosphorus, it resulted that: total nitrogen has a value of 1514.2 mg/kg and total phosphorus has a value of 1231 mg/kg. These values indicate a healthy soil environment. From the analysis performed, it is seen that the value of the nutrient elements (macroelements) N and P is around normal agronomic concentrations.

Regarding the organic matter content, it results in relatively high values (3% of dry matter), which indicates that the technology of cultivation of these medicinal plants has positively affected the soil environment. Regarding the above, the state of the studied soil in the monitoring area varies from neutral to weakly basic in reaction, average to rich in organic matter, nitrogen and phosphorus assimilable by plants. The differences between soils are not only related to the natural conditions of their formation and evolution, but also strongly depend on the technologies used in the cultivation of medicinal plants and in particular on the fertilization with macroelements.

The soils condition of the farm where the sampling was done are medium in nitrogen, medium in phosphorus and poor in potassium. They are comparatively rich in calcium, an element that sage requires in greater quantities than other medicinal and aromatic plants.

The calcium content also affects the content of the essence and has a direct relationship with it. This seems to be one of the reasons for the high content of essence in plants cultivated in this area, since it is found that exchangeable Ca^{++} (ppm) is at high levels.

Based on the analyzed indicators and comparing them with the standards, we can say that the quality of the soil in this area is of good quality, which indicates a relatively low level of inputs

used. The high level of organic matter indicates that organic fertilizers are used more in cultivation technologies. Added to this is the fact that in the established standards and in the cultivation technologies of MAPs, based on the required quality of the products, the use of synthetic chemical inputs is not allowed.

The determination of the trend of the state of soil quality was made by referring to other previous studies DAME, (UBT, Monitorime Janar – Dhjetor, 2015), on the basis of which it was possible to compare the analyzed indicators to determine their trend.

In addition to analyzing the terrestrial environment in the study area, according to the objectives of the study, the aquatic environment was also analyzed. Based on the study methodology, defined above, water samples were taken and analyzed in the laboratory. The results of the physico-chemical parameters in water are given in table 2.

Table 2: Results of the physico-chemical parameters in water

Code	pH	Ec	$N\text{-}NO_2$	$N\text{-}NO_3$	$N\text{-}NH_4$	N tot	Ptot	$P\text{-}PO_4$	O_2	COD	BOD	TSS
	pH unit	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
M1	7.7	419	0.0055	3.51	0.051	3.586	0.14	0.043	5.43	1.36	<1	ld

From the analysis of the values of the mentioned parameters, it results that the pH is around normal values, not affecting the growth and development of plants. While the values of the nutrient elements N and P are at low levels, which indicates that there is no high level of their infiltration from the cultivation environments into the aquatic environment.

From the analysis of the indicators obtained for the assessment of the state of the aquatic environment, we note that they are at normal values, which indicates good water quality.

It should also be noted that, referring to other studies conducted in the Malesia e Madhe area, the results of the physico-chemical parameters of both the soil and the quality of the water used in agriculture are at the same levels as those found in the aforementioned analyses.

4. CONCLUSIONS

From the study conducted to analyze the climatic conditions, physical-chemical parameters of soil and water as well as the state of the environment in the Koplik area (Malësi e Madhe) it results that this area is characterized by a suitable climate for the cultivation of medicinal and aromatic plants.

Based on the analyzed indicators and comparing them with the required MAPs standards, we can say that the state of the land environment in this area is of good quality and quite suitable for the

cultivation of MAPs. Also referring to the data on the quality of the water used, it results that the main indicators of their quality are in normal values, which indicates a good quality of the water used for agricultural purposes in this area.

Referring to the information obtained not only in cultivated lands but also in the natural habitats of the populations "Veliopja", "Taraboshi" and "Hoti", it results that there is a higher number of plants and better development has plants with a south, east and west orientation, despite such recorded temperatures and the lack of rainfall.

Also referring to climate change and the concerns that they bring to the cultivation of MAPs in this area, it results that in years with extreme climatic conditions, such as the heat waves particularly verified in recent years, there has been drying of plants in many cultivated areas. Therefore, adaptation to these changes requires special attention both in terms of aspects of cultivation technology as well as the adaptation of good agricultural practices suitable for this purpose.

Consider discussing modern cultivation technologies, such as irrigation systems, climate-resilient farming practices, or innovative processing methods. It is recommended that farmers use best agriculture practices, especially in the context of climate change, which is greatly affecting the cultivation activity of MAPs farmers.

The Malesia e Msadhe area is a very important area for the cultivation of MAPs, not only for Albania but also for the Western Balkans. There is a need to deepen research in technology, but also in genetic studies of MAPs, sustainable harvesting practices, or alternative uses of MAPs in diverse industries.

REFERENCES

[1]. Lila, A. Kacani, R. Ndreu, N. Alku., FKPKKSH.,"Bimet mjeksore e aromatike dhe teknika e kultivimit te tyre", Thesari i gjelber., mars 2014, fq.1-2.

[2]. Abazi S., Taraj K., (2011), "Avantazhet dhe kufizimet e metodës së ekstraktimit me CO2 nënkritik në krahasim me metodat tradicionale të ekstraktimit të bimëve medicinale dhe aromatike", Fakulteti i Shkencave Natyrore, Universiteti i Tiranës, Bulevardi Zogu i Parë, Tiranë, Albania, Reviste Shkencore e Institutit Alb-Shkenca, ISSN 2073-2244, 1: 48 – 54.

[3]. Abdurramani, Sh.: Studimi i variacionit të rigonit për disa tregues morfologjikë dhe të prodhimit në disa saite tipike të rrethit të Beratit. Mikrotezë, Tiranë 2011.

[4]. Asllani U. "Esencat e bimëve aromatike të Shqipërisë" Tiranë 1994.

[5]. Asllani U., (2000), "Chemical Composition of Albanian Sage Oil, Salvia officinalis L". Franz C., (1993), "Genetics. Volatile Oil Crops: Their Biology, Biochemistry and Production", Hay RKM & ËatermanPG.

[6]. AULEDA (Local Economic Development Agency), (2010) "Bimët medicinale dhe aromatike, burim për zhvillim të qëndrueshëm, Projekti ―Mbështetje fermerëve për kultivimin e bimëve medicinale në zonën e Lumit të Vlorës", Vlorë. SNV Albania, The Netherlands Development Organisation: Establishment of Albania Rural Organizations Network, Tiranë, 2012-2013.

[7]. Bardhi N. , etj.: "Bimët aromatike e mjekësore", Leksione. Tiranë, 2010.

[8]. Barolli, A. Shehu, A. Plaku, F. Salillari, A.: Study of Variation of Sage Plant (Salvia 106 Officinalis) based on Some Morphological Key Indicators in Southern Regions of Albania, Journal of Agricultural and Animal Production Science for Rural Development. Vol. 1, No. 2, pp. 51-56, Tiranë, 2011.

[9]. Bernet T., Kazazi S., (2011), "Organic agriculture in Albania", fq 7-8.

[10]. Canter PH., Thomas H., Ernst E., (2005), "Bringing medicinal plants into cultivation: opportunities and challenges for biotechnology", TRENDS Biotechnol 23(4):180–185.

[11]. Catizone P., Marotti M., Toderi G., Tétény P., 1986 – Coltivazione delle piante medicinali e aromatiche. Patron Editore, Bologna, pag. 253-258.

[12]. Climate and climate change data for Albania SHUKALB, (2014), Ëater Supply and Seëerage Utility of Albania (FB11) Tirane.

[13]. Çeku. K., Koni.H., Sahatçiu.L., Balla. K.: "Teknologjia e bimëve eterovajore e mjekësore".

[14]. Çeliku. N. "Studimi i borzilokut në Shqipëri" . Disertacion. Tiranë 2017.

[15]. DODA. Q. " Aspekte teknologjike dhe të përmbajtjes së esencës tek sherebela në rrethin e Dibrës". Disertacion. Tiranë 2015.

[16]. Dervishi-Shengjergji D., Papajani V., Nuro A., Ninga E., (2014), Analyses of Volatile Components of Albanian Vitex Agnus Castus L. Fruits, Albanian j. agric. Sci, 14-17.

[17]. Drejtoria Rajonale e Statistikave Shkodër, 2013.

[18]. Drejtoria Rajonale e Bujqësisë, Shkodër, 2015

[19]. Duke JA., (2007), "Medicinal plants of the Bible", CRC Press, Atlanta, 488 pp

[20]. F.Kutrolli, J.Ukaj. Manual në ndihmë të mbledhësve, grumbulluesve, ekspertëve e trainerëve të bimëve mjekësore e aromatike të Shoqatës AgroPuka. 2008.

[21]. GIZ 2015-sq-portfolio- albanien. "Ruajtja e Agrobiodiversitetit në Shqipërinë Rurale (CABRA)".,2015, pg.1-3.

[22]. Good Agricultural and Collection Practices for Medicinal Plants Food And Agriculture Organization Of The United Nations, (2010), Neë Delhi, India, fq 1-5.

[23]. "Guidelines for Good Agricultural and Ëild Collection Practices for Medicinal and Aromatic Plants", (2010), (GACP-MAP) EUROPAM, the European Herb Growers Association Brussels.

[24]. Gunther RT., (1959), "The Greek herbal of Dioscorides", Hafner Publishing Company, New York Lee MR, 41(1):78–84. doi:10.4997/JRCPE.2011.116, 1959.

ISSN: 2455-6939

Volume: 11, Issue: 01 "January-February 2025"

[25]. Gjoni.Z.: "Vjelja dhe grumbullimi i bimëve mjekësore të Dibrës".
[26]. Hornok L., 1992 - Cultivation and Processing of Medicinal Plants. John Wiley & Sons, pag. 210-213.
[27]. Ibraliu A., Lipman E., (2009), "An overvieë of the flora and genetic resources of medicinal and aromatic plants in Albania", Report of a Working Group on Medicinal and Aromatic Plants. fq.4.
[28]. Ibraliu A. "An overview of the flora and genetic resources of medicinal and aromatic plants in Albania". Report of a Working Group on Medicinal and Aromatic Plants. Lipman E, 2009.
[29]. INSTAT, Drejtoria Rajonale e Statistikave Shkodër
[30]. INSTAT, Web Atlas, Census 2011
[31]. Kathe A., Honnef S., Heym A., (2000), "Medicinal and Aromatic Plants in Albania, BosniaHerzegovina, Bulgaria, Croatia and Romania", Bonn, Germany, fq.40.
[32]. Kullaj E., Liçaj F., (2013), "Albania's natural heritage of medicinal and aromatic plants. Monograph description of 40 medicinal and aromatic plant species and their importance for the livelihoods of mountain communities in Albania), GIZ, fq 79-81, 92-93.
[33]. Lee MR., (2011), "The history of Ephedra (ma-huang). J R Coll Physiçians Edinb 41(1):78–84. doi: 10.4997/JRCPE.2011.116
[34]. Lev E., (2008), "Ethnopharmacology in Israel and neighboring countries", In: Pretorius R (ed) Trends and developments in ethnopharmacology. Research Signpost, Kerala, fq 35–71.
[35]. Manual në kuadrin e Programit për Zhvillimin Ekonomik Rajonal «ËIRAM», të financuar nga Ministria Federale Gjermane për Bashkëpunim Ekonomik dhe Zhvillim (BMZ) dhe i zbatuar nga GTZ (Shoqëria Gjermane Bashkëpunimit Teknik).
[36]. Mathe A., (1994), "Utilization of biodiversity in horticultural crops", Scientific Theses, degree Doctor of the Hungarian Academy of Sciences, Budapest.
[37]. Mathe A., (2015), "Medicinal and Aromatic Plants of the Ëorld, Part I", Faculty of Agriculture and Food Science, University of West Hungary, Hungary, Springer Dordrecht Heidelberg New York London, pp 102-105.
[38]. Mathe A., (2015), "Medicinal and Aromatic Plants of the World", Faculty of Agriculture and Food Science, University of West Hungary, Hungary, Springer Dordrecht Heidelberg New York London, fq 67-70.
[39]. Ministria e Bujqësisë, Zhvillimit Rural dhe Administrimit të Ujrave (sipas ATSH), 2015
[40]. Mullaj, A.:"Aspekte fenologjike të bimësisë mesdhetare"-Punime të I. K. Biologjike, Nr.9,1994, fq. 36-39.
[41]. Papathopuli G., (1976), "Bimët mjekësore dhe aromatike të Shqipërisë", fq.5, Tiranë.

[42]. Pazari F., (2014), "Vlerësimi ekonomik dhe ekologjik i bimëve mjekësore dhe aromatike të Shqipërisë në funksion të zhvillimit të ekonomisë rurale", Tiranë.

[43]. Palevitch D., Yaniv Z., (2000) "Medicinal plants of the holy land", Modan, Tel-Aviv, fq 358

[44]. Palevitch D., Yaniv Z., (2000), "Medicinal plants of the holy land", Modan, Tel-Aviv, fq 358.

[45]. Parimet bazë në kultivimin e bimëve mjekësore. Perspektiva për kultivimin e bimëve mjekësore dhe aromatike në Bullgari.

[46]. Programi i Zhvillimit Rural 2014 – 2020, (2015), "Instrumentit të Asistencës së Parazgjerimit (IPA)", Ministria e Bujqësisë, Zhvillimit Rural dhe Administrimit të Ujërave. Ministria e Bujqësisë, Ushqimit dhe Mbrojtes së Konsumatorit, 2012 AFI, Përmirësimi i performancës së sektorit te BMA, fq 1-2.

[47]. Savnur HV., (1984) Ayurvedic materia medica: principles of pharmacology and therapeutics. Sri Satguru Publications, Delhi; Lev E., Amar Z., (2000) "Ethnopharmacological survey of traditional drugs sold in Israel at the end of the 20th century", J Ethnopharmacol 72:191–205.

[48]. Skreli E., Imami D., (2019), "Studim për sektorin e bimëve mjekësore dhe aromatike", Programi i Mbështetjes së Agrobiznesit Shqiptar (AASF), Instituti i Studimeve Ekonomike dhe Transferimit të Njohurive, Tiranë.

[49]. Stevanovic Z., Pecinar I., Kresovic M, Vrbnicanin S., Lj T., (2008), "Biodiversity, utilization and management of grasslands of salt affected soils in Serbia", Community Ecol 9:107–114.

[50]. Vangjeli J, Ruci B., Mullaj A., (1997), "Libri i Kuq", fq 5.

[51]. Vangjeli, J.: "Udhëheqës Fushor i Florës së Shqipërisë" IKB, Akademia e Shkencave të Shqipërisë, Tiranë 2003.

[52]. Vender C., 2001 - Salvia (*Salvia officinalis* L.): produzione e qualità. Atti del Convegno: La biodiversità vegetale del Pollino come opportunità di sviluppo. Cersosimo (PZ) 16-17 giugno 2000, pag. 75-82.

[53]. Vines G., (2004), "Herbal harvests ëith a future toëards sustainable sources for medicinal plants", Plantlife International, fq 4-7, (www.plantlife.org.uk).

[54]. Vjelja në Natyrë e Bimëve Aromatike Material Trajnimi, Prodhimi Organik i Bimëve Aromatike në Shqipëri, 2008

[55]. Yaniv Z., Dudai N., (2014), "Medicinal and Aromatic Plants of the Middle-East", Volume 2, University of West Hungary, Faculty of Agriculture and Food Sciences, Springer Science, Business Media Dordrecht, fq 4-8.

[56]. Yaniv Z., Bachrach U., (2005), "Handbook of medicinal plants", The Haworth Medical Press, New York.

ISSN: 2455-6939

Volume: 11, Issue: 01 "January-February 2025"

[57]. INSTAT (2022) https://www.instat.gov.al/

