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Deliverable 4.5.2	**"Mapping and valuation of biodiversity services in peri-urban forest"**

BIOPROSPECT: Conservation and sustainable capitalization of biodiversity in forested areas

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Deliverable Title: 4.5.2. "Mapping and valuation of biodiversity services in peri-urban forest"

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VERSION HISTORY

Version	Completion date	Modifications
Version 1	14.06.2019	Number and selection of ecosystem services – 1st draft version of the Report
Version 2	20.06.2019	Adapt the actual GIS datasets of the maps (raster/vectors) according to the common methodology
Version 3	25.08.2019	Final report

ABBREVIATIONS

Term	Explanation
ES	Ecosystem services
EES	Environmental ecosystem services
NBS	Nature-based solution
CICES	Common International Classification of Ecosystem Services
C	Carbon
MA	Millennium Ecosystem Assessment
TEEB	The Economics of Ecosystems and Biodiversity
NAPFO	National Association of Private Forest Owners
PENF	Public Enterprise National Forests
PE Pastures	Public Enterprise for Management of Pastures
NP Mavrovo	National Park Mavrovo
HAN	Hunting Area Number
HMP	Hunting Management Plan
AH/SQ	Annual hunting/shooting quota
BF	Basic Fond
TGF	Total Game Fond
TFV	Total Fund Value
UP	Unit Price
TMVSA	Total Monetary Value of the Shooting Quota
TMVHA	Total Monetary Value of the Hunting

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Foreword

This document provides all related information of the report for "Mapping and valuation of biodiversity services in peri-urban forest". In the report are located the description of the study area (Municipality of Vrapchisht), applied methodology and methods used for collection of data, which were necessary for analyzing and writing the results and conclusions part of working package 4, more specific activity 4.5.2 of the BIOPROSPECT project.

Executive Summary

Creation of the report "Mapping and valuation of biodiversity services in peri-urban forest" is one of the most important document necessary for valuation of biodiversity. It is a starting point for many further activities for Municipality of Vrapchisht in regards to biodiversity and nature conservation.

Although the report follows the common methodology and methods for valuation and mapping of ecosystem services additionally this report is the first report in Republic of North Macedonia created with such comprehensive approach. The report is consisting of 6 Sections which are closely connected and integrated among themselfs.

Section 1 or Introduction provides information about the classification of ecosystem services following the CICES classification which is the most relevant for ecosystem services and accepted by the partners of the BIOPROSPECT project.

Section 2 – Methodology and methods is developed in a descriptive, explanatory and exploratory way. Descriptive because describe the categorization of ecosystem services (provisioning, regulatory and cultural) and also describe the current situation within the study area. Due to the fact that the methods and methodology were commonly agreed among the partners in the report were explain which data were necessary to be collected and the way of analyzing them following the common project approach. Considering that this research is the first in the country in the report was implemented exploratory approach in order, the approach to be replicable in other parts, regions, municipalities, national parks within the territory of Republic of North Macedonia.

In Section 3 are located the results. In total 12 ecosystem services were mapped and valuated. Seven (7) ES from provisioning group of ecosystem services (milk production, meat production, forage production, wild animals, timber production, water supply and ground water for drinking; three (3) ES from regulatory (carbon storage, air purification and soil erosion) and two (2) from cultural ES (cultural heritage and nature photographers). The values and maps are provided per each type of ecosystem service.

Section 4 is dedicated for conclusions. Based on the values the recommendation for further activates were provided.

Section 5 is listed all relevant and utilized references-literature review which can help to other in allocating appropriate literature.

Section 6 Annexes are presented the reports from workshops and consultation process with relevant stakeholders, list of churches, mosques and archeological sites, calculations for valuation of ecosystem services, policy analysis (explanation of the Law on Forests) necessary to be considered for calculation of ES and monetary values of some costs per ecosystem service.

1 INTRODUCTION

The 'ecosystem services' term can mean different things to different people. From one side this can be considered as an advantage, because it can engage people in new conversations about the importance of biodiversity and the environment. In this regards 'ecosystem services' might be thought of as a boundary object, that is, an idea that can be adapted to represent different perspectives while retaining some sense of continuity across these different viewpoints (Abson et al., 2014). On the other side the multi-faceted characteristic is a disadvantage once we come to measure and monitor these things called services: if we cannot agree what they are then people will not believe what is said about them or act on the evidence we collect. These problems of definition are amplified once we start to make a case for valuing or managing ecosystem services (Ojea et al., 2012). Conventional urban greening management primarily aims at enhancing amenity values (Pandit et al., 2013) and maintaining biodiversity (Llausàs and Roe, 2012), but growing interest has been focusing on carbon (C) management perspectives (Grimm et al., 2008) and other environmental ecosystem services (EES) in the priority area of Nature-Based Solutions (NBS).

Ecosystem services (ES) are defined as benefits that humans obtain from ecosystem functions (De Groot et al., 2002), or as direct and indirect contributions from ecosystems to human well-being (TEEB 2010). Many types of ecosystems services have been identified and grouped into three (provisioning, regulating, and cultural services, Maes et al. 2016) or four categories (the former three, plus supporting services, TEEB 2010). Overall the most important thing is what we all already know what people are 'getting at', namely the importance that nature has for people. The significance lies in the facts if we want to understand how ecosystems provide benefits to people, we need a way in which the ecosystem services that can be analyzed.

For analyzing we need definition, categorization, valuation and mapping. The evolving nature of the science of ecosystem services and the way it is practiced, together with a field that brings together a range of disciplines, each with their own terminology, means that the design of a classification system that meets all needs is a major challenge. The development of Common International Classification of Ecosystem Services (CICES) illustrates many of the issues involved, and the fact that we must probably think of the creation of a classification system as a process rather than a design problem that can be solved in a single step.

It is very important to point out that CICES was created through a consultative process, initially as part of the efforts to design integrated environmental and economic accounting systems, with further involvement of the broader ES community take involvement. A main goal in 2009 when the process started was creation of system that will be related and connected to the already used terminology and to be applicable for wider utilization. Therefore the starting point for CICES was used the typology of ecosystem services suggested in the Millennium Ecosystem Assessment (MA, 2005), and adopted and integrated

with the issues identified in the wider scientific research literature. Ecosystems (forests, mountains, wetlands, agricultural land, freshwater) provide a variety of services that are economically valuable: fresh water supply for human settlements (e.g. by filtering water from contaminants); irrigation and power generation; or storm protection and pollination.

Ecosystem services within CICES are grouped into three main categories:

1. Provisioning services (the products obtained from ecosystems such as food and fresh water);
2. Regulating services (the benefits obtained from the regulation of ecosystem processes such as air quality and pollination);
3. Cultural services (the non-material benefits that people obtain such as spiritual enrichment, recreation and aesthetic experiences) that directly affect people. The provision of such services might require communities living in the proximity of the ecosystem to undertake or not to undertake certain activities.

The first fully operational version CICES (V4.3) was published in 2013. On the basis of the experience gained since then by the user community, its structure and scope has been reviewed, and a fully revised version (V5.1) is available.

At the highest or most general level are the three familiar categories used in the MA: provisioning, regulating and maintenance, and cultural. Below these major 'Sections' in the classification are a series of 'Divisions', 'Groups' and 'Classes'. Diagram 2 shows the way in which the hierarchical structure works for Provisioning Services. In addition will be shown the "Definition of the major categories of ecosystem services used in the CICES "Version 4.3" Classification (after Haines, Young, and Potschin, 2013) also defined in CICES V.5.1 which categorizes ES into:

1. **Provisioning:** All nutritional, material and energetic outputs from living systems. In the proposed structure a distinction is made between provisioning and material outputs arising from biological or organic materials (biomass) and water. Materials can include genetic structures. The Division for energy makes a distinction between biomass based energy sources, where the organic material is consumed (e.g. fuel wood) and power provided to people by animals.
2. **Regulating and Maintenance:** All the ways in which living organisms can mediate or moderate the ambient environment that affects human performance. It therefore covers the degradation of wastes and toxic substances by exploiting living processes. Regulation and maintenance also covers the mediation of flows in solids, liquids and gases that affect people's performance. as well as the ways living organisms can regulate the physico-chemical and biological environment of people.
3. **Cultural:** All the non-material, and normally non-consumptive, outputs of ecosystems that affect physical and mental states of people. Cultural services are primarily regarded as the physical settings, locations or situations that give rise to changes in the physical or mental states of people, and whose character are fundamentally dependent on living processes; they can involve individual species, habitats and whole ecosystems. The settings can be semi-natural as well as natural settings (i.e. can include cultural landscapes)

providing they are dependent on in situ living processes. In the classification we make the distinction between settings that support interactions that are used for physical activities such as hiking and angling, and intellectual or mental interactions involving analytical, symbolic and representational activities. Spiritual and religious settings are also recognized. The classification also covers the 'existence' and 'bequest' constructs that may arise from people's beliefs or understandings.

BIOTIC ecosystem outputs		
Section	Division	Group
Provisioning (Biotic)	Biomass	Cultivated terrestrial plants for nutrition, materials or energy
Provisioning (Biotic)	Biomass	Cultivated aquatic plants for nutrition, materials or energy
Provisioning (Biotic)	Biomass	Reared animals for nutrition, materials or energy
Provisioning (Biotic)	Biomass	Reared aquatic animals for nutrition, materials or energy
Provisioning (Biotic)	Biomass	Wild plants (terrestrial and aquatic) for nutrition, materials or energy
Provisioning (Biotic)	Biomass	Wild animals (terrestrial and aquatic) for nutrition, materials or energy
Provisioning (Biotic)	Genetic material from all biota (including seed, spore or gamete production)	Genetic material from plants, algae or fungi
Provisioning (Biotic)	Genetic material from all biota (including seed, spore or gamete production)	Genetic material from animals
Provisioning (Biotic)	Other types of provisioning service from biotic sources	Other
Provisioning (Abiotic)	Water	Surface water used for nutrition, materials or energy
Provisioning (Abiotic)	Water	Ground water for used for nutrition, materials or energy
Provisioning (Abiotic)	Water	Other aqueous ecosystem outputs
Regulation & Maintenance (Biotic)	Transformation of biochemical or physical inputs to ecosystems	Mediation of wastes or toxic substances of anthropogenic origin by living processes
Regulation & Maintenance (Biotic)	Transformation of biochemical or physical inputs to ecosystems	Mediation of nuisances of anthropogenic origin
Regulation & Maintenance (Biotic)	Regulation of physical, chemical, biological conditions	Regulation of baseline flows and extreme events
Regulation & Maintenance (Biotic)	Regulation of physical, chemical, biological conditions	Lifecycle maintenance, habitat and gene pool protection
Regulation & Maintenance (Biotic)	Regulation of physical, chemical, biological conditions	Pest and disease control
Regulation & Maintenance (Biotic)	Regulation of physical, chemical, biological conditions	Regulation of soil quality
Regulation & Maintenance (Biotic)	Regulation of physical, chemical, biological conditions	Water conditions
Regulation & Maintenance (Biotic)	Regulation of physical, chemical, biological conditions	Atmospheric composition and conditions
Regulation & Maintenance (Biotic)	Other types of regulation and maintenance service by living processes	Other
Cultural (Biotic)	Direct, in-situ and outdoor interactions with living systems that depend on presence in the environmental setting	Physical and experiential interactions with natural environment
Cultural (Biotic)	Direct, in-situ and outdoor interactions with living systems that depend on presence in the environmental setting	Intellectual and representative interactions with natural environment
Cultural (Biotic)	Indirect, remote, often indoor interactions with living systems that do not require presence in the environmental setting	Spiritual, symbolic and other interactions with natural environment
Cultural (Biotic)	Indirect, remote, often indoor interactions with living systems that do not require presence in the environmental setting	Other biotic characteristics that have a non-use value
Cultural (Biotic)	Other characteristics of living systems that have cultural significance	Other

Diagram 1: Categories of Ecosystem services (source: https://cices.eu/)

During the development of the CICES classification it was explicitly attempted to identify what are considered to be 'final services' influence in designing the all concept around the idea of a hierarchy, to accommodate the fact that people worked at different thematic as well as spatial scales. In order to define the "final ecosystem services"CICES describes them using a five-level hierarchical structure. Each level is progressively more detailed and specific. The way the system works can be illustrated for the contributions that ecosystems make to a cultivated crops such cereals: Section (e.g. Provisioning), Division (e.g. Biomass), Group (e.g. Cultivated terrestrial plants for nutrition, materials or energy), Class (e.g. Cultivated terrestrial plants (including fungi, algae) grown for nutritional purposes), Class type (e.g. Cereals The ecological contribution to the growth of cultivated, land-based crops that can be harvested and used as a raw material for the production of food). More illustrative on the way how the system is working can be seen in the diagram 1.

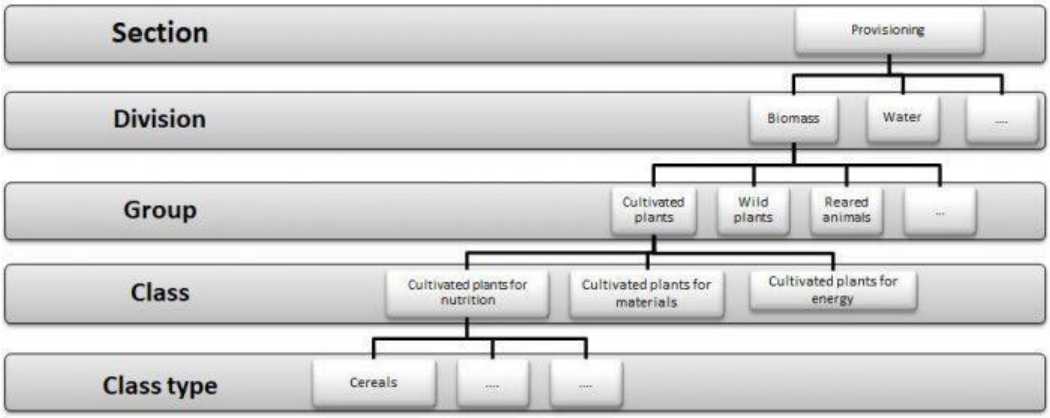


Diagram 2: System of final ecosystem services (Source: https://cices.eu/)

CICES V5.1 retains four level hierarchical structure of V4.3, and the facility for users to add class-types below the class level is retained. The nomenclature has been modified in order to ensure that it is more clearly seen as a 'functional' classification. The Group level descriptors are now framed in a way the ecosystem that are ultimately useful to people (e.g. nutrition), while the Divisional level captures functional attributes, or the ecosystem properties under consideration, that facilitate human use (directly or indirectly).

2 MATERIALS AND METHODS

Ecosystem accounts, like more general ecosystem assessments, have to be based on a well-defined and credible metrics which are often specific to particular geographical situations or ecosystem types. For the purposes of reporting or comparison these may need to be aggregated and generalized. The hierarchical structure illustrated in Diagram 2 allows going to the most appropriate level of detail required, grouping or combining the results for comparing. Thus moving down from Section, through Division, Group and Class 'service' is increasingly more specific, and these detailed service types are nested within the broader categories that sit above them.

In the classification system there is therefore 'dependency', in the sense that the characteristics used to define services at the lower levels are inherited from the Sections, Divisions and Groups above them. There is also a sense of 'taxonomy' in that elements within the same Group or Class are conceptually more similar to each other, in terms of the ways they are used by people, than they are to services elsewhere in the classification; Diagram 1 sets out the basic definitions at the Section level. At any level in the hierarchy the categories are intended to be exclusive and non-overlapping, so that CICES can be regarded as a classification system rather than an arbitrary nomenclature.

CICES Section Definition – Version 4.3 sets out the basic structure of CICES and also shows the equivalence with the categories used in the typology of the MA and TEEB. In many cases there is a fairly simple read-across at the group level, but there are categories included in CICES, such as bioenergy, that are not explicitly covered by the others.

The main goal of this report is to include the overall status and trends for ecosystem services valuation and mapping of certain ecosystem services within the area of Vrapchisht Municipality. Therefore the CICES nomenclature for ecosystem services mapping will be used and is already well explained and specified in the *Introduction* part of this report. In regards to the ecosystem service that will be quantified and mapped it was considered the specific characteristics of the area of Vrapchisht Municipality to provide as much as possible to satisfy the minimum criteria of **at least** 2 ecosystem services per category: Two (2) related to provisioning services, Two (2) related to regulating services and Two (2) related to cultural services. In the report will consider some economical figures on the ecosystem services in order to evaluate them. After the process of evaluation the large-scale mapping of the evaluated ecosystem services will be done.

The important part of this study was dedicated on the data collection. Due to the fact that this study is a pioneer study and first in the Republic of North Macedonia, the process of data collection was considered as very important.

The expert team first made analysis of the possible ecosystem services that are planned to be evaluated and mapped. Second step was identification of the data necessary for assessment of each ecosystem service and stakeholder mapping. The stakeholder mapping was also identified as crucial activity in this study. Based on the ecosystem service were

identified stakeholders that are responsible for management, implementation and monitoring of activities related to the ecosystem services.

For this proposed activity few workshops and events were organized. As important stakeholders were identified: Municipality of Vrapchiste, the branch "Sar" - Gostivar from P.E.National Forests, National Park "Mavrovo", Public Communal Enterprise - Vrapchisthe, NGO organization from Municipality of Vrapchisht, Ministry of Agriculture, Forestry and Water Economy, branch in Gostivar for rural development, financial support of the farmers and subsidies for agriculture, P.E. Pastures - branch - Kicevo (Kicevo, Mavrovo, Gostivar), local farmers (milk and cheese producers), veterinary station in Municipality of Vrapchisht, branch of the Agency for wood and veterinary in Gostivar and Vrapchisht and National Association of Private Forest Owners (NAPFO) - branch Vrapchisht. Almost all of the above mentioned stakeholders had taken active participation on the workshops and events as well as has shown interest to cooperate and to be informed about the study results. In the Annex 1 partly are presented the list of the participants and pictures from conducted workshops and events. It is important to be mentioned in this report that the expert team has informal meeting with the State Statistical Office of the Republic of North Macedonia. On the meeting was discussed about the process of data collection, the type of data, quality of the data and cross (sectoral) data analysis. It was highlighted that unfortunately the policy of the State Statistical Office of the Republic of North Macedonia to collect and published data on regional level. The study area Municipality of Vrapchisht belongs to the Polog statistical region. Also the officials from State Statistical Office of the Republic of North Macedonia were interested about the study results and showed interest in the near future to start with collection of data that can contribute to the evaluation/determination of the ecosystem services.

3 RESULTS

3.1 Study area

Municipality of Vrapciste is located in the northwestern part of the Republic of North Macedonia, within Polog region.

Polog planning region is situated in the northwest part of North Macedonia, with an area of 2,416 km^2. It covers the Polog valley, Mavrovo plateau, Bistra mountain range and the valley of the river Radika.On a state level, the Polog region is one of the eight regions, which is composed of the following nine municipalities: Tetovo, Gostivar, Mavrovo and Rostushe, Zhelino, Tearce, Bogovinje, Vrapchisht, Jegunovce and Brvenica. On this territory, there are 184 settlements in which 304,125 citizens live. From 304,125 citizens 18.4% are Macedonians, 73.2% Albanians, 5.7% Turks, 1.6% Romas, 0.01% Vlachs, 0.32% Serbs, Bosnians 0.08% and 0.66% are other nationalities.The region has great natural and artificial wealth. Polog planning region is rich in mineral resources that are found throughout its territory. Of great economic importance are the ore deposits of gray marble in Gostivar and

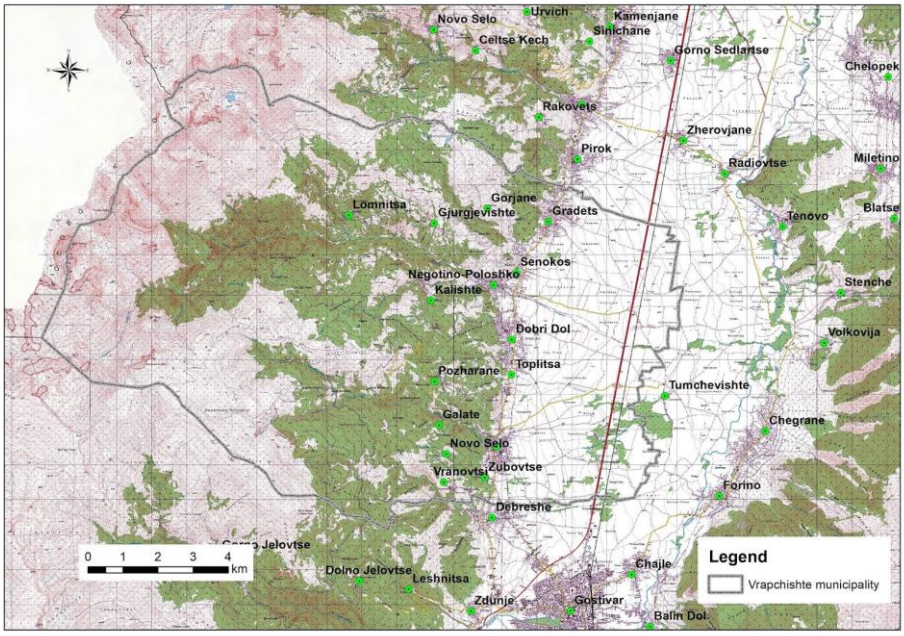
dolomites in Jegunovce and Chajle. Other ores and minerals present in the region are: manganese, molybdenum, copper, arsenic, lead, chrome and marble.

The Polog planning region is a tourist pearl which abounds in natural beauty, historical and cultural monuments. Tourism as an industry is not sufficiently developed in the Polog planning region, but there is a lot of unused potential that represent an opportunity for investments and with its exploitation to make the region one of the biggest tourist destinations in the country and in Europe. The already existing ski centers „Mavrovo“ and „Popova Shapka“ offer the possibility to upgrade the development of ski tourism and an opportunity for promotion and visit of other natural beauties that this region possesses.

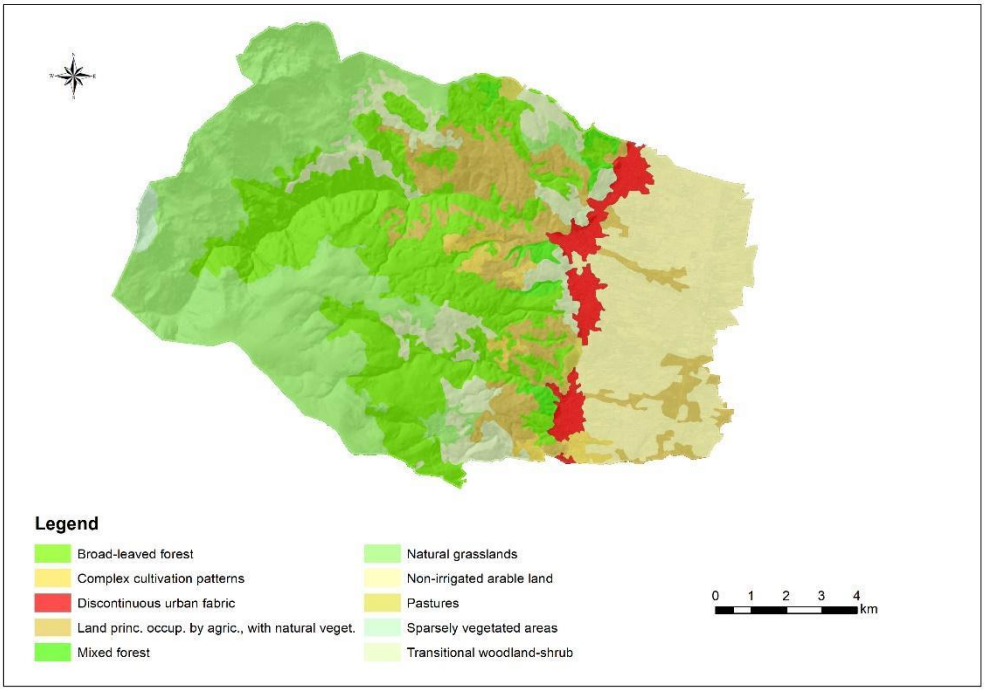
Polog planning region has 170,310 ha of agricultural land of which 41,876 ha is arable land and 128,433 ha are pastures. Of the total arable land 30,565 ha are arable land and gardens, 10,244 has grassland, 1,023 ha of orchards and only 44 ha are vineyards. Most of the agricultural areas or even 75 percent in the Polog planning region are pastures; the remaining 25 percent is arable land. The region does not allow for intensive development of agricultural production, but it is known for products like Tetovo apple, Tetovo beans and cheese, which opens prospects for fostering and promoting products that would increase exports.

Wholesale and retail trade, as well as repair of motor vehicles and motorcycles, are sectors of activity that are most present in the Polog planning region, with a total of 1,611 business entities registered and 22 percent share in the total economy. The second sector is the processing industry with a total of 905 business entities registered and 12.4 percent economic participation, and the construction sector with 651 business entities and 8.9 percent share. With this information the most important economic sectors are selected, such as production of building materials, processing and production of finished wood products, food processing, processing of plastic, aluminum processing and manufacturing of textile products.

Vrapchisht is the name of the village where the municipal main office is located. Municipality of Vrapchisht is part of Polog statistical/administrative region of North Macedonia. The GPS coordinates of the Municipality of Vrapciste are 41° 51' 52.47" N and 20° 52' 17.83" E. According to the last census in 2002 the population of the Vrapciste municipality is 25,399 of whom 4,484 live in the municipality center Vrapchisht, while the rest lives in the villages of the municipality. The area of the Municipality of Vrapciste is 157km^2, and the population density is 161,78 people/km^2. The Municipality of Vrapchisht have 15 inhabited places (villages): Dobri Dol, Galate, Gjurgjevishte, Gorjane, Gradec, Kalishte, Lomnica, Negotino (Poloshko), Novo Selo, Pozharane, Senokos, Topolica, Vranovci, Vrapchisht and Zubovce.



Map 1: Study area, administrative borders



Map 2: Land cover/use map Corine 2018

3.2 *Results on Provisioning Ecosystem Services*

Provisioning services are ecosystem services that describe the material or energy outputs from ecosystems. They include food, water and other resources.
Usually the provisioning ecosystem services can be categorized additionally on:

- **Food**: Ecosystems provide the conditions for growing food. Food comes principally from managed agro-ecosystems but marine and freshwater systems or forests also provide food for human consumption. Wild foods from forests are often underestimated.
- **Raw materials:** Ecosystems provide a great diversity of materials for construction and fuel including wood, biofuels and plant oils that are directly derived from wild and cultivated plant species.
- **Freshwater:** Ecosystems play a vital role in the global hydrological cycle, as they regulate the flow and purification of water. Vegetation and forests influence the quantity of water available locally.
- **Medicinal resources:** Ecosystems and biodiversity provide many plants used as traditional medicines as well as providing the raw materials for the pharmaceutical industry. All ecosystems are a potential source of medicinal resources.

With this report will be analyzed provisioning ecosystem services from first three categories (food, raw materials and fresh water) this due to the current trends and importance for the people of Municipality of Vrapchisht.

3.2.1 Milk production

The Milk production is considered as provisioning ecosystem services which can be categorized in category of Food provision - subcategory Animal food products: live animals; meat; milk, eggs and honey. According to the CICES V5.1 Milk production has the code 1.1.3.1 with short description as animal production and derived milk. The necessary data for evaluation of milk production as ecosystem services are data about the total milk production within the area Municipality of Vrapchisht, official statistic reports, data from the public enterprise responsible for management with the pastures in Republic of North Macedonia – P.E. Pastures and the data from the Farm register. At the beginning the data about the number of animals (sheep, cows, goats) registered within the area of the Municipality of Vrapchisht from the Farm register – veterinary station were collected. Further the data regarding the issued licenses for pasture under jurisdiction of P.E. Pastures. The cross data analysis was used to identified to possibility of other Shepard on the territory of Municipality of Vrapchisht. The P.E. Pastures is responsible for issuing the permissions for pastures. According to the farm register in Municipality of Vrapchisht exists 1.669 cows, 29.155 sheeps and goats. Based on the organized events, stakeholder meeting it was identified that some of the farmers bread the animals in own (home) farms and some in the public pastures.

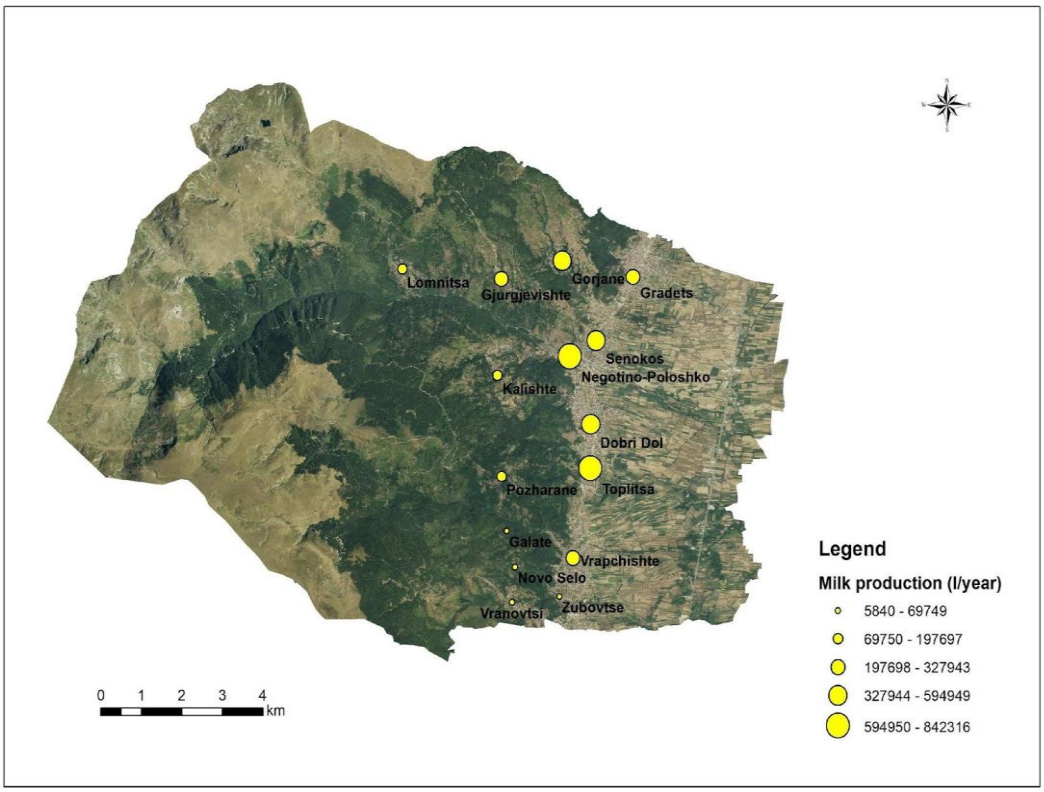
Further we made an analysis of the contract that P.E. Pastures had signed with the local population within the area of the Municipality of Vrapchisht. Based on these contracts there are different number of pastures activities on different localities.

- Locality Bristovac: farmers from Gjurgjevisthe have contract for 1.500 sheep and 150 cows;
- Locality Crno Ezero: farmers from Gorjane have contract for 500 sheep;
- Locality Krzelino: farmers from village Vrapchisht have contract for 1.000 sheep;
- Locality Murgovec: farmers from village Pozarane, Senokos and Debreshe, have contract for 3.300 sheep;
- Locality Kuci Baba: farmers from Toplice, Kalishte have contract for 2.500 sheep;

It is also important that farmers from Municipality of Vrapchisht pastures their sheep on the Korab and Bistra Mountain at neighboring municipality.

- Locality Korab and Bistra there are contract for 2.000 sheep.

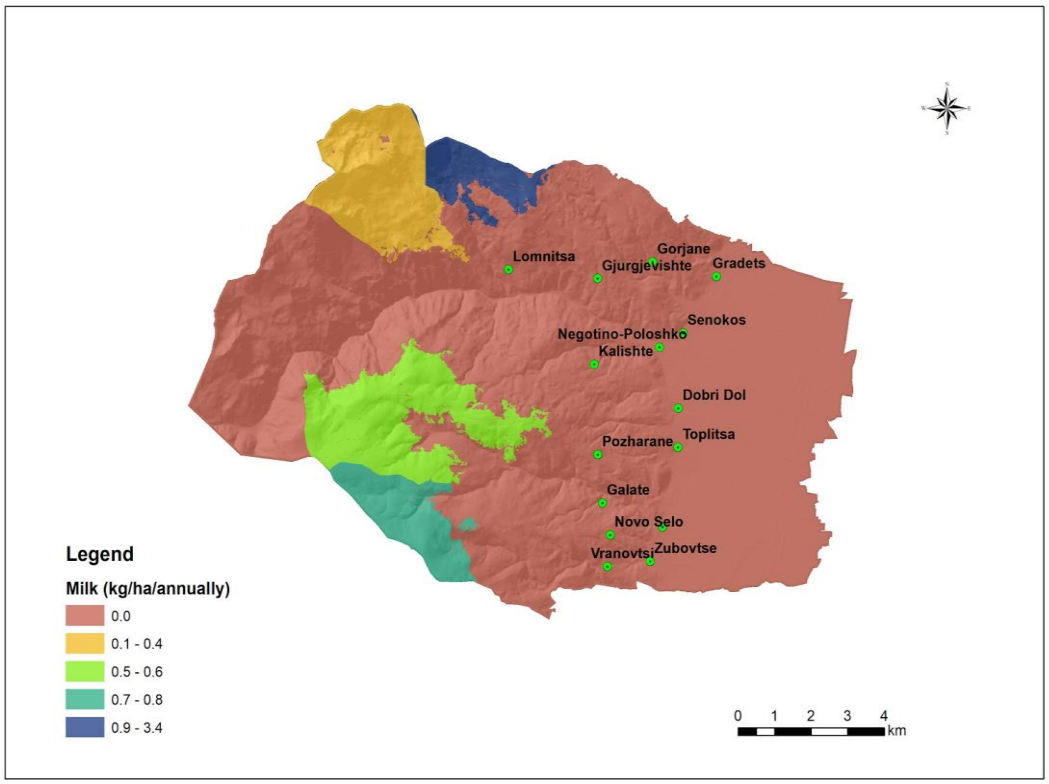
Half of the sheep population has a contract with the P.E. Pastures. For calculating of the milk production were used the coefficients based on the statistical data and data for farm register: 8 liter/cow, 0.27 liter/sheep and 1.1 liter/goat. On the Map 3 are presented data about the production of milk per hectare per village annually.



Map 3: Milk production per village

The Map 3 was developed based on the data related to the number of sheep farmers per village. In addition on Map 4 are presented the milk production for the study area the Vrapchisht Municipality. Based on the collected data the total milk production for cow is 4.873,480 l/annually, for sheep 2.759.400 l/annually and for goat 463.732,5 l/annually. Total annual milk production is 8.096.612,5 l/annually, and per hectare is 515,71 l/ha/annually.
The breeding of the animals as it was explained previously is done in two ways: near houses in the villages or on the pastures in the highest mountain region. In previous part were calculated the milk production for both types of breeding animals. Based on expert knowledge was considered to separate the data between both types due to the reason that animals breed in the pastures gives more adequate data for the real potential of the pastures in milk production as ecosystem services.

Therefore the data from the signed contracts on the pastures within the borders of the Municipality of Vrapchisht were taken into consideration. The content analysis of the contracts shows five (5) pastures are constantly exploit for pasturing (Bristovac, Crno Ezero, Krzelino, Murgovec and Kuci Baba). The pasture on locality Bristovac is the only where cows and sheep are bred together. This is important to be mentioned due to the fact based on that locality Bristovac has the biggest production of litter per ha 3.44 l/ha compared to the other localities where the production of milk per ha is less than 1 litre/ha (Map 4).



Map 4: Milk production

Due to the fact that there is a need for a common approach in order the data from Vrapchisht Municipality to be comparable with the other partners included in BIOPROSPECT project, the milk data instead of liters per hectare were converted into kg per hectare (Map 5). Based on the references sciencing.com was used the calculating coefficient of 1litre milk = 1.03 kg as converting value. The new calculation will be:

- for cow 5.019.684,4 kgr/annually,
- for sheep 2.842.182 kgr/annually and
- for goat 477.644,48 kgr/annually
- total annual milk production is 8.339.510,88 kgr/annually, and per hectare is 527,887 kgr/ha/annually.

3.2.2 Meat production

Meat production is considered as provisioning ecosystem services which can be categorized in the category of Food provision - subcategory Animal food products: live animals; meat; milk, eggs and honey.

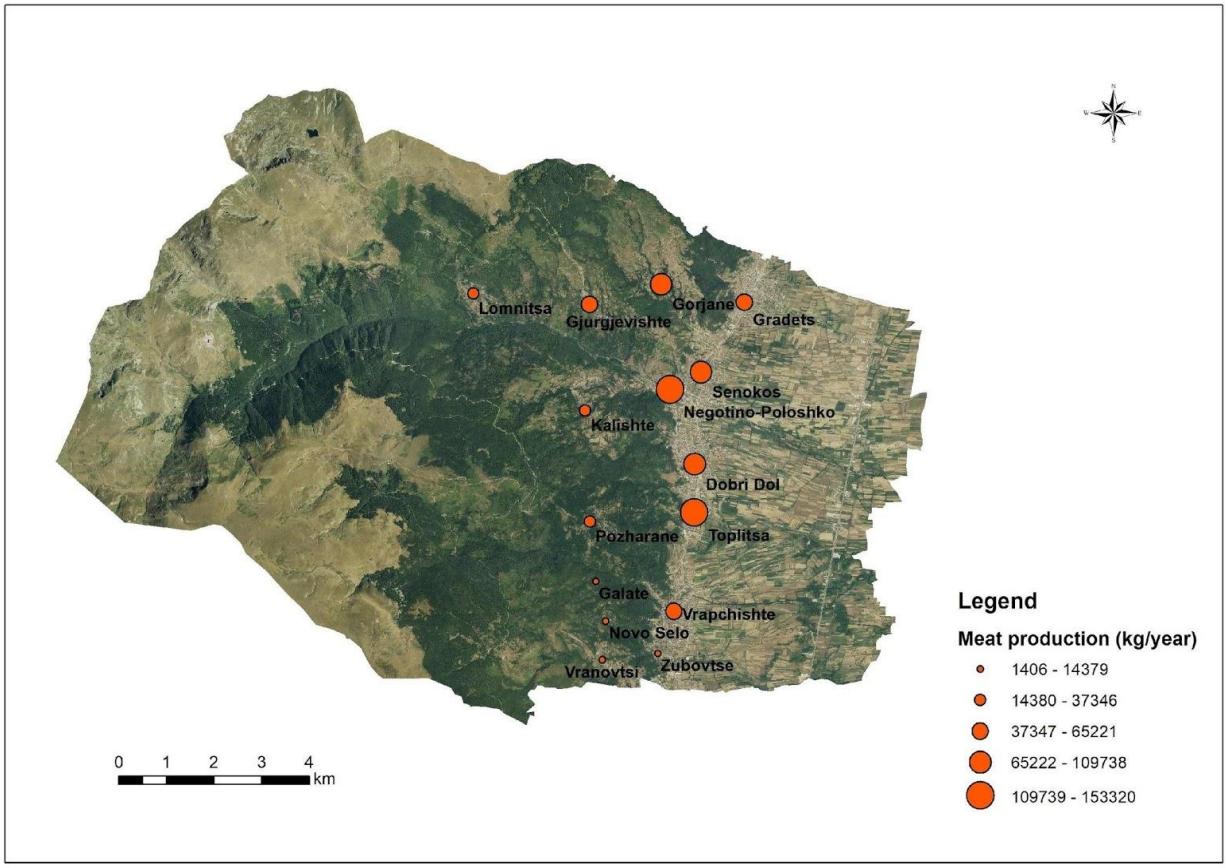
According to the CICES V5.1 Meat production has the same code 1.1.3.1 as milk production with short description as animal production and derived milk. The necessary data for evaluation of meat production as ecosystem services are data about the total meat production within the area Municipality of Vrapchisht, official statistic reports, data from the public enterprise responsible for management with the pastures in Republic of North Macedonia – P.E. Pastures.

At the beginning the data about the number of animals (sheep, cows, goats) registered within the area of the Municipality of Vrapchisht from the Farm register – veterinary station were collected. Further the data regarding the issued licenses for pasture under jurisdiction of P.E. Pastures. The cross data analysis was used to identify the possibility of other Shepard on the territory of Municipality of Vrapchisht.

The P.E. Pastures is responsible for issuing the permissions for pastures, and often the shepard from one area get permissions into other areas outside municipality, for better pastures, yet in Municipality of Vrapchiste this was not the case, and all permits are given to local farmers. According to the farm register in Municipality of Vrapchisht exists 1.669 cows, 29.155sheeps and goats. Based on the organized events, stakeholder meeting it was identified that some of the farmers bread the animals in own (home) farms and some in the public pastures. Further we made an analysis of the contract that P.E. Pastures had signed with the local population within the area of the Municipality of Vrapchisht. Based on these contracts there are different number of pastures activities on different localities. Locality Bristovac: farmers from Gjurgjeviste have contract for 1.500 sheep and 150 cows.

For calculating of the meat production were used the coefficients based on the statistical data and data for farm register which are 351 kg/cow, 22 kg/sheep. Also selection of cattle for meat production from milk and reproduction was done in cooperation with the National Farm Register, compared to the State Statistical Office data trends.

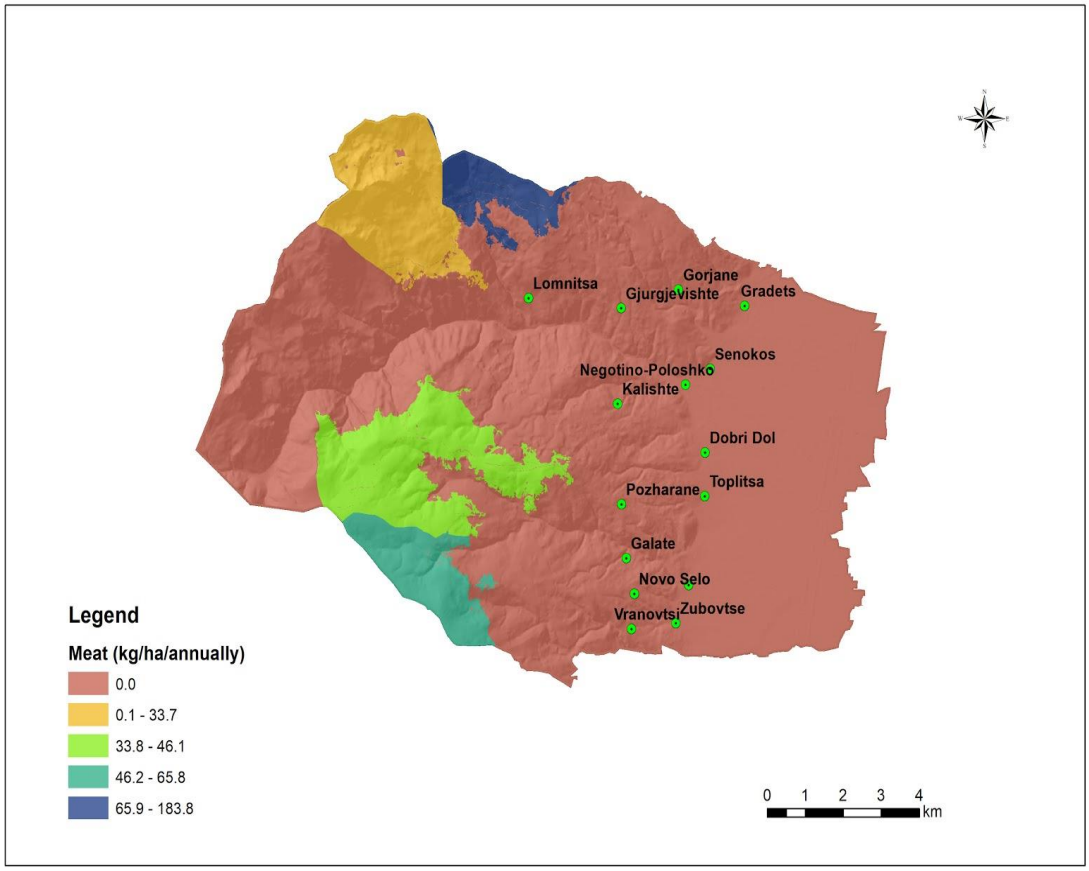
Similar to the previous ecosystem service (Milk production) on the Map 5 are presented data about the production of meat per hectare annually.



Map 5: Meat production per village

Total meat production for: cow is 78,17 kg/ha/annually.585,819 kg/annually and for sheep/goat is 641.410 kg/annually or the total meat production is 1.227.229 kg/annually analyzed on the total area of the Municipality.

Similar to the milk production the same approach for estimation of the real potential of the pastures in milk production as ecosystem services was used for meat production. Therefore the data from the signed contract on the pastures within the borders of the Municipality of Vrapchisht were taken into consideration. The content analysis of the contracts shows five (5) pastures are constantly exploit for pasturing (Bristovac, Crno Ezero, Krzelino, Murgovec and Kuci Baba). The pasture on locality Bristovac is the only where cows and sheep are bred together. This is important to be mentioned due to the fact based on that locality Bristovac has the biggest production of meat kg/ha 183.81 kg/ha compared to the other localities where the production of milk per ha is less than 65 kg/ha (see Map 5).



Map 6: Meat production

Similar to the milk production and in order the data to be compared among the partners included in BIOPROSPECT project the meat data were presented for the study area as well (Map 6).

3.2.3 Forage production

According to CICES V5.1 the forage production is considered as provisioning ecosystem services classifies with same code as meat and milk production same code 1.1.3.1. There is debate that forage production is considered as provisioning or regulating service. In this report the forage production is basically considered for livestock and therefore suited the best under the category of provisioning services: "the weight of forage that is produced within a designated period of time in a forest area."

The necessary data for evaluation of forage production as ecosystem services are data about the grazing area multiplied by the forage production per forest (land) type within the area Municipality of Vrapchisht based on Map 2. For this purposes and appropriate calculation of forage production was used the formula:

Vg = Area ×Pg,

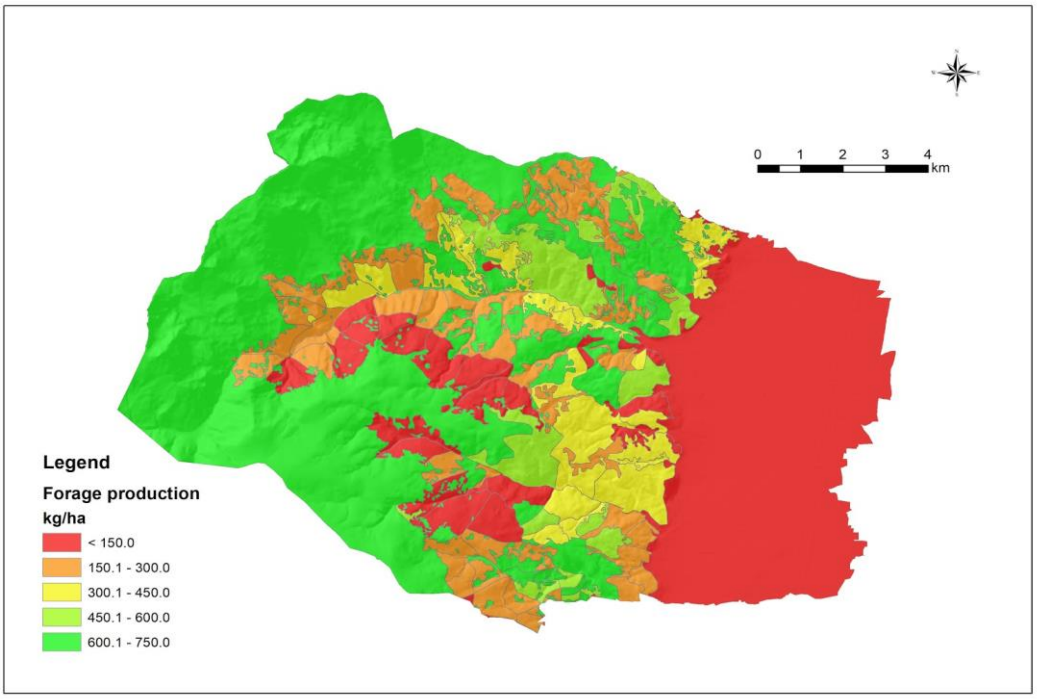
Where:
Vg = total forage production (kg);
Area = grazing land; Pg= forage production per forest type (kg/ha),

Based on the common agreement in the frame of the InterReg project was agreed common methodology for estimation of forage production per forest (land) type presented in Table 1.

Table 1. Forage production per forest type – Modified for study area

Forest (land) type	Forage production (kg/ha)
Forest with forest cover of 50%	375
Pastures	750

The forage production was calculated on the basis of the location of pastures and open areas within forests. The pastures were estimated with forage production of 750 kg/ha. On the other hand the forests with forest cover of 100% are practically without any forage produce. If the forest is not with full forest cover, then it can have forage production. The rationale behind is that if the forest is with 50% cover, then 50% of the area has no forage production and the other open part has forage produce of 750 kg/ha and therefore on average the area has 375 kg/ha of forage produced. According the spatial calculations the production of forage in the municipality of Vrapchisht is 6.552 t/ha.



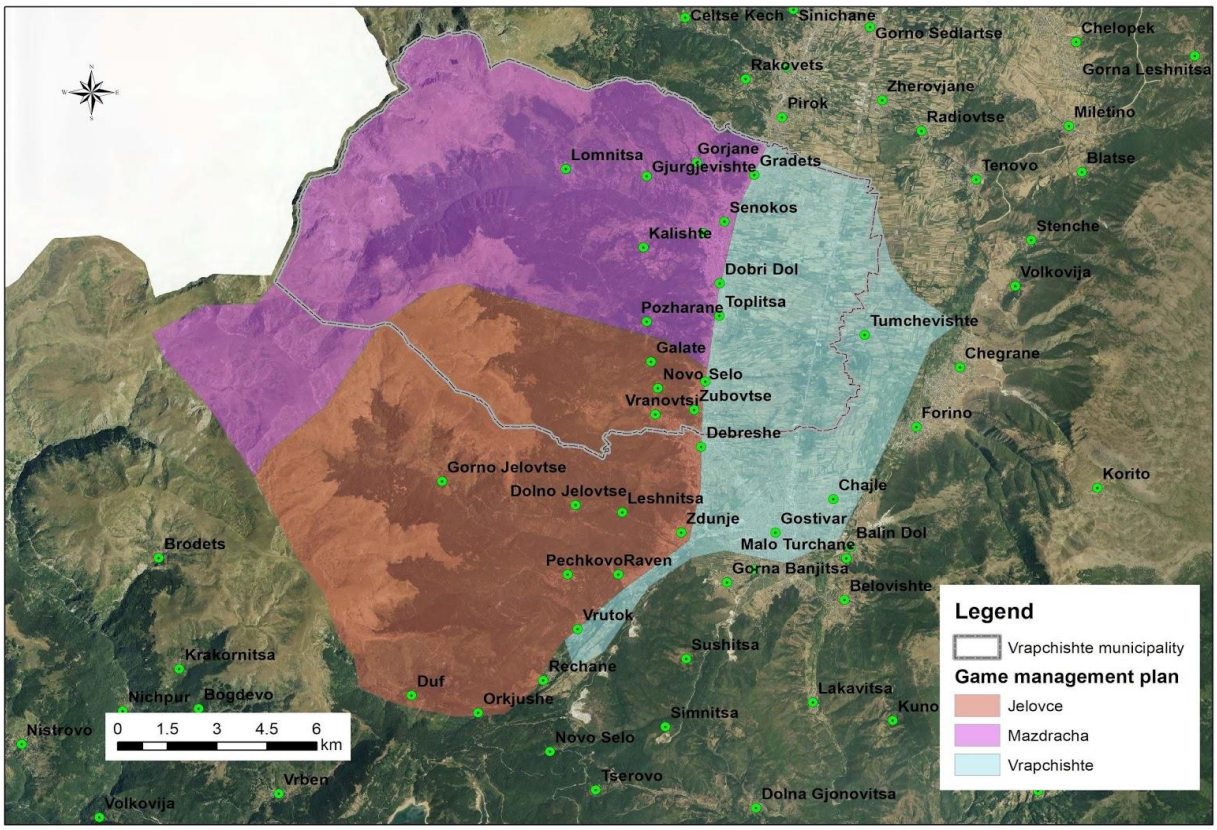
Map 7: Forage production

Note that according to Law on Forests, generally there is a ban on grazing in forests, with some exclusions. Details on law provisions can be seen in Annex 3.

3.2.4 Wild animals

Territory of Municipality of Vrapchisht includes three (3) hunting areas which have by separate Hunting Management Plans. Two hunting areas in mountains and hilly region of the municipality are established for big game and one hunting area in the lower part for small game. From small game within the area of the Municipality of Vrapchisht for commercialized hunting are identified this species: Grey Partridge (Perdix *Perdix*) and Hare (Lepus *Europeus*) while the commercialized big game are: Roe deer (Capreolus *Capreoulus*), Chamois (Rupicapra *Rupicapra*) and Wild boar (Sus *Scrofa*).

The Hunting Areas (HA) Jelovce, Mazdraca and Vrapchichte occupy the territory of Municipality of Vrapchisht consisting of forest, forest land, agriculture land etc. Tables with the number of game for hunting and basic game fund are based on the appropriate Hunting Management Plans (HMPs) for the 3 hunting grounds for more detail information see Annex 4, 5 and 6. Notyfining tha from total area of HA Jelovce, only 24% occupy territory of the Municipality of Vrapchisht, 82% from HA Mazdraca are in the territory of the Municipality of Vrapchisht and half of the HA Vrapchisht or 50% are occupying the territory of the Municipality of Vrapchisht. On Map 10 are presented the hunting areas within the study area (Vrapchisht Municipality).



Map 8: Hunting areas within Municipality of Vrapchisht

The wild animals is classified with code name 1.1.3.3 according to the CICES V5.1. For calculation of this ecosystem service we used several data. First according to the Game Price List (Official Gazette of RNM No.17/10), the prices of game was taken into consideration. Further two calculations were conducted one for the amount of shooting game annually multiple with the price and second the total game fond (shooting game + basic fond) multiply with the price according to the official price list. Notifying that for the small game there was no distinction between male and female game, while for the big game this distinction in price for male and female was considered. The basic prices for the game shooting quota are: Grey Partridge (*Perdix Perdix*) 8.95€, Hare (*Lepus Europeus*) 13 €, Roe deer (*Capreolus Capreoulus*) 325.7 € for male population and 162.86 € for female population, Chamois (*Rupicapra Rupicapra*) 219.87 € for male population and 179.15€ for female population, and Wild boar (*Sus Scrofa*) 219.87 € for male population and 89.58 for female population.

Based on this in addition is presented the value of shot game. Calculation was done for the last three years (2017, 2018, 2019) for total area of three Hunting management plan (HMP) and the area of the Municipality of Vrapchis the that was occupied by the HMPs. Note that hunting grounds/areas do not correspond to municipality administrative borders.
The area according to the HMP Jelovce is 13.100 ha and 24% or 3.144 ha belongs to the Municipality of Vrapchisht, the total area of HMP Mazdracha is 11.090 ha and 82% or 9.093,8ha belongs to the Municipality of Vrapchisht and hunting area of HMP Vrapchisht is 6.610 ha and 50% or 3.305ha belongs to the Municipality of Vrapchisht).
The prices are presented in Euros.

Year	Value HMP	Value SQ/Vrapchisht
2017	21921.45	10969.9
2018	22651.72	11543.4
2019	22651.72	11543.4

Alternative tourism (hunting) perspective the value of the 1ha hunting area is:

Year	Hunting area	Value SQ/Vrapchisht	Value/ha
2017	15542.8	10969.9	0.70579
2018	15542.8	11543.4	0.74268
2019	15542.8	11543.4	0.74268

Notifying that the shooting quota is depending of the total population of game and if the total game population increases the shooting quota will increase too.

The total value of the game as ecosystem service is considering the value of the total game population according to the official price list per hunting area (per ha). In addition are presented the calculation of the total game population made on the same way as for the shooting game considering differences in prices for big game (males and females).

Year	Value HMP	Value TGF/Vrapchisht
2017	106424.65	54851.1
2018	107167.92	55431.2
2019	107180.92	55437.7

The total value of three HMP (Vrapchisht, Jelovce and Mazdracha) in 2019 is 107.180,92€, while comparing to the territory that these HMP occupy within the border of the area of the Municipality of Vrapchisht in 2019, we estimate the value of total hunting area on 55.437,70 €. If want to make estimation of the value of 1ha hunting area we calculated that 1ha of hunting area in 2019 has value of 3,6 €. The total value of game as ecosystem service is 5 times bigger if analysed from hunting tourism perspective.

Year	Hunting area	Value TGF/Vrapchisht	Value/ha
2017	15542.8	54851.1	3.529036
2018	15542.8	55431.2	3.566359
2019	15542.8	55437.7	3.566777

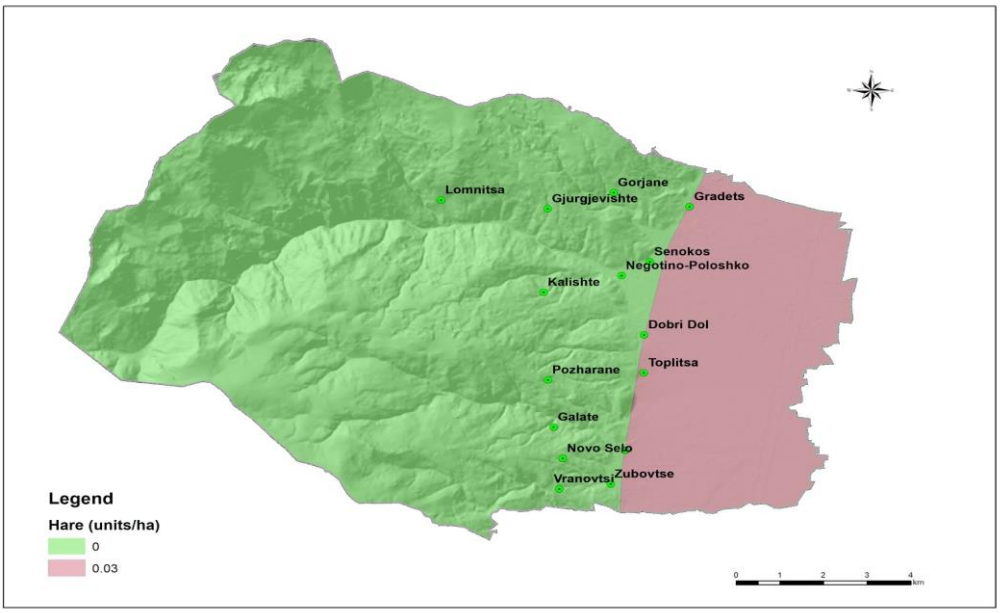
The following legend was produced for easily understanding the estimations.

Legend:

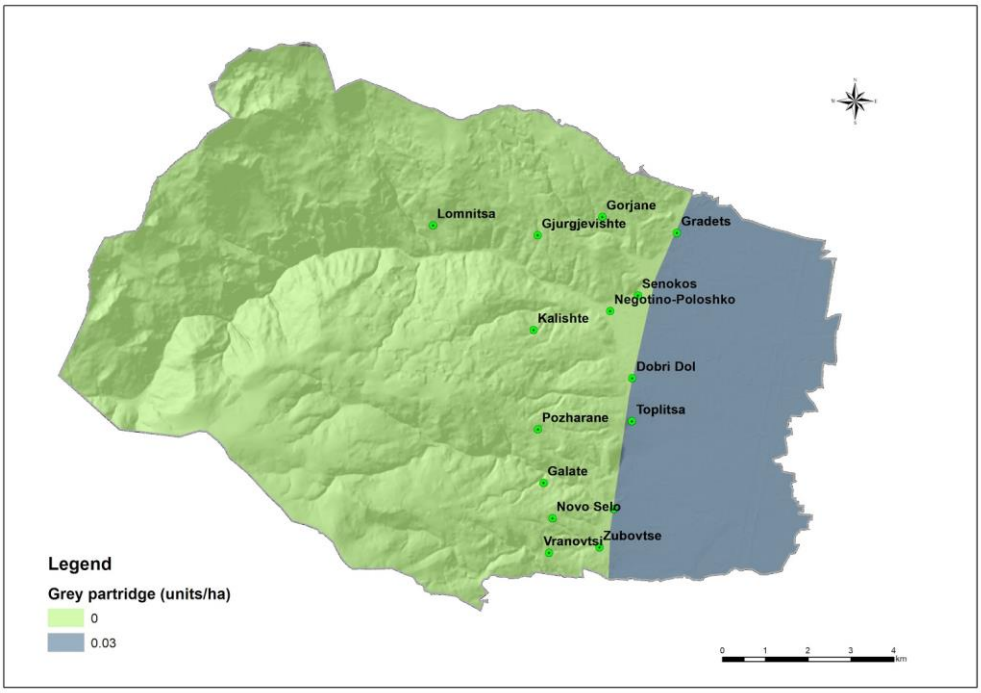
HAN - Hunting Area Number; HMP - Hunting Management Plan; BF - Basic Fond, AH/SQ - Annual hunting/shooting quota, TGF – Total Fame Fond, TFV - Total Fond Value, TMVSA –Total Monetary Value of the Shouted Quota; TMVHA –Total Monetary Value of the Hunting Area and UP – Unit Price.

The legend is also relevant for the Tables in Annex 4 , 5 and 6.

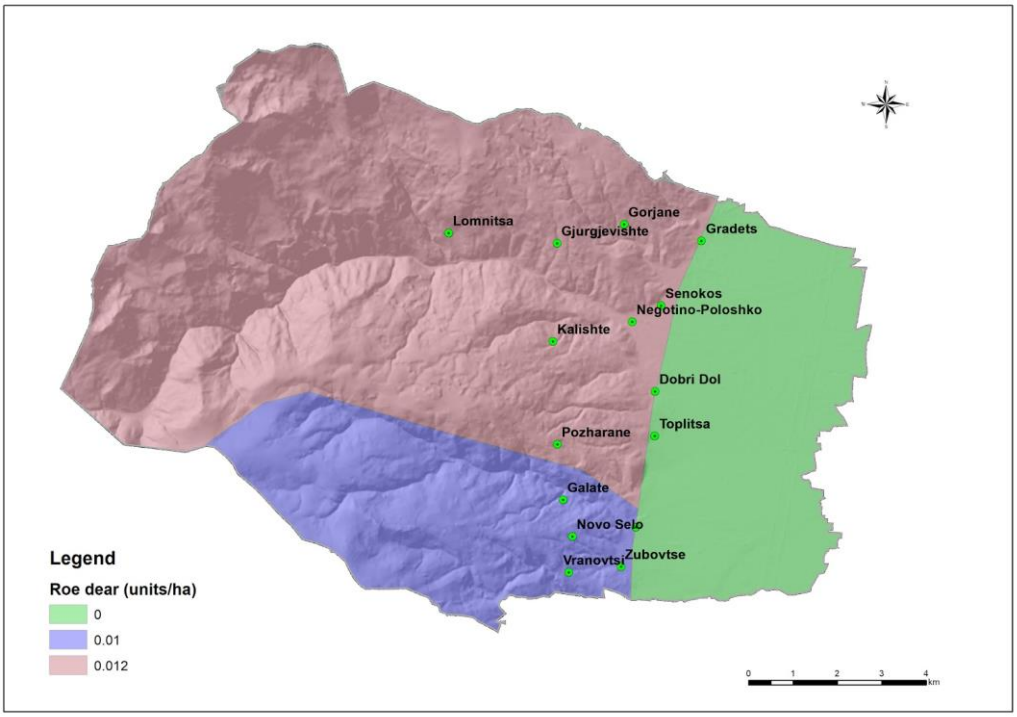
Additionally in this report separate maps for each game species (hare, grey partridge, roe deer, chamois and wild boar) per ha per each hunting management area were developed (See Map 11, Map 12, Map 13, Map14 and Map15).



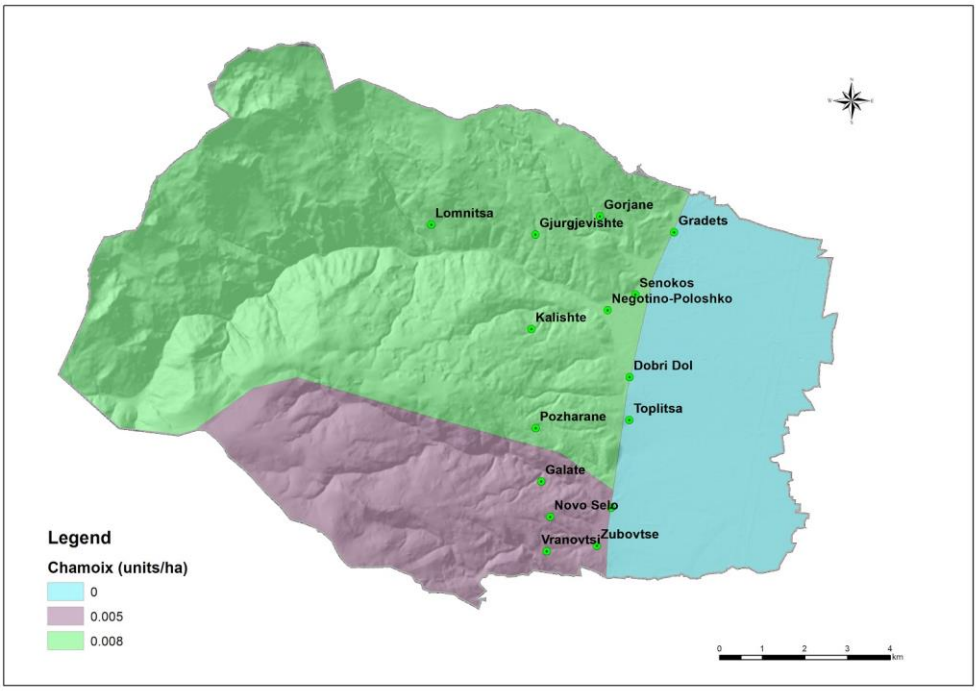
Map 9: Map of Hare distribution



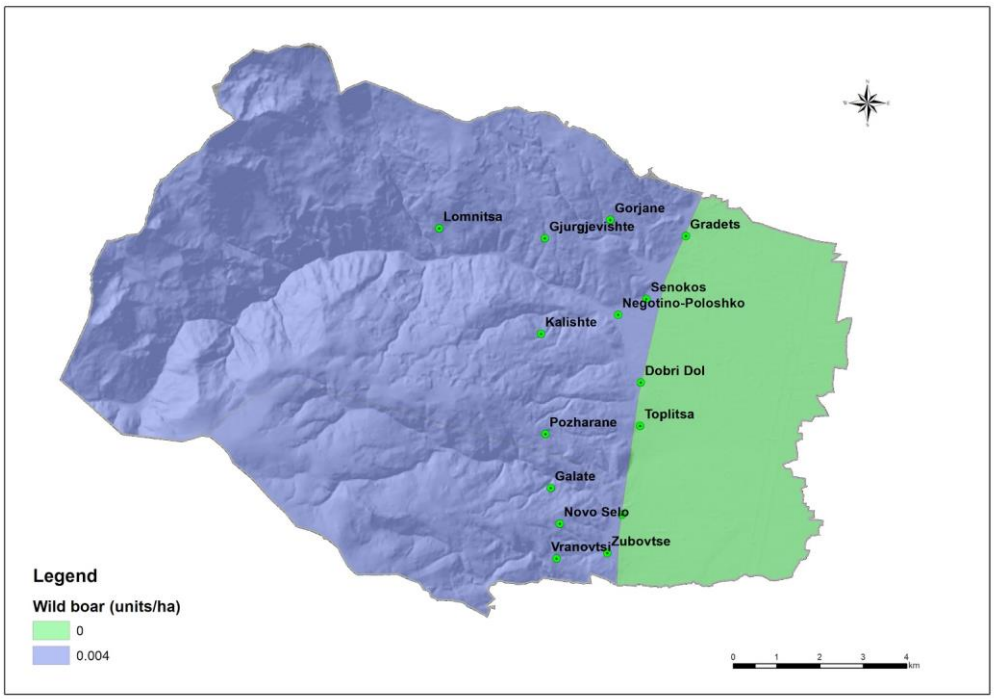
Map 10: Map of Grey partridge distribution



Map 11: Map of roe deer distribution



Map 12: Map of chamois distribution



Map 13: Map of wild boar distribution

3.2.5 Timber production

Timber production is considered as provisioning ecosystem services which is classified as Biomass-based energy sources – Plant-based resources.

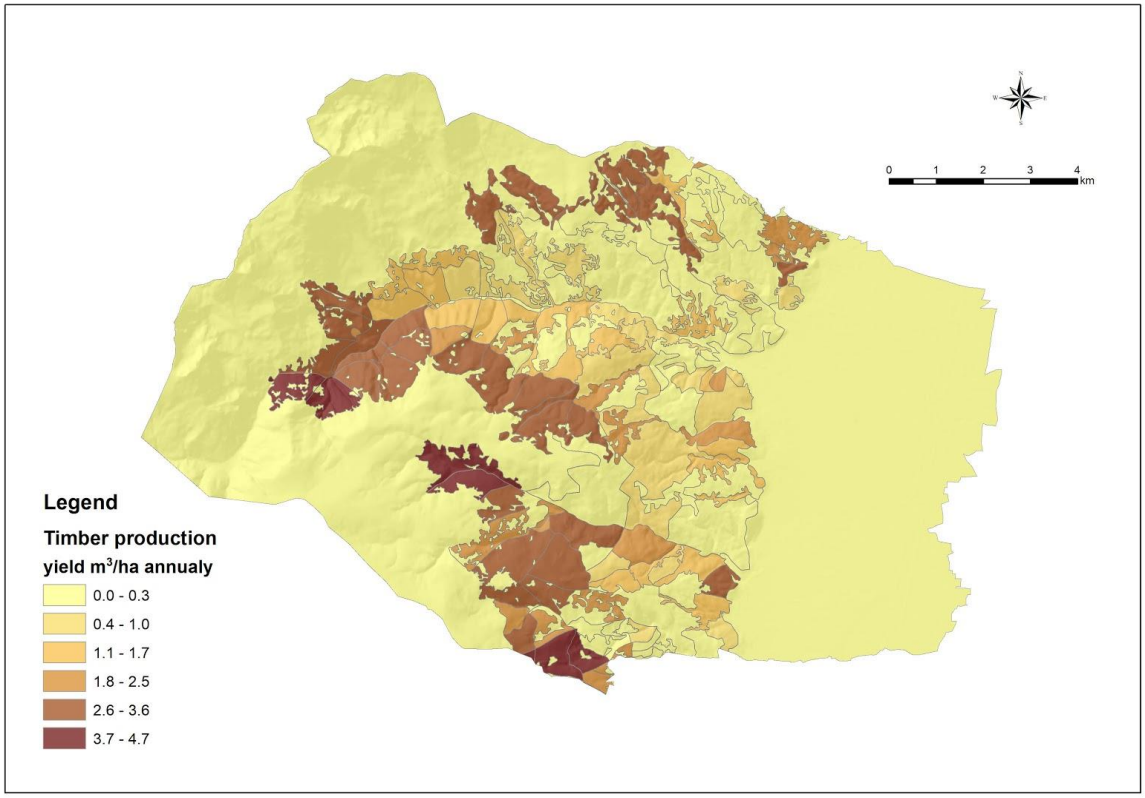
According to the CICES V5.1 Timber production has the code 1.1.5.2. The description of this service is the volume of timber in m^3 harvested per year. Necessary data for evaluation of timber production as ecosystem services are data from the forest management plans (FMPs) from Public Enterprise National Forest (PENF). With notification that within the area of the Municipality of Vrapchisht exist forest in private and state property. The forest in state ownership are managed by PENFs' branch "Šar –Gostivar" in accordance to the approved FMPs. The private forest owners are managing their forests. Private forests within the area of the Municipality of Vrapchisht are small and scattered parcels and as such are integrated within the FMP of the PENF's branch "Šar –Gostivar".

For evaluation was used the FMP "Mazraca" which is covering the forest territory of the Municipality of Vrapchisht in accordance to the Law on Forest (2009) - Official gazette of RNM 64/09 from 22.05.2009. Based on the FMP Mazdracha and also from the workshops and events discussion with the representative from PENF's branch "Šar –Gostivar" in last three years is harvesting almost 100% of planned annual cut, due to sanitary cutting as results of forest fires, snow and winter falls, while in the previous period annual cut was around 70%. Based on FMP "Mazdracha" as well as from the workshop and discussion with

the representatives from PENF's branch "Šar –Gostivar" the main product is firewood, the price of the firewood is 47-48 Euros, and the annual cut for last (2019) year was 5.500m3 of firewood.

Due to the low demand of the wood-processing industry the PENF's branch "Šar – Gostivar" is not producing (cutting) technical wood. According to the FMP Mazdraca, forests occupy 7.206 ha and 54% of the them are within the territory of the Municipality of Vrapchisht and the other 46% belong to the territory of the neighbouring Municipality of Gostivar. Therefore the annual cut for the forest area within the borders of Municipality of Vrapchisht should be reduced proportionally at 2.970 m3 of firewood. The estimation will be: 2,970m3 firewood x 47,56 Euro = 141.253,20 Euro/annually or the value of the forest land is 47,56 Euro/ha.

The total woodlands are not covered by the forest management plan. In order to estimate the total wood mass also the area which was not covered by the FMP was estimated using field mapping and aerial photo interpretation. It was estimated that the total wood mass of the area is 462.661 m^3 and the distribution of this wood mass is 67 m^3/ha. This is a low value but it has to be considered that besides the managed forests which have higher wood mass also here were taken into account small wooded areas with forest cover of 5-10%.



Map 14: Timber production

3.2.6 Water Supply

In this report the water supply is defined as "… *by subtracting evapotranspiration and water requirement for maintaining the aquatic ecosystems from the precipitation into forests*" and its classified with code name 4.2.X.X according to the CICES V5.1.
For calculation of the water supply is used this formula:

$$\mathbf{V = h \times A \times 10}$$

Where the:

V is the annual water yield of the basins (m3y-1),
A is the area of the basin (hectare) and
h is the surface runoff height that occurred in the basin (mm y-1)

Calculation of the surface runoff height is done by the formula:

$$\mathbf{h}=\boldsymbol{P}-\boldsymbol{ET}$$

Where:

ET is evapotranspiration (mm yr-1) defined according to TurcL., 1954:

$$\boldsymbol{ET}=\boldsymbol{P}/(\mathbf{0,9}+(\boldsymbol{P}^{\mathbf{2}}/\boldsymbol{L}^{\mathbf{2}}))^{1/2}$$

Further on this equation is modified by (Konukcu et al., 2005) and the following equation is used:

$$\boldsymbol{ET}=\boldsymbol{P}/(\mathbf{0,68}+(\boldsymbol{P}^{\mathbf{2}}/\boldsymbol{L}^{\mathbf{2}}))^{1/2}$$

P is the mean precipitation (mm y-1) in which the correlation parameter L is described as

$$\boldsymbol{L}=\mathbf{300}+\mathbf{25}\boldsymbol{T}+\mathbf{0,05}\boldsymbol{T}^{\mathbf{3}}$$

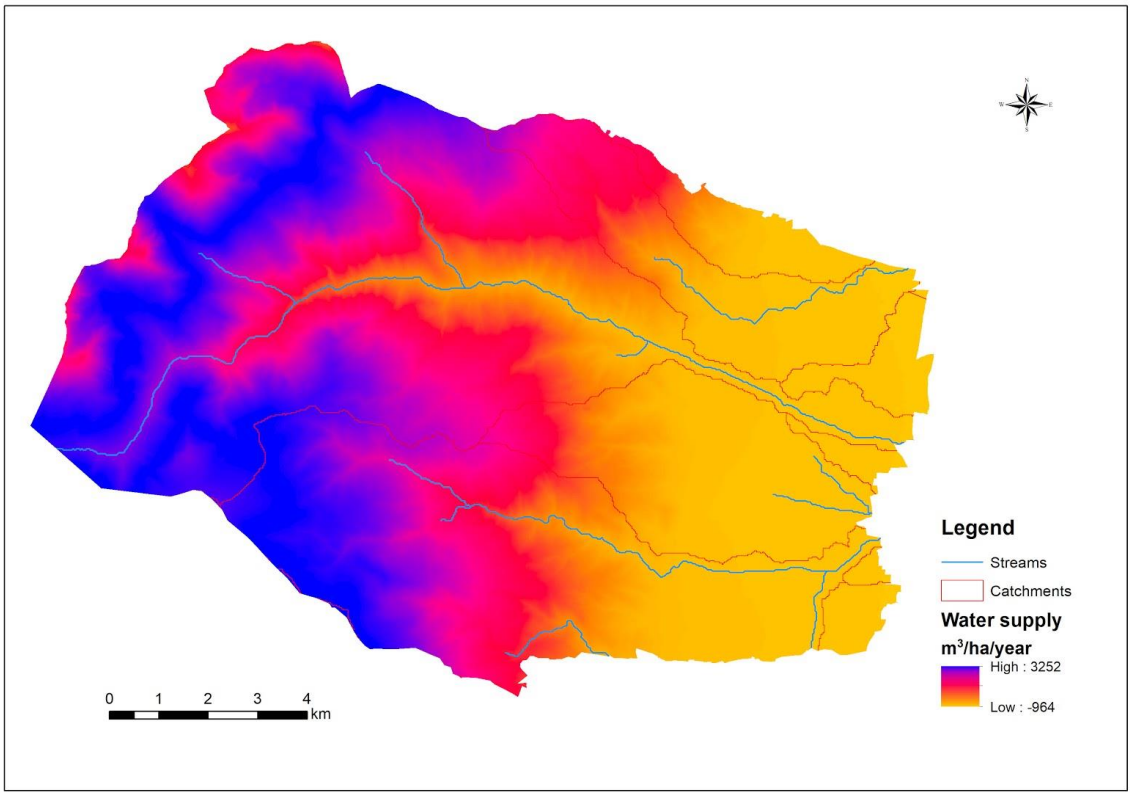
and T is the mean air temperature (°C).

Additionally there is a need to subtract the water requirements for maintaining the aquatic ecosystems. In this regards for the estimation of the water supply model (WS in mm yr−1) improvements were done:

$$\mathbf{WS = SPTC - ET - EF \ (1)}$$

where SPTC is the precipitation water (mm yr−1), ET is evapotranspiration (mm yr−1) and EF is the water requirement for maintaining the aquatic ecosystems (mm yr−1), which for the territory of the Republic of North Macedonia is 30% of the rain according to the Smakhtin, V et al 2004.

For calculation were used hydro meteorological data for the period 1981-2010. The precipitation and temperature maps were produced using 18 meteorological stations. The measurements were correlated using elevation. The correlation of the elevation with the measurements was over 90%. For the elevation it was used 20 m DEM.



Map 15: Water supply (including watersheds and streams)

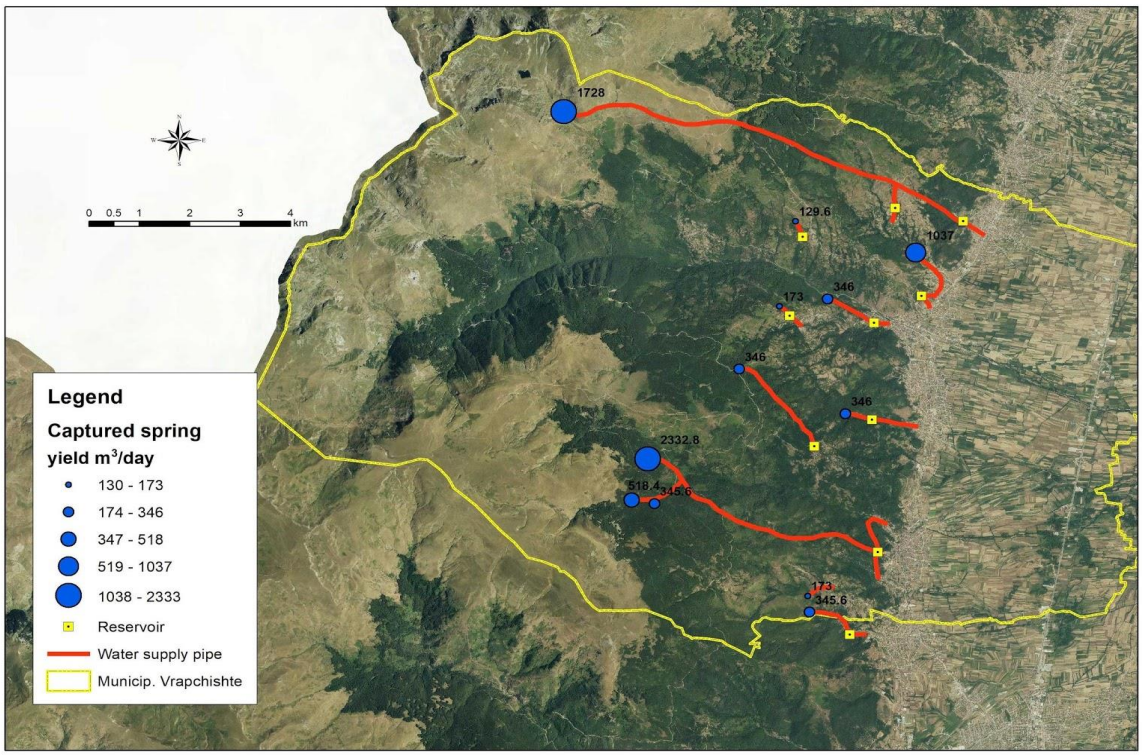
3.2.7 Ground (and subsurface) water for drinking

Analyzing the EU trends for water consumption per capita per day which can be from 85 liter/day in Lithuania, Estonia 100 liter/day, Belgium 115 liter/day, Poland 118 liter/day, Germany 122 liter/day, Hungary 150 liter/day, Austria 159 liter/day, France 164 liter/day, Netherlands 218 liter/day and Spain 265 liter/day, can be concluded that Municipality of Vrapchisht has good water potential. The quantity of 7.821m^3/day is equal to 7.821.000,00 liter/day water divided with the population of Municipality of Vrapchisht which is 25.399 inhabitants the potential of all springs in Municipality of Vrapchisht is 307,92 liter/day which is above each of the mentioned EU trends for daily water use. The data were obtained from the Water Object Map of the Republic of North Macedonia in scale 1:50.000.

Additionally, the World Health Organization states: *"Based on estimates of requirements of lactating women who engage in moderate physical activity in above-average temperatures, a minimum of 7.5 liters per capita per day will meet the requirements of most people under most conditions. This water needs to be of a quality that represents a tolerable level of risk. However, in an emergency situation, a minimum of 15 liters is required. A higher quantity of about 20 liters per capita per day should be assured to take care of basic hygiene needs and basic food hygiene."*

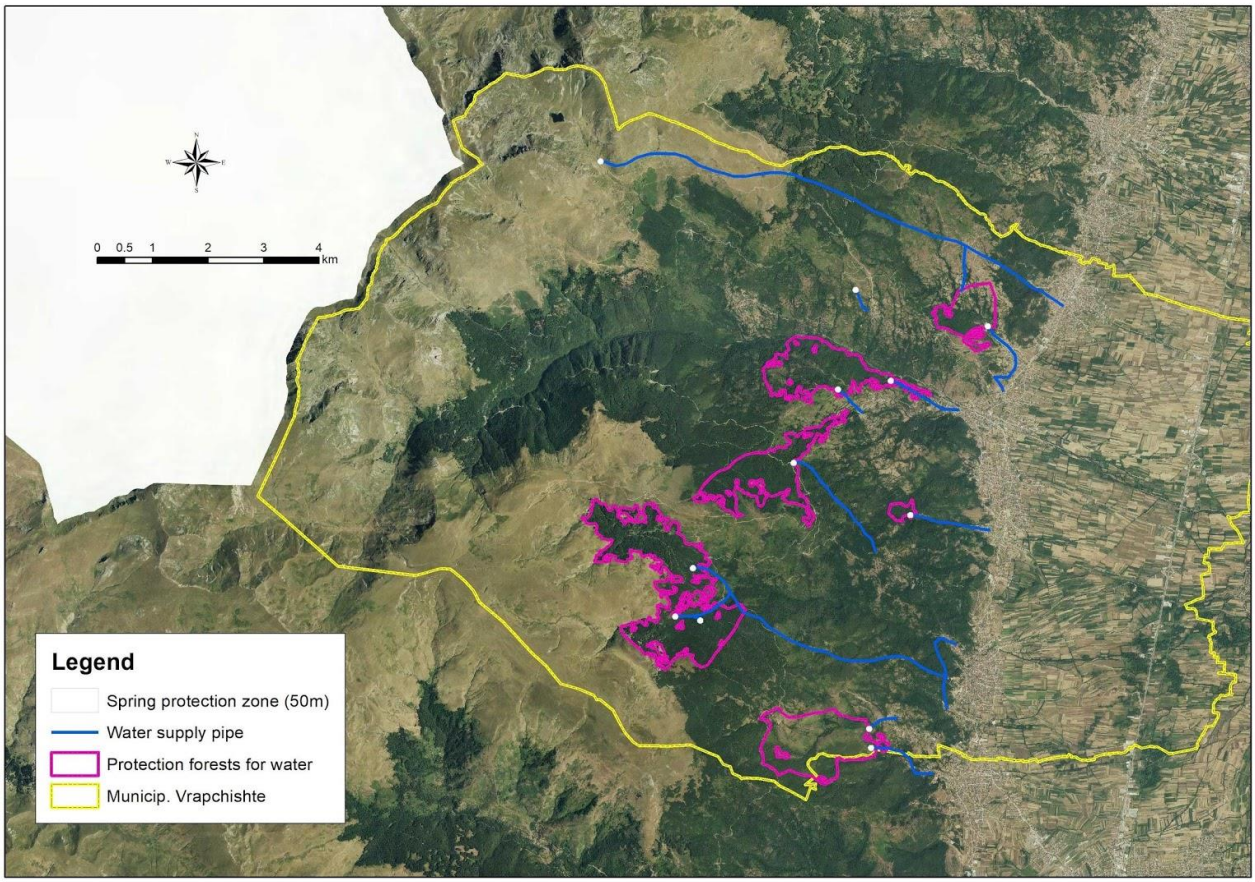
Based on the above mentioned statement is shown that Municipality of Vrapchisht has very good potential for drinking water. The statistical data shows that the water is cheapest in Gostivar 0,15 €/m3, Skopje 0,28€/m3 up to 0,58€/m3 in Shtip.

Putting in monetary value the value of drinking water as an ecosystem service in Municipality of Vrapchisht is 1.173,15€ per day or 428.199,75€ on annual level. Ground (and subsurface) water for drinking is classified with code name 4.2.2.1 according to the CICES V5.1.



Map 16: Captured springs of surface water for drinking

Total yield from the springs in the municipality of Vrapchisht is 7821 m^3/day. Almost all of the springs are situated in forested or other wooded land, highlighting the role of the forests as very important in preserving the water resources. According the Law on water, every captured spring should be protected with fence in radius of 50m. Keeping in mind the role of forests in the process of water conservation, forests around the springs and immediate catchments which gravitate towards the springs, should be considered protective forests and semi natural areas for water conservation. Based on the GIS analysis these zones which should be considered for protection cover 936 ha.



Map 17: Forested/semi natural areas for protection of sources for drinking water

3.3 *Results on Regulating ecosystem services*

Regulating services are defined as the benefits obtained from the regulation of ecosystem processes these include: air quality maintenance, climate regulation, water regulation and purification, erosion control, waste treatment, regulation of human diseases, biological control, pollination, and protection from extreme weather and climatic events.

Within this report will be analyzed three regulating ecosystem services: carbon storage, air purification and soil erosion, there three were identified of high importance for the people of Municipality of Vrapchisht during discussion with the stakeholders on the workshops and events organized in the frame of this study.

3.3.1 Carbon Storage

Carbon storage is the process of capturing carbon that is sequestered in wood volume. Carbon storage was considered one of the most important regulating ecosystem services. In this study focus is on storage of carbon in forest, due to the fact that woodland help to mitigate climate change by binding carbon within biomass, thereby reducing greenhouse gas concentration. Atmospheric carbon is sequestered by, and is stored in vegetation through the process of osmosis and plant growth (FAO, 2001). Carbon is distributed throughout the landscape but is highly concentrated where timber production and biodiversity are high. The carbon storage is classified with code name 2.2.6.1 according to the CICES V5.1.

The calculation of the Carbon storage was done according to the accepted methodology using the formula:

$$\mathbf{C = [V \times D \times BEF] \times (1 + R) \times CF}$$

Where C = total carbon in biomass calculated

V = wood volume stock, m3ha-1

D = basic wood density, tonnes d.m.m^{-3}

D= 0,58

BEF = biomass expansion factor for conversion of volume to aboveground tree biomass, dimensionless

BEF= 1,4

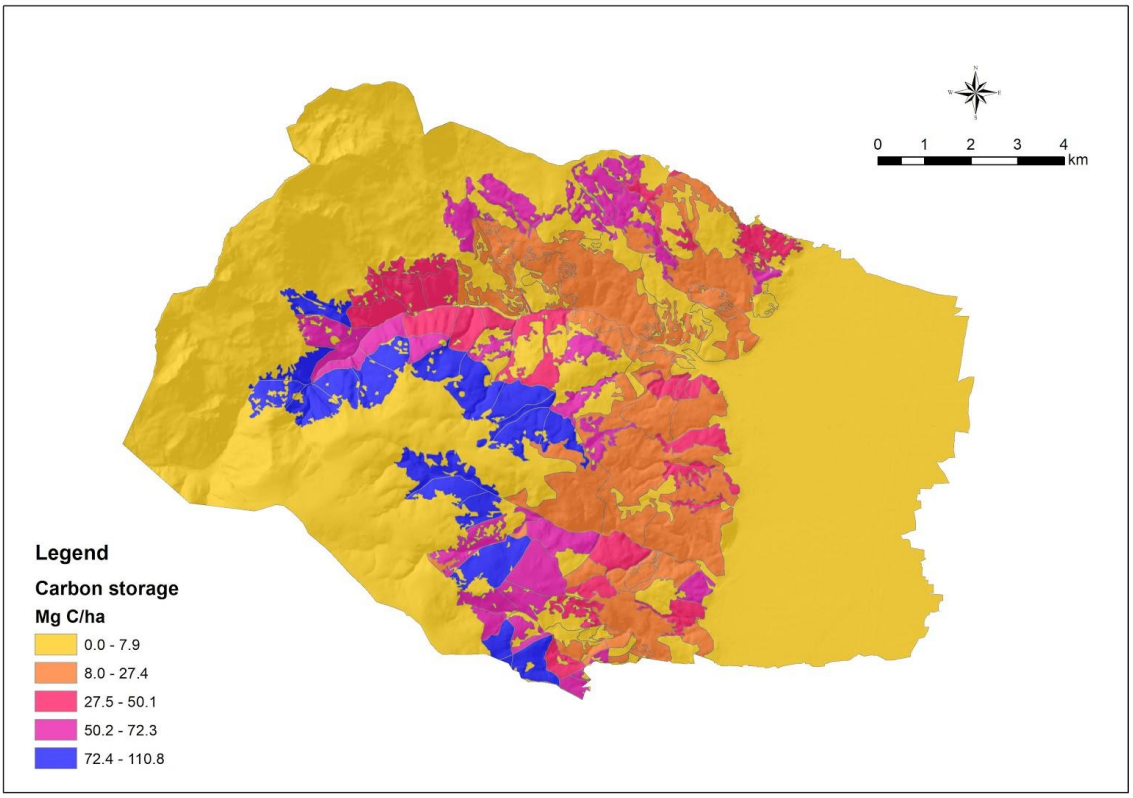
R = root-to-shoot ratio, dimensionless

R= 0,3

CF = carbon fraction of dry matter (default = 0.5), tonnes C (tonned.m.)-1

CF= 0,5

The total carbon storage per study area is 244.192 mg of C. For calculation of the total carbon storage were taken values from literature (IPCC guidelines) and as well as data regarding wood volume which were taken from relevant FMP Mazdracha.



Map 18: Carbon storage

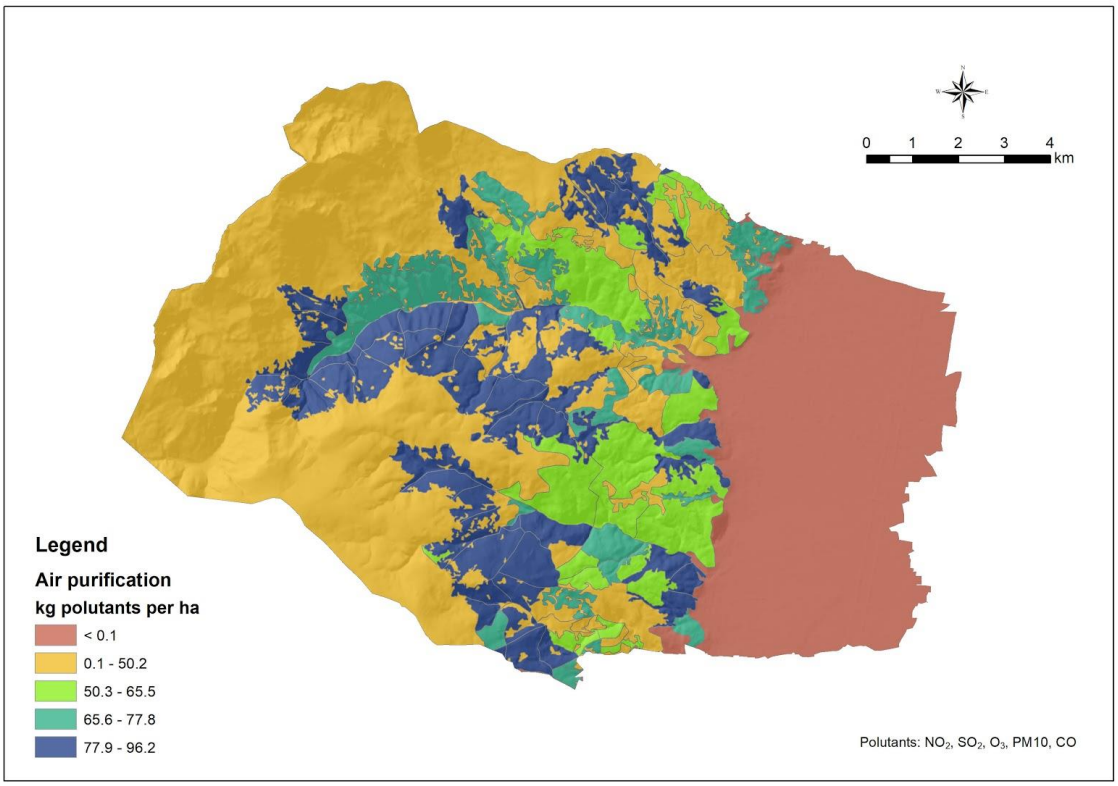
3.3.2 Air Purification

Ecosystems both contribute chemicals to and extract chemicals from the atmosphere, influencing many aspects of air quality. Trees absorb and decompose damaging gases such as SO_2, NO_2 and other harmful gases through the plant's special organs and physiological performance. The air pollutants are highly absorbed by forests and therefore are considered as crucial in the process of air purification. In this study is considered the capture/filtering of pollutants by forest that mitigates its harmful effects and reduces the costs of disposal by other means. The air purification is classified with code name 2.2.6.2 according to the CICES V5.1. According to the agreed methodology and after conducting summary of literature values used for estimation of air pollution removal services of trees, shrubs and herbaceous land cover the following classification was used:

Pollutant	Trees	Grassland	
SO_2	1.32 g/m^2yr	0.65 g/m^2yr	Short grass
NO_2	2.54 g/m^2yr	2.33 g/m^2yr	Short grass
PM10	2.73 g/m^2yr	1.12 g/m^2yr	Short grass
O_3	3.06 g/m^2yr		
CO	0.58 g/m^2yr		

According to McPhearson , T. et all., 2013

Further on, this table was summed up per land cover (see map 2). The five pollution agents SO_2, NO_2, PM10, O_3 and CO were taken as a sum for forest with 100% cover (10.23 g/m^2yr) and SO_2, NO_2, PM10 for grassland (4.1 g/m^2yr). The total air purification effect is 475,7 tons of the total study area.



Map 19: Air purification

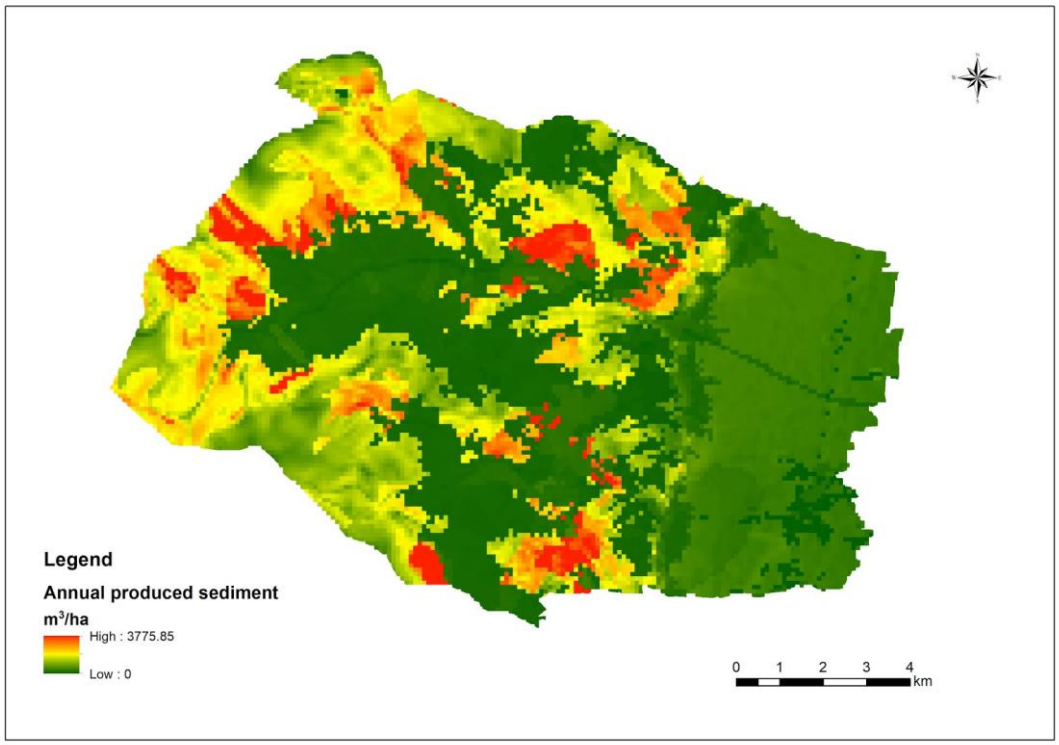
3.3.3 Soil erosion

The soil erosion is classified with code name 2.2.1.1 according to the CICES V5.1. The soil erosion was calculated with the Erosion potential method (Gavrilovic, 1972). This method was used in most of the Balkan countries and all of the erosion maps of former Yugoslavia were developed with this method. It was mainly developed for sediment production and sediment transport for sediment deposition in water reservoirs. The deposited sediment is directly measured with bathymetry using echo-sounding equipment and the results of the erosion modelling are validated with the direct measurements (Mincev, 2015).

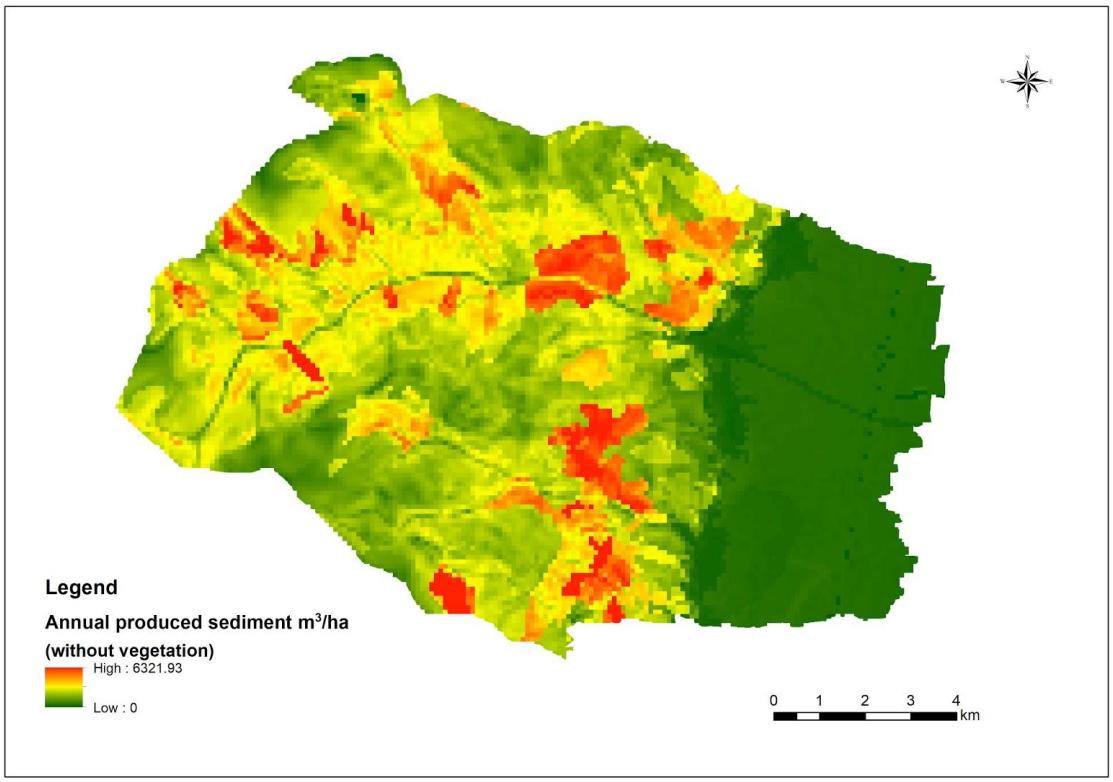
$$W = T\ H\ Pi\ Z^{1.5}\ F[\ m^3/km^2/year] \qquad Z = \gamma\ Xa\ (\ fi + J_{sr}^{0.5})$$

where:

W – quantity of produced sediment
Z – erosion coefficient
γ- erodibility of the surface,
Xa - coefficient of land cover and anti erosion measures undertaken,
fi - coefficient of visible erosion processes,
J_{sr} - average slope, T - average temperature,
H - average annual rainfall,
F - area



Map 20: Soil erosion with forests



Map 21: Soil erosion without forests

The quantity of produced sediment is connected with how much soil and sediment material is removed from the site and it is a real indicator with the loss of productivity of the land. Based on data analysis the expert team decided to create two maps of the soil erosion. The decision is due to the fact that there is a big difference if we look at the data for sedimentation with and without forest. The quantity of produced sediment is connected with how much soil and sediment material is removed from the site and it is a real indicator with the loss of productivity of the land. The total quantity of produced sediment in the catchment is 64,651 m3/year or the specific production of sediment is 409 m3/km2/year. If the vegetation is removed then the total quantity of produced sediment in the catchment will be 174,357 m3/year or the specific production of sediment will be 1103 m3/km2/year. So the value of the forest is very significant in keeping the soil in the catchment and the total stabilized sediment because of the vegetation is 109,706m3/year.

3.4 *Results on Cultural ecosystem services*

The non-material benefits people obtain from ecosystems are called 'cultural services'. They include aesthetic inspiration, cultural identity, sense of home, and spiritual experience related to the natural environment. Typically, opportunities for tourism and recreation are also considered within the group. Cultural services are deeply interconnected with each other and often connected to provisioning and regulating services: Small scale fishing is not only about food and income, but also about fishers' way of life. In many situations, cultural services are among the most important values people associate with Nature – it is therefore critical to understand them. Agriculture, and forestry are influenced and influence all types of ecosystem services. Below, we are looking at the interaction between the different production systems and the types of ecosystem services according to the typology of CICES. According to the agreed methodology and CICES within this report will be analyzed two cultural ecosystem services: cultural heritage and nature photographers.

3.4.1 Cultural Heritage

The cultural heritage is classified with code name 3.1.2.3 according to the CICES V5.1. One of the main messages in the Millennium Ecosystem Assessment (MA) related to cultural and amenity services is that human cultures, knowledge systems, religions, heritage values, social interactions and the linked amenity services always have been influenced and shaped by the nature of ecosystems and ecosystem conditions in which culture is based. At the same time,people have always influenced and shaped the environment to enhance the availability of certain valued services. MA recognises that it is artificial to separate these services or their combinedinfluence on human well-being, but identifies six categories of cultural and amenity services provided by ecosystems and landscapes in order to facilitate valuation (MA, 2005).

The Millennium Ecosystem Assessment states that the importance of cultural services and values is not currently recognized in landscape planning and management and that these fields could benefit from a better understanding of the way in which societies manipulate ecosystems and then relate that to cultural, spiritual and religious belief systems. MA also states that the ecosystem approach implicitly recognizes the importance of a socio-ecological system approach, and that policy formulations should empower local people to participate in managing natural resources as part of a cultural landscape, integrating local knowledge and institutions (MA, 2005). For terrestrial ecosystems, the most important direct drivers of change in ecosystem services in the past 50 years have been land-use and land cover changes. Landscape-scale approaches to reducing loss of ecosystem services and biodiversity have therefore become increasingly important (Sanderson et al., 2002).Sweden and other European countries have for example introduced specific forms of payments for the maintenance of grasslands with high cultural and natural heritage values (Hasund,2009). However, local and traditional knowledge is often under-utilized in decision-making about landscape and ecosystem management, which may contribute to loss of heritage values and cultural landscapes (Wu and Petriello, 2011).

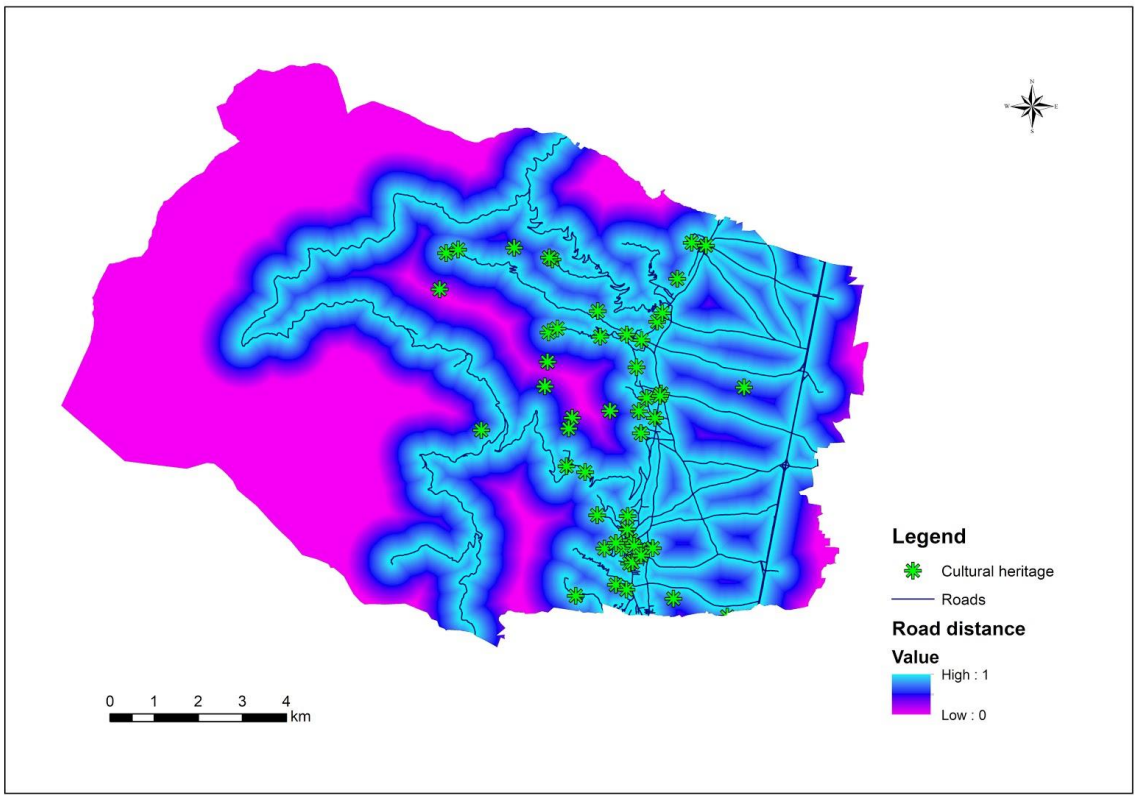
Diagram 3: Definition of cultural heritage as stated in MA (2005)

A recent literature review and bibliometric analysis concluded that cultural ecosystem services have been assessed only marginally and therefore propose to link ecosystem services research with cultural landscape research to fill the knowledge gaps (Schaich et al,2010). According to this view, the ecosystem services and cultural landscape research communities share a common interest in the demands people place on, and benefits derived from ecosystems and landscapes. Moreover, cultural landscapes are at the interface between nature and culture, tangible and intangible heritage, biological and cultural diversity. Gee and Burkhard (2010) also showed that the concepts of landscape (seascape, in their study) and

place provided a useful conceptual bridge linking ecosystem functioning outcomes and cultural values in the ecosystem. An overview of past efforts to value and protect ecosystem services concluded that more research is needed on developing non-monetary methods for valuing cultural ecosystem services and incorporating these into easy-to-use tools (Daily et al, 2009).An exclusive focus on the economic valuation of ecosystem outputs may indeed run the danger of narrowing the debate and hinder the development and application of the idea (Potschin and Haines-Young, 2011). In Sweden, the National Heritage Board has recently analyzed opportunities of monetary and non-monetary valuation of cultural services but further empirical studies are needed (Soutukorva and Soderqvist, 2008). However, there have also been suggestions to remove cultural ecosystem services from the frame-work altogether (Fisher et al., 2009), while recognizing cultural and amenity values and benefits resulting from the other services.

The specific concept of ecosystem services is mainly based on natural science paradigms, which make it difficult to apply the concept in safeguarding of cultural ecosystem services. This is evident in published literature on ecosystem services that show a strong bias of studies carried out by researchers with the base in natural science and economics. One example is the MA publication (MA, 2005),which devotes two per cent of its total pages to cultural ecosystem services, and the assessment of The Economics of Ecosystems and Biodiversity (TEEB, 2010), which provides detailed economic analysis of ecosystem services, but no discussion of their intangible cultural values. One reason for this could be that the MA was designed to respond to government requests for information received through multilateral environmental agreements (MEAs) and conventions—the Convention on Biological Diversity (CBD), the United Nations Convention to Combat Desertification (UNCCD), the Ramsar Convention on Wetlands, and the Convention on Migratory Species (CMS)—which are generally perceived to be the responsibility of the environment sector alone. MA focuses on the linkages between ecosystems and human well-being. The four main ecosystem services, provisioning, regulating, cultural and supporting services are inter-related in the MA concept, but, the literature shows clear tendencies of separating these categories in specialized research fields. As defined by MA, cultural ecosystem services are one of the four main service categories. However, cultural services cannot be treated independently and depend on provisioning, regulating and supporting services, at the same time as the expression of cultural ecosystems services influences the way ecosystems are viewed and managed (MA, 2005). Interdisciplinary approaches are therefore needed to improve the understanding of cultural ecosystem services that takes into account the dynamic nature of human–environment interactions and possible synergies and trade-offs between cultural, supporting, provisioning and regulating ecosystem services. It has been pointed out that conservation perspectives and heritage planning and management need to be better incorporated within regular planning processes, rather than operating on their own as isolated phenomena. This implies close cooperation with relevant sectors of society, such as social, ecological and physical planning (Engelbrektsson, 2008). As the Ecosystem Services Approach (e.g. Turner and Daily, 2008) is becoming a key tool in environmental decision

making, there is a need for the discipline of conservation of cultural heritage to engage and influence the ecosystem services discourse. Existing international instrument for the conservation and management of cultural heritage includes the UNESCO Convention Concerning the Protection of the World Cultural and Natural Heritage from 1972 that provides for the protection of the world's cultural and natural heritage places and the identification and nomination of cultural and natural properties of outstanding universal value. Furthermore, UNESCO Universal Declaration on Cultural Diversity (2001), UNESCO Convention for the Safeguarding of the Intangible Cultural Heritage (ICH; 2003) and UNESCO Convention on the Protection and Promotion of the Diversity of Cultural Expressions (2005) reveal an increased recognition of the importance of intangible heritage and cultural diversity within conservation and heritage preservation. These conventions aim at supporting conservation efforts, ownership, protective legal frameworks, and issues related to authenticity and how global initiatives can be implemented at a local level, where most ICH is located. The more recent European Landscape Convention (ELC), established by the Council of Europe in 2000, covers all landscapes and promotes the integration of landscapes in cultural, environmental, agricultural, social and economic policies, using a participatory approach (Jones and Stenseke, 2011). This further emphasizes the need for methods and tools for integrated assessment of cultural and ecological values in the landscape to ensure informed policy making.



Map 22: Cultural heritage

The accessibility to cultural heritage sites (i.e. landscape goods and archaeological sites, monastery) depends on their proximity to the road network. In the analysis were considered 55 objects (Churches, Mosques, Archaeological sites). The analysis has shown that 31 of the analyzed objects are very close to the roads network or ≤ 40m. The most distant point of the cultural object to the road network is around 800m.

The map is created with fuzzy relationship of the distance: where 1 represents the closest to roads and 0 is the most distant. Also the values which are more than 1 km away are considered as not suitable and have a value of zero.

3.4.2 Nature Photographers

Using crowdsourced imagery you can detect cultural ecosystem services. Within ecological research and environmental management, there is currently a focus on demonstrating the links between human well-being and nature conservation. Within this framework, there is a clear interest in better understanding how and why people value certain places over others. You can measures cultural preferences by exploring the potential of multiple online georeferenced digital photograph collections. Using ecological and social considerations, with the mapping done with this project, we contribute to the detection of places that provide cultural ecosystem services. The degree of appreciation of a specific place is derived from the number of people taking and sharing pictures of it. The sequence of decisions and actions taken to share a digital picture of a given place includes the effort to travel to the place, the willingness to take a picture, the decision to geo-locate the picture, and the action of sharing it through the Internet. Hence, the social activity of sharing pictures leaves digital proxies of spatial preferences, with people sharing specific photos considering the depicted place not only "worth visiting" but also "worth sharing visually." The nature photographers are classified with code name 6.1.1.1 according to the CICES V5.1.

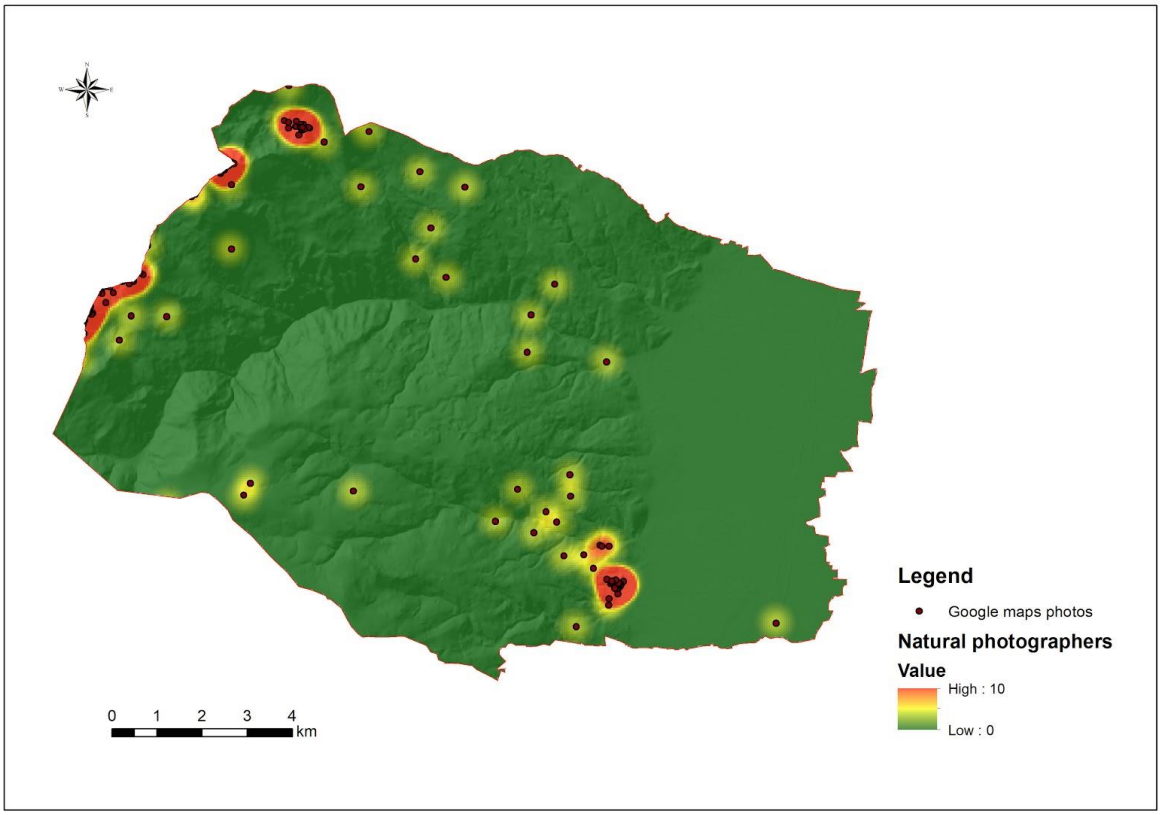
We used Google Earth Pro tool, considering it a perfect example of combined georeferenced photo sharing platform with spatial data from Google satellite imagery. Google has integrated into this tool all sources of imagery, including former Panoramio into Google Maps Photos. Google Earth Pro, which integrates all sources of photo services within, with Google Maps/Photos as main one. For such application, geographic location is either explicitly requested for every image or is a complementary tag for the photo collection. A characteristic is that the application requires users to be registered.

Historically, Panoramio was created in 2005 and was explicitly intended for sharing photos of landscapes. Google acquired this service in 2007 and is the main provider of geo-located pictures overlaid on Google mapping services such as Google Maps and Google Earth. As witnessed in community discussions, some users are motivated to contribute because of the global visibility of their pictures. A very active community not only contributes to the collection but also creates online events and contests.

Using this study, we help identify key geographic features of high cultural value. These results highlight how the inclusion of geographical user-generated content, also known

as volunteered geographic information, can be very effective in addressing some of the current priorities in conservation. Indeed, the detection of the most appreciated non-urban areas could be used for better prioritization, planning, and management.

The analysis used for creation of this ecosystem service shown that in this platform 26 photographers had inserted their pictures/images or in total 167 pictures/images were uploaded. It is interesting that one photographer had uploaded 55 pictures/images, two other photographers had uploaded 26 pictures/images and one photographer had uploaded 17 pictures/images.



Map 23: Nature photographers/shots taken

The Map 24 was developed as heat map where the original values were from 0 to 20 where 20 is the number of photographer per unit area. Further the data was rescaled from 0 to 10. The most popular areas are those where more people take pictures, subsequently sharing them online (Gliozzo et al.,2016).

The qualitative analysis of the pictures indicated that top hot spots for nature photographers within the study area and on its borders are this localities: lake Black Lake, site Golem Rid and most of the sites above village Vrapchishte, Small Vraca peak with almost all mountain border line with Republic of Kosovo and those should be further promoted, planned and managed toward tourism promotion of the municipality.

4 CONCLUSIONS

- Total annual milk production is 8.096.612,5 l/annually, and per hectare is 515,71 l/ha/annually. The cows are considered as the larger milk producers with 60% of the total milk production or 4.873,480 l/annually.

- For more comprehensive approach the data for milk production can be presented in kg as well. The total annual milk production is 8.339.510,88 kg/annually, and per hectare is 527,887 kg/ha/annually where the milk from cow is 5.019.684,4 kg/annually, from sheep 2.842.182 kg/annually and from goat 477.644,48 kg/annually

- Locality Bristovac has the biggest production of litter per ha 3,44 l/ha or 3,54kg/ha compared to the other localities where the production of milk per ha is less than 1 litter/ha.

- Total meat production is 1.227.229 kg/annually analyzed on the total area of the Municipality of Vrapchisht is 78,17 kg/ha/annually. The sheep/goat are categorized under the same category and their participation in the total meat production is 52% or 641.410 kg/annually.

- Locality Bristovac has the biggest production of meat kg/ha 183.81 kg/ha compared to the other localities where the production of milk per ha is less than 65 kg/ha.

- The spatial calculations for the forage production shows that the capacities are 6.552 t/ha.

- The total hunting area in Municipality of Vrapchisht is 15.542ha, with monetary value around 55.000 € or 3.5€/ha.

- The ecosystem service game is 5 times bigger than hunting tourism as service.

- The forests according to FMP Mazdraca occupy area of 7.206 ha.
- 54% of the forests from FMP Mazdraca are within the territory of the Municipality of Vrapchisht.
- The annual cut is 2.970m3 of firewood.
- The total value of forest products (firewood) 141.253,20 Euros/annually
- The value of the forest land is 47,56 Euros/ha.
- The Municipality of Vrapchisht has potential from the spring in regards to the drinking water with quantity potential of 7.821m^3/day

- Total potential of drinking water compared per inhabitant in the Municipality of Vrapchisht is 307,92 liter/day which is above each of the mentioned EU trends for daily water use necessary per inhabitant.

- The monetary value of the drinking water as ecosystem service in Municipality of Vrapchisht is 1.173,15€ per day or 428.199,75€ on annual level

- The forests around the springs and immediate catchments which gravitate towards the springs, should be considered protective forests and high conservation value forests for water conservation. Based on the GIS analysis these zone which should be considered for protection covers 936 ha.

- The total carbon storage per study area is 244.192 mg of C.

- The total air purification effect is 2060,4 tons of the total study area.

- The total quantity of produced sediment in the catchment is 64,651 m3/year or the specific production of sediment is 409 m3/km2/year.

- Without vegetation the total quantity of produced sediment in the catchment will increase and will be 174,357 m3/year or the specific production of sediment will be 1103 m3/km2/year. If we consider the market price for soil (5-8 EUR/m3) than the total value of soil conservation that forest provide would be around 1mliion EUR.

- The value of the forest is very significant in keeping the soil in the catchment and the total stabilized sediment because of the vegetation is 109,706 m3/year.

- Municipality of Vraphishte have good cultural potential, within this report were considered 55 objects - Churches, Mosques, Archaeological sites.

- 56% or 31 objects are very close to the roads network or less or equal to 40m.

- The longest distance of the cultural point to the road network is around 800m.

- The analysis shown that 26 photographers had insert 167 pictures/images.

- 33% pictures/images were uploaded by one photographer.

- Top hot spots for nature photographers within municipality and on its borders are this localities: lake Black Lake, site Golem Rid and most of the sites above village Vrapchishte, Small Vraca peak with almost all mountain border line with Republic of Kosovo and those should be further promoted, planned and managed toward tourism promotion of the municipality.

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6 ANNEXES

6.1 Annex A - Event participation and data gathering

According to ToR, the team of consultants had participated on different consultation and data gathering events, as follows:

6.1.1 A1. "Informing and mobilizing stakeholders and social partners in the Municipality of Vrapciste, in order to optimally support the ecosystem and value of its services"

Date: Wednesday, 06 March 2019

Venue M-LINE Restaurant, Conference Hall Gradec, Municipality of Vrapciste

6.1.2 A2. Stakeholder mobilization in peri-urban area,

Date: 15 March 2019

Venue: Municipality of Vrapcisht

6.1.3 A3. Stakeholder mobilization in peri-urban area,

Date: 27 March 2019

Venue: Municipality of Vrapcisht

6.1.4 A4. Stakeholder mobilization in peri-urban area,

Date: 29 March 2019

Venue: Municipality of Vrapcisht

6.1.5 A5. Stakeholder mobilization in peri-urban area,

Date: 05 April, 2019

Venue: Faculty of Forest Science, Landscape Architecture and Environmental Engineering – Hans Em – University SS Cyril and Methodius in Skopje.

6.2 Annex B - List of Churches, Mosques and Archeological sites

Churches

1. Church - Debreshe 41°49'06.9"N 20°52'36.3"E
2. Church Presveta Bogorodica - Galate 41°50'32.5"N 20°52'27.6"E
3. Church St. Kliment Ohridski - Pozharane 41°51'04.7"N 20°52'16.8"E
4. Church St. Nikola - Pozharane 41°51′8″N 20°51′58″E
5. Church St. Ilija - Vrapchiste - 41° 50′ 5″ N, 20° 52′ 38.5″ E
6. Church St.Dimitrij - Vrapchisht - 41°50'08.0"N 20°52'52.0"E

Mosques

1. Mosque - Debreshe 41.818545, 20.877870
2. New Mosque - Debreshe 41.817879, 20.881897
3. Debreshe Central Mosque - Debreshe 41.819222, 20.886978
4. Vranovci Mosque - Vranovtsi 41.825685, 20.868679
5. Hadzhi Ahmet's Mosque - Vrapchisht 41.832328, 20.883306
6. Vrapchisht Mosque - Vrapchisht 41.835194, 20.886073
7. Vrapchisht Mosque - Vrapchisht 41.837074, 20.883766
8. Mosque - Toplitsa 41.858986, 20.886429
9. Old Mosque - Mehalla e Eperme, Dobri Dol 41.866212, 20.887953
10. Mosque Hamza - Dobri Dol 41.867095, 20.891940
11. Mosque Negotino-Poloshko 41.879156, 20.882526
12. Mosque - Kalishte 41.879580, 20.861195
13. Mosque - Sanokos 41.881825, 20.890829
14. Mosque - Gjurgjeviste 41.894505, 20.862203
15. Mosque - Lomnitsa 41.895755, 20.833128

Archaeological sites

Name	Inhabited area	Type	Period
Брца	Vrapchisht	necropolis	late antique time
Градиште	Vrapchisht	населба	late antique time
Тумба	Vrapchisht	necropolis	middle century
Ограда	Vrapchisht	settlement and necropolis	late antique time
Топлишница	Vrapchisht	settlement and necropolis	late antique time
Гладница - Топлички Извори	Galate	settlement and necropolis	late antique time
Градиште	Galate	settlement	iron and roman time
Голема Чешма	Gradec	church and necropolis	middle century
Градиште	Gradec	settlement	roman time and middle century
Поточане	Gradec	settlement	middle century
Тумба	Gradec	fortification	roman time
Црквиште	Gradec	church and necropolis	middle century
Ливадиче	Dobri dol	necropolis	middle century
Молака	Dobri dol	fortification	middle century
Православни Гробишта	Dobri dol	necropolis	middle century
Сред Село	Dobri dol	depot of coins	middle century
Кај Школото	Dobri dol	necropolis	middle century
Православни Гробишта	Dobri dol	necropolis	middle century
Стари Лозја	Dobri dol	single finding	roman time
Пандилова Тумба	Zubovce	settlement	neolite
Пилигринци	Zubovce	settlement	middle century
Св. Марија	Zubovce	necropolis	middle century
Фиќуровци	Zubovce	necropolis	middle century
Мемски Гробишта	Kalishte	necropolis	middle century
Орман	Kalishte	settlement and smelter	late antique
Соколец	Kalishte	settlement	iron and late antique time
Стојанов Камен	Kalishte	church and necropolis	middle century
Црква	Kalishte	church and necropolis	middle century
Православни Гробишта	Lomnica	necropolis	late middle century
Под Јазот	Negotino	settlement	roman time
Село	Negotino	necropolis	middle century
Сред Село	Negotino	settlement	late antique

Христијански Гробишта	Negotino	necropolis	middle century
Катрање	Pozharane	settlement, church and necropolis	middle century
Царева Чешма	Pozharane	necropolis	late middle century
Сенокоска црква	Senokos	church and necropolis	middle century
Калиполе	Toplica	necropolis	middle century

6.3 Annex C - Legal provisions on grazing

According to LAW FOR FORESTS ("Official Gazette of the Republic of Macedonia" No. 64/09, 24/11, 53/11, 25/13, 79/13, 147/13, 43/14, 160/14, 33/15, 44/15, 147/15, 7/16 and 39/16), article 12, certain terms used in this law concerning grazing have the following meaning:

9. Protection of forests is a system of measures and activities that are implemented in order to ensure the survival of forests, preservation of health status and vitality of forests from illegal appropriation and use, illegal fellings, fires, plant diseases and pests, grazing of cattle, desires, illegal collection of other forest products and other damages; &
22. Pasture is agricultural land that is mostly overgrown with grassland and green vegetation and is primarily used for game nutrition and livestock feeding/grazing;

According to article 13 (1) (Bans), in order to achieve sustainable forest management grazing, grazing of goats and other cattle and acorn extraction/collection without permission is prohibited.

According to article 52 (Grazing and acorn extraction/collection) (1) it is forbidden to feed/graze cattle and acorn collection in the forest. (2) As an exception to paragraph (1) of this Article, on a certain area, cattle can graze, except for goats, and only on forests whereat any ameliorative measures are active, that is, no amelioration measures have been carried out in the past, also on forests in which it is not in progress natural or artificial restoration and rejuvenation, of forests which are set aside (assigned) as seed stands, as well as on the undisturbed forest land. (3) If allowed, grazing and acord collection in the forest may be carried out only under the control of the shepherd of the livestock and with the approval of the forest management entities. (4) The entities that manage the forests and the owners of forests shall be obliged in the forest in which the grazing is prohibited, to determine parts of the forest through which the passage of the livestock to the place of grazing, i.e to the water taps, will be permitted.(5) The forest-managing entities are entitled to compensate/charge for grazing, if allowed. (6) The conditions under which grazing can be carried out (time of grazing, type of stock, number of heads, amount of compensation for grazing, determining the crossings for livestock, etc.) are determined by the subjects that manage the forests.
For misconduct, law prescribes at chapter XII the Misdemeanor Provisions.

6.4 Annex D - Calculation for capitalization of wild animals as ecosystem service

Legend:

HAN - Hunting Area Number
HMP - Hunting Management Plan
AH/SQ - Annual hunting/shooting quota
BF - Basic Fond
TGF – Total game Fond
TFV - Total Fund Value
UP – Unit Price
TMVSA –Total Monetary Value of the Shooting Quota
TMVHA –Total Monetary Value of the Hunting Area

HAN	HMP	Year	Small game						
			Hare			Grey Partridge			TMVTGF
			TGF	UP	TMV	TGF	UF	TMV	
5	Vrapchisht	2017	189	13	2457	210	8.95	1879.5	4336.5
		2018	194	13	2522	213	8.95	1906.4	4428.35
		2019	195	13	2535	213	8.95	1906.4	4441.35

HAN	HMP	Year	Big game					
			Roe deer			Chamois		
			TGF	UP	TMV	TGF	UP	TMV
4	Mazdracha	2017	54+53	325.7/162.86	26219.38	39+39	219.87/179.15	15562
		2018	55+55	325.7/162.86	26870.8	39+39	219.87/179.15	15562
		2019	55+55	325.7/162.86	26870.8	39+39	219.87/179.15	15562

HAN	HMP	Year	Big game			
			Wild boar			TMVTGF
			TGF	UP	TMV	
4	Mazdracha	2017	22+22	219.87/89.58	6807.9	48589.06
		2018	22+22	219.87/89.58	6807.9	49240.48
		2019	22+22	219.87/89.58	6807.9	49240.48

HAN	HMP	Year	Big game					
			Roe deer			Chamois		
			TGF	UP	TMV	TGF	UP	TMV
3	Jelovce	2017	65+65	325.7/162.86	31756.4	32+32	219.87/179.15	12769
		2018	65+65	325.7/162.86	31756.4	32+32	219.87/179.15	12769
		2019	65+65	325.7/162.86	31756.4	32+32	219.87/179.15	12769

HAN	HMP	Year	Big game			TMVTGF
			Wild boar			
			TGF	UP	TMV	
3	Jelovce	29+29	219.87/89.58	8974.05	53499.09	48589.06
		29+29	219.87/89.58	8974.05	53499.09	49240.48
		29+29	219.87/89.58	8974.05	53499.09	49240.48

Year	Value HMP	Value TGF/Vrapchisht
2017	106424.65	54851.1
2018	107167.92	55431.2
2019	107180.92	55437.7

Year	Hunting area	Value TGF/Vrapchisht	Value/ha
2017	15542.8	54851.1	3.529036
2018	15542.8	55431.2	3.566359
2019	15542.8	55437.7	3.566777

6.5 Annex E: Game population in hunting areas

HAN	HMP	Area in ha	Year	Small game			
				Hare - Lepus Europeus		Grey Partridge - Perdix Perdix	
				AH/SQ	BF	AH/SQ	BF
5	Vrapchisht	6610	2017	28	161	44	166
			2018	32	162	47	166
			2019	32	163	47	166

HAN	HMP	Area in ha	Year	Big game					
				Roe deer - Cepreolus Capreolus		Chamoirs - Rupicapra Rupicapra		Wild boar - Sus scrofa	
				AH/SQ	BF	AH/SQ	BF	AH/SQ	BF
4	Mazdracha	11090	2017	10+9	44+44	5+5	34+34	9+9	13+13
			2018	11+11	44+44	5+5	34+34	9+9	13+13
			2019	11+11	44+44	5+5	34+34	9+9	13+13
Note (Males + Females) = M+F				M + F	M + F	M + F	M + F	M + F	M + F

HAN	HMP	Area in ha	Year	Big game					
				Roe deer - Cepreolus Capreolus		Chamoirs - Rupicapra Rupicapra		Wild boar - Sus scrofa	
				AH/SQ	BF	AH/SQ	BF	AH/SQ	BF
3	Jelovce	13100	2017	13+13	52+52	4+4	28+28	12+12	17+17
			2018	13+13	52+52	4+4	28+28	12+12	17+17
			2019	13+13	52+52	4+4	28+28	12+12	17+17
Note (Males + Females) = M+F				M + F	M + F	M + F	M + F	M + F	M + F

Legend:

HAN - Hunting Area Number
HMP - Hunting Management Plan
AH/SQ - Annual hunting/shooting quota
BF - Basic Fond
TGF – Total game Fond
TFV - Total Fund Value
UP – Unit Price
TMVSA –Total Monetary Value of the Shooting Quota
TMVHA –Total Monetary Value of the Hunting Area

6.6 Annex F - Value of shot game

HAN	HMP	Year	Small game						
			Hare			Grey Partridge			TMVAH/SQ
			AH/SQ	UP	TMV	AH/SQ	UF	TMV	
5	Vrapchisht	2017	28	13	364	44	8.95	393.8	757.8
		2018	32	13	416	47	8.95	420.65	836.65
		2019	32	13	416	47	8.95	420.65	836.65

HAN	HMP	Year	Big game					
			Roe deer			Chamoirs		
			AH/SQ	UP	TMV	AH/SQ	UP	TMV
4	Mazdracha	2017	10+9	325.7/162.86	4722.74	5+5	219.87/179.15	1995.1
		2018	11+11	325.7/162.86	5374.16	5+5	219.87/179.15	1995.1
		2019	11+11	325.7/162.86	5374.16	5+5	219.87/179.15	1995.1

HAN	HMP	Year	Big game			
			Wild boar			TMVAH/SQ
			AH/SQ	UP	TMV	
4	Mazdracha	2017	9+9	219.87/89.58	2785.05	9502.89
		2018	9+9	219.87/89.58	2785.05	10154.31
		2019	9+9	219.87/89.58	2785.05	10154.31

HAN	HMP	Year	Big game					
			Roe deer			Chamoirs		
			AH/SQ	UP	TMV	AH/SQ	UP	TMV
3	Jelovce	2017	13+13	325.7/162.86	6351.28	4+4	219.87/179.15	1596.1
		2018	13+13	325.7/162.86	6351.28	4+4	219.87/179.15	1596.1
		2019	13+13	325.7/162.86	6351.28	4+4	219.87/179.15	1596.1

HAN	HMP	Year				
			Wild boar			TMVAH/SQ
			AH/SQ	UP	TMV	
3	Jelovce	2017	12+12	219.87/89.58	3713.4	11660.76
		2018	12+12	219.87/89.58	3713.4	11660.76
		2019	12+12	219.87/89.58	3713.4	11660.76

6.7 Annex G Type of ecosystem services costs

Type of Ecosystem service	MKD	EUR (1Euro = 61.5 MKD)
Milk production	Price per l	
Cow	20	0.325
Sheep	27	0.439
Meat Production	Price per kg	
Lamb	170	2.764
Beef	230	3.74
Pork	130	2.114
Forage	Price per kg	
Hay	3	0.049
Wild Animals	Price per animal	
Hare	800	13
Grey partridge	550	8.943
Roe Deer (Male/Female)	20,030/10,000	325.7/162.86
Chamois (Male/Female)	13,522/11,018	219.87/179.15

Wild boar (Male/Female)	20,030/5,510	219.87/89.58
Timber production	price/m3	
Fire wood – Oak	2,970	48.293
Fire wood - Beech	2,870	46.666
Water supply	price/m3	
Weighted water	7.64	0.124
Ground water	price/m3	
Drinking water for households	10	0.163
Water for industrial objects	15	0.244
Carbon storage (using the Bulgarian data as neighboring country)	Not established market for this service	
	n.a.	n.a.
	550	8.93
Air purification	Not established market for this service	
	n.a.	n.a.
Soil erosion (direct costs for reforestation of 1ha)	Price per ha	
	153,750	2,500

The prices for reforestation are from 1,000 Euro up to 5,000 euros, depends of the terrain, for this purpose we use 2,500 euros		
Cultural heritage	Not established market for this service	
	n.a.	n.a.
Nature photographers	Not established market for this service	
	n.a.	n.a.