DIKTAS

Protection and Sustainable Use of the Dinaric Karst Transboundary Aquifer System

Country Report
Albania

November 2012

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HYDROGEOLOGICAL OVERVIEW

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CHAPTER 1 CURRENT KNOWLEDGE ON GROUND WATER RESOURCES

1. INTRODUCTION

DIKTAS is a project initiated by the aquifer-sharing states and supported by Global Environment Facility (GEF) to improve understanding of transboundary groundwater resources of the Dinaric region and to facilitate their equitable and sustainable utilization, including the protection of unique karst groundwater dependent ecosystems. The core DIKTAS project partners are four GEF fund-recipient countries of the Dinaric region, namely Albania, Bosnia and Herzegovina, Croatia and Montenegro. Several other countries (in the Dinaric region and beyond) and international organizations have also joined this challenging project. DIKTAS is a full-size GEF regional project, implemented by UNDP and executed by UNESCO-IHP.

Many other countries and international organizations have joined to the Diktas project challenging and provide a valuable contribution to the realization of its objectives. This project is addressing the issue of a sustainable management of groundwater and karst ecosystems. It is the first time introduced the universally proven principles of integrated management in fresh water of a karst groundwater aquifer of this type and size. There is a collaborative effort aimed at:
- To facilitate the use of transboundary sustainable water resources of the Dinaric karst aquifer
- To protect ecosystems dependent on underground waters those uniquely characterize the Dinaric karst region of the Balkan Peninsula. The project aims, in its own views, to identify the progress and perceptions about water management issues that apply to transboundary karst aquifers. It needs the opinion of all participants involved in order to help to design a groundwater management in the project area. The project is built according to the following model, giving us in its first part so-called - **situations analyse:**

1 - Context in which applied and implemented as well as global importance of the project
2 - Concerns, causes and socio-economic base and analysis of the barriers encountered
3 - The problems which we referred
4 - Analysis of stakeholders in the project area.

In the second half according to the project - **Strategy** - stays its strategy which takes into account:

1 - Political context and institutional sector
2 - Rationalization and political conformity
3 - Objectives and goals of the project, results and achievements / activities
4 - Indicators of project, risks and assumptions

5 - Justification of growth of benefits at local, national and world level
6 - The sustainability of the project
7 - Replication of the project during its development stages.

The third part takes into consideration project management in different stages of its progress while the fourth is that of monitoring. In the fifth and last part of the legal context is presented according to the project development. Albania through its experts participated in the four working groups consolidated as part of the project. It has contributed in the context of analysis of potential users of project results or interested groups that will effectively help in the successful implementation of the project. From the other hand an abundant database is created regarding the water resources and the other activities related to them.

1.1 Project tasks and the role of WG

Karst studies have been a part of the UNESCO Science Sector programmes (International Geoscience Programme, IGCP and International Hydrological Programme, IHP) since last three decades.Since 1972 UNESCO has coordinated and conducted a Global Study of Karst Aquifers and Water Resources and supported an array of international activities in the field of Karst Hydrogeology and Karst Water Resources Management in the region. Through these activities the UNESCO was instrumental in increasing global understanding of karst hydrogeology and water resources challenges.
The Project is organised in four components, wherein the following fields of activities are foreseen:

Component (1)

1. Improving the understanding of the resource and of its environmental status.
2. Scientists and experts of the participating countries develop a Transboundary Diagnostic Analysis; countries agree on baseline conditions and adopt environmental status indicators.
3. Information database, including harmonized morphologic and thematic base maps, is prepared and adopted as basis for joint actions.
4. Countries select sites for possible pilot demonstrations, based on agreed upon criteria.

Component (2)

1. Establishing cooperation mechanisms among countries sharing the aquifer.
2. Cooperation schemes identified and tested in pilot sites, addressing different transboundary situations and concerns.
3. Results achieved are shared among countries, and consensus is built on more effective frameworks for cooperation and exchanges.

4. Establishment of a Consultative Body for the Dinaric Karst Aquifer System, and of coordination mechanisms with other relevant activities in the region – including GEF projects.

Component (3)

1. Facilitating the harmonization of policies and priority reforms. Establishment of inter-ministerial committees that oversee the preparation of and agreement on a Strategic Action Program, based on analysis of options, which includes:
2. priority policy, legal and institutional reforms, and investments that the countries are willing to undertake to address key transboundary concerns;
3. environmental quality targets and a joint harmonized monitoring program of the environmental status. Adoption of the SAP at governmental level.
4. Organization of a Partnership Conference with the participation of all countries of the region, key regional and international agencies and academic institutions, bilateral and multi lateral.

Component (4)

1. Communication, dissemination and replication of activities
2. Various communication tools identified and used to highlight relevance of the Dinaric Karst Aquifer
3. A project website
4. Targeted capacity building programs to encourage effective replication of new practices
5.

The task of Work Group 1 – Hydrogeology within DIKTAS project is to collect, analysing and process data and information necessary for a complete and reliable Transboundary Diagnostic Analysis (TDA). It is necessarily prepare a report about the current status of knowledge on the assessment of the hydrogeological characteristics of the Dinaric Karst aquifers at the national level including compilation of information available, review of existing relevant text and cartographic documentation on geology, structural geology, hydrogeology, geomorphology, hydrochemistry etc.

Briefly, the WG Hydrogeology will provide based on all relevant data defined (if it is precisely possible) transboundary aquifers (TBA) between parties:

- characterisation of TBA, including definition of status of present use of the aquifers
- collect data and analyse existing plans and projects and possible interactions regar ding.
- transboundary karst aquifers;
- define qualitative status of groundwaters in the transboundary aquifers
- define main pressure regarding quantity
- analyze and prioritize existing threats to groundwater quality in the the Dinaric Karst including contamination from point and disperse sources and land degradation;

The group will develop the first regional GIS hydrogeological base, with all relevant data regarding groundwater, especially in the area of TBA.

The content of this report (and all national hydrogeological reports) is proposed by advisor of hydrogeological group professor Zoran Stevanoviæ and adopted by project management.

1.2 General on karst term, distribution, importance

Karst is defined as a terrain, generally underlain by limestone or dolomite, in which the topography is chiefly formed by the dissolving ofrock, and which is characterized by sinkholes, sinking streams, closed depressions, subterranean drainage and caves (Field 2002).

A wide range of closed surface depressions, a well-developed underground drainage system, and strong interaction the between circulation of surface water and groundwater typify karst.

Due to very high infiltration rates, especially in bare karst, overland and surface flow is rare in comparison with non-karst terrains.

Carbonate rocks are more soluble than many other rocks. They are subject to a number of geo-morphological processes. The processes involved in the weathering and erosion of carbonate rocks are many and diverse. The varied and often spectacular surface landforms are merely a guide to the presence of unpredictable conduits, fissures and cavities beneath the ground. But at the same time these subsurface features can occur even where surface karstic landforms are completely absent. Diversity is considered the main feature of karstic systems, which are known to change over time and in space so that an investigation of each system on its own is required. Interactions between the surface and subsurface in karst are very strong (Bonacci 1987). Groundwater and surface water are hydraulically connected through numerous karst features that facilitate theexchange of water between the surface and subsurface (Katz et al 1997). High and fast oscillations of groundwater levels in karst control the hydrogeological and hydrological regimes of influent and underground streams. An important issue in studying these streams isthat subsurface water is highly heterogeneous in terms of the location of conduits, the location of vertically moving water, and flow velocities. Due to the previously mentioned reasons, the occurrence of losing, sinking and underground stream flows is more the rule than an exception. The first version of the world map of carbonate rocks appeared in Ford & Williams (1989) Karst Geomorphology and Hydrology. A revision was published in Williams & Ford (2006) Zeitschrift für Geomorphologie

Suppl-Vol 147, 1-2, and used in Ford & Williams (2007) Karst Hydrogeology and Geomorphology (Wiley).

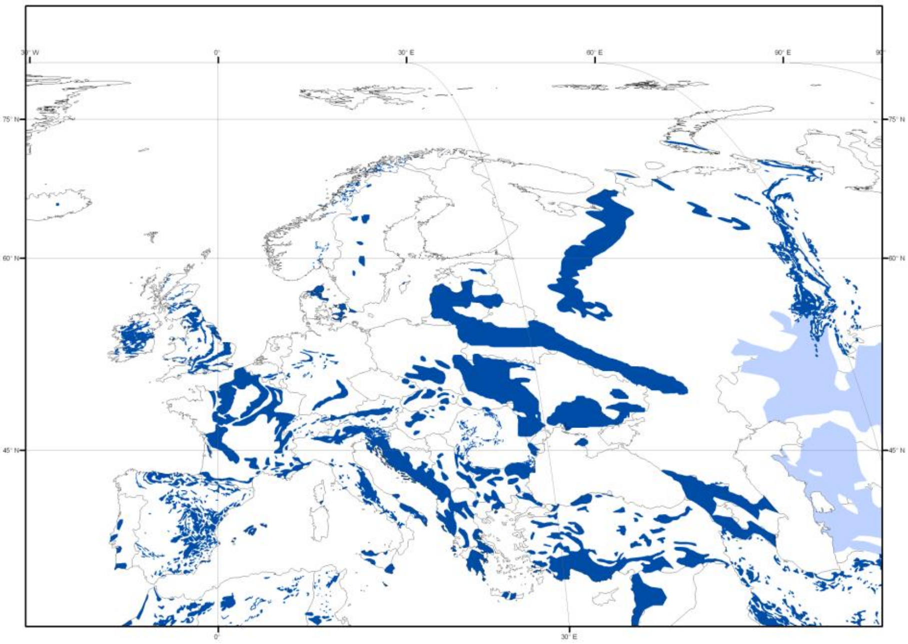


Fig. 1: Karst regions in the Europe

Excluded Antartica, Grenland and Island karst regions wide the world cover 133448089 km^2 or 13.2%. In Europe the karst areas cover 6125842 or 21.8% of territory (table 1).

The Dinaric karst, one of the European the biggest, extended from Slovenia via Croatia, Bosnia and Herzegovina, Serbia, and Montenegro up to Albania.

Table 1: **WORLD CARBONATE OUTCROP AREAS**

SGGES, University of Auckland, New Zealand-21-Mar-10

Region	**Countries Included**	**Land Area km^2**	**Maximum Carbonate Outcrop (km2)**	**Percentage**
World	Exclude Antarctica, Greenland and Iceland	133448089	17655024	13.2
Russia Federation plus	Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Russia, Turkmenistan, Uzbekistan	20649781	3993639	19.3
South America	Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Falkland	17792882	370809	2.1

	Islands (Malvinas), French Guiana, Guyana, Paraguay, Peru, South Georgia and the South Sandwich Island, Surinam Uruguay,Venezuela			
Africa	Algeria, Angola, Benin, Botwana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo, Congo the democractic, Cote D'ivoire, Djibouti, Egypt, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Libya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mayotte, Morocco, Mozambique, Namibia, Niger, Nigeria, Reunion, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, Sudan, Swaziland, Tanzania, Togo, Tunisia, Uganda, Western Sahara, Zambia, Zimbabwe	30001574	3041664	10.1
North America (exclude Greenland)	Anguilla, Antigua and Barbuda, Bahamas, Barbados, Belize, Bermuda, Canada, Cayman Islands, Costa Rica, Cuba, Dominica, Dominica Republic, El Salvador, Guadeloupe, Guatemala, Haiti, Honduras, Jamica, Martinique, Mexico, Monsterrat, Nicaragua, Panama, Puerto Rico, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Turks and Caicos Islands, US, Virgin Islands, Virgin Islands (US)	22229293	4076077	18.3
East and South East Asia	Brunei Darussalam, Cambodia, China, East Timor, Indonesia (excluding Papua), Japan, Korea (north and south), Lao, Malaysia, Mongolia, Myanmar, Philippines, Singapore, Taiwan, Thailand, Vietnam	15638629	1688219	10.8
Middle East and Central Asia	Afghanistan, Bangladesh, Bhutan, Cyprus, India, Iran, Iraq, Israel, Jordan,Kuwait, Lebanon, Maldives, Nepal, Oman, Pakistan, Palestine, Qatar, Saudi Arabia, Sri Lanka, Syria, Tajikistan, Turkey, United Arab Emirates, Uzbekistan, Yemen	11129677	2554380	23.0
Europe (exclude	Albania, Andorra, Austria Belarus,	6125842	1337635	21.8

Iceland and Russia)	Belgium, Bosnia and Hercegovina, Bulgaria, Croatia, Czech, Denmark, Estonia, Faroe Islands, Finland, France, Germany, Greece, Hungary, Ireland, Italy, latvia, Liechtenstein, Lithuania, Luxembourg, Macedonia, Malta, Moldova, Monaco, Netherlands, Norway, Poland, Portugal, Romania, San Marino, Slovakia, Slovenia, Spain, Sweden, Switzerland, Ukraine, UK, Vatican City, Yugoslavia			
Australasia	American Samoa, Australia, Baker-Howland-Jarvis, Christmas Island, Cook Islands, Fiji, French Polynesia, Guam, Kiribati, Marshall Islands, Micronesia, New Caledonia, New Zealand, Niue, Norfolk Island, Northern Mariana Islands, Palau, New Guinea (Papua New Guinea plus Papua) , Solomon Islands, Tonga, Tuvalu, Vanuata, Wallis and Futuna Islands, West Iran, Western Samoa.	9611377	592601	6.2

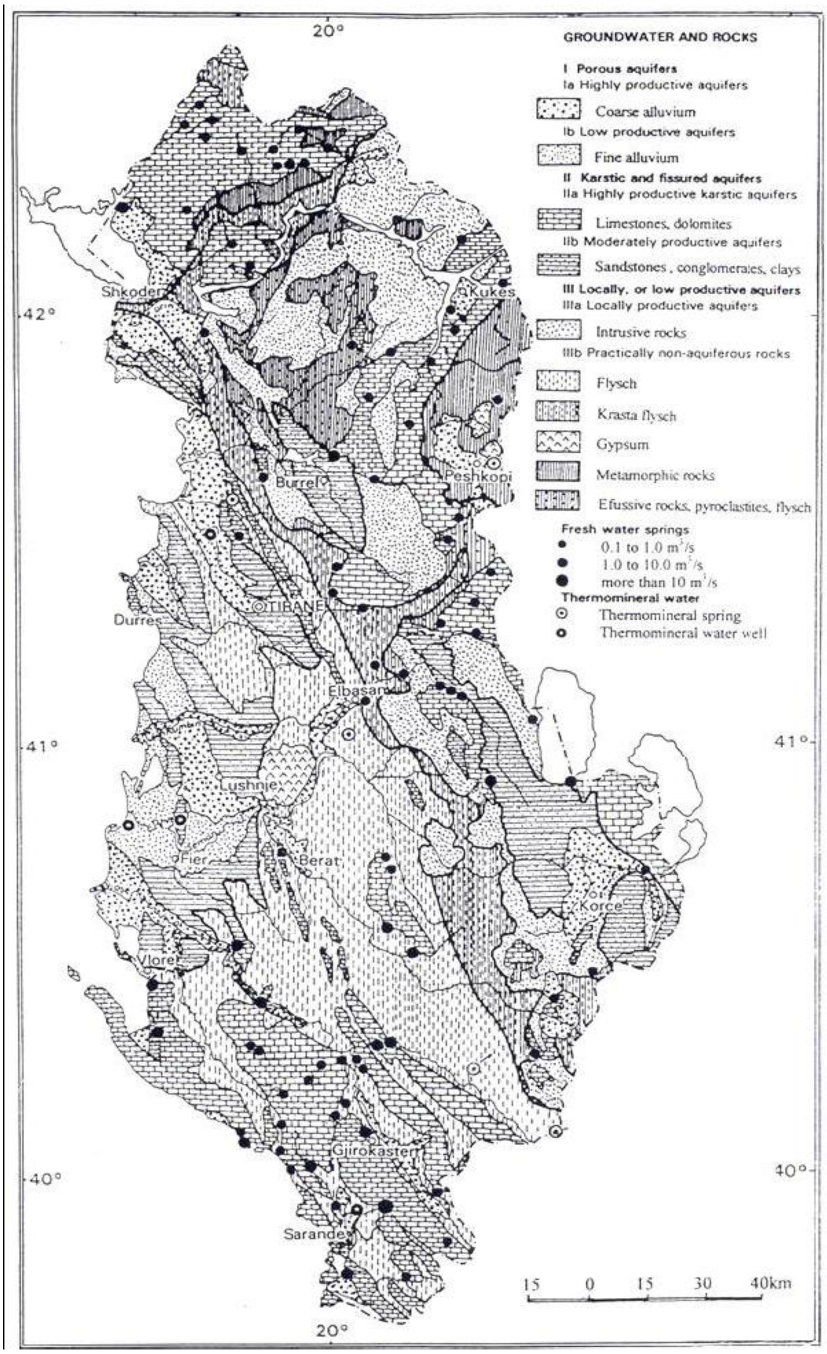


Fig. 2: Hydrogeological Albanian Map (by R. Eftimi, 1983)

The first studies for karstic waters in Albania had beggining in 1952 when the hydrogeology Enterprise was established. before were realized some partiall studies at the framework of regional geological studies for Albania from the the foreigner scientist as of austrian, italian, russian and chinesse geologists. After 1952 the karst areas are delineated and some geological studies were made in terms of tproperties determination. At 1980 when the Albanian geological map was finished the new knowledge were collected related to karst formation and thier extention and elongation. More studies has been carried from the Geographic Center of Albania but mainly for the caves,meantime the geological studies are concetrate to the evaporitic rocks as the karstic formations. The hydrogeology department has studied the karst characteristics for the drinking water purposes regarding to mainl natural springs. Some other effortsin 2001 are made through the trace elements using for the hydraulic connection of karstic waters with surround objects.

Albania is one of the most karst developed countries in Eastern Mediterranean Alpine Chain. Carbonate and evaporate rocks over of about 23% of total surface of Albania. The Stages of karst development are divided in two groups:
a- Triassi_c-Palaeo_ene-Eo_ene stage
b- Palaeo_ene-Eo_ene up to nowadays karst stage.
Karst is developed mainly during second stage, with which is linked morphology of karst processes. In Albania there are developed surface and underground karst processes, expressed with different forms such as: Karst holes, depressions, lapieses and up to large forms karst fields and karst caves. The main factor influencing to the karst development it is the tectonic one. Development, extension and dynamics of karst in Albania have conditioned different karst ecosystems. These ecosystems are expressed in main natural components such as: relief, hydrography, living world, soils, and management of ecosystems by human beings. In Albania there are widespread large karst fields which over tenths km^2. Amongst them we _can name:

1. Mbi Shkodra Karst field,
2. Mali me Gropa ("Mountain with holes"),
3. Bjeshket e Vermoshit, Lepusha,
4. Kurveleshi Plateau, Cajupi, Tomorri et_.

In Karst e_osystems there is noted hydrography of spe_ifi_c features expressed on surfa_ce and in underground of carbonate massifs. Carbonate massifs represent natural basins for _olle_tion of large water reserves. The biggest water springs there are:

1. Selita springs in Mali me Gropa, east of Tirana
2. Cold water springs in Tepelena region
3. Big water springs in Albanian Alps
4. Bogova springs in Skrapari region.
5. Kel_cyra _springs in Permeti region

In Karst springs there are determined high content of bicarbonate ions. Commonly they are old-water springs of low temperature. On the surface of carbonate rocks there are widespread agri_cultural soils whic_h over 30-40% of total agric_ultural soils. These soils are of good _chemical, physical and biological features useful for natural and artificial plants. Karst ecosystems in Albania are of different biological forms. Albania is one of the ri chest countries in biolological diversity related to its small surface. Water springs in ecosystems are of different views. In soils of full profile there are grown high forests such as in Tomorr, Dajti, Albanan Alps, in Morava et. At 1983 was designed the Albanian hydrogeological map but only as a picture without a text that should be accompanied it. At 2010 was beginning another project for a new hydrogeological map of Albania undertaken by Hydrogeological Department of Albanian Geological Survey. The project is in its third year. It will fulfill the needs for this map and the text.

CHAPTER 2 PHYSIOGRAPHY AND CLIMATE

2. Physiography and climate

The next sub-chapters briefly describe main physiographic, land use and climate characteristics of Albania with emphasize on the area of interest for DIKTAS project.

2.1. Geographic position and boundaries

Albania has a total area of 28,748 km^2 (11,100 sq mi). It shares a 172 km (107 mi) border with Montenegro to the northwest, a 115 km (71 mi) border with Kosovo http://en.wikipedia.org/wiki/Geography_of_Albania to the northeast, a 151km (94 mi) border with Macedonia to the north and east, and a 282 km (175 mi) border with Greeceto the south and southeast. Its coastline is 487 km (303 mi) long. The lowlands of the west facethe Adriatic Sea and the strategically important Strait of Otranto, which puts less than 100 km (62 mi) of water between Albania and the heel of the Italian "boot" (links Adriatic Sea to Ionian Sea and Mediterranean Sea).Albania has coastline on the Adriatic Sea and the Ionian Sea.

Continent	Europe
Subregion	Southeast Europe
Geographic coordinates	41°00′N 20°00′E
Area - Total - Water	Ranked 143rd 28,748 km² 1,350- km² (2.30%)
Coastline	487 km
Land boundaries	720 km
Countries bordered	Greece 282 km, Montenegro 172 km, Macedonia 151 km, Kosovo 115 km
Maritime claims	12 nmi (22.2 km; 13.8 mi)
Highest point	Mount Korabi, 2,754 m
Lowest point	Adriatic Sea, 0 m
Longest river	Drini River, 335 km
Largest inland body of water	Lake Shkodër 530 km²
Land Use - Arable land - Permanent crops - Other	20.1 % 4.21 % 75.69 % (2005 est.)
Irrigated Land	3,530 km²
Climate:	Mild temperate to cool
Terrain:	Mountains, hills, small plains
Natural resources	petroleum, natural gas, bauxite,chromite, copper, iron ore, nickel, salt, timber, hydropower
Natural hazards	earthquakes, tsunamis, floods,drought
Environmental issues	deforestation, soil erosion, water pollution

Table 2 Geographic data of Albania

Fig.3 Geographic position of the Albania

The 70% of the country that is mountainous is rugged and often inaccessible. The remainder, an alluvial plain, receives precipitation seasonally, is poorly drained, and is alternately arid or flooded. Much of the plain's soil is of poor quality. Far from offering a relief from the difficult interior terrain, the alluvial plain is often as inhospitable as the mountains. Good soil and dependable precipitation, however, are found in intermontane river basins, in the lake district along the eastern frontier, and in a narrow band of slightly elevated land between the coastal plains and the interior mountains.

In the far north, the mountains are an extension of the Dinaric Alps and, more specifically, the Montenegrin limestone plateau. Albania's northern mountains are more folded and rugged, however, than most of the plateau. The rivers have deep valleys with steep sides and arable valley floors. Generally un navigable, the rivers obstruct rather than encourage movement within the alpine region. Roads are few and poor. Lacking internal communications and external contacts, a tribal society flourished in this area for centuries. Only after World War II were serious efforts made to incorporate the people of the region into Albanian national life.

Land use-Land organization after World War II to 1991

A low coastal belt extends from the northern boundary southward to the vicinity of Vlorë. On average, it extends less than sixteen kilometers inland, but widens to about 50 km (31 mi) in the Elbasan area in central Albania. In its natural state, the coastal belt is characterized by low scrub vegetation, varying from barren to dense. There are large areas of marshlands and other areas of bare, eroded badlands. Where elevations rise slightly and precipitation is regular in the foothills of the central uplands, for example the land is highly arable. Marginal land is reclaimed wherever irrigation is possible.

Just east of the lowlands, the central uplands, called Çermenikë by Albanians, are an area of generally moderate elevations, between 305 and 915 m (1,001 and 3,002 ft), with a few points reaching above 1,520 m (4,987 ft). Shifting along the fault that roughly defines the western edge of the central uplands causes frequent, and occasionally severe, earthquakes.

Although rugged terrain and points of high elevation mark the central uplands, the first major mountain range inland from the Adriatic is an area of predominantly serpentine rock (which derives its name from its dull green color and often spotted appearance), extending nearly the length of the country, from the Prokletije to the Greek border south of Korçë. Within this zone, there are many areas in which sharp limestone and sandstone outcroppings predominate, although the ranges as a whole are characterized by rounded mountains.

The mountains east of the serpentine zone are the highest in Albania, exceeding 2,754 m (9,035 ft) in the Mount Korab (*Mali Korabit*) range at Korabi's Peak (*Maja e Korabit*). Together with the Prokletije and the serpentine zone, the eastern highlands are the most rugged and inaccessible of any terrain on the Balkan Peninsula.

The three lakes of easternmost Albania, Lake Ohrid (*Liqeni Ohrit*), Big Prespa Lake (*Prespa e Madhe*), and Small Prespa Lake (*Prespa e Vogël*), are remote and picturesque. Much of the terrain in their vicinity is not overly steep, and it supports a larger population than any other inland portion of the country. Albania's eastern border passes through Lake Ohrid; all but a small tip of Prespa e Vogël is in Greece; and the point at which the boundaries of three states meet is in Lake Prespa. Each of the two larger lakes has a total surface area of about 260 square kilometers, and Prespa e Vogël is about one-fifth as large. The surface elevation is about 695 m (2,280 ft) for Lake Ohrid and 855 m (2,805 ft) for the other two lakes.

2.2 Vegetation and land cover

Irrigation, desalination, terracing of highlands, and drainage of marshes, often carried out by forced labor, added to the country's cultivable land after 1945. Large population increases reduced the amount of cultivable land per capita by 35% between 1950 and 1987, and by 20% between 1980 and 1988. About 423,000 hectares were irrigated in 1991, up from about 39,300 hectares in 1950. The economic disruptions of the early 1990s left only about 40% of the irrigation system functional and 20% in complete disrepair. Albania also invested substantially in imported Dutch greenhouses during its drive for food self-sufficiency.

Land organization 1991-present

Photo. 1 Albanian farmers outside Peshkopi

In July 1991, the government enacted a law that removed old property claims and regulated redistribution of farmland. The law granted landownership rights to members of the former collective farms and their households without requiring compensation, and also granted land-use rights up to 0.4 hectares to other qualifying residents. The law banned land sales and leases, thereby blocking voluntary consolidation of tiny landholdings.

The law met especially stiff resistance in the country's mountainous northeastern regions where clans tried to stop large numbers of postwar immigrants from gaining title to their land. Local officials also impeded the reform process. Under the land-distribution program, Albania's agricultural sector gained about 380,000 small family farms averaging about 1.4 hectares in size. Western economists estimated that 35% of the new farms would not be economically viable. The government amended the land law to provide for income support of farmers in mountainous areas. The land reform did not account for the 216 state farms and their 155,000 employees, who accounted for about 20% of the agricultural labor force and controlled 24% of the arable land. State farms contributed about 30% of the value of the country's agricultural output. The state farms' yields were about third more than cooperative farms because the state farms benefited from richer soils, moremechanization, easier access to farm services, government finance, and transportation. The breakdown of the communist structure dealt the state farms serious setback. By mid-1991 lines of authority had snapped, equipment and buildings had been plundered, andthe amount of cultivatedland had decreased by half. Although it planned to dissolve 60 unprofitable state farms in the mountainous northeast, the government generally spared the state farms from redistribution because their breakup would reduce urban food supplies.

Agricultural Production

Product	1979-81 Averages	1985	1987	1988-90	2007
Wheat	492	530	565	589	553
Corn	318	400	320	306	412
All cereals	916	1,055	1,010	1,024	1,200
Potatoes	112	136	135	137	
Beef, Mutton, Pork	52	54	55	56	
Vegetables	193	186	188	188	210
Tomatoes	44	47	48	48	
Fruit (excluding melons)	156	193	210	216	200
Sugar Beets	298	320	360	360	
Milk	326	342	346	347	580-95
Eggs	10	13.2	13.2	14	

Table. 3 Production in thousands of tons

Photo. 2 Farmers stacking hay in Vermosh

Before the 1990s, Albania's main food crops were wheat, corn, fruits, and vegetables; however, there was increasing attention to tobacco, olives, and oranges. Between 1989 and 1991, the country's crop structure underwent a radical transformation. A lack of demand led to steep declines in the wheat, tobacco, sugar beets, sunflowers, and cotton grown in Albania. Disputes with the government's land-privatization program, shortages of funds for seeds and machinery, and the hastyprivatization of the companies that provided farmers with machinery and fertilizers also had an effect. In the first third of 1991, milk production was down 50% compared to the corresponding period in 1990, bread-grain production was down 67%, and areas sown with cotton and tobacco had decreased by 80% and 50%, respectively.

In mid -1991, 10% to 15% of Albania's cultivable land lay fallow mainly because the state enterprises were not giving small farmers seed, fertilizers, and other necessities. Transportation breakdowns and other problems continued to force farmers away from crops requiring processing, leaving wheat, sugar, and vegetable oils in short supply. However, corn, meat, egg, and vegetable production increased. Despite these grounds for optimism, domestic production in 1992 was projected to meet only about 88% of the country's need for meat, 48% for wheat, 30% for sugar, and 5% for vegetable oils.

2.3 Rainfall regime

Average precipitation is heavy, a result of the convergence of the prevailing airflow from the Mediterranean Sea and the continental air mass. Because they usually meet at the point where the terrain rises, the heaviest rain falls in the central uplands. Vertical currents initiated when the Mediterranean air is uplifted also cause frequent thunderstorms. Many of these storms are accompanied by high local winds and torrential downpours.

When the continental air mass is weak, Mediterranean winds drop their moisture farther inland. When there is a dominant continental air mass, cold air spills onto the lowland areas, which occurs most frequently in the winter. Because the season's lower temperatures damage olive trees and citrus fruits, groves and orchards are restricted to sheltered places with southern and western exposures, even in areas with high average winter temperatures.

Lowland rainfall averages from 1,000 millimeters (39.37 in) to more than 1,500 millimeters (59.06 in) annually, with the higher levels in the north. Nearly 95% of the rain falls in the winter.

Rainfall in the upland mountain ranges is heavier. Adequate records are not available, and estimates vary widely, but annual averages are probably about 1,800 millimeters (70.87 in) and are ashigh as 2,550 millimeters (100.39 in) in some northern areas. The seasonal variation is not quite as great in the coastal area.

The higher inland mountains receive less precipitation than the intermediate uplands. Terrain differences cause wide local variations, but the seasonal distribution is the most consistent of any area.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Avg low (°C/°F)	2 °C/35.6 °F	2 °C/35.6 °F	5 °C/41 °F	8 °C/46.4°F	12 °C/53.6°F	16 °C/60.8 °F	17 °C/62.6 °F	17 °C/62.6 °F	14 °C/57.2 °F	10 °C/50°F	8 °C/46.4 °F	5.0 °C/41.0 °F
Avg high (°C/°F)	12 °C/53.6 °F	12 °C/53.6 °F	15 °C/59 °F	18 °C/64.4°F	23 °C/73.4°F	28 °C/82.4 °F	31 °C/87.8 °F	31 °C/87.8 °F	27 °C/80.6 °F	23 °C/73.4°F	17 °C/62.6 °F	14 °C/57.2 °F
Humidity in %	71	69	68	69	70	62	57	57	64	67	75	73
Sunshine (h/day)	4	4	5	7	8	10	12	11	9	7	3	3
Precipitation in days	13	13	14	13	12	7	5	4	6	9	16	17

Table.4 Climatic data of Albania

2.4 Air temperature

With its coastline facing the Adriatic and Ionian seas, its highlands backed upon the elevated Balkan landmass and the entire country lying at latitude subject to a variety of weather patterns during the winter and summer seasons, Albania has a high number of climatic regions for so small an area. The coastal lowlands have typically Mediterranean weather; the highlands have a Mediterranean continental climate. In both the lowlands and the interior, the weather varies markedly from north to south.

The lowlands have mild winters, averaging about 7 °C (45 °F). Summer temperatures average 24 °C (75 °F), humidity is high, and the weather tends to be oppressively uncomfortable. In the southern lowlands, temperatures average about 5 °C (41 °F) higher throughout the year. The difference is greater than 5 °C (41 °F) during the summer and somewhat less during the winter.

Inland temperatures are affected more by differences in elevation than by latitude or any other factor. Low winter temperatures in the mountains are caused by the continental air mass that dominates the weather in Eastern Europe and the Balkans. Northerly and northeasterly winds blow much of the time. Average summer temperatures are lower than in the coastal areas and much lower at higher elevations, but daily fluctuations are greater. Daytime maximum temperatures in the interior basins and river valleys are very high, but the nights are almost always cool.

2.5 Other climate elements

Evapotranspiration in Albania

Evapotranspiration in Albania is determined by the correlation of different geographical factors like: climate, relief, territory, lithological structure, vegetation, etc. The evaluation of potential evapotranspiration, has been performed with reference to diverse climatic zones in Albania. ET is evaluated by computing its principal components, such as: ETp or reference ETo, ETr, Evaporation Deficit -ÄE, Pluviometric Deficit – ÄXo and Water flow deficit – Zo.

It is calculated by some different methods, such as: Direct observed method, indirect methods using empiric formulas and water balance. ETp or ETo (reference) is calculated by various   methods such as: Turc, Penman, Thornthweit, Penman Monteith, Equation FAO56 Penman-Monteith. In 1990 International Commission for Irrigation and Drenage of OBM in collaboration by the experts researches of FAO is choose the FAO Penman Monteith that correct method for evaluated of ETp. The values of ETp, calculated by different ways, are difference about – äETp ±5÷10%. to the results of the direct observed method by experimental stations

The average monthly ETp on the Albanian territory differs from about ETp = 10 ÷ 40mm in January, the coldest month of the year, to about ETp = 120 ÷ 170mm in June, the hottest month, refersFAO Pennman-Monteith. (fig.1)

The average annual ETp for the multi-annual period is about 800 ÷ 1100mm. The average annual ETp in the plains varies from 1000 ÷ 1100mm and on the mountains about 800 ÷ 850mm. (refers FAO Pennman-Monteith etc.)

Many important indicators to evaluate the integral impact of the natural conditions of the territory on the ETprocess are respectively: Reference ETp, ETr and Deficit Evaporation – ÄE. Apart from, deficit Pluviometric – ÄXo is also important.

In the general scheme of evapotranspiration intensity process, the natural conditions of the Albanian territory are grouped as the following:

Territory morphometric parameters.

Morphometric factors are determined by the topographical characteristics of the Albanian territory. The main parameters considered are: territory average altitude, and distance from the Sea.

Territory climatic parameters are: Sun radiation (J), Air temperature (ta), precipitation (Xo), Air humidity (I0), wind (v), etc.

Water balance parameters are: pluviometric deficit (_Xo) and water flow deficit – (Zo).

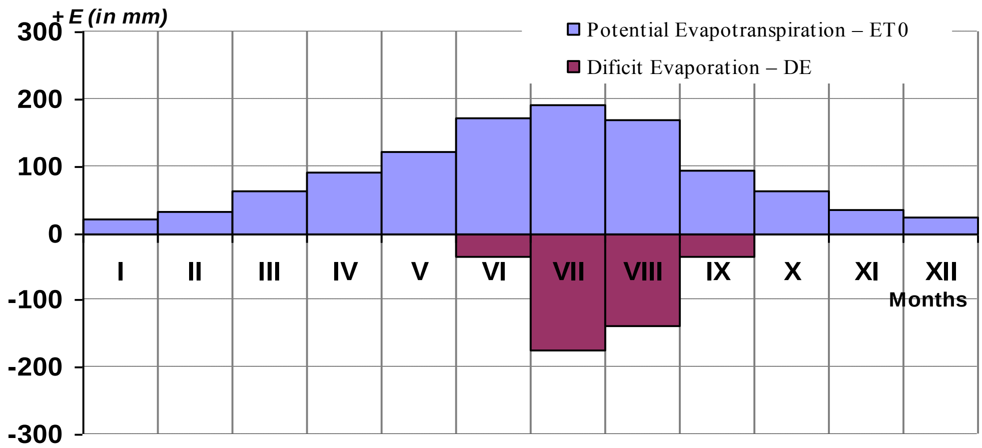
For the natural specific conditions of the Albanian territory, particularly, for mountainous areas, values of both evapotranspiration components were computed based on their vertical gradients and their altitude above sea level.

Composition methodology of the distribution for annual evapotranspiration components (ET0, ETR, AE, AX0 and Z0) used in the paper consist in classification of the Albanian territory by respectively gradient Pm=Xo/h.

Evapotranspiration components and territory altitude subdues the vertical zone low, having a typical regional character. Using these dependences, in the table 4 are made their components for the Albanian territory.

Deficit evaporation ÄE is computed as the difference ÄE=(ETp-ETr). ÄE in Albania varies about 425 ÷ 450mm on the coastal area to 150 ÷ 200mm in the mountains. Having already recognised the ETp values, it is possible to determine the pluviometric deficit ÄE referring to every period of the year, as a difference of potential evapotranspiration with the respective rainfalls corresponding to this period. It is in this way that the water balance-sheet for every month of the year is calculated, likewise the pluviometric deficit is later determined during the dry months, whereas the superfluous water-supply is determined during the wet months.

The pluviometric deficit in Albania is represented in fig.3, wherein it is evident that during the June-September period Et0 is greater than the rainfalls, consequently there is shortage of water-supply. The opposite happens during the October-May period when the rainfalls are greater than Eto, consequently there are excessive rainfalls.



Graph. 1 Potential Evapotranspiration on Albania

CHAPTER 3 - Hydrology

3.1. Hydrographic network

Fig. 4 Map of major riversin Albania

Nearly all of the precipitation that falls on Albania drains into the rivers and reaches the coast without even leaving the country. In the north, only one small stream escapes Albania. In the south, an even smaller rivulet drains into Greece. Because the topographical divide is east of the Albanian border with its neighbors, a considerable amount of water from other countries drains through Albania. An extensive portion of the basin of the White Drin river (*Drini i Bardhë*), basin is in the Rrafshi i Dukagjinit area, across Albania's northeastern border. The three eastern lakes that Albania shares with its neighboring countries, as well as the streams that flow into them, drain into the Black Drin river (*Drini i Zi*). The watershed divide in the south also dips nearly 75 km (47 mi) into Greece at one point. Several tributaries of theVjosa River rise in that area. With the exception of the Black Drin, which flows northward and drains nearly the entire eastern border region before it turns westward to the sea, most of the rivers in northern and central Albania flow fairly directly westward to the sea. In the process, they cut through the ridges rather than flow around them. This apparent geological impossibility occurs because the highlands originally were lifted without much folding. The streams came into existence at that time. The compression and folding of the plateau into ridges occurred later. The folding process was rapid enough in many instances to dam the rivers temporarily. The resulting lakes existed until their downstream channels became wide enough to drain them. This sequence created the many interior basins that are typically a part of the Albanian landform. During the lifetime of the temporary lakes, enough sediment was deposited in them to form the basis for fertile soils. Folding was rarely rapid enough to force the streams into radically different channels. The precipitous fall from higher elevations and the highly irregular seasonal flow patterns that are characteristic of nearly all streams in the country reduce the economic value of the streams. They erode the mountains and deposit the sediment that created the lowlands and continues to augment them, but the rivers flood when there is local rainfall. When the lands are parched and need irrigation, the rivers usually are dry. Their violence when they are full makes them difficult to control, and they are unnavigable. The Buna River is an exception. It is dredged between Shkodër River and the Adriatic Sea and can be navigated by small ships. In contrast to their history of holding fast to their courses in the mountains, the rivers constantly change channels on the lower plains, making wasteof much of the land they create. The Drini River is the largest and most constant stream. Fed by melting snows from the northern and eastern mountains and by the more evenly distributed seasonal precipitation of that area, its flow does not have the extreme variations characteristic of nearly all other rivers in the country. Its normal flow varies seasonally by only about one-third. Along its length of about 282 km (175 mi), it drains nearly 5,957 km2 (2,300 sq mi) within Albania. As it also collects from the Adriatic portion of Kosovo's watersheds and the three border lakes (Big Lake Prespa drains to Lake Ohrid via an underground stream), its total basin encompasses about 15,540 km2 (6,000 sq mi). The Semani and Vjosa are the only other rivers that are more than 160 km (99 mi) long and have basins larger than 2,600 km2(1,004 sq mi). These rivers drain the southern regions and, reflecting the seasonal distribution of rainfall, are torrents in winter and nearly dry in the summer, in spite of their length. This variable nature also characterizes the many shorter streams. In the summer, most of them carry less than a tenth of their winter averages, if they are not altogether dry.

Although the sediment carried by the mountain torrents continues to be deposited, new deposits delay exploitation. Stream channels rise as silt is deposited in them and eventually become higher than the surrounding terrain. Shifting channels frustrate development in many areas. Old channels become barriers to proper drainage and create swamps or marshlands. It is difficult to build roads or railroads across the lowlands or otherwise use the land.

Adriatic Sea	
Bunë/Bojana (near Ulcinj)	Zezë (near Kodër-Thumanë)
Great Drin (near Shkodër)	Gjole (near Kodër-Thumanë)
branch of Drin (near Vau-Dejës)	Tiranë (near Prezë)
Lake Scutari (near Shkodër)	Lanë (near Bërxullë)
Drin (near Lezhë)	Tërkuzë (near Prezë)
Valbonë (near Fierzë)	Erzen (near Shijak)
Black Drin (in Kukës)	Shkumbin (near Divjakë)
White Drin (in Kukës)	Seman (near Libofshë)
Mat (near Fushë-Kuqe)	Devoll (near Kuçovë)
Fan (near Milot)	Osum (near Kuçovë)
Ishëm (near Ishëm)	

Table 5. Main Albanian Rivers

3.2 Streamflow regime

This is a list of rivers that are situated wholly or partially in Albania. The rivers flowing into the sea are sorted north to south along the coast. Rivers flowing into other rivers are listed by the rivers they flow into. Some rivers (e.g. Moraca) do not flow through Albania themselves, but they are mentioned for having Albanian tributaries. They are given in italics. The names are in the Albanian indefiniteform, the confluence is given in parentheses.

An alphabetical overview of rivers of Albania is given below:

Photo. 3 Mati River (dammed to Liqeni i Shkopetit) in Northern Albania

Photo. 4 The mouth of the Buna River at the Montenegro border

3.3. Controlling stream flow – dam and reservoirs

Albania is located in the western part of the Balkan Peninsula. • The hydrographic territory of Albania has a surface of 44,000 km2 or 57% more than the national area of Albania. The average height of the hydrographic territory of Albania is very large, about 700 m above sea level. The average perennial total inflow of Albanian rivers is about 1,245 m3/s. All Albanian rivers running to the sea about 40 billion water cubic meter/year.
The Bojana or Buna River (Serbian: Áî¼àíà, Bojana, Albanian: Bunë or Buna), is a 41 km long river in Albania and Montenegro which flows into the Adriatic Sea.
An outflow of Skadar Lake, measured from the source of the lake's longest tributary, the Moraèa, the Moraèa-Lake Skadar- Bojana system is 183 km long.
The river used to be longer, but due to a raise in the level of Lake Skadar, the uppermost part of the river is now under the lake's surface. The river initially flows east, but after only few kilometers reaches the city of Shkodër and turns to the south. On the southern outskirts of the city, the river receives its most important tributary,

the Great Drin, the greater part of which became its tributary after changing course during a flood in 1858 and now brings ten times more water than the Bojana itself (320 m³/s). After flowing around the Peak of Tarabosh, it passes through the villages of Zues, Bërdicë, Tarragiat, Oblika, Obot, Shirq, Dajç and Gorica.

Buna river and the mouth

After 20 kilometers in Albania, it forms the border between Albania and Montenegro. On this bordersection, which is 24 km long, the river meanders widely, flowing around Lakes Das and Zogajsko blato, both in Montenegro. Settlements include villages of Sveti Đorđe and Rec on the Montenegro, and Luarz and Pulaj on the Albanian side. The area surrounding the river in this section is low and marshy, the Buna being the eastern border of the Field of Ulcinj and of the 12 km-long Long beach (Velika Placa) of Ulcinj.
At its mouth into the Adriatic the Buna forms a small delta with two arms, the left one forming the border with Albania, and the right one, with the island between the arms, being part of Montenegro. The island is called Ada Bojana - Ada, the Turkish word for "island", has found its way into the Montenegrin language. It was supposedly formed around a ship's wreck in the 19th century, and now covers an area of 6 km2, and is Montenegro's largest island. With the neighboring resort of Sveti Nikola ("Saint Nicholas"), it is a major center of nudism along the Adriatic.The other, smaller island belongs to Albania and is called Island of Franz Joseph or 'Ada Major'. This small island is not artificial such as Ada Bojana but natural. The Island of Franz Joseph frequently receives tourists.

Photo. 5 The Buna river in Shkodër, Albania

Despite being short, the river has quite a large watershed, covering 5,187 km², because the whole drainage area of Lake Scutari, the largest lake in southeastern Europe, is also part of it. Also, thanks to the waters from the Great Drin, the Bojana/Buna ranks second place among all tributaries to the Adriatic, measured by the annual discharge, after the Po in Italy (with 352 m³/s).
The Bojana/Buna is navigable throughout its whole course, depending on the size of your boat.

References:Mala Prosvetina Enciklopedija, Third edition, Prosveta, 1985, ISBN 86-07-00001Jovan Đ. Markoviæ, Enciklopedijski geografski leksikon Jugoslavije, Svjetlost-Sarajevo, 1990, ISBN 86-01-02651-6.

The Drini river starts at the confluence of its two headwaters, the Black Drin in the city of Struga and White Drini in the city of Kukës in the Trektan area of eastern Albania. Measured from there until its end atthe Adriatic sea, the Drin is 160 km (99 mi) long. However, measured from the source of White Drini, its length is 335 km (208 mi), making it the longest river that runs through Albania. The Black Drin (Crn Drim in Macedonian, Drini i Zi in Albanian) flows out from the Lake Ohrid in Struga and runs through the Republic of Macedonia and Albania. The White Drin (Beli Drim, Cyr. Áåëè Äðèì, in Serbian, Drini i Bardhë in Albanian) originates from the Žljeb Mountain, north of the town of Peæ in the Dukagjin region of Kosovo[a], and runs from there through to Albania.From Kukës, the Drin flows through northern Albania, first flowing through the Has area to the north, passing through the towns of Spas, Msi and Fierzë, and then, upon reaching the Dukagjini area, it descends to the south, flowing through Apripë e Gurit, Toplanë, Dushman, Koman, Vjerdhë Mazrrek, Rragam, and Pale Lalej. At Vau i Dejës, it enters the low Shkodra Field and splits into two arms. One empties into the Bay of Drin (Albanian: Pellg i Drinit) into the Adriatic Sea southwest of the city of Lezhë (The Mouth of Drin, Albanian: Gryk'e Drinit). The other empties into the Bojana River near the Rozafa Castle. Even though being a shorter branch by 15 km, the section that reaches the Bojana is called Great Drin (Drini i Madh in Albanian), because it brings much more water than the longer branch which reaches the sea. The Great Drin also once reached the sea but a major flood in 1858 cut it short from the sea, and breached through to the Bojana. The Great Drin is very wide and brings a huge amount of water (320 m³/s), but being short, some maps indicate it as a lake. After Vau i Dejës, the longer branch continues to the south, passing through Bushat, Mabë, Gajdër, Lezhë and Medes. South of Lezhë it enters the low and flooded littoral area and flowing through the marshes it finally reaches the Adriatic.

The Kosovan section of the White Drin flows entirely in the semi-karst Metohijan part of Kosovo, in an arc-shaped 156-kilometre (97 mi)-long course. The river originates in the southern slopes of the Zhleb (Srb: Žljeb) mountain, north of the town of Peja (Srb: Peæ). The stream is originally a sinking river which eventually springs out from the strong well and falls down as a 25-metre (82 ft)-high waterfall named the White Drin Waterfall near the village of Radovac. The White Drin first flows to the east, next to the spa of Banja e Pejes (Srb.: Peæka Banja) and the villages of Banje, Trbuhovac and Zlakuæan, where it receives the Istoèka river from the left and turns to the south. The rest of the course is through the very fertile and densely populated central section of Metohija (Podrima region), but oddly, there is not even one large settlement on the river itself, despite many smaller villages on the river. The largest cities arekilometers away from the river (Peæ, Đakovica, Prizren) while some smaller towns (Klina) and large villages (Velika Kruša, Đonaj) are closer to it. The White Drin also creates the small White Drin Canyon in Kosovo.

The White Drin receives many relatively long tributaries: Peæka, Bistrica, Deèanska Bistrica,Prue potok, and Erenik from the right; Istoèka, Klina, Miruša, Rimnik, Topluga and Prizrenska Bistrica from the left. The Kosovar part of the White Drin basin comprises4,360 km2 (1,680sq mi). Here the waters of the river are used for waterworks of the big nearby towns, irrigation and power production (especiallyits right tributaries). At the Vrbnica-Shalqin border crossing, the river enters the eastern Albanian region of Trektan. The Albanian section of the river is19 km (12 mi) long with the drainage area of 604 km2 (233 sq mi). There are no settlements on the river and it receives the Lumë river from the left(which also originates in Metohija, from several rivers in the Gora region). Finally, the White Drin reaches the town of Kukës where it meets the Black Drin and forms the Drin, which flows into the Adriatic Sea; thus the White Drin belongs to the Adriatic Sea drainage basin. The river is not navigable

The entire Albanian section (and part of the Kosovan) is flooded by the artificial Fierza lake.

Lake Scutari, also called Lake Shkodër or Lake Skadar (Albanian: Liqeni i Shkodrës, is a lake on the border of Montenegro with Albania, the largest lake in the Balkan Peninsula. It is named after the city of Shkodra. Its surface, 6 m (20 ft) above sea level, can vary between 370 km2 (140 sq mi) and 530 km2 (200 sq mi), of which 2/3 is in Montenegro. The lake is a cryptodepression, filled by the river Moraèa and drained into the Adriatic by the 41 km (25 mi) long Bojana, which forms the international border on the lower half of its length. There are additionally some fresh water sources at the lake bottom. Some small islands like Beška, with two churches on it and Grmožur, a former fortress and prison can be found on the southwest side of the lake.

The Montenegrin part of the lake and its surrounding area were declared a national parkin 1983. The Albanian part has been designated as a Managed Nature Reserve. It is one of the largest bird reserves in Europe, having 270 bird species, among which are some of the last pelicans in Europe, and thus popular with birders. The lake also contains habitats of seagulls and herons and is abundant in fish, especially in carp, bleak and eel. Of the 34 native fish species, 7 are endemic to Lake Skadar. In 1996, by Ramsar Convention on Wetlands, it was included in the Ramsar list of wetlands of international importance.

3.4 Electricity production

The Mati River (Definite Albanian form: Mati, Ancient Greek: Mathis, Ìáèéò) is a riverin northern Albania. Its source is near Martanesh, in the Bulqizë District. It flows west towards the Mat District, which takes it name from the river, and northwest through the towns Klos and Burrel. About 10 km (6 mi) downstream from Burrel it flows into a large reservoir (Liqeni i Ulzës "Lake Ulëz"). After passing through a hydroelectric dam, it flows through another, smaller reservoir (Liqeni i Shkopetit – "Lake Shkopet") and forms a narrow gorge through the mountain range that separates the Mat district from the coastal plains. It enters the plains between Milot and Zejmen.

Mati River Origin	Bulqizë District, Albania
Mouth	Adriatic Sea Coordinates: 41°382123N 19°342173E
Basin countries	Albania
Length	115 km
Avg. discharge	103 m³/s
Basin area	2,441 km²

Table 6. Mati River data

Hydropower potential: 112 MW. On Mati river, actually, are constructed: Ulza HPP, with installed capacity25 MW, Shkopeti HPP, with installed capacity 24 MW

The Ishëm River is a river in western Albania. It forms part of a water course (Tiranë-Gjole-Ishëm) that measures 79 km, but only the lower third of the watercourse is known as the Ishëm. The Ishëm proper is formed at the confluence of the rivers Gjole and Zezë, a few km northwest of Fushë-Krujë.It flows into the Adriatic Sea near the town Ishëm.

Ishëm River	
Origin	Krujë District, Albania
Mouth	Adriatic Sea, Coordinates: 41°342403N 19°332273E
Basin countries	Albania

Table 7 Ishmi river data

The Erzen is a river in western Albania. Its source is in the mountains east of Tirana,near the village Shëngjergj. It flows west through Bërzhitë, Petrelë, Vaqarr, Ndroq, Shijak and Sukth. It flows into the Adriatic Sea near Sukth, north of Durrës.

Erzen River	
Origin	Tirana District, Albania
Mouth	Adriatic Sea, Coordinates: 41°262123N 19°272353E
Basin countries	Albania
Length	109 km

Table 8. Erzeni river data

Shkumbin River (Definite Albanian form: Shkumbini, Latin: Genusus) is a river in central Albania, flowing into the Adriatic Sea. The river is 181 km (112 mi) long. The sources of the Shkumbin river are in the mountains southwest of Lake Ohrid, in the southwestern corner of the Pogradec District. and also in the Librazhd District at Valamra and the Guri i Topit Mountain. The Shkumbin is fed by the waters of the Dushna, Radicina, Bushtrica, Sheja, Hotolisht, and Dragostunja streams. The Shkumbin flows through the town of Librazhd. The Rrapun River joins the Shkumbin at Murrash.The Shkumbin initially flows north, then northwest, through Qukës, Librazhd, where it turns west and continues through Polis, Elbasan, Cërrik, Peqin and Rrogozhinë. It flows into the Adriatic Sea northwest of Divjakë. The two canals "Naum Panxhi" and "Ferras" stem out of the river in the Elbasan area and through an irrigation plan system satisfy the agricultural water needs of the Cërrik low plains.

Origin	Pogradec District, Albania
Mouth	Adriatic Sea, Coordinates: 41°22233N 19°262343E
Basin countries	Albania
Length	181 km

Table 9. Ishmi river data

The Seman River is a river in western Albania. It is formed at the confluence of the rivers Osum and Devoll, a few km northwest of Kuçovë. It flows west through Fier Shegan and Mbrostar (near Fier). It flows into the Adriatic Sea near Topojë.

Seman	
Origin	Osum and Devoll Rivers
Mouth Coordinates:	Adriatic Sea 40°492253N 19°22203E
Basin countries	Albania
Length	85 km (53 mi)

Table 10. Semani river data

During the years 1945-1951, it was produced in average10 KWH per resident.
In 1952, was put in operation the Hydropower Plant (HPP)of Selita, with installed power 5 MW.
In January 1958, was put in operation the HPP of Ulza, with installed power 25 MW.
In 1970, were put in operation HPP of Shkopeti, HPP of Bistrica I and HPP Bistrica II, with installed power 51.5 MW.
In 1971-1978, were put in operation HPP of Vau i Dejës and Fierza, 750 MW.
In 1985, was put in operation HPP of Koman,

Table 12. PHASES OF ELECTRICITY DEVELOPMENT IN ALBANIA

Actual situation	
6 big HPP in operation:	1421.5 MW
37 small HPP in operation:	34.5 MW
Main generation base	

Cascade on Drini river:	1350 MW
Cascade on Mati river:	49 MW
Cascade on Bistrica river:	27.5 MW
Possibilities for water potentials utilization	
Theoretical potential energy:	4500 MW
Exploited potential:	1461 MW

Table 13. ALBANIAN HYDROPOWER POTENTIAL

Drini river derives from Ohri lake of Macedonia running to Adriatic Sea
Hydropower potential : 1750 MW
On Drini river are actually constructed :
Vau i Dejes HPP, with installed capacity: 250 MW
Fierza HPP, with installed capacity: 500 MW
Komani HPP, with installed capacity: 600 MW
Project-proposals under the concession issue procedure:
Skavica HPP, with installed capacity 350 MW. It is anunsolicited proposal of TGK & Kinglor consortium. This is actually under tender proces.
Ashta HPP, with installed capacity 48.2 MW, is under construction from the Austrian Verbund Company.

Table 14. CURRENT SITUATION OF HYDROPOWER SECTOR DEVELOPEMENT

MATI RIVER

Mati river derives from Burreli and Peshkopia areas running to the Adriatic sea.
Hydropower potential: 112 MW
On Mati river, actually, are constructed:
Ulza HPP, with installed capacity25 MW
Shkopeti HPP, with installed capacity 24 MW

Table 15. General data of Albanian rivers

DEVOLLI RIVER

Devolli river derives from Devolli and Korca areas running to Adriatic Sea after its bundling with Osum river.
Hydropower potential: 350 MW
Project-proposals under the concession issue procedure:
It is signed the concession contract of HPP's cascade on Devolli river with Austrian EVN AG Company.

River	Length km	Catchment area km²	Average flow. m³/s
Buna	41	5.187	320
Drini	285	14.173	352
Mati	115	2.441	103
Ishmi	74	673	20,9
Erzeni	109	760	18,1
Shkumbini	181	2.441	61,5
Semani	281	5.649	95,7
Vjosa	272	6.706	195

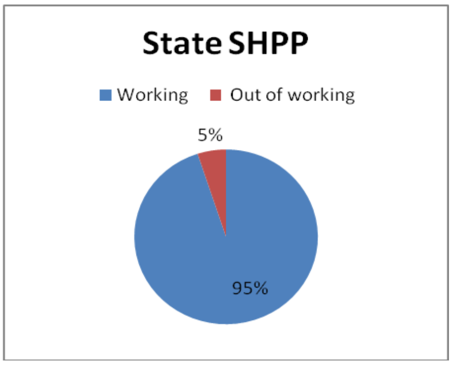
Table 16. General data of Albanian rivers

OSUMI RIVER

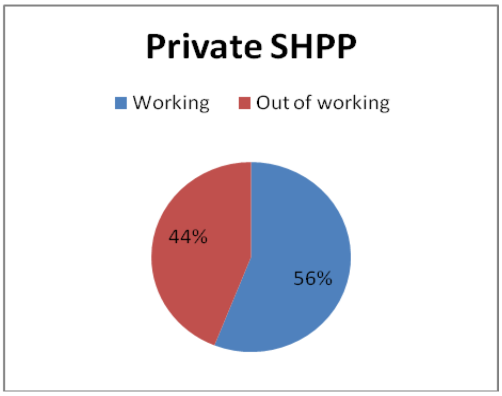
Osumi river is the main branch of Semani river. Its total length is 161 km. The water-accumulation surface is 2150 sq km and 828 m abovethe sea level.Project-proposals under the concession issue procedure: It is prepared the technicaland economic feasibility study of projects for HPP's construction on Osumi river, which will be notified from the Albanian Government as solicited proposals.

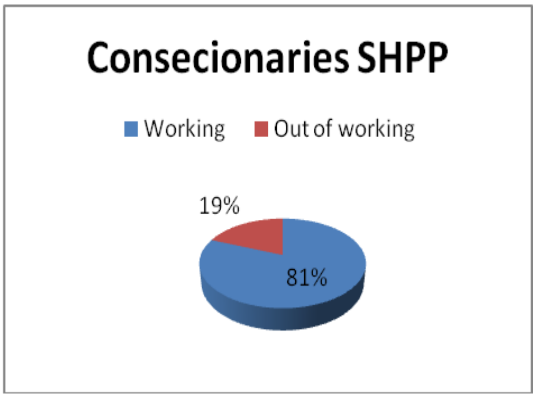
There were 90 SHPPs in Albania constructed before the year1990,with installed capacity from 20 kWto 9200 Kw. Till now are put in operation only 37 SHPP. The average long life of SHPP is about 30 years.

2 HPP, with installed capacity 24.4 MW have obtained the concessionary contract. 6 HPP, with installed capacity 2 MW are owned by private companies. 21 HPP, with installed capacity 10.9 MW are owned by state.



Graph. 3 StateSHPP





Graph. 2 Private SHPP

Graph. 4 Concesionaries SHPP

CHAPTER 4 GEOLOGICAL PATTERN

4.1 Overview of the geological structure of Albania

Although Albania is geographically a very small country, it is characterized by a variety of geological formations. Among these are rocks ranging from Paleozoic to Quater_nary in age and they comprise sedimentary and magmatic types together with rather less frequent metamorphic. The country is divisible into internal and external zones. The former occur in the north-east and the latter are found in the south-west. Oph_iolites are widespread and among them are ultrabasic rocks concentrated in the internal zones. The Albanian ophiolites are the largest in the western regions of the Alpine folded belt where they are better exposed than anywhere else. In fact, other ophiolites of similar magnitude occur only in the eastern part of this belt, for instance in Turkey or Iran. The geological structures in Albania, a sector of the Dinarides (the southern branch of the Alpine folded belt), verge in a south-westerly direction from the inner towards the outer zones. Tectonic nappes playa primary role in the geological construction of the country. In_deed, large nappes were shown here for the first time in the Dinarides, see NOPscA (1906). Among them are those of the Albanian Alps and Cukali as well as Krasta's Nappe, Mirdita's Nappe and the Korabi Nappe.

4.2 The geological position of Albania

From a geological standpoint, Albania belongs to the Dinarides s. I., the southern branch of the Alpine folded belt. The Dinarides were described by SUESS (1883) and extend south of the Southern Alps, along the east coast of the Adriatic and Ionian Seas and through the Aegean Sea to meet the Taurides and model the Dinaro-Tauric Arc. KOBER (1929) re_garded the Dinarides s. I. as separated by the Shkodra-Peja transverse structure into two: the Dinarides s. s. and the Hellenides. The Dinarides pass into the Hellenides in Albania, most of the country being encompassed by them, see Fig. 2. The Aegean Arc is visible in the southern part of the Hellenides and, unlike the Adri_atic collision into both the Hellenides and Dinarides, has marked geological and geophy_sical features which resemble those of island arcs (MERCIER 1979). The oceanic subduction zone dips from the Hellenic trench towards the north-east for approximately 180 km. The Cycladic volcanic arc and the southern Aegean sedimentary arc trace the curvature of the Aegean Arc (MERCIER et al. 1987). The Aegean Arc is situated between the Arabo-Africa/Eurasia collision to the east and the Adriatic collision to the west. The passage from the zone of the Aegean oceanic subduction to the Adriatic collision (zone of continental subduction) is along the Ionian Islands (SoREL 1976) and accom_plished by a transform fault. MONOPOLIS & BRUNETON (1982) took into consideration general tectonic features derived from geological and geophysical data and indicated that the fault is orientated 30° NNE and lies along the western edge of the Cefalonia-Lefkas Islands. It is a dextral strike-slip with a thrust component (CUSHING 1985; SOREL 1989; SCORDILIS et a1. 1985).

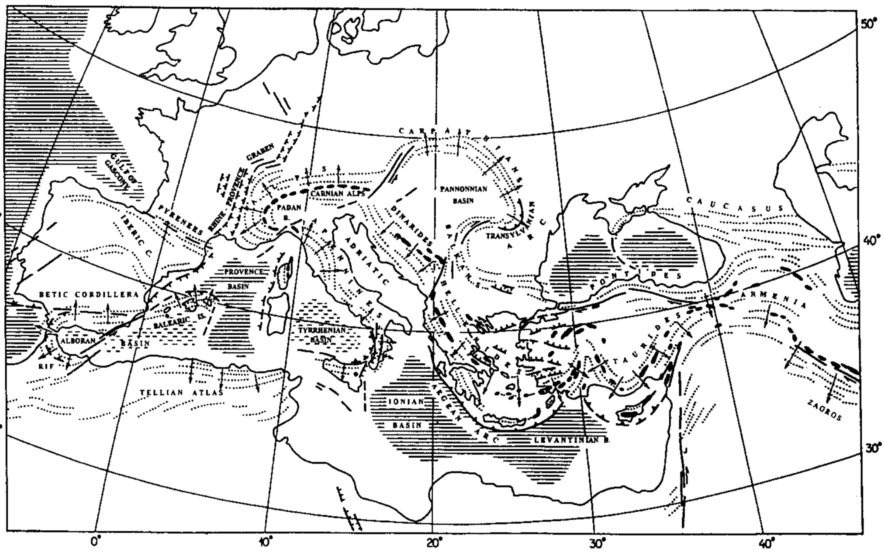


Fig. 2: The major tectonic structures of the Alpine Mediterranean domain (after TAPPONIER 1977) showing the geological position of Albania. The transition from the Dinarides to the Hellenides is realized in Albania, most of which is enclosed in the Hellenides.

Consequently, the Dinarides s. 1. are separated into three large segments by transversals.

The Dinarides s. s. are divided from the Hellenides by the Shkodra-Peja transversal, while the Aegean Arc to the south of the Hellenides is separated by the transform fault along the western edge of the Ionian Islands. The geological structure constituting Albania is called the Albanides (PEZA 1967). While this is a term widely used in geological jargon both in the country and abroad, it is mainly favored by Albanian geologists. The Albanides are divisible into two parts, namely the Northern Albanides which extend into the former Yugoslavia with the Dinarides and the Southern Albanides continuing southwards to Greece with the Hellenides. The internal zones are within the Inner Albanides and the external zones are within the Outer Albanides.

In this respect, the Albanides replace the Dinarides and the Hellenides, terms which have earned the right to be used in the international bibliography. However, the introduc_tion of the name Albanides has not met with general approval, see BIÇOKU et a1. (1970) and is ignored by the most foreign scholars. Hence, one of the authors of this chapter discussed and tabled the possible geological placement of the Albanides many years ago (ALIAJ 1979). Since the Hellenides start in northern Albania just south of the Shkodra_Peja transversal, the Albanides can be put into the segment between this and that of Sperchios in Greece to comprise a large sector with similar neighboring zones and similar old and new geological development.

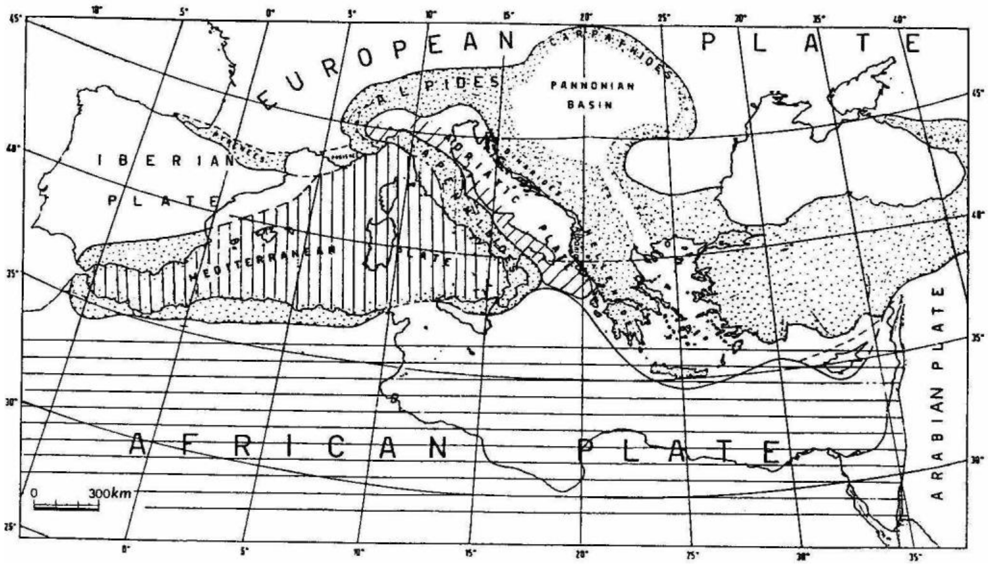


Fig. 3: Scheme of the geological plates in the Mediterranean region (after FINETII & MORELLI 1972).

Thus, northwards, the passage would be from the Albanides to the Dinarides beyond the Shkodra-Peja transversal, while, to the south, it would be from the Albanides into the Hellenides beyond the Sperchios transversal. Such an understanding of the Albanides ought both to be accepted and widely used by foreign scholars. However, the present authors consider it inappropriate to use it here.

As the passage from the Dinarides to the Hellenides traverses Albania through the Shko_dra-Peja transversal, this should be described. It was defined by Cvmc (1901) and was studied particularly during the last few decades, see BIÇOKU & NDOJAJ (1964), DERCOURT (1968), BIÇOKU & DERCOURT (1975), CHOROVICZ et al. (1981), ALIAJ (1979, 1988) and PAPA et al. (1991). The structure in question has a NNE extension (30°) and corresponds to a multi-phase first order fault, see Fig. 4. Some considered it an old transverse fault initiated after conti_nental rifting and functioning as a transform fault in the oceanic basin of Mirdita (ALIAJ 1988; PAPA et al. 1991). It delimits the southern palaeogeographical termination of the Albanian Alps ("High Karst"), see PAPA et al. (1991). During the Tertiary orogenic epi_sodes, it acted as a dextral, strike-slip, fault pushing the internal zones towards the south_west and touching the outer ones (ALIAJ 1988). Due to it, the structures of the Mirdita and Korabi Zones to the south and in its vicinity have their general NNW to SSE ex_tension curved towards the north and north-northeast. The same thing happened in Lezha town where the structures of the Krasta-Cukali Zones and that of Kruja are touched and pushed to the right, so changing direction. Consequently, the Kruja Zone anticlinal belts deviate from a NNW direction of 335° south of Lezha to a WNW direc_tion of 310° immediately north of this town.

During the Pliocene and the Quaternary, the Shkodra-Peja transverse structure was complicated by a normal faulting directed NNE to delineate graben units from Tropoja to Qerreti in Puka and reaching Vigu, but always in the terrain of the Mirdita

Zone. In Tro_poja, the Albanian Alps create a high "wall" surmounting the Mirdita sunken zone (ALIA] 1988). This transversal played a special role in the location of the Tertiary molasse basins in Albania. So the molasse Albanian-Thessalian Basin, together with the Mati-Librazhdi Basin on its back, plus the molasse Periadriatic Basin are located south of the Shkodra-Peja transverse structure. Such positioning indirectly attests that this transversal cut and pushed the frontal thrusts of the orogen in Albania (ALIAJ 1997).

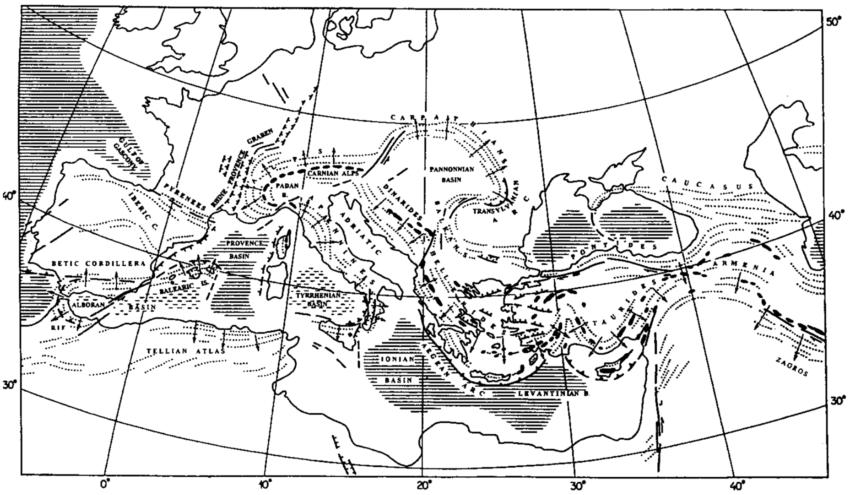


Fig. 4: The tectonic zonation of Albania. SP = Shkodra-Peja transversal dividing the Dinarides from the Hellenides. 1,2,3,4: Windows of the Kruja Zone.

The Mediterranean Alpine orogenic belt resulted from the movement of the vast African and European plates as well as small plates detached from them, see in Fig. 3. The Dinarides and Hellenides of this mountain belt, in which the geological structure of Albania developed, follow the contours of the eastern margins of the Adria microplate (GIESE & REUTTER, 1978) or the Adriatic plate as demarcated by the CHANNEL & HORVATH (1976), FINNETI & MORELLI (1972) and others. The tectonic transport in the Dinarides and Hellenides is towards the Adria microplate and thus they are front to front and converge towards the Apennines, see Fig. 2. Folds, thrusts and tectonic nappes reflect various compressional orogenic movements in the folded belts encircling the Adria microplate, **see Fig. 3**.

The unusual loop-shape of the Apennines, Alps, Dinarides and Hellenides, which sur_rounds the unfolded Po plain, the Adriatic Sea and the Apulian platform, attracted the atten_tion of early, systematic, geological studies. This comparatively unfolded region acted as a relatively rigid element extending 1,300 km in length and 100 to 200 km in width. It may be contrasted with the surroundings of strong compression and plastic deformation. The compa_rison induced ARGAND (1924) to regard it as a promontory of the African continent, the rigid area being a small continental plate with consumed margins besides those of the south-east.

The Adria microplate does not contact the African continent directly, but, if some mar_ginal parts be excluded, has acted as if it were a headland of it (GIESE & REUTTER 1978). The shape of the circum-Adriatic orogens is due to its irregularity as a promontory of the Adria microplate that interacted with the European pre-Alpine plate. However, there is as yet no clear delineation between the Adria microplate and the African plate. Contrary to the opinion of ANDERSON & JACKSON (1978), the data available do not confirm its passage in the Straits of Otranto. The boundary between the Adria microplate and the Albanian orogen seemingly runs along morphological accidents in the Ionian and Adriatic Seas. It represents the zone of the Adriatic collision, see ALIA] (1998).

4.3 The structural zones north of the Shkodra-Peja transversal and their connections with the Dinarides

The tectonic zones north of this transversal lie in northern Albania and pass uninterruptedly through Montenegro towards the north-west. They generally extend WNW to ESE and are part of the Dinarides s. s., according to KOBER (1929).

Adjacent structural zones occur from the littoral towards the north-east. They are the Kruja Zone, Cukali Zone, Albanian Alps Zone, Vermoshi Zone and Gashi Zone. The continuation of analogous tectonic zones from Albania into the former Yugoslavia are represented in Fig. 4 and the following table:

Albania	Former Yugoslavia
Kruja Zone	Dalmatian Zone
Cukali Zone	Budva Zone
Albanian Alps Zone	High Karst Zone
Malsia e Madhe Sub-Zone	Prekarst Sub-Zone
Valbona Sub-Zone	Prekarst Sub-Zone
Vermoshi Zone	Bosnian Zone
Gashi Zone	Durmitor Zone

NOPSCA was the first to distinguish the tectonic zones and to confirm the tectonic nap_pes in Northern Albania and throughout the Dinarides. He made the first, classic, synthesis of the geology of the Dinarides (N0PSCA 1921), using the model of the tectonic nappes.

It has been largely admitted that each isopic zone in Albania was transformed during the corresponding folding phase into an individual tectonic unit, the so-called isopic-struc_tural zone (BELOSTOCKIJ 1963; PAPA & BIÇOKU 1965).

Kruja Zone. This represents the most westerly coastal zone in the Dinarides and it was denominated as the zone of coastal belts (KOSSMAT 1924). It starts north of the

Shkodra- Peja transversal with Renci and Kakariqi WNW extending anticlines and follows the Montenegrin coast uninterruptedly north-west from Ulcin as the Dalmatian Zone (BIÇOKU 1960).

Palaeogeographically, it embodies a neritic platform which was characterized from the Upper Cretaceous to the Middle Eocene by a neritic carbonatic formation and a flysch for_mation from the Middle Eocene to Oligocene.

The carbonatic series underwent a phase of emergence at the Cretaceous-Tertiary boundary marked by Kosina classic strata, one part Cretaceous and the other Eocene, with a more or less important hiatus between them, this associated with an interruptive bauxite level (BIÇOKU et al. 1970). Drillings in the Dalmatian Zone at Ulcin uncovered important gypsum tectonics at depth in a diapiric position up to the Cretaceous (KALEZIC et al. 1976; BIÇOKU et al. 1970).

From Ulcin to Velipoja, also from Lezha southwards, the Middle and Upper Miocene molasses discordantly transgresses structures of the Kruja Zone. It seems that this zone north of the Shkodra-Peja transversal to the Dinarides was formed about the same time as that formed south of the transversal into the Hellenides. The carbonatic neritic formation reached the Middle Eocene in the Dinarides where flysch accumulation commenced, while, in the Hellenides, it extended into the Upper Eocene and flysch developed only from the Oligocene onwards. The Kruja area shows linear anticline folds accompanied by reverse faults on their south-western flanks.

Cukali Zone. In Albanian geological literature, the term Krasta-Cukali is used (PAPA & BIÇOKU1965). The zone is divisible into two sub-zones, the Cukali in the north between the Kruja Zone (= Dalmatian Zone) and the Albanian Alps Zone (= High Karst Zone) and the Krasta in the south between the Kruja Zone and the Mirdita Zone, see below. The former is incorporated into the Dinarides and the latter into the Hellenides. As observed from their differing tectonic positions and formational differences, they actually represent distinct structural zones. Therefore, the authors decided to treat them separately, that is to say, as the Cukali Zone and the Krasta Zone, even though they show similarities.

The Cukali Zone is named after the Cukali Mountain in northern Albania (NOPSCA 1929). The Krasta Zone derives its name from the Krasta Hills near Elbasani in central Al_bania (ZUBER 1940: "Krasta flysch"). The Cukali Zone of the Dinarides is widely de_veloped at and around Cukali Mountain and also as a relatively narrow belt between the Kruja Zone and the Albanian Alps called the Budva Zone (Psrxovrc 1956). This extends beyond the administrative Albano-Montenegrin border to the Kotor Gorge and further north-west, finally disappearing under the High Karst Nappe. It is a zone with pelagic sediments.

In Albania, a radiolarite-siliceous-carbonate series (with clay schist inter bedded by car_bonate, siliceous and basic volcanic rocks at the bottom) extends from the Middle Triassic to the Upper Cretaceous and the Maastrichtian-Eocene flysch.

The Cukali Mountain represents a tectonic window between the Albanian Alps Zone overthrust from the north and the ophiolitic Mirdita Zone over thrusting from the south (N0PSCA 1929). Here, it comprises a series of isoclinals folds extending WNW and with a south-south-west asymmetry forming a north-easterly-extended transverse dome. To_wards the north-west, the Cukali Zone is apparently buried beneath the Albanian Alps Nappe. The Cukali Zone (= Budva Zone) in Montenegro is marked by some imbrications and is overthrust on to the Dalmatian Zone (KALEZIC et al. 1976).

4.4. Litostratigraphic units

Albanian Alps Zone - This is widespread only in northern Albania, north of the Shkodra-Bajram Curri-Peja transversal. As a result of this latter, the Albanian Alps Zone to the south and south-east abuts on the Mirdita and Cukali Zones, over thrusting the Cukali Zone and itself overthrust by the Mirdita Zone. To the north and north-east, the zone is overthrust by the Gashi and Vermoshi Zones. The palaeogeographical and tectonic regime on the surface is not the same in the framework of the entire zone. From Upper Permian to Upper Triassic, the situation was more or less uniform. The Upper Permian and Lower Triassic comprise terrigenous and terrigeno-carbonatic deposits. The Anisian is repre_sented by nodular beds, while the Ladiniani contains mainly the "Buchenstein Forma_tion" of tuffs and tuffites, but also black Thethi limestones and typical facies of stroma_tolites and dolomites with megalodonts. In some structures of the Albanian Alps Zone between the Ladiniani and the Upper Triassic at Valbona, Lugu Thiut and Taraboshi, bauxites are found.

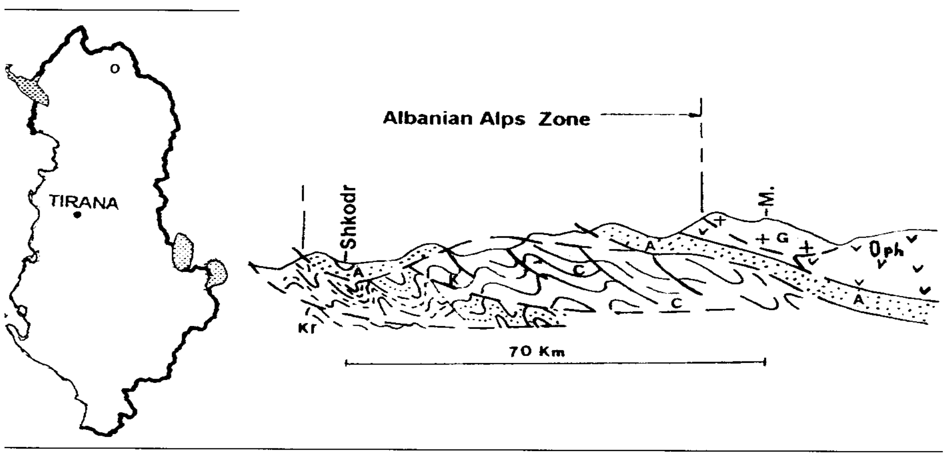
From the Jurassic to the Lower Cretaceous and to middle of Upper Cretaceous, the zone is heterogeneous and can be subdivided into two sub-zones, namely the Malsia e Madhe (= High Karst Sub-Zone) and the Valbona (= Prekarstic Sub-Zone).

The Malsia e Madhe Sub-Zone developed west of the Alps and it is restricted north, east and south-east by the Valbona Sub-Zone which over thrust it. By contrast, to the south and south-west, it over thrust the Cukali Zone. In general, the Malsia e Madhe Sub-Zone is structurally a large monocline split by faults into separate blocks with 20 to 25° dip angles which are divided between north and north-east directions. In the Gruemira to Brigje sec_tor, this monocline bends and ends its fold by dipping south-west at a 10 to 15° angle under Pliocene to Quaternary molasses and Lake Shkodra.

The flanks of the anticlines and synclines of this zone are characterized by gentle slopes of7 to 15° as at the Reci Anticline and the Veleciku Syncline. Near the large fault, there are also asymmetrical structures which are sometimes overturned. From Shkodra to Malsia e Madhe, the separate fault extends between two sub-zones that further follow to the Rrjolli River. All this leads to the conclusion that the Malsia e

Madhe Monocline was affected by a vertical fault with an amplitude of 400 to 600 m following a north-east to south-west di_rection (Tektonika e Albanideve 1984). Among such faults, those of Boga-Graboni, Brigje_Kozhnja-Rec,:i-Malsia e Madhe are the most conspicuous and have a block structure with a sinking tendency to the south-west towards Lake Shkodra.

Most Albanian Alps Zone researchers (Gjeologjia e Shqiperise 1982; Tektonika e Alba_nideve 1984) opine that the tectonic movements which structured this zone occurred in the Early Eocene. On the grounds of these movements, on one side the over thrusting of the Gashi Zone on the Vermoshi and Albanian Alps Zones occurred and on the other side the Albanian Alps Zone over thrust the Cukali Zone. In the Shkodra-Mesi-Domeni-Shakota sector, it is possible to follow the over thrusting of the Albanian Alps Zone over the Maas_trichtian to Paleocene flysch of Cukali. The over thrust proceeds further north-east to the



Kiri meadow and the Shala and Curraj Rivers. In the area Kolshi Pass to Padeshi, the zone is overthrust by the Mirdita Zone. Determining exactly where the contact between the two zones has long been a matter for discussion. It may relate to the role of the Shkodra-Peja transversal, generally taken to be deep and seism active, see SULSTAROVA (1987), but QI_RINXHI et al. (1991) found that it is not expressed by development on the surface (Fig. 42).

The contact surface of the Mirdita Zone with the Albanian Alps and Cukali Zones is of over thrust nature and also, according to the most recent authors, the Palaeo geographical role of the transversal and palaeogeographically closure is not proven. The most prominent autho_rities (XHOMO et al. 1972; Gjeologjia e Shqiperise 1982; Tektonika e Albanideve 1984; PEZA L.H. 1990) argued that the over thrust of the Alps over the Cukali Zone was realized from the Jurassic through the Valbona Sub-Zone in the role of continental slope. QIRINXHI et al. (1991) suggested that the Mesozoic deposits, which developed in the east and south-east of the Alps, do not establish the palaeo geographical transition of the Alps "platform" in the Cukali "Basin", but only the existence of the Valbona Palaeo zone.

Stratigraphically, the profile from the Permian to the end of the Triassic is similar almost throughout the entire zone and the differentiation appears only from the Jurassic and be_came especially marked in the Dogger, see Fig. 43.

But researches on the stratigraphical profile by PEZA L.H. et al. (1974) demonstrated that the sub-zone started in the Upper Triassic where there are inter bedded dolomites and stromatolitic limestones plus algal limestones in which locally megalodonts and Involutina occur. The Lias comprises dark, finely stratified biomicritic limestones in which are found Lithiotis problematica, Orbitopsella praecursor (GUEMBEL), etc. The Dogger and Lower Malm are represented by oolitic and pisolitic limestones which may be locally dolomitized. The Kimmeridgian and Tithonian are better and more clearly differentiated in this sub-zone. The former has two dovetailing facies. On the one hand, it starts with a basal unit of alternating deposits and these are composed of limestones and pebble beds. Higher up, these change into thickly bedded to massive limestones. On the other hand, at Zagori_Rrapshi-Brigje, the limestones are marly and coarser stratified with Cladocoropsis mirabilis ALLOITEAU. The basal Tithonian has bauxitic clays while these pass above into biomicritic limestones and dolomites where Clypeina jurassica FA VRE and S alpingoporella annulata CAROZZI occur. The thickness of the Tithonian reaches 120 m. The Neocomian comprises either purely biomicritic limestones or alternations with dolomitic limestones. Cambbeliella striata (CAROZZI) and Clypeina jurassica FAvRE are found in these limestones. The thickness of the Neocomian deposits fluctuates between 300 and 700 m.

The entire Barremian to Senonian series is over 1,000 m thick and it is composed of a permanent facies of biomicritic limestones of which the structure alters from middling to thick strata. During the Barremian to Aptian in the corresponding microfacies are found Salpingoporella dinarica CAROZZI, Baccinella imgularis RADOICIC, etc. Higher, in the Albian to Cenomanian, slides show Chondrodonta and Cuneolina pavonia D' ORBIGNY, Accordiella conica FA_RINACI, etc. The uppermost part of the Senonian is represented by pelagic platey limestones with rare alternations of pebble beds. In the 20 to 30 m thick facies mentioned, there are Globotruncana coronata BOLLI, G. calcarata CUSHMAN, G.fomicate PLUMMER, etc., as well as frag_ments of rudists introduced through submarine disturbances. The stratigraphical profile of this sub-zone ends with red marly to terrigenous facies which gradually change into clay and sandstone flysch. In the 60 m thick Palaeocene to Eocene facies, there are planktic forami_nifers such as Globorotalia velascoensis CUSHMAN, Globigerina daubergensis BRONNIMAN, etc.

Geological profiles of tectonic zones

	LITHOL.		SHORT LITHOLOGIC DESCRIPTION	MAIN FOSSILS
Pg_{1-2}		> 60 m	Marls and clays	Globorotalia velascoensis
SENONIAN		30	Biomicritic limestones with Globotruncana	Globotruncana coronata
		480 m	Massive, biomicritic limestones with Rudistae	Dicyclina schlumbergeri Accordiella conica Discorbis sp.
TURON		180 m	Biomicritic limestones, marls with Chondrodonta, Rudistae and Gastropoda	Cuneolina pavonia parva
ALB-CEN.		170 – 270 m	Biomicritic - biosparitic limestones, sparsely dolomites	Cisalveolina fallax
B.-APT		80–170	Biomicritic limestones with Rudistae and Orbitolina	Salpingoporella dinarica Baccinella irregularis
NEOCOMIAN		300 – 700 m	Interbedding of biomicritic and biosparitic limestones, partly dolomites	Salpingoporella annulata
TITHON.		120 m	Biomicritic limestones with pelagic Bivalvia (C. striata)	Campbeliella striata Clypeina jurassica
KIMMERIDGIAN		250 – 380 m	Limestones and siliceous, biomicritic limestones, coral and algae limestones	Cladocoropsis mirabilis
$J_2 - J_3$		50 – 400m	Oolithic - pisolitic limestones, biomicritic limestones, partly dolomitize	Dictyoconus coyexi
LIAS		240 m	Biomicritic limestones with Lithiotis	Lithiotis problematica Orbitopsella praecursor Pal. mediterraneus
UPPER TRIASSIC		> 400 m	Interbedding of stromatolitic limestones with biomicritic limestones with megalodonts	Megalodus damesi Megalodus triquetter Involutina gaschei

Fig,: Stratigraphical profile of the Malsia e Madhe Sub-Zone (after Gjeologjia e Shqiperise 1982).

The Valbona Sub-ZI Gashi Zone which it OV (Mountain), south-west 0 and Involutina liassica (JON)

In the eponymous V, (Shkelzeni Mountain) eXI induced crosswise faults. Triassic terrigene and ten to Upper Triassic carbor and the eastern peri cline is represented by a mon east. This is affected by cr bonatic-terrigenous and I
The blocks encounter kali Zone flysch. Among Thethi-Qafa e Kolshit (I< res Pass)-Curraj i Eperm

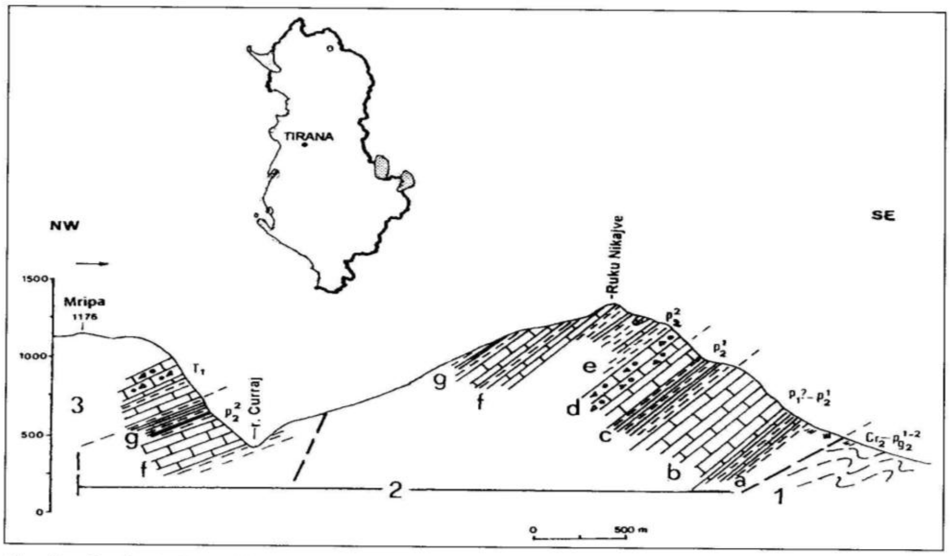


Fig. 44: Geological profile Curraj Poshtem-Curraj Eperm (Albanian Alps Zone) (after Gjeologjia e Shqiperise 1982). 1-Maastrichtian-Lower-Middle Eocene flysch of Cukali. 2-Permian deposits: a-Shistose-carbonatic unit, b-Biomicritic crinoidal- and algal-bearing limestones, locally dolomitized, c,e,g-Alternations of black clay-schists with biomicritic crinoid- and algal-bearing limestones, d-Biomicritic and conglomeratic limestones, f-Biomicritic crinoidal- and algal-bearing limestones. 3-Upper Triassic deposits.

The Valbona Sub-Zone occurs mainly between the Malsia e Madhe Sub-Zone and the Gashi Zone which it overthrusts. Its south-western corner is Mali Taraboshit (Taraboshi Mountain), south-west of Shkodra town, where pink limestones with ammonitic remains and *Involutina liassica* (JONES) are found.

In the eponymous Valbona sector, the large anticlinal structure of the Mali Shkelzenit (Shkelzeni Mountain) extends to the Tropoja River and is split into blocks by tectonically induced crosswise faults. The anticlinal core is extended east-west and it comprises a Lower Triassic terrigene and terrigenous-carbonatic facies which often contacts tectonically Middle to Upper Triassic carbonates. In the eastern direction (Padeshi), the anticlinal axis plunges and the eastern pericline is set up. In the sector from Mesi to Curraj i Eperm, the sub-zone is represented by a monocline which is generally directed west-north-west to east-south-east. This is affected by crosswise faults which originated the tectonic blocks comprising carbonatic-terrigenous and terrigenous Permian to Lower Triassic facies, see Fig. 44.

The blocks encounter to the south of the sub-zone, where this sub-zone overthrust Cukali Zone flysch. Among greater faults with amplitudes from 50–100 to 700 m are those of Thethi-Qafa e Kolshit (Kolshi Pass), Prroi Rrjollit (Rrjolli stream) and Qafa e Thores (Thores Pass)-Curraj i Eperm which in the Thethi area change into small nappes.

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The stratigraphical profile of the sub-zone (Fig. 45), and also the entire Albanian Alps Zone, begins with alternations between majority coarse grained massive limestones and minority clayey shales. In some limestone layers are species of Tubiphytes sp. and numerous fusulinids such as Pseudqfusulina sp., Codonqfusiella sp., Hemigordius ren'(j (REICHEL), Neoschwagerina cratulifera SCHWAGER, etc., and these usually indicate an Upper Permian age (BIGNOT et al. 1982). However, the presence of Permian limestone nodules is often unclear. The idea that they are in situ is questionable and there are alternative views, for instance that they slumped from more distant areas and stayed in a melange type milieu (possibly a Cretaceous melange).

The Lower Triassic comprises a conglomeratic terrigenous series with fewer limestone horizons in which gastropods and rarely condodonts such as Neospathodus homeri BENDER, these confirming Scythian age. Among the best occurrences of Permian to Triassic deposits and of the tectonic contact with Cretaceous to Palaeoegene flysch of the Cukali Zone is that of Curraj (Fig. 44).

Geological profiles of tectonic zones

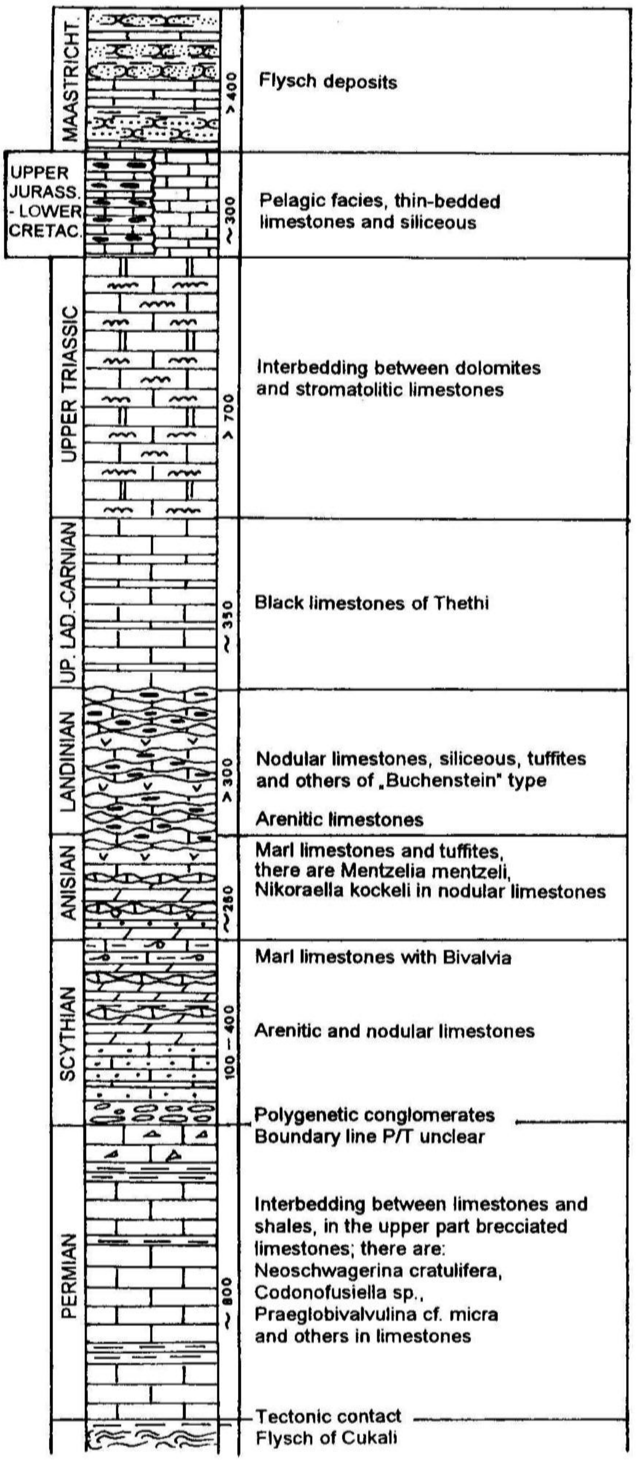

Fig. : Generalized stratigraphical profile of the Valbona Sub-Zone (after Gjeologjia e Shqiperise 1982 and unpublished work of MEÇO 1996).

The Anisian is mainly represented by a lumpy limestone facies of Hanbulog type or with some tuff and tuffite levels (Gjuraj profile). The limestones contain brachiopods (Mentzelia mentzeli, Spiriferina fragilis, etc.), conodonts such as Neogondolella bulgarica BUDUROY & STEFANOY, N. bifurcate BUDUROY & STEFANOY, N. kockeliTATGE, etc., all indicating a Pelsonian substage age. The Ladinian of the sub-zone has facies analogous with thesouth Alpen "Buchen stein" type. From the Upper Ladinian, the so-called black limestones of Thethi start and pass up to the Carnian. The Upper Ladinian age is evidenced by the conodont fauna with Budurovignathus diebeli KOZUR & MOSTLER, etc. In other sites (Gjuraj), the Upper Ladinian is represented by a reddish limestone facies with badly preserved ammonites and conodonts. Periodically, the Carnian limestones are also recrystallized mudstone type similar to the Raibl facies. The thickness of such black limestones exceeds 400 m. The other part of the Upper Triassic is 500 to 1,000 m thick and comprises biomicritic algal and stromatolitic dolomitized limestones and dolomites in which are megalodonts (Megalodus damesi, M. triqueter') and corals such as Clypeina besia PANTIC. From the Jurassic, the sub-zone became continental slope and lay between the neritic platform of Malsia e Madhe and the Cukali Basin. Further up the profile, the Jurassic and Cretaceous are represented by platey limestones 200 to 300 m thick, locally with strata and lenses of pebble rocks. In slides, Saccocoma, Calpionella alpina LORENZ, CalpionellopJiJ simplex (COLOM), Tintinopsella catpathica (MURGEANU & FILIPESCU), Rotalipora appenninica (RENZ) and Praeglobotruncana species were found. Yet higher, as a result of a small stratigraphical hiatus, terrigenous-carbonatic flysch with clays, sandstone and platey limestones are found. In the last, there are, in thin sections, Globotruncana stuarti (LAPPARENTI), G. contusa (CUSHMAN), G. gan.reri (BOLLI), Pithonella oualis (KAUFMANN), etc. This end of Maastrichtian flysch closes the profile and reaches more than 400 m in thickness.

Vermoshi Zone

Fig. 46 shows the position of this zone and its boundary relationships with its neighbours within the regional framework. Regarding this zone, there have been changes in geological opinion. PAPA et al. (1977) left it in the framework of the neighbouring, larger, Gashi Zone, but distinguished the Lower Cretaceous (Cenomanian) flysch as paralleling the Bosnian flysch of the Dinarides and also the so-called Gramozi flysch in Albania. PEZA L. H. et al. (1988) differentiated Upper Jurassic- Cretaceous flysch in the meadowland of the Vermoshi River which parallels the Bosnian flysch. In the well-known monograph of Albanian Geology (Gjeologjia e Shqiperise 1982), the Cretaceous flysch is stressed and, in the north, is overridden by volcanic Mesozoic for_mations of the Gashi Zone while, to the south, it overrides the Albanian Alps.

80 Geological profiles of tectonic zones

Fig. 46: Tectonic schema of the Vermoshi region (after MELO et al. 1991). 1-Gashi Zone, 2-Vermoshi Zone, 3-Valbona Sub-Zone, 4-Malsia e Madhe Sub-Zone, 5-Tectonic overthrust contact.

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Fig. 46: Tectonic schema of the Vermoshi region (after MELO et al. 1991). I-Gashi Zone, 2-Vermo_shi Zone, 3-Valbona Sub-Zone, 4-Malsia e Madhe Sub-Zone, S-Tectonic overthrust contact.

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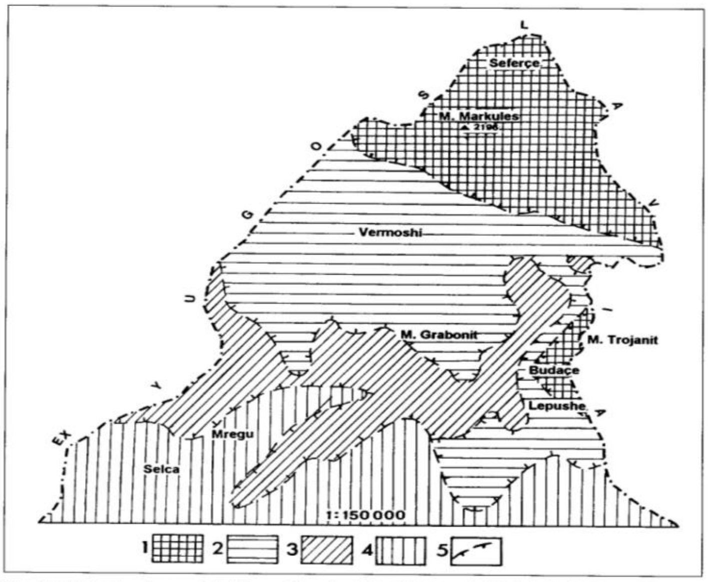

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Fig. 47: Transverse profile on Mali Bojes (Vermoshi Zone) and the relationship with neighbouring zones (Gashi and Albanian Alps Zones) (after PEZA L.H. et al. 1990).

Gashi Zone: 1-Ladinian stratified limestones, 2-Laminated limestones, 3-Thick-bedded to massive limestones, 4- Dolomites, 5- Lower Triassic marly limestones, 6-Volcano-sedimentary formation. Vermoshi Zone: 7-Kelmendi flysch (=Vermoshi flysch).
Albanian Alps Zone: 8-Valbona Sub-Zone flysch, 9-Limestones with megalodonts of the Upper Tri_assic (Malsia e Madhe Sub-Zone), 10-overthrust plane.

PEZA L. H. et al. (1990) left the Vermoshi region in the framework of the Gashi Zone, but differentiated the so-called Kelmendi Zone, of which the main member is the Lower Cretaceous (to Cenomanian) flysch (this paralleling the Bosnian flysch which is of similar age). J\1ELO et al. (1991) also maintained the Vermoshi region in the Gashi Zone, but distinguished the Kelmendi Unit which equates to the Kelmendi Zone of other authors.
The present authors think that the Vermoshi region represents an individual tectonic zone (see Chapter 2) in which the Mesozoic deposits built the core of the anticlinal structures and differ from those of the Gashi Zone. In general, the zone mentioned comprises a typical tec_tonic nappe on the Albanian Alps Zone. The contact between the two zones is best displayed between the Maastrichtian flysch of the Valbona Sub-Zone and the Palaeocene to Eocene flysch of Malsia e Madhe. The nappe

character of this zone on the Albanian Alps is shown by the presence of tectonic windows and half-windows (Budaca, Dabku, Berishdoli, etc.), where the amplitude of the horizontal shifts exceeds 10 km (Tektonika e Albanideve 1984).
The stratigraphical profile of the zone starts with carbonatic to terrigenous formations and in some levels are found Upper Jurassic to Lower Cretaceous calpionellids, while higher up there occur more typical flysch and flysch-like deposits extending from Neocomian Geological profiles of tectonic zones
to Cenomanian (inclusive) and overthrusting the Valbona Sub-Zone (Fig. 46, 47). In the lower part of the formation, the predominant deposits are marls with Lower Cretaceous tintinids while in the higher part (Neocomian), there are Orbitofina, Baccine/fa irregufaris RADOICIC, rudist remains, etc., which confirm a Barrenian to Aptian age.
In the middle of the flysch formation, there are marly slates, sandstones, clay strata and rarer brecciated limestone levels. In the upper part, marls, sandstones, biocalcarenites and fine clay layers alternate with each other. The age of the flysch formation was established as Lower Cretaceous to Cenomanian through the presence of Ticineffa, Pithone/fa ovafis (KAUFMANN) etc. (PAPA et al. 1977). The flysch and flysch-like deposits reach Upper Creta_ceous levels with Globotruncana.
Alps zone (PAPA & Biçoku 1965) was previously denominated the Northern Albanian Plate or the Albanian Alps Nappe (N0PSCA 1929). It is developed in the north of the country, actually fromShkodra north and north-west, thereafter ex_tending without interruption into Montenegro where it is termed the High Karst Zone (KOSSMAT1924).
The Albanian Alps Zone mostly lies between the Cukali Zone and the Gashi Zone. Only in Tropoja, it is in contact with the Mirdita Zone and in Vermoshi it meets the Ver_moshi Zone. The Albanian Alps Zone comprises two sub-zones. These are the Malsia e Madhein the south-west and the Valbona in the north-east; XHOMO et al. (1969).
The former is characterized by a terrigenous formation from the Permian to the Middle Triassic, by a neritic carbonatic formation extending from the Middle Triassic to the Creta_ceous and then by Paleocene to Lower Eocene flysch. Above Upper Jurassic limestones in Tamara, there is a bauxite clay horizon (Geology of Albania 1990).
This represents a neritic platform.
The Valbona Sub-Zone (= Prekarst Sub-Zone in Montenegro according to BLANCHET et al. 1970) has a stratigraphical profile similar to that of the Malsia e Madhe up to the middle of Upper Jurassic. From the Kimeridgian to the Cretaceous inclusive, there occurs a mixed tur_biditic facies containing a pelagic fauna (XHOMO et al. 1969). The flysch is Maastrichtian and outcrops around the Shkelzeni Anticline and also in the Vila imbrications. In this sub-zone, Upper Triassic limestones are overlaid by a hiatus on top of those of the Middle Triassic through a bauxite level. The Valbona Sub-Zone embodies a linking slope from the neritic plat_form of the Albanian Alps (Sub-Zone of Malsia e Madhe) to the pelagic Vermoshi Basin.

The Albanian Alps Zone represents a slightly deformed carbonatic plate thousands of meters in thickness and this is why NOPSCA (1929) called it the Plate of Northern Albania.

It comprises an imbricates tectonic nappy thrusting south-south-westwards. In the northern section, the Vila structural unit of the Valbona Sub-Zone thrusts southwards in the form of a nappe (MELO et al. 1991).

Vermoshi Zone. This zone is situated in the northernmost part of Albania, north of the Vermoshi River, and it outcrops in the shape of a narrow belt 1 to 2 km wide which extends WNW between the Gashi Zone to the north and the Valbona Sub-Zone to the south. Beyond the Albanian border towards the north-west in Montenegro, it expands upstream along the Moraca River and, after being completely covered by the Durmitor Massif, re_emerges in the southern Bosnia where it is called the Bosnian Zone (BLANCHET et al. 1969).

In Albania, it occurs as intensively folded Tithonian-Valanginian flysch and is over thrust on to the Maastrichtian flysch of the Valbona Sub-Zone. In the former Yugoslavia, the Bosnian Zone has been a basin comprising Jurassic limestones and radiolarite pelagic facies overlaid by the Tithonian-Berriasian flysch with some known Cretaceous levels (BLANCHET et al. 1969).

Gashi Zone. This zone is located in the northernmost part of Albania on the ridges of Vermoshi and Gashi (PAPA & Biçoku 1965). It continues north-west to enter Montenegro as the Durmitor Zone (Besic 1948), or the zone of Paleozoic shale's and Mesozoic carbonates (Petkovic 1958). In the eponymous Gashi region, it is made up of three main formations.

At the bottom, there is a "schist terrigenous formation" ranging from Lower Silurian to Lower Devonian in age (MEÇO et al. 1991a). This formation was mistakenly attributed to the Carboniferous-Permian time interval, an error resulting from lack of palaeontological information. It has been called "the Formation or the Series of Ceremi schist's".

The second, younger, formation of the relevant region is an "eruptive-sedimentary" one which is situated east of the Trokuzi (plagiogranitic) Massif. It contains alternating lime_stones and eruptive, acidic, rocks such as dacite, andesite, etc. In its carbonatic part, Upper Permian and Lower Triassic conodonts have been found (HOXHA & ME<;:o 1989).

Between the two above-mentioned formations is the plagio-granitic Trokuzi Massif of which the age is controversial. However, paleontological evidence from adjacent forma_tions suggest that it is probably Carboniferous to early Permian (MEÇO et al. 1991). The third, last, youngest and uppermost formation is the "conglomeratic one" of Verrucano classic series type often met with in the Korabi Zone and other inner zones in Albania. The entire stratigraphical profile has a general north-north-westerly dip and, towards the south _south-east, it overthrusts the Maastrichtian flysch of the Valbona Sub-Zone.

In the Vermoshi region, the Gashi Zone comprises volcanic, intermediate to acidic, rocks alternating with limestones and succeeded by Triassic limestones. There is a mono_clinal structure dipping north-north-east and overthrusting Vermoshi Zone Tithonian_Valanginian flysch towards the south.

The Durmitor Zone in Montenegro is characterized by a Paleozoic basement covered with red sandstones and sandy limestones of the Werfenian, then neritic limestones and finally an "Ammonitico rosso" horizon with facies of Hanbulog type. This is associated with Anisian porphyrites, tuffs and radiolarites and Upper Triassic to Upper Maim reef limestones. In the pre-Portlandian time interval, there is a stratigraphical hiatus comprising a bauxite level. Above this, there is a diabase-radiolarite series which is not widely distributed and reaches the Berriasian. It transgresses the Malm locally, also the Lower Jurassic or Upper Triassic (RAMPNOUX & FOURCAOE 1969). Some authorities considered the Dur_mitor Zone to be a sub-zone of the Serbian ophiolites zone (BIÇOKU et al. 1970).

4.5. Geomorphology and karstification

The **Dinaric Alps** or **Dinarides** form a mountain chain in Southern Europe, spanning areas of Slovenia, Croatia, Bosnia and Herzegovina, Serbia, Albania and Montenegro.

They extend for 645 kilometres (401 mi) along the coast of the Adriatic Sea (northwest-southeast), from the Julian Alps in the northwest down to the Korab massif, where the mountain direction changes to north-south. The highest mountain of the Dinaric Alps is Mount Jezerca, located on the border of eastern Montenegro and northern Albania, with the peak called "Jezerca Crest" at 2,692 metres (8,832 ft).

The Dinaric Alps are the fifth most rugged and extensively mountainous area of Europe after the Caucasus Mountains, Alps, Pyrenees and Scandinavian Mountains. They are formed largely of secondary and tertiary sedimentary rocks of dolomite, limestone,sand and conglomerates formed by seas and lakes that had once covered the area.

During the Alpine earth movements that occurred 50-100 million years ago, immense lateral pressures folded and overthrust the rocks in a great arc around the old rigid block of the northeast. The Dinaric Alps were thrown up in more or less parallel ranges, stretching like necklaces from the Julian Alps as far as the areas of northern Albania and Kosovo, where the mountainous terrain subsides to make way for the waters of Drin and the fields of Kosovo. The Šar and Korab mountains then rise and the mountainous terrain continues southwards to the Pindus of Greece and the mountains of the Peloponnese and Crete, Rhodes to the Taurus Mountains of southern Turkey.

The Mesozoic limestone forms a very distinctive region of the Balkans, notable for features such as the Karst, which has given its name to all such terrains of limestone eroded by groundwater. The Quaternary ice ages had relatively little direct geologic influence on the Balkans.No permanent ice caps existed, and there is little evidence of extensive glaciation. Only the highest summits of Durmitor, Orjen and Prenj have glacial valleys and moraines as low as 600 m (1,969 ft). However, in the Prokletije, a range on the northern Albanian border that runs east to west (thus breaking the general geographic trend of the Dinaric system), there is evidence of major glaciationOne geological feature of great importance to the present-day landscape of the Dinarides must be considered in more detail: that of the limestone mountains, often with their attendant faulting.They are hard and slow to erode, and often persist as steep jagged escarpments, through whichsteep-sided gorges and canyons are cleft by the rivers draining the higher slopes.The most extensive example of limestone mountains in Europe are those of the Karst of the Dinaric Alps. Here, all the characteristic features are encountered again and again as one travels through this wild and under populated country. Limestone is a very porous rock, yet very hard and resistant to erosion. Water is the most important corrosive force, dissolving the limestone by chemical action of its natural acidity. As it percolates down through cracks in the limestone it opens up fissures and channels, often of considerable depth, so that whole systems of underground drainage develop. During subsequent millennia these work deeper, leaving in their wake enormous waterless caverns, sinkholes and grottoes and forming underground labyrinths of channels and shafts. The roofs of some of these caverns may eventually fall in, to produce great perpendicular-sided gorges, exposing the water to the surface once more. The magnificent gorges of many of the Dinaricrivers, for example those of the Vrbas, Neretva, Tara and Lim, are justly famous. The partially submerged western Dinaric Alps form the numerous islands and harbors along the Croatian coast.

Only along the Dinaric gorges is communication possible across the Karst, and roads and railways tunnel through precipitous cliffs and traverse narrow ledges above roaring torrents. A numberof springs and rivers rise in the Dinaric range, including Drini River noted for SHPP construction in Albania. At the same time, the purity of these rocks is such that the rivers are crystal clear, and there is little soil-making residue. Water quality testing of the Mati River River, for example, indicates the low pollutant levels present. Rock faces are often bare of vegetation and glaring white, but what little soil there is may collect in the hollows and support lush lime-tolerant vegetation, or yield narrow strips of cultivation.

Dinaric Carbonate Platform - The Dinarides are a 200-300-km-wide southwest vergent fold and thrust belt extending along the eastern margin of the Adriatic Sea. The complex and varied structural and stratigraphic relationships can be used to define three major tectonic units: the internal, central, and external Dinarides. In the Internal Dinarides, platform sequences deposited in the Early and Middle Triassic underwent rapid subsidence and drowning in the Late Triassic and Early Jurassic along with rifting and subsequent formation of oceanic crust. Melange and flysch were deposited during the late Jurassic through Cretaceous as the developing thrust belt encroached upon the northeastern margin of the Dinaride carbonate platform. The Dinaride carbonate platform forms the cores of the central and external Dinarides and is composed primarily of Permian-Triassic clastics and evaporites overlain by Middle Triassic through early Eocene platform carbonates. The entire sequence is overlain by late Eocene and early Oligocene synorogenic flysch. In the central Dinarides, late Jurassic and Early Cretaceous unconformities suggest structuraluplift prior to the onset of thrusting. Deformation involves Paleozoic basement and includes a major decollement in the Permian Triassic clastic and evaporite unit. Thrusting in the external Dinarides occurred in the late Eocene-early Oligocene and is restricted to Middle Triassic and younger units with major detachments forming near the base of the Ladinian and within a Late Jurassic-Early Cretaceous evaporite. Important oil source and seal lithofacies occur within intraplatform basins and lagoons in the Mesozoic sequences of the central and external Dinarides. Widespread dolomitized units within the Mesozoic carbonate sequence are potential reservoir zones. The presence of surface hydrocarbon seeps and of existing production on trend to the Dinarides in the thrust belt of Italy and Albania suggest the potential for hydrocarbon discoveries in this underexplored area.

Out of all natural characteristics of Dinaric Alps mountain chain, the most important and the most known is the karst (also known as Dinaric karst). Karst is a type of relief with formed hydrographic and geomorphological shapes and structures, created by water penetrating into soluble rocks as are dolomite, gypsium and especially the limestone. Karstic action is very much present in Dinaric areas that are chiefly composed of limestone. The most of the rocks in the Dinaric Mountains are late Paleozoic and Mesozoic limestones and dolomites. Therest of the Chain is characterized by clastic flysch-like sediments interbedded occasionally with limestone layers. Limestone in this area comes from the former Tethys sea (placed here 200 milion years ago) from which more vast plates arised later, including the Adriatic and Dinaric plates. Marine organism previously deposited on ocean flors, the secretions, shells or skeletons of plants and animals had already formed a layer that was now risen to heights of Dinaric Alps.

Dinaric karst area is larger than a half of the surface of all Dinarics. This area comprises the south-western half of the Chain, stretching from Italian/Slovenian border all the way to Skadar/Scutari Basin in Montenegro and Albania. The Dinaric mountain regions, already difficult to access, are even more inhospitable thanks to this intensive karstic action. This natural characteristic is one of the main reasons for depopulation of this area and its economic decay, over decades and centuries.

In spite of high rainfall averages in many karstic areas in the Dinarics, the coastal side of the chain has few surface watercourses, because the rainwater quickly sinks underground into the crevices and cavities in the limestone. The more you move inland and to higher grounds the rainfall levels are still high and that supports the forming of dense forest covers (in Notranjska area of Slovenia, Gorski kotar area of Croatia, northern parts of Western Bosnia). Still further inland the limestone areas are less frequent. Locally, there are karstic areas even in Central and SE parts of the Chain, but they give place to other less-porous rocks (schists, grey-wackes, serpentines and crystalline rocks), which hold up surface flows and huge expanses of forests and other vegetation. This kind of karst is called covered, or green karst, because karstic processes are still taking place under the surface mantle of vegetation and humus-soil. Closer to the coast the bare karst.

Karst develops after dissolving of limestone in water, which contains carbon dioxide(CO2). This is generally a result of mildly acidic rainfall acting on soluble limestone. The rain picks up CO^2 (whichdissolves in the water) when passing through the atmosphere.

On the ground, the rain-water sinks into the limestone (which has more than 50 percent of kalcium carbonate - $CaCO_3$) where it picks up more carbon dioxide and form a weak carbonic acid solution ($H_2O + CO_2 \rightarrow H_2CO_3$). This mildly acidic water seeps through and begins to dissolve fractures and bedding planes in limestone bedrocks ($H_2O + CO_2 + CaCO_3 \rightarrow\leftarrow Ca(HCO_3)_2$ - forming unstable kalcium hydrobicarbonate). Over time these fractures enlarge as the bedrock continues to dissolve. Openings in the rock increase in size, and an underground drainage system begins to develop, allowing more water to pass through and accelerating the formation of karst features. This whole process is called the karstification.

CHAPTER 5 Geomorphology and karstification

5.1. Karstification process

The process of karstification results in a topography with distinctive features and varieties, and overall the Dinaric Mountain region abounds in literally hundreds of examplesof karstic landforms including sinkholes, doline(s), uvale(s), polja (fields), karst plains, dry valleys,karren (kamenice), pits, swallow holes (ponori), vertical shafts, disappearing streams, and springs. After sufficient time of water-action, complex underground drainage systems and extensive caves and cavern systems may form (the most of them with again deposited calcium carbonate in formsof stalactites and stalagmites). The roof of such subterranean cavities may collapse, forming funnel-shaped holes in the ground; the sides of these holes are then gradually levelled down, and a soil is carried into them by the heavy rain. These are the characteristic karstic features known as dolina(doline, *plural*) or swallowholes - conical depressions, usually ranging in diameter between 10 and 100 ft (cca 30 to 300 ft), with their floors lying 30, 60 or even more feet below the surrounding ground level. Smaller dolines can also be formed at the intersection of enlarged clefts. In many areas in the karstic upland region (for example on Velebit and Orjen) one doline comes up against another, with only a narrow ridge between them; and when the intervening ridges in time disappear the dolines coalesce into a larger feature known as an uvala.

Still larger depressions, surrounded on all sides by hills, are called polje (polja,*plural*). These very typical karstic features have usually very flat floors covered with alluvial deposits of fertile terra rossa. Polja (fields) are agriculturally important because they are basins of good soil in this otherwise barren upland region. At the edges of many poljes, set at an angle to the floor of the depression,underground rivers emerge, they flow through the polje and disappear again into ahole at the other end. Frequently, however, these holes - ponors (ponor, *sing.*) are too small to cope with the mass of water when the underground rivers are swollen by heavy rain, or after snow melting; the water then accumulates in the lowest part of the polje, and if the heavy flow of water continues the whole of the polje is transformed into a periodical lake. In some fields this flooding can last for several months. They are usually dry again by the beginning of summer, but if the autumn rains come early theymay again be flooded in late summer, which produces lots of problems for people farming this small (and maybe, the only) parches of arable land. The villages and hamlets in which they live avoid the floor of the polje and stay out of reach of the water on the arid slopes around its edges which are not suitable for cultivation. The water which sinks into the ground in the karstic uplands finds its way to another polje and lower laying land or the sea through underground channels.

After their disappearance into a ponor many rivers re-emerge again in the form of karstic springs on the coast or even under the sea. A normal surface drainage system develops in the areas of less permeable clays and marls which occur here and there in the limestone region, but as soon as the rivers reach limestone territory they disappear underground like the others.

5.2. Karstic features

The karstic rocks in Albania are mainly represented by carbonatic and evaporatic rocks. They spread over the south-west, north and northwest parts of Albania. The age of the karstik rocks is Trias, Jurassic, Cretaceaus and Paleogene. The Permo-Trias evaporides are mainly encountered in the northeast, central and southwest regions of the country. Geologic, hydrogeologic, geomorphologic and climatic conditions of the country cause the intensive development of the karst phenomenon. The limestone has more than 90% CaC03, the plateaus of the mountain belts have moderate steepness of they have rough relief, so suitable conditions exist for the development of the karst phenomenon. Karstification is also developed in the western steep slopes of the coastal mountains, because of the humidity due to sea. The average annual temperature is 12 ^{0}C in the south of the country and 8 ^{0}C in the Alps of Albania. The average annual rainfall is more than 1300 mm^{2}. The massive upper Triasicc age limestones and thick-bed layered limestones of Cretaceous-Eocene are much karstified. The Eocene age limestones are also karstified. Karst is weakly developed in the lower and middle Trias age limenstones. Jurassic and Cretaceous rocks are altered with siliceous and clay layers in some regions. The studies have shown existence of the open karst or young and the old karst (the buried karst). The open karst is presented by cuspate microrelief in the valleys, caves, funnels and karstic fields with surface of hundreds of square kilometers and with residue of the altered material

This karst has been created channals, grottos, wells and caves in the subsurface. Groundwater is drainaged in the form of huge karstic springs. A) type of karst is developed when the limenstone is placed over the ophiolides and Creatacous-Eocene age limestone. This formation occurs at the crest of the anticline and take placed above the impermeable rocks. The occurence of this phenomenon has been encountered in the massive caused by the flowing surface waters. The river valleys in the limestone are the deepest drainage sectors of the groundwater, therefore the karst phenomenon is developed through both sides of the valleys. Karst is also developed through the river bed, in sectors where the lowering of the erosion base of rivers are accompanied with the corosion and the dissolution of the limenstone. Otherwise, karst is developed only at high levels without necessity of reaching the erosional base of the rivers. These rivers show rapid vertical movement of the territory in the valleys between the massive Upper Trias limestone with steep dips which has a similar characteristic of the karstic nearby valley where the slope of the karst is prominent. In this hydrodnamic karst type, there is also such a kind of karst participation which is developed near the contact of the limestones with the impermeable rocks. The disjunctive tectonic is often encountered in the limenstone structures of the Albania. Groundwaters circulate through altered zones and that is the reason of the tectonic karst development. It is especially spread at over the intersection points of the longitudinal and transversal faults where many karst springs exist. Due to the structure of limestone in Albania, it is also possible to meet the old karst, which is generally linked with the stratigraphic gap of Trias, Lower Jurassic, Cretaceus and Paleogene, proved by deep boreholes. The karst cavity is filled with clay and bauxite. The karst phenomenon is also present in the evaporites. Their weak physical-mechanical properties provide the possibility for karstic lattice to be closed by evaporites fall and as a result of this holes, they are formed on the earth's surface. These holes, today, constitute the small lakes, especially in the Belshi zone (Central Albania). During the construction of the reservoirs, the presence of the pseudokarst in the form of hollows or pipes in the subargillite covers of the karstic rocks has become evident. Many empty pipes with a diameter of 0.1 -1 m exist in the karstic fields. If there is no outcrop, they cause problems for reservoirs water.

5.3.Surficial karstic features

Karstic carbonates rocks outcrops at about 22.6 % of the Albanian territory; they construct 25 carbonate massifs having the total surface of about 6500km^2. Carbonate rocks outcrops in all tectonic zones of Albania. There are encountered different lithological types of carbonate rock like pure massif and stratified limestones, conglomerate limestone, limestone with siliceous rocks, dolomite limestone and dolomite.

Morphology of the karstic massifs is characterized of the presence of sinkholes, oval, poljes, dead valleys, vertical shafts, swallow holes and caves. The surface hydrographic network is poorly developed in the karstic areas but the underground hydrographic network is good developed.

The permeability is very non-uniform, more significant is the secondary permeability related to the tectonic fracturing, water circulation and the fractures enlargement through the solution. There are two end members of the possible flow system in the karst area, 1) diffuse flow along joints factors, bedding plants and, 2) flow through integrated conduit systems with water flowing, often turbulently. As the consequence, it is impossible to predict with high degree of accuracy the yield of a well before drilling in the karst area. The specific capacity of many drilling karst wells in Albanian is usually less than 1l/s/m, but values up to 50-70l/s/m are known.Efficient infiltration in the karstic massifs of Albania varies usually from 45-55% of the yearly precipitation. Absolute value of the efficient of infiltration in the karstic massifs of Albania various in wide limits. In Albanian Alps it is about 1500-1700mm/year, in south of Albania in Kurvelesh, it is about 1200-1300mm/year and in Dry Mountain (Mali I Thate) masssif in south-east Albania it is about 600mm/year.

Karstic ground water is drained mainly through big springs issuing in lowest outcrop areas of carbonates rocks, mostly near the bottom of valleys and near the sea in the coastal areas. The regime of the karstic springs is very non-uniform, they have the biggest discharge during the period January-May and meantime, during the dry season the spring`s hydrograph is characterized by the recession curve. Some time recession curve is composite by some segments indicating the dimension of the feeding fissures or channels. In them is bigger than 1000 l/s.

The total exploitable resources of carbonate groundwater resources of Albania are estimated to be about 4.8 x 10^9 m^3/year or 152 m^3/s, which constitute about 68% of the total fresh groundwater resources of Albania. Their exploitation is still limited.

Actually, for the urban water supply, are used about 3.2 m^3/s or only about 2% of total fresh groundwater resources of Albania.

5.4. Potholes and caves

Brief survey of the studies of karst and speleology in Albania

The first scientific researches of surface karst phenomena are made by the Albanian geographers Kristo, 1973, Gruda, 1981, 1985, 1990, Hoti, 1990 etc. The first archaeological and paleontological studies of Albanian Alps cave (Shpella Gajtanit) date back to 1923. This cave was excavated by A.Fistany in 1961, and in 1982 there were discovered fossil remains of Hominoids. Numerous underground cavities have been distributed from the pioneers of Albanian speleology - Z. Ubani, M. Uruci, G. Uruci, K. Gjilbegu, A. Codra, H. Hasa etc. (Uruci, 1994). The beginning of biospeleological studies date back to 1914, when C. Lona from Triest, collects the first Coleoptera from the caves of Mt Cukali. Some other caves were explored biospeleologically by A. Bischoff, C. Lona and A. Winkler in the period 1922-1931 (Genest & Juberthie, 1994), and later - by the Czech zoologist Hanak (Hanak, 1964) and some Italian explorers. Recently, starting from 1989, many foreign speleological expeditions have been carried out in different areas of Albania. The Italian and San-Marinian cavers had explored mainly the Albanian Alps, but some areas in Central and South Albania (Polisi, Kurvelesh, Tomor,Karaborun, Mali me Gropa etc.) were studied also. Due to the detailed and systematic investigation in the Alps were discovered many new and attractive caves. Among them are: Shpella e Pusit, deep 370 m and long 5 km (the longest cave in Albania); Shpella Uomini umidi - deep 520 m (second deepest in Albania), and Shpella e Gjek Markut - 234 m deep. The Dutch cavers made 3 expeditions in Mali me Gropa Mt. and Daiti Mt. British expeditions were held in 1992, 1995 and 1996. Some karst regions and caves were object of exploration from Belgian, Croatian, French, Polish and Slovak cavers and speleologists. The obtained results are presented in over 150 publications, referred in Speleological Abstacts Bulletin (BBS) of U.I.S. and other bibliographical publications.

The North Albanian Alps are a part of the Dinaric Mountains. It is the largest Mt in Albania, which covers an area of 2010 sq.km (TALANI, 1990). This vast area constitutes a typical karst region in Europe due to its geographical position, its climatic and geological conditions.The main explored territory covers an area of approx. 320 km2 and is located in Southern and Central part of the Albanian Alps. Some explorations have been carried out also in Mt. Dejes and Mt. Gollobordes andin South Albania in Mali I Thate Mt. and its surroundings. Two hundred and ten new caves were discovered and surveyed. The most important vertical caves are: BB-30 (-610 m); Shpella Cilicokave (-505 m) and B33 (-205 m). 14 o ther caves are deeper than 100 m. The most important horizontal cave is Shpella e Majes te Arapit with total length 840 m. The largest cave chamber is in Shpella e Gjolave with an area of 8875 m3 and volume 443 750 m^3. The deepest and longest explored karst spring is Syni i Sheganit (160 m long, 52 m deep).

VI. CHAPTER Hydrogeology Aquifer systems

6.1. The karstic waters in Albania

The total outcropping area of karstic aquifers in Albania is about 6,500 km^2 and, on large areas of the Ionian and Kruja Zones, are covered by flysch deposits. Usually, they comprise carbonatic rocks such as limestones and, to a lesser extent, dolomites as well. Strong fissuration and karstification are the norm. Karstic aquifers differ in permeability, but it is generally high.

Isotopic studies have been made in some karstic areas in order to better understand their water circulation patterns (AKITI et al. 1990; EFTIMI et al. 1997). There are some 25 karstic areas in the country and most constitute important groundwater reservoirs (EFTIMI 1979; EFTIMI et al. 1986). Karstic water discharges as large karstic spring which vary greatly in productivity. There are roughly 110 karstic springs with average dischar_ges exceeding 100 1/s. Among these, 17 have discharges ranging from 100 to 1,000 1/s. The average discharge of the largest one of all, the Blue Eye Spring in southern Albania, is approximately 18.5 m^3 / s.

Karstic waters show significant differences in physico-chemical characteristics (EFTIMI 1997, 1998). Most relate to limestones, are low in minerals and soft (containing calcium bicarbonate). In dolomites, karstic water is again low in mineral content, but harder (containing about 80 mg of magnesium sulphate per litre). Occasionally, higher sulphate levels occur due to the presence of gypsum in the catchment area. This is demonstrated by the Glina Spring, a well known drinking water mineral spring in Albania which has a sulphate content of approximately 600 mg/l. Along the southern Ionian carbonate rock coast, mixing with seawater takes place and there are mineralized karstic springs of chlorine-sodium type.

6.2. Groundwaters

Albania is part of the Mediterranean climatic belt. However, because of its mountainous nature, there is great climatic variability within it. The annual mean temperature for the coastal region varies from 14 to 17° C as compared with an average 10° C in the mountains. Annual mean precipitation varies from 700 to 800 mm in the south-east to over 3,000 mm in the Albanian Alps of the north. Consequently, Albania has an abundance of surface water, the total annual run-off being estimated as 42.25 billion rrr', The groundwater flow is 12.8 billion m^3 per year (PANO 1984).

Groundwater and rocks

The general hydrogeological map of Albania shown in Fig. 116 shows hydrogeological conditions in a simplified form. The basic element shown is that of the aquifers which are classified according to type and importance of their groundwater resources (EFTIMI et al. 1986). The most important freshwater and thermo-mineral springs are shown as well. Major characteristics of the aquifers are discussed below and reflect their classification into porous, karstic-fissured and locally (low) productive categories.

These are divisible into high and low production types.

Highly productive aquifers are represented mainly by Quaternary alluvial and gravelly ones usually filling river valleys and some Periadriatic lowland plain synclines (EFTIMI 1966,1975,1979,1982; LAKO 1973) as well as intermontane plains (EFTIMI 1989; TYLI 1971). Most such aquifers comprise high yield groundwater reservoirs. Gravelly aquifers with maximum thicknesses of about 150 m are normally covered by less permeable deposits. Generally, they have high permeability and transmissibility and their wells have capacities ranging from approximately 101/ s up to over 1001/ s. As a rule, groundwater quality is good as the water has a low mineral content and ranges from soft to moderately hard in composition. The phenomenon of groundwater "natural softening" due to the precipitation of carbonates has often been observed (EFTIMI 1966, 1998). Groundwater resources from the gravelly aquifers are intensively exploited for the domestic and industrial water supplies. Near urban areas, such aquifers are vulnerable to contamination.

Low production porous aquifers occur in the Quaternary deposits of some parts of cen_tral and western Albania where gravelly aquifers do not occur.

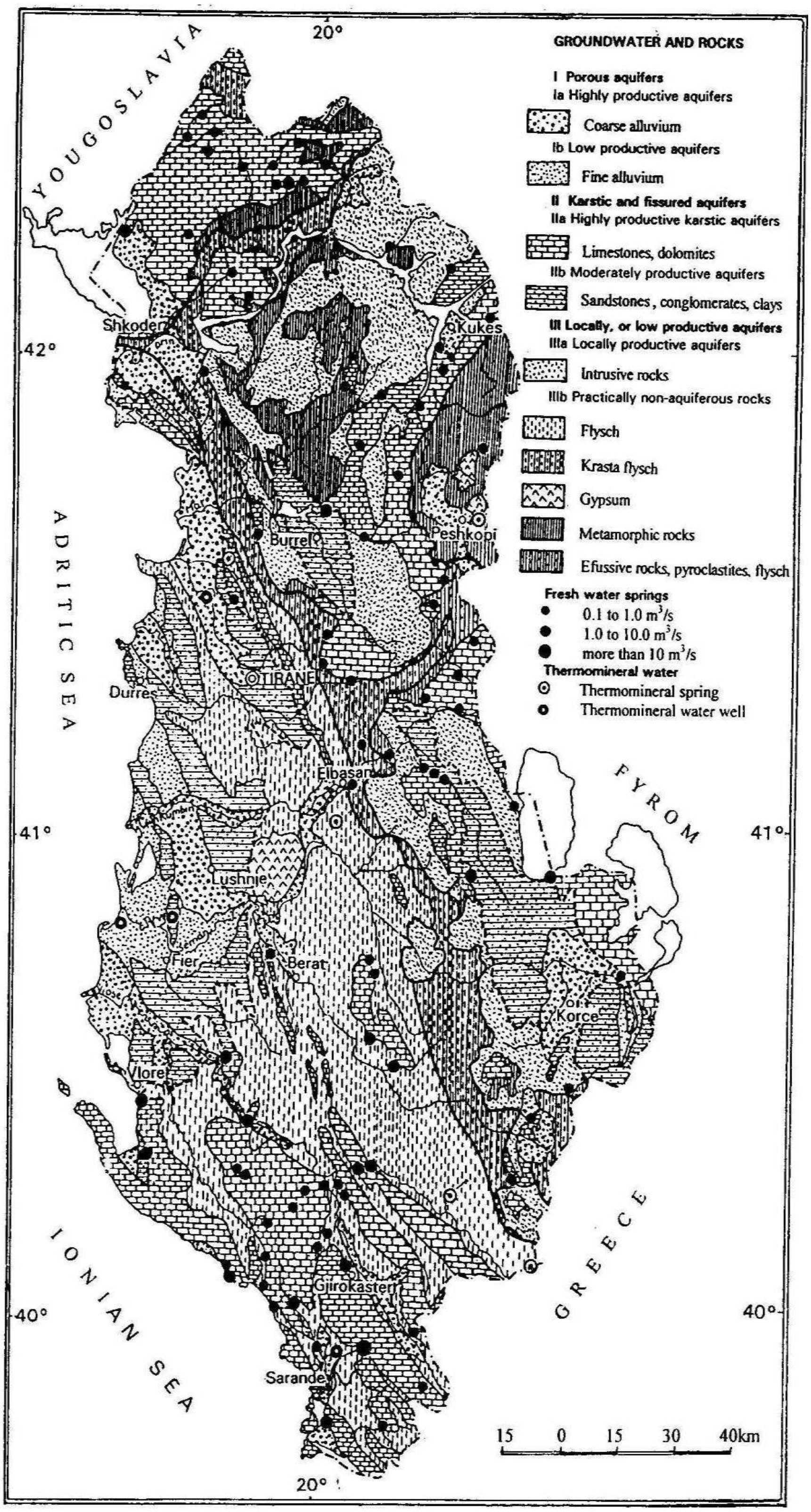


Fig. Simplified hydrogeological map of Albania (From Eftimi et al. 1996)

6.3.Tracing tests results

Environmental isotope and hydrochemical methods have been applied in some karst areas of Albania in order to better understand their water circulation patterns. In some areas “underground piracy” has been observed, a term used by Stevanovic et al. (1994) when a karst
aquifer with a lower hydraulic head is recharged by another with a higher hydraulic head. With environmental isotopes it has been established that Prespa Lake recharges the Ohrid Lake through the Mali Thate karst massif and about 50% of the discharge of the common discharge of Tushemisht and St. Naum springs represents the Prespa Lake water (Anovski 1991, Eftimi et al. 1996, 2007). An artificial tracer experiment carried out in 2002 physically demonstrated the underground connection between both lakes, and maximum karst underground flow velocity was about 700 to 2900 m/h (Amataj et al. 2005), which is much higher than reported velocities for other karst areas (Garašic 1997, Kogovšek et al. 1997). By a similar combined study it was established that the Poçem karst spring is replenished by the Vjosa River by about 80% (Akiti et al. 1989, Eftimi at al. 2006b). Through another environmental isotope and hydrochemical study it has been established that the Blue Eye Spring is replenished by the Drinos River gravelly aquifer (Fig. 6) by about 30 t0 35%, and the remaining quantity is replenished by the precipitation infiltrating into the Mali Gjere karst massif (Eftimi et al. 2007, 2009).

6.4. Regional groundwater direction

In Albania, the ground water direction, depended not only by the hydro-geomorphological features and river`s network but from the rate of fissures and caverns of karst rocks. So, the main direction goes from east to the western part of Albania, to the Adriatic and Ionian Sea. The waters related to the transboundary zone with Montenegro flow just to the Adriatic sea in major part through their discharges to the Shkodra Lake, buna and Drini Rivers. A smaller part goes toward the Monte Negro in the region of Vermoshi Zone as wellas to the Kosovo, from south to the north.
From springs which drain karst masses of Albanian Alps in Shkodra lake are created some permanent channels as the case of "Syri i Sheganit spring" with a max. = 2.7m^3/s. From the other hand there are many local flow directions of these karstic water but anyway all them are collected by the local or main streams whic drenage to the Adriatic Sea. In external sides of the Albanian dinarides the main direction as we mentioned before are going to Monte Negro from south to north, to Kosovo from northwestern part to northeast and in Macedonia from west to the east.

6.5 Groundwater bodies

Albania is rich in water resources, including rivers, groundwater, lakes, lagoons and seas. Overall its resources exceed by far its consumption, although locally water shortage and conflicts among users may occur in the dry season. The hydrographic basin of Albania covers 43,305 km^2, of which 28,748 km^2 lie within its boundaries. The rest (i.e. 33 per cent) is in Greece, the former Yugoslav Republic of Macedonia and Yugoslavia, so Albania shares upstream and downstream water resources with its neighbours. Albania's 247 natural lakes are an important component of the country's hydrographical network. Resources are unevenly distributed throughout the country. The major water resource is surface water, and is found in rivers, lakes, and lagoons.

Despite being naturally rich in water, Albania suffers from a shortage of available drinking water.This is partly because the rainfall is unevenly distributed across the country and partly because more than two thirds of the water is lost during transport and distribution as a consequence of the obsolete supply infrastructure. The towns are supplied with drinking water for only a few hourseach day while, in rural regions, the public supply does not even reach one citizen in two. In all rural areas as well as in the majority of towns, sewage is discharged in an uncontrolled manner. The consequences are that water is contaminated and the environment polluted; gastrointestinal illnesses are very common.

Groundwater is an important source widely used for drinking, industrial and agricultural water supply in Albania. Amount of groundwater for domestic and industrial water use varies from 70 to 93% of total water consumption.

For human consumption groundwater is abstracted by drilled wells and natural springs. Boreholes are installed mainly on the plain terrains and in river valleys, and springs most frequently are captured on the hills and slopes of mountain areas.

BCM or 13,300 cubic meter per capita, of which about 65 percent are generated within Albania and the remaining from upstream countries. Resources are unevenly distributed throughout the country. The major water resource is surface water, and is found in rivers, lakes, and lagoons. The most important rivers are Drini, Mati, Ishmi, Erzeni, Shkumbini, Semani., Vjosa and Bistrica The country has several rivers which form the six main basins, a number of natural lakes, and a multitude of artificial ones for energy and irrigation. Lakes cover about 4 percent of the country'sterritory. The largest lakes are Ohrid,, Prespa and Shkodra. There are also several reservoirs totaling 5.60BCM of storage capacity, which have been built for flood protection, irrigation and production of hydropower.

Preliminary characterization of GW bodies, in accordance with the WFD of the EU, was performed within CEMSA project in the territory Albania. Now it is a project regarding GW bodies characterization undertaken by Albanian geological Survey at the framework of new hydrogeological scale in ratio1:200 000. Characterisation of GW bodies is under this entity jurisdiction. This project in collaboration with Cemsa project has been started in 2007 (by CEMSA) and in 2010 (by AGS) and will be finished by 2014. Delineation of GW bodies was not the object for two above mentioned entities but the other project as: “Master Plan for Drinking Water Supply in Albania” has it as a topic to be achieved. This project was undertaken by the Austrian Company.

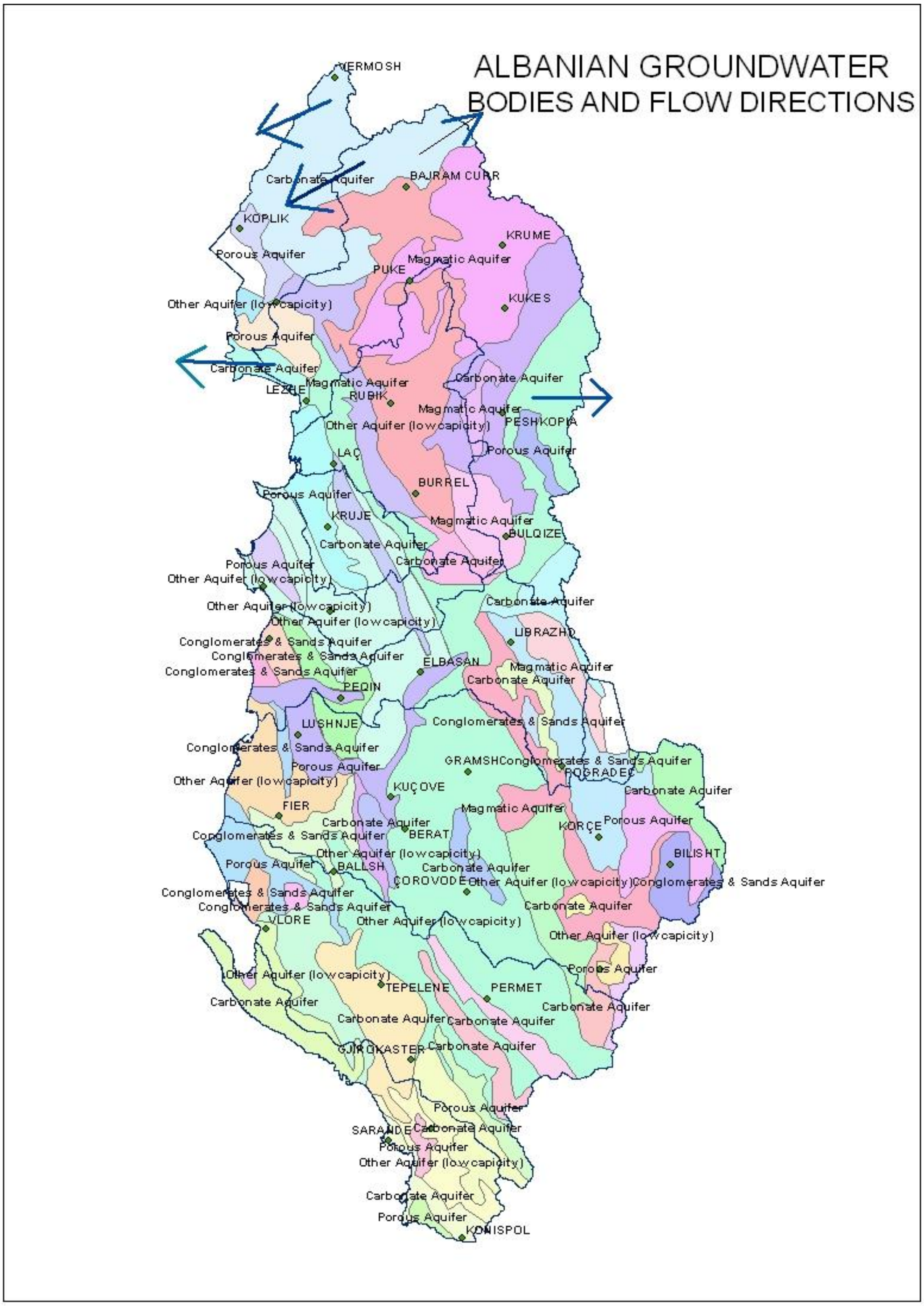


Fig. Albanian Groundwater bodies and their flow directions in Alps

Aquifer type	Aquifer code		Aquifer type	Aquifer code
Porous Aquifer	ALG2013		Carbonate Aquifer	ALG1007
Porous Aquifer	ALG2012		Porous Aquifer	ALG2006
Carbonate Aquifer	ALG1018		Conglomerates & Sands Aquifer	ALG4003
Other Aquifer (low capicity)	ALG5010		Conglomerates & Sands Aquifer	ALG4002
Carbonate Aquifer	ALG1017		Conglomerates & Sands Aquifer	ALG4009
Porous Aquifer	ALG2011		Magmatic Aquifer	ALG3006
Porous Aquifer	ALG2010		Magmatic Aquifer	ALG3005
Carbonate Aquifer	ALG1015		Conglomerates & Sands Aquifer	ALG4001
Carbonate Aquifer	ALG1012		Carbonate Aquifer	ALG1006
Carbonate Aquifer	ALG1016		Porous Aquifer	ALG2005
Carbonate Aquifer	ALG1014		Carbonate Aquifer	ALG1005
Other Aquifer (low capicity)	ALG5009		Magmatic Aquifer	ALG3004
Porous Aquifer	ALG2009		Other Aquifer (low capicity)	ALG5004
Carbonate Aquifer	ALG1013		Carbonate Aquifer	ALG1004
Other Aquifer (low capicity)	ALG5007		Porous Aquifer	ALG2004
Carbonate Aquifer	ALG1011		Porous Aquifer	ALG2003
Conglomerates & Sands Aquifer	ALG4007		Magmatic Aquifer	ALG3003
Conglomerates & Sands Aquifer	ALG4006		Carbonate Aquifer	ALG1003
Conglomerates & Sands Aquifer	ALG4010		Porous Aquifer	ALG2002
Carbonate Aquifer	ALG1010		Other Aquifer (low capicity)	ALG5003
Other Aquifer (low capicity)	ALG5006		Other Aquifer (low capicity)	ALG5002
Carbonate Aquifer	ALG1009		Magmatic Aquifer	ALG3002
Porous Aquifer	ALG2008		Carbonate Aquifer	ALG1002
Porous Aquifer	ALG2007		Porous Aquifer	ALG2001
Conglomerates & Sands Aquifer	ALG4005		Other Aquifer (low capicity)	ALG5001
Other Aquifer (low capicity)	ALG5008		Magmatic Aquifer	ALG3001
Carbonate Aquifer	ALG1008		Carbonate Aquifer	ALG1001
Conglomerates & Sands Aquifer	ALG4004		Other Aquifer (low capicity)	ALG5004
Conglomerates & Sands Aquifer	ALG4008		Other Aquifer (low capicity)	ALG5004
Other Aquifer (low capicity)	ALG5005		Other Aquifer (low capicity)	ALG5004

Table. Types and Aquifer Codes

CHAPTER 7 Hydrogeological resources in Albania

7.1. Groundwater basins

Albania is a rich country with underground waters of different types (freatic, artesian, karstic, minerals, etc.). It is conditioned; firstly by distribute of the good-featured rocks collectors, such as: Alluvial gravel, karst limestone, conglomerates, etc, secondly, by the complicated geological - structural composition, which has lead to the formation and storage of large groundwater reserves, and thirdly by the physical - geographical conditions and favourable climate for intensive groundwater flow.
The underground water distributed by lithological - hydrogeological criteria is presented in hydrogeological map of Albania at scale 1:200 000. Based on this map, results that the possible zones where we can take more reserves of the groundwaters for drinking and industrial purposes are the karstic massifs and alluvial depositions of the rivers. Today in Albania are encountered numerous water supplying systems, where some calculated to cubic meters per second are taken by the karstic springs or are taken by the drilling in fluvial depositions.
Tirana water pipeline takes 800l/s water, Vlora 500l/s, Ballshi 700l/s, etc, which are supplied with water from karstic springs.
In this report are considered as a whole the waters taken the karst and magmatic formations where the last are surrounded by the limestone formations.

The basin consists of several anticline and syncline belts that divide them. Here can be mentioned:

- Anticline belt of Tomorri,
- Syncline of Permeti
- Anticline belt of Berati (Trebeshin – Dhembel – Nëmerçke and Shendelli – Lunxheri – Bureto belts)
- Syncline of Memaliaj
- Anticline region of Kurveleshi
- Syncline of Shushica
- Western field of Vjosa

The average River flow into the sea results to be 210 m^3/sec.

7.2. Brief description of hydrogeological conditions Vjosa Basin

Vjosa Basin represents a new age basin with intensive erosion. Vjosa valley in Permet, Tepelena, Memaliaj, Vlora, Selenica areas and surroundings is the most populated in the country and at the same time, it represents a strong basis for agriculture development.
According to the hydrogeological characteristics of the basin and geological structures that constitute the basin, are identified the following hydrogeological areas:

Hydrogeological area of Krasta carbonate massif, which is represented by the limestone of the Upper Cretaceous. Water bearing of this region is poor, because it is conditioned by the limited diffusion of limestone within Krasta flysch. Springs that come out from limestone have a flow thaThe water bearing complex of the Lower and Middle Paleocene-Eocen depositionsIt ranges from 0.1 - 0.4l/s. The hydrogeological carbonate area of Kruja zone is represented by small anticline structures, which occurs in the eastern side of Permeti syncline, and is represented mainly by Paleocene - Eocene (Pg1 - Pg21-2) and the Upper Cretaceous (Cr1) limestones. Characteristic feature in this region is the presence of thermo - sulfur springs of their western wing.

In the basin, this area consists of Trebeshina - Dhembel – Nëmerçke and Shendelli-Lunxheri - Bureto belt. These two belts represent a single karstic massif, with a hydraulic (water) connection between them, belonging to a common water feeding area (Pindos mountains), widely distributed and with high water catchment. Lithologicaly, it is represented mainly by stratified and tabulated (flulike) limestones with fissures and strongly developed karst. Among the biggest springs in this massive, can be distinguished:

The spring of Syri i Zi,

The springs of Lekli

The springs of Hormova.

Hydrogeological region of Kurveleshi

This region is one of the most karst massifs of Vjosa Basin with an area about 580 km2. This massive is represented by limestone, belonging to the Upper Triassic to Paleocene - Eocene age.The limestones are characterized by developed joints and karst, from which come out a considerable number of springs at flow from 100 to 1000 l/s. Here can be mentioned Tafzani, Kalivaçi, Poçemi, Verniku, Kuci, Smokthina, Gurra e Picarit, Kolonja, Uji Ftohte of Tepelena springs, etc. Useful springs in this massive are estimated to be about 20 m3/sec.

In order to present the hydrogeological conditions of the area, we are based not only on the results of work performed over the years, but also on the existing ones. The description of the hydrogeological conditions of the area is made on basis of water bearing complexes. In dividing the water bearing complexes, we will take into account the age of deposition, lithological composition, which is closely related to the structure, permeability of the rocks, the type of water they contain, and their practical importance. In the area, the following water bearing complexes are distinguished:

Water bearing complex of carbonate rocks

Water bearing complex of carbonate rocks

In the water bearing complex of the carbonate rocks are included carbonate rocks of Tragjasi anticline from Jurassic to Lower and Middle Eocene. Including of these rocks in a single complex is made by the fact that they appear as a single unique hydrogeological unit.

They are rocks with high permeability and contain fissures and karst waters. In water bearing complex of Tortoniane depositions, basins of Tortoniane deposition of water bearing complex is related to sandstone layers, which contain fissures or porous

water. These are characterized by medium to low permeability. Conglomeratic sandstone strata are associated with water bearing basins of Astian complex.
Water bearing complex of Lower and Medium Paleocene-Eocene depositions.
Water bearing complex of deposition of "Krasta suite".
Water bearing complex of the Cretaceous carbonate depositions.
Water bearing complex of the Jurassic depositions.
Water bearing complex volcano-sedimentary depositions of the lower and medium Triassic
Water bearing complex of upper Triassic depositions.
Water bearing complex of intrusive rocks.
Below are shown descriptions of general characteristics of this water bearing complex:

Water bearing complex of Lower and Medium Paleocene-Eocene depositions.

The water-bearing complex is encountered almost in all positive structures, such as Lunxheria, Dhembeli, Nëmërçka anticlines and in the structural nose of Kalivaçi. Similarly, in rare cases, the groundwater of this water-bearing complex is found in other parts of the area, where the depositions of Lower and Middle Paleocene - Eocene are exposed on the surface like elongated spots and belts. In general, these groundwaters fill the fissures and gaps of these depositions with variable thickness from 120 to 300 m. Natural springs that flow from this complex, have various flow rate. More frequently are encountered springs with flow 0.05 - 2l/s, however there are cases of strong spring`s exits with very large flow, some of the main ones are: Kalivaç and Qesarat of Delvina springs with flow about 250 l/s. From the hypsometric point of view, these springs are encountered at different elevations 350-1000 m and rarely over 1000 m. Feeding of the complex is made mainly by rainfalls, which filtrate in the interior part of the numerous limestones through existing fissures. Obviously, filtration of water in depth is not very large, because fissures of the formations in depth decreases. However, for specific cases and areas, where fissures are larger and when flysch depositions are displayed like belts or barriers for limestone depositions of this stage, then discharge of ground waters is made through empty and extended erosional or tectonic fissures. In these cases, they serve as the main water bearing collector, which follow and drain large quantities of water, displayed in surface as large springs such as Kalivaç spring, etc. The direction of underground water flow is uncertain. According to field observations, we may assume that the flow of these waters is done by decreasing formations. We can point out that, despite the conditions of groundwater discharge, natural springs that displayed in this watery complex have water throughout the year, and are not dried up in summer. Their water temperature is 8° - 15°C, rarely 20°C and is widely used by locals for drinking, irrigation and electricity.

The water bearing complex of the "Krasta" suite depositions

The waterbearing complex of "Krasta" suite depositions are located in the north - eastern part of the area, such as the main mountains in Erseka area and Gramozi, Piskali, Radomoi mountains. Within the water bearing area, the water bearing complex is represented mainly by the depositions of the package of middle-and upper Krasta suite, and only very small spots belong to depositions of lower suite.

Krasta suite depositions are composed mainly by flysch, while only in the middle and upper limestone package are evidenced limestones at various thickness. Flysch of the "Krasta"suite are easily eroded, forming a very steep terrain caused by numerous streams and steep hills.

Water bearing complex of "Krasta" suite is too poor with groundwater. Springs that flow from this complex have small flow rate, usually under 0.2l/s. Springs of this complex are erosional, appeared in most cases in embankments of streams, while from the hypsometric point of view, they flow in various elevations from 800 - 1700 m above sea level.

Springs that flow from the Krasta flysch, especially those that are near residential areas, are captured and used for drinking water.

In this water bearing complex are included groundwaters in limestone of Upper and Lower Cretaceous deposition, which flow in western part of Mali i Gjere, in Lunxheria massif, Leskovik area, Butrintos anticline and different parts of our territory. Water bearing layer of the complex is composed by stratified marly limestone, with cherts intercalations and sometimes phosphatised silica.In fact, these formations are broken, eroded on the surface, leached and karstified. Karst activity in surface and eroding process is very developed, creating various forms of relief: digitations, holes, edges, and many other karst processes. Systems of fissures (along the strike and dip of formations.) expand and enter to the depth as corridors, caverns, large karstic caves, with their typical display in Lunxheria (Kelcyra springs). Feedings of karst springs, related to these big water bearing corridors or collectors, are subject to atmospheric precipitation during long and deep way of circulation in karst terrains with relatively large water bearing territory. These waters, through the dense network of fissures, are sent towards depth, to be collected in groundwater basins. Different cherts and silica layers, are encountered without any rhythm or regularity among limestones, in this case play the role of an impermeable screen that interrupts and connects all different water bearing fissures systems, accumulating and sending these waters up to the surface like water springs with considerable flow and huge water reserves.

The waters of this water bearing complex are encountered like a series of natural springs that flow in different hypsometric elevations 200-1500 m. They are rarely evidenced below the elevation 200m and higher than1500 m. The springs have different flows, which fluctuates from 0.005 up to hundreds of l/s. Springs with flow 0.50-10l/s are more predominant.

Water bearing complex of Jurassic

The water bearing layer is composed by marly siliceous and stratified limestones, which in Upper Jurassic are micro granular with non-regular stratification and with cherts and silica intersection. It is precisely the reason that in the Upper Jurassic, are encountered springs have considerable flow up to some m3/sec, meantime at the same limestone formations of the Lower- Middle – Jurassic, springs seem to have low, sometimes variable flow. Different silica and cherts lenses join the fissure systems, gathering groundwater in a single stream. The underground stream is displayed at the surface in different springs.

The springs are found at hypsometric elevations 170-850 m above sea level. Normally, they have flow rates from 0.2 to 15 l/s and are not dried up during the summer. The water of springs is clean, odourless, and tasteless. The springs appear at flow of1l/s and temperature 14.5°C.

Water bearing complex of Upper Triassic depositions (T_3)

Water bearing complex of Upper Triassic depositions (T^3) is found in Korabi, Mirdita and Ionian tectonic zones, and here we will give the descriptions of this water bearing complex in some areas as below.

Water bearing complex of Lower Triassic depositions (T_2)

Moreover, in this area, this water bearing complex is represented by intensively broken and karstified limestones. In the west, limestones contact tectonically the flysch of Upper Eocene, while in east, on top of them, concordantly are found limestones of Lower Jurassic. The contact line of limestone with flysch is at the same time the actual drainage water front of this complex.

7.3.Brief description of hydrogeological conditions Seman Basin

Groundwaters of Berati Basin.

Ground water in carbonatic rocks, Hydrogeological conditions

Main basins are Shpiragu, Tomorri and Mali i Thate where flow some important natural springs such as U.Vajgurore, Poshnja, Bogova, Mançurishti and Golloborda springs.

Shpiragu carbonatic massif consists mainly of limestones of Middle Paleocene-Eocene. These depositions are represented by limestones with rare cherts intercalations. Limestones are thin layered, tabulated, white to light grey and belong to pelitomorphic type. Frequently are are encountered clastic limestones. Tectonically, from these limestones emerge Ura Vajgurore spring at Q = 150 l/sec and Poshnja spring at Q=50 l/sec.

In Ura Vajgurore spring, water is generally clean, but are evidenced presence of iron, especially in first stages of monitoring, resulting by meddle of Osumi waters (in cases of huge flows), while in other stages, parameters remain in acceptable norms.

Bogova springs emerge at tectonic contact of Lower and Middle Eocene limestones with Middle Oligocene flych; are frontal and display a flow of 600-2000 l/sec. These waters are used to supply Policani and Berati towns. Mali i Thate, with which Mançurishta and Golloborda springs are related, is composed mainly of Upper Triassic, where structures are folded, dipping to the west of flanks at angles 400 - 500, and about 1000 m thick. Just in the tectonic contact of limestones with molassic depositions of Neogene, emerge springs of Mançurishta and Golloborda, at flow about 25 – 35 l/sec.

Mancurishta springs have Q=15 l/sec

Unlike of last year's, where are evidenced traces of Fe and NO2, currently (2008 – 2009) these springs keep the acceptable norms.
These rocks are outcropped in the south and south-west part of Korca field. There are some springs that flow from tectonic fissures with discharge of 0,5-1,5 l/sec, such as Boboshtica, Vithkuqi, Voskopoja, Gjergjelica, Bellovoda (Ujbardhi), Shalesi, Zemblaku, Drenova, Dvorani (Mollasi) springs. From tectonic fissures flow some great springs with discharge of 7-10-15 l/sec.
There are some other private drilling In these rocks, from which is used a quantity of 20-30 l/sec. There is also a private drilling in Korca city with discharge of 2 l/sec.
Annual coefficient of utilisation is K= 0,3-0,5.
Water bearing complex of magmatic rocks.

This complex is composed by ultra basic and volcano-sedimentary rocks of T1-2. In general, ultra basic rocks in normal conditions are characterized by small groundwater springs that drain to the surface within a short period of time (during winter). This is why in many springs of ultra basic rocks we have small flows, often of temporary character. The flow of springs ranging from 0.001 to 1 l/sec, rarely up to 3-5l/sec. The springs with the greatest flow in ultra basic rocks belongs to the faults zone, which drains at the surface of erosional slopes caused by deep streams. Such springs have flow up to 5l/sec and belong to erosional type, or to the contact of wall rocks.
Volcanic-sedimentary rocks are characterized by low permeability, and as such, they are very poor in water bearing. In these rocks there are springs at flow Q = 0.1-0.2 l/sec. Physical-chemical qualities of groundwater that are related to ultra - basic rocks are very good. Springs with larger flows, related to ultra basic rocks, usually come in higher levels and away of residential areas. Catchment springs from ultra basic rocks are very good for water supply (such as water supply, the spring of Qafe Shtama camp).

7.4 Brief description of hydrogeological conditions Shkumbini Basin

Ground waters of Elbasani basin.

Hydrogeological region of Elbasani field has northeast-southeast strike, from Labinoti Field to Paper, known as Elbasani waterbearing basin.

It is a field, surrounded by Krraba hills, which are composed by flysch of Oligocene (Pg32 dhe Pg23) as well as clay - sandstone - conglomerate - marly-limestone rocks of Neogene (N11a, N11b dhe N12t). The same formations are found south of this basin by Sulova-Gostime-Shalesi hilly belt. From the east, the basin is surrounded by carbonatic formations of T3-J1, Cr2, flysch of Cr2m-Pg1-2 as well as Shpati ultra basic rocks of (J2-3). Southern part is surrounded by hilly zone of Dumreja, represented by evaporites of P-T.

This graben was created during the Quaternary, along the Elbasan - Diber fault axis, therefore, this field has a very gentle slope towards the south – west; it is filled by loosened quaternary depositions, represented by the prolluvial depositions along its borders, in shape of terraces, and with strongly developed alluvials in its central part.

At foothills are found considerable concentration of coarse material, which toward the field center, the diameter of grains gradually becomes smaller.

Water bearing lithology is represented totally by coarse gravels of limestones, ultra basics and less sandstones, containing sand to 20%, where the gravels are coarser in eastern part (8-14 cm), while in western part 4-8 cm. They are illustrated below:

Based on hydrogeological features, in Shkumbini basin are distinguished the following hydrogeological regions:

Hydrogeological region of karstic carbonate massif of Polisi.

Hydrogeological region of ultra basic massifs of Shpati and Shebeniku.

Hydrogeological region of Gropa e Mokres and Librazhdi.

Hydrogeological region of Elbasani graben and Peqini.

Hydrogeological region of Lushnja depression.

In this basin have some waterbearing complexes as below:

Waterbearing complex of loosened quaternary depositions (Q)

Waterbearing complex of carbonate rocks

Waterbearing complex of magmatic rocks

Water bearing complex of carbonate rocks.

This complex is related to carbonate depositions of Polisi mountain and with the upper Triasic carbonate massif, belonging to Mirdita tectonic zone. Carbonates are characterized by a highly developed karst, with small plateau with steep slopes. The karst is developed in stages, and interlaced with glacial karst forms, which are very good premises for their water bearing, which drain through springs, some of which are given below:

- Llenga Spring, at Q = 180 l/sec.
- Radicina Spring, at Q = 30 l/sec
- Berzeshta Springs (Librazhd) with inputs that vary with 200 to 500 l/sec
- Gjuraj Springs (Librazhd) at Q = 400 - 1800 l/sec
- Vila Springs (Elbasan) at Q = 120 l/sec
- Gurra e Sopotit Springs at Q = 80 - 380 l/sec
- Dardha Springs at Q = 170 - 1200 l/sec

Springs with tectonic-karstic origin in Polisi massif, are characterized by variable flow. Its physical-chemical composition is good presented.

There are two important water bearing complexes in Elbasani area.

Water bearing complex of the quaternary alluvial gravels

Water bearing complex of carbonates

Water bearing complex of carbonates (of the T, J, and Cr)

Water bearing complex of carbonates has limited reserves and natural resources in the form of discharges in alluvial gravels near the structures of Krasta e Madhe and Krasta e Vogel. Their quality is very good and is recommended the continuation of utilization for the supply of the population.
Water carbonates are currently used in alluvial gravels by 9 drillings and one cased, for supplying with drinking water the city of Elbasani. The ten wells are distributed in three areas: Mengel, Frigoriferi, and Krasta e Vogel.
It is concluded that, in the dry season has been evidenced a decrease of specific initial flow at 30 - 40%.
Groundwater has very good features, but risk of becoming polluted by a disregard of sanitary protection zones.
It turns out that the reserves used by each basin, are smaller than the stocks recommended for use.

7.5 Brief description of hydrogeological conditions Ishmi - Erzen Basin

Assessment, management and monitoring of the ground waters, is constantly monitoring of hydrodynamic, chemical, microbiological changes under the influence of natural and artificial factors. Today, in development of contemporary hydrogeology through hydrogeological stations (monitoring stations), are carried out detailed and regional studies about the groundwater regime under the influence of natural and artificial factors. The purpose of the groundwater regime studies is discovery of the laws and phenomena, which take place during the formation of waters, utilization - management, and their explanation.

Erzeni-Ishmi Basin - There are large surfaces. This area represents the most populated and industrialized region of our country, where Tirana, Durresi, Shijaku, Fushe Kruja, Kruja and their surrounding villages are situated. The population of this area reaches over 1 million habitants.

The basin consists of several depressions that are surrounded by hills and high mountains in the East. The major one is Tirana-Ishmi depression, that divides the sea with hills in Northwest; Mati depression in North (Droja river) and Erzeni depression in West. High mountains, Dajti and Mali me Gropa are located in the eastern part of the basin.

Grameza-Thumana aquifer is located in Bilaj, Derveni, Grameza, Thumana, Bushnesh - Marvalak, Bushneshi, Fushe-Mamurrasi, Dukagjin i Ri areas, etc.

It represents a depression filled with Quaternary depositions, mainly gravel, products of solid alluvial material, brought by Ishmi and Droja rivers. This depression to the east and west, is surrounded by compact rocks like limestones of the Upper Cretaceous until Paleocene - Eocene limestones and by sandstone and siltstones, clays of Tortoniane. Gravels, generally, form a single water layer, which, in some specific sectors in the northwest, has 2 or more water bearing interlayer.

On the west of Thumana are distinguished two separated horizons, the second horizon is mineralized over 1 g/l. Water bearing layer thickness is from 4-5m up to

23m. The aquifer is covered by a layer of clay and sandy clays at thickness 2-5m up to 40m.

Gravel water bearing layer has average hydrogeological indicators. In Fushe Mamurrasi, specific flow rate has the value q = 0.8-6.3 l/sec/m, flow rate of Q = 3.5-16 l/sec, filtration coefficient k =91m/day, while the water conductivity is valid up to T = 785 m2/day. In drilling no. 29, specific flow rate is q = 12.25 l/sec/m, k = 119.7 m/day, T = 1317 m2/day. In Grameza, hydrogeological indicators are low, q = 0.3-0.9 l/sec/m and drillings have artesian water of Q = 0.5-2 l/sec. The better indicators in Grameza are found at drilling No.34 (No.1N), with artesian water flow at Q = 5 l/sec. Drilling No.34 is the only pumping station that supplies with water Gramëza and Derven. In Marvalak-Bushneshi, Dukagjini i Ri, Shkoza, Bardha areas, drilling that are used by families and groups of families, give to them artesian water of Q = 0.5 l/sec. By increasing the number of drilling, is decreased the spontaneous flow, even critical point level of drought is reduced to 0.5 m below the surface.

Compact rocks

Compact rocks with high and not uniform water bearing

In this complex are classified the following geological formations:

- Eocene depositions - Pg_2 - carbonate formation, limestones, bauxites,
- Paleocene depositions - Pg_1 - carbonate formation, limestones,
- Cretaceous depositions of the upper - Cenomanian - Machstritian -Cr_2 - limestones,
- Lower Cretaceous depositions - Cr_1 - conglomeratic limestones, conglomerates
- Upper Triassic - Lower Jurassic depositions - T_3 - J_1 - limestones,
- Upper Triassic - Lower Jurassic depositions – T $_{2\text{-}3}$ - limestones,
- Middle Triassic depositions - T_2 - limestones,

Depositions of T3-J1 and T2 are encountered from Mali me Gropa up to Guri i Bardhe. This water bearing basin is represented by carbonate formation, composed of megalodonte limestones, as well as shale and limestone formation. Mali me Gropa represents the largest carbonatic block of karstified limestone massif of T3-J1 700 m thick, located on top of younger flysch depositions of Pg2. Limestone are ovary in shape with major meridional axis, striking about 11 km, whereas the small axis is about 5.5 km long. The surface of the massif is almost flat, with absolute elevation 1500-1700m above sea level, bounded on the periphery by very steep slopes that descend to absolute elevations of 900-1000m, at dipping angles 35-45 degrees. Mali me Gropa limestones are intensely affected by karst. Diameter of karst funnels is 50-60m, depth up to 50m, rarely up to 100m. The main part of karst funnels is located between elevations 1500-1600m. Between elevations, 1300-1400m there are separated funnels, but not below elevation 1300m. Karst funnels form three separate karst areas, which are related to three main springs of karst. The causes of this developed karst are related to the following factors:

- Intensive atmospheric precipitation
- Solubility of the dolomitic limestone and lack of the insoluble layers
- High spatial position of the karstifcated massif, which is based on karst erosion.

Another more important reason is the intensive karst processing of limestone blocks related to the huge post Paleocene dislocation. This processing led to the formation of the crushed areas that later became the main accessible roads for moving of groundwater, and karstified process.

The hydrogeology of Mali me Gropa is abundant. It is distinguished for a rich water bearing. The great karst process of the limestone massif, with numerous holes, conditions this and karst funnels. In Mali me Gropa region,the surface of hydrographic network (R = 0) , is virtually absent. On the contrary, underground network is strongly developed and of greater flow. Average rainfalls in this region are about 2500 mm/year and useful infiltration takes values up to 0.55. The groundwater resources for the western part of the massif, result to be at a flow of Q = 2.2 m3/sec, and in the eastern part, which drain towards Mati basin are Q = 4.2 m3/sec. In the western part of Mali me Gropa region, in the foot of mountain slopes, flow 3 strong karst springs and some other springs such as Gurra e Zeze spring, Linosi spring, Gurra e Lenes spring, etc. The surface of the feeding area according to the springs is approximately:

Selita water bearing basin 18km^2.

Shen Meria water bearing basin 25km^2

Guri i Bardhe water bearing basin 10 km^2.

Selita spring - takes its waters from the Triassic-Jurassic (T3-J1) limestones and is of karst origin.

Since 1953, regular daily surveys have been carried out for flows of Selita spring and atmospheric precipitation measurements were made by the Institute of Hydrometeorology of Tirana. The smaller flows are in September, while the major flows are mainly in May. Minimum flow rate of the spring is Q = 200-300 l/sec and maximum flow rate is about 1,000 l/sec. The minimum average monthly flow is Q = 281 l/sec. The maximum average monthly flow is Q = 767 l/sec.

Shenmeria Spring - takes its waters from the Triassic-Jurassic (T3-J1) limestones, which occur in tectonic contact with the flysch of Pg2. Minimum flow rate in the Shenmeria spring is Q = 350l/sec and maximum flow rate is Q = 2000 l/sec. Average flow is Q = 894 l/sec. Shenmeria water spring has very good physical and chemical properties. Mechanically, water passes through a tunnel in Dajti Mountain and then flows to Lanabregasi Hydroelectric station to produce electricity. Then, by water pumping station for water supply, it flow down to Tirana. All the indicators of chemical composition and hygienic - sanitary norms are not only acceptable, but are even best quality indicators of drinking water. The springs of Selita, Shenmeria, and Gurra e Lenes are captaged, and used for Tirana city water supply, as well for production of electricity in Lanabregasi Hydroelectric station.

T_3-J_1 depositions are also are encountered in Shkreta of Kruja as massive blocks, which create the impression of a tectonic wedge that can be expanded to the depth. These limestones form a ridge to SE-NW direction, which separates the western flysch with ultra basic rocks that rise in North-East of map sheet and Shkreta village. Limestone ridge width in the surface is about 150m. The limestones are massive, with broken surface, where no signs of intensive karst have been evidenced.

The carbonate massif of Kruja-Dajti - represents a monocline that deepens towards the East. It consistsmainly of dolomites and dolomite - limestones of Upper Cretaceous Cr2, and limestone massif of Paleocene-Eocene Pg1-2. Two carbonatic zones of Kruja-Dajti, in East and West, border the flysch formation that serves as an impermeable barrier of the groundwater. This massive is deeply interrupted by Erzeni, Tirana, Terkuza, Gjolja and Droja rivers. Carbonatic formation of Dajti mountain is not much karstified on the surface, but it is intensively cracked. With this Aquifer are related Pëllumbasi and Buvilla springs.

Makareshi Region - is like Dajti region, consists of dolomites and limestones of the Cretaceous and less Paleocene - Eocene limestones.The most important is Makareshi Spring that comes out close to Fushe Kruja Cement Plant. The flow rate of Q =15-500l/sec, the water is putrid with small content of sulphide gas.

Compact rocks with high and not uniform water bearing

In this complex, are classified the following geological formation:

Tortonian depositions-N_1^3t(a)-molasses, lythotamnic limestones, conglomeratic sandstones, sandstones,

Tortonian depositions – N_1^3t (c), conglomerates, sandstones, siltstones

Mesinian depositions - N_1^3m(a + b) - conglomerates, sandstones, siltstones

Pliocene depositions - N_2^1h(b+ c) - clays, sandstones, conglomerates, siltstones

Burdigalian depositions of - N11b (b) - clays, sandstones, conglomerates, siltstones

Ultra basic formations of Middle Jurassic J2 - dunites, serpentines

Ultra basic formations of Middle Jurassic J2 – are represented by dunites and serpentines and distributed to northeast of the map sheet, and include a small part of the Skanderbeg ultra basic massif.

Ultra basic rocks are encountered in the East of limestone ridges of Upper Triassic - Lower Jurassic T3-J1 and rise in absolute elevation higher than limestones. Ultra basic rocks are serpentinized and cracked. With this aquifer is related the outflow and feeding of Shkreta and Livadhi-Nalle springs. The place where the spring comes out, represents an oval shaped hole, filled with limestone and ultra basic deluviale clasts mixed with sandy clays which are located in Palaeocene-Eocene flysch of Pg1-2. These deluviale hide the contact between limestones and flysch depositions. The general geological and hydrogeological structure, and in particular, elevations where is exposed Livadhi spring No. 12, that allows to feed the groundwater in limestones and ultra basic rocks. Since limestone has a relatively small exposure in the surface, the staple feeding in the area comes from ultra basic rocks. The outcrop of limestones serves as an accessible and draining line for groundwater of ultra basic rocks. Based on the chemical analysis, we can say that the main spring is fed by ultrabasic rocks. Water belongs to hydrocarbon-magnesium type. General mineralization is Tm = 167.45 mg/l, total hardness is Th =5:46 of German degree, while pH of 8.4. Flow rate of the source is Q = 13-40l/sec. Spring No. 15 also comes out from ultra basic rocks, and captured for supplying Kruja town with drinking water. Flow rate of the spring is Q = 25 l/sec. Water has good physical and chemical properties, Tm = 240.94 mg/l, Th = 7.88, German degree, Ph = 8.28, water belongs to hydrocarbon-magnesium type.

Aquifer of the sandstones limestones of Tortoniane, Mesiniane, and Burdigalian has a lithologicaly is composed by clays, siltstones, sandstones, molasses and lythotamnic limestones. This aquifer has relatively large distribution in the basin. Are encountered in the surface in form of series with NW-SE direction, and lies Northwest and Northeast of Tirana in Fushe Kruja (Laçi), towards Borizana, Radheshi, Qinami, Zall Herri, Priska, Berzhita, Iba, Lalzi (Qafa e Gurit) Kuratni, Gerdeci, Marqineti, Marikaj, Sauqeti, Pine, Gerblleshi, Zbarqja, Gropaj, Mezezi, Bozanxhia, Romanati, Zhurja, Ndroqi, etc..

It surrounds the hilly area of Tirana city and is represented by intercalations of thick sandstone layers with average cementation, clays and siltstones with rare interlayers of lythotamnic limestones of Tortonian. Their depth under Quaternary depositions increase moving towards the Adriatic Sea. Specific discharge varies Q = 0.0017-0.02-0.05l/sec/m. Drilling give a flow rate of Q = 0.5-2-5 l/sec. It is worth mentioning that in this water bearing complex are put into use a large number of drillings. Groundwaters of this group are widedistributed in hilly unit. They form the aquifer through cracks and pore-cracks with variable groundwater resources. Waters of this basin are studied by a number of village wells, springs with small flow and drillings, in which measurements are performed for groundwater level, analysis for their chemical composition too. Water bearing formations in this area represented by thick sandstone layers with average cementation, and rare lythotamnic limestones of Tortonian. They have western dipping, making up basement of water bearing basin of alluvial gravels. Water spring in this area are rare at an average flow of 0.1l/sec, without any practical significance for drinking water. Tortonian formations are intersected by drillings in Bilaj (Drill no 75) The water of this compound is of good quality and is used to supply with water households. He has a mineralization Tm = 371.64-561.9mg/l, Th =10.64 German degree, temperature 14-17ºC and low specific flow.

With low water bearing

With low water bearing are included depositions at following lithological composition:

Tortonian depositions - to - N13t (d) - clays, siltstones, with sandstone and coal interlayers.

Tortonian depositions - N13t (b) - clays, siltstones sandstones

Tortonian depositions - N13t (a + b) -) - clay, siltstones sandstones,

Upper Miocene depositions - N13 - sandstones, clays, conglomerates,

Serravallian depositions - N12s - clays, sandstones, and lythotamnic limestones,

Serravallian depositions - N12s (a) - clays, conglomerates, sandstones,

Serravalian depositions - N12s (b) - siltstones, carbonate sand, sandy limestones, limestones.

Serravallian depositions - N12s (c) - clays, lythotamnic sandstones and limestones,

Ladinian depositions - N12l - clays, lythotamnic sandstones and limestones

Ladinian depositions - N12l (a) - sandstones, limestones, marls, marly clays,

Ladinian depositions - N12l (b) - marls, marly clays, conglomerates,

Upper Cretaceous - Maastrichtian depositions - Cr2m, siltstoness - sandy flysch, limestone- marly flysch

Upper Cretaceous – Maastrichtian depositions - Cr1al-Cr2cm – siltstones, sandy flysch, limestone- marly flysch

Cretaceous – Aptian - Albian depositions - Cr1ap-al - flysch, siltstones, marls, sandstones, limestones,

Upper Cretaceous – Maastrichtian depositions - Cr2m, siltstones, sandy flysch, limestone- marly flysch

Jurassic-Cretaceous depositions - J3t-Cr1v - siltstones, sandy flysch, limestone- marly flysch

Upper Cretaceous – Maastrichtian depositions - J3t-Cr2cm, - siltstones, sandy flysch, limestone- marly flysch.

Formations of this complex (Cretaceous-Aptian-Albian Cr_1ap-al, - Upper Cretaceous- Cr_2m - Maachtristian, Cr_1ap-al) with the lowest water bearing, is found as a massif from Mafsheqi up to Cudhi. They have the general shape of a range, and have tectonic contact with the flysch of Lower Oligocene - Pg_3^1 .Transition package is composed by marls and marly clays. Of these formations, flow several springs at flow Q = 0.06-1-2 l/sec as the spring No. 7, 19, 28.

The Lower Cretaceous, Aptian-Albian, has a lithological composition formed by siltstonesstone, marls, sandstones, limestones, and formation flysch of Derja. The Upper Jurassic-Lower Cretaceous has a limited distribution in the Northeast end; siltstonesstone, conglomerates, breccias, boulders with ophiolitic material, represent the lithology.

Upper Cretaceous formations - Maachstritian and the Lower Cretaceous-Aptian-Albian, exposed in Bastar (Zdralla e Jamkut), Vilza and Mneri i Siperm, etc. In Mneri i Siperm, is encountered a tectonic contact with flysch of Pg31 (a, b). There are several springs in these formations, such as Gurra e Shabanit, with a flow rate of Q = 1-2 to 5 l/sec. The springs are captaged and used to supply with water Mneri i Siperm-Zgurja etc.

Upper Cretaceous formations, Mahstritian Cr2m, and Lower Cretaceous, Albian-Aptian Cr1ap-al, are intersected at depth of 179.4m, by drilling in Vilza no.2. Drilling in the interval 156.0-179.4 has intersected water level, which, by pumping has a flow rate of Q = 1l/sec. Water belong to hydro-sulphate-sodium chloride-calcium-magnesium type.

Formations of this basin with low water bearing occur also in the valley of Stanet e Linosit, Burimasi, Derja and in Murriza slope. There are several springs in these formations, like Stanet e Linosit, Vrri-Gurra e Salmetes, Kroi i Molles etc, at a flow of Q=1-2 to 5l/sec.

Compact rocks of Tortoniane depositions N_1^{3t} (d), N_1^{3t} (b), Serravallian depositions - N_1^{2s} N_1^{2s} (a), N_1^{2s} (b), N_1^{2s} (c), Mesiniane depositions - N_1^{3}, Ladiniani depositions N_1^{2l}, N_1^{2l} (a) N_1^{2l} (b) are composed by clays, siltstones with sandstones and coal siltstones interlayer's, carbonate sandstones, conglomerates, sandy limestones, lythotamnic limestones etc, which have a low water bearing. These formations are encountered in Derveni, Fushe Kruja (Zalli), Dritasi, Çerkez-Morina, Paskuqani, Farka e Madhe, Sauku, Stermasi, Krraba, Mihajasi (Lama), Kusi, Mamli (Nure), Daci, Kertusha, Likmetaj, Tarini, Mazha Preza e Madhe, Marqineti, Koder Vora, Gjokaj, Allgjata, Maknori, Peza e Madhe, Ballashej, Poiana, Grece, Gjyslikane, Vrapi, etc. There are few water springs in this complex. Springs are characterized by small and fluctuated flow at 0:01 to 0:05 l/sec, practically insignificant and not usable, because it dries up during the summer. Rural wells are connected mainly with sandstone layers in 6-15 m of depth, collect a little water and are dry during the summer. The water level is different depending on the hypsometric levels and varies 3.5-8m under the surface. Hydrogeological drilling performed by private entities has intersected sandstone layers 2-3-5 m thick. Drilling deeper than 100m, has intersected artesian water that come to the surface at flow Q = 0.1 l/sec.

Pumping of wells done for the study of hydrogeological conditions of Mezezi formation have returned almost the same results. Based on these pumping, results that, when the level decreases at 10.5m, the water flow in the well does not exceed 0.2-0,56 l/sec, while specific flow qs = 0:03 to 0:04l/sec/m.

Compact rocks

This complex has wide distribution in the form of belts between carbonate deposition, striking SE – NW, with a width of about 0.5 -2.5 km, are encountered on the surface in Selita (Lestere), Zheja, Mafsheq, Shkrete, Kruje, Picrrage, Shenmeri, Bruze, Ranxa, Shupal, Murrize, Selita e Malit, Brrari, Priska e Vogel, Herraj, Mukja, Fraveshi, Pashkasheshi, Mollagjeshi, Prushi-Yzberish, Vaqari, Damjan-Fortuzaj, Picalle, Baldushk, Mustafa Kocaj, Lug Shalqize, Shenkoll, Lalzi, Hamallaj, Manza, Rada, Maminasi, Gjepalaj, Likesh, Romanat, Maskuria, Rrashbull, Shkallnur, Kryemedhej. These formations have the following lithology: clay, siltstonesstone, sandstones, marls, limestones, flysch formations, which are practically not water bearing. In these formations are are encountered some natural springs, such as in Shenmeri and Picrrage at Q = 0.01-0.3 l / sec.

This complex strikes to the south and west of Malit me Gropa. These formations are composed by the following lithology: clay, siltstones, sandstones, marls, limestones and flysch formation, without having any water bearing significance. In these formations we are encountered some of small natural springs at flow Q = 0.1-0.5 l /sec. The water has good physical - chemical properties.

7.6. Brief description of hydrogeological conditions Mati Basin

Mati basin has a big distribution. It starts in SE with massif of Martaneshi from where comes and Mati River. It continues until the Munella massif in north.

Mati River, from which it received the name, derives from the mountain of Kaptina of Martaneshit. It has a length of 144 km, and water bearing aquifer area of 2441 km2 and an average altitude of the aquifer by 746 m. Its branches are Fani and Uraka River's.

Since the springs near to Klosi location, Mati River passes through narrow gaps.

Beyond Klosi River enters in a broad valley at north of Burrel up to the mouth of Shkopet lake. It is equivalent to Ulza Lake and that of Shkopet, who serve as artificial regulatory of Mati regime. After leaving the dam of Ulza, Mati River in some sectors enters in a narrow gap until to Shkopeti Lake.

After mouth's Shkopet, Mati River starts expanding until it opened in the coastal area. Before this, in Mati discharge the River of Fan which was formed from the merger of the Great Fan and Small Fan.

Multi-year average at a flow rate of Mati River with pouring into the sea is 103 m3/sec, which responses a module of 42.2 l/s/km2. The flow coefficient for all water bearing aquifer is 0.80. The groundwater food represents 30% of annual flow, while superficial is 70%. Its maximum at a flow rates are associated with rainfall and melting snow. Maximum at a flow rate with repeat once in 100 years in the estuary is 3100m3/sec. The waters of Mati River have low mineralization (22 mg/l) and included in the class of carbonates.

Separation of complexes in Mati basin is made by the waterbearing of rocks and lithology:

Porous rocks

- With high water bearing
- With medium water bearing
- With low water bearing

Compact rocks

- With high water bearing
- With medium water bearing
- With low water bearing

Rocks practically without water

- In loose rocks
- In compact rocks

Compact rocks

- ***With high water bearing***

In compact rocks with high water bearing included depositions:

- Depositions of Upper Cretaceous Cr2.
- Depositions of Lower Cretaceous - Cr1
- Depositions of Cretaceous Cr
- Depositions of Middle - Upper Jurassic J2 - 3
- Depositions of Lower - Middle Jurassic J1-2
- Depositions of Jurassic J
- Depositions of Upper Triassic – Lower Jurassic T3- J1
- Depositions of Middle Triassic – Middle Jurassic T2 - J2,
- Depositions of Middle Triassic T2

- Depositions of Lower - Middle Triassic T1-2

The descriptions are treating by eastern and western belts:

Carbonatic East Belt

Represented by massive of Deje and Lura that contact with each other and have N-S, and SW-NE direction. They contact tectonically with the eastern ophiolitic belt. Limestones that build these massive are of the upper Cretaceous age and distinguished for more intense karsts in the surface and depth. Limestones of Cretaceous in area are about 20 - 30% of their distributed and are profoundlykarstify. They have too much funnels with depth 40-80 m. Karstic funnels are joined with each other and have formed a plateau at elevations around 1900 m. The spring come in quotes 1300 - 1500 m and is not dry in the hot season. Springs flow from the limestones of Cretaceous have differentata flow rate from 1 l/sec up to hundreds of liters per second, such as the Spring of Vinjolli which comes from conglomerates, but it actually feeds by limestones. Thickness of this water bearing complex is 700 - 800 m. These massifs are very rich in groundwaters. From them flow Springs with large at a flow rate such as Shutria Spring near Bruci village with at a flow rate over 1.02 m3/sec, theSpring of Vinjolli with at a flow rate 150-250 l/sec, Spring in Mushte village with at a flow rate 150 l/sec, Spring to the right of the Uraka stream with at a flow rate 200 l/sec, Spring in the village Orosh, Mirdite etc.Are encountered at a flow rates are more than 2-5 l/sec. The food of groundwater of this complex becomes mainly by atmospheric precipitation, which infiltrate in limestone through the fissures, caves and karstic funnels. Karstified plateau is the main food area, because there are numerous karstic funnels that not only help the infiltration of rain water, but during winter also, accumulate large quantities of snow.

Carbonatic West Belt

It is composed by two belts almost parallel to the direction SE -NW. The limestones of Upper Triassic – Lower Jurassic age T3-J1,T2 - J2, T2, T1-2, Cr2 contact tectonically with western ophiolitic belt, also contact tectonically with flysch of Pg13.
Triassic depositions have considerably distributed in our basin. These depositions build massive of Malit me Gropa and in the western part of the region mountains of Vela and Melleza. Also, these depositions lie in the form of belt in the east - northwest direction and cross near Shkalle, Darsi villages and go up to Llapushi Mount in northwest. The formations of Upper Triassic - Lower Jurassic (T3 - J1) represented by carbonate formation, limestones while the Middle Triassic depositions T2 represented by shale formation, limestones, etc.
Limestones have many fissures and various forms on superficial karst and in the deep. Particularly are karstified limestones in massif of Mali me Gropa. The process of karst especially in the Mali meGropa area has advanced so much. All the channels, caves and the other corridors inside of the massif are related to each other. It is explained by the flows of the greatest springs in lower quotes tolimestone massive. By these formations flow springs of Guri Bardhe, Gurra of Murrizes and

other smaller springs. At a flow rate of springs varies from Q = 5 to 20 l/sec up to Q = 1000 l/sec, spring ofGuri Bardhe. Springs have variable regime and directly dependent by the temperatures and the rainfall infiltration. The spring of the Guri Bardhe is with karstic origin and origin of over thrust tectonictype and comes in contact of limestones with flysch. It is untapped and used by residents for drinking and irrigation. It is a spring without a real exploitiation for this zone. It can be used with a centralized water supply to supply all villages of the zone which suffer from lack of drinking water.

The groundwaters of these springs have good physical - chemical properties. The main springs flow from this water bearing complex are:

From the massif of Mali me Gropa apperas these springs:

Guri te Bardhe Spring " 300 l/sec

From the massif of Mellezes appears:

Vinjolli Spring with flow at rate 300 l/sec.

Shkopeti Spring with a flow at rate 150 l/sec

Karstified and fissured limestones and dolomites of the Upper Triassic – Lower Jurassic flow in the region in the form of "tree" that thrusting over the Krasta flysch in Pllana, Zejmen, Tresh villages.

Limestones of the Upper Cretaceous - Paleocene and Eocene lie to the right of the Lezhe road – in the north of region and in Milot -Fushe - Kruje sector in east of the region. They are a continuation of the Kruje - Dajti anticline structure. The main springs flow from this water bearing sector are :

1. Gurra of Laci spring with at a flow rate 15 l/sec
2. Gjormit Spring at a flow rate 3-100 l/sec
3. Zhejit Springs at a flow rate 60 l/sec

Limestone, generally characterized by numerous fissures and karst are developed. This has conditioned the great water bearing of this formation. These springs with great at a flow rate have the variable regime. In the exposed part on the surface of karstic limestones, groundwaters are generally sweet, but in areas where these rocks diving and covered by flysch depositions groundwater's are often salty, thermals, rich with sulfur - gas (Makareshit structure). Due to the large heterogeneity of permeability in these rocks is difficult to predict at a flow rate taken by drillings which arrives limestone in depth. The main springs of this water bearing composition come in lower elevations to the surface of limestones and latter contact with less permeable formations. Above mentioned springs are with sweet waters, with good physical - chemical and sanitary properties.

Springs flow from limestones of Makareshi location are two types:

Sulfur mineral springs, coming from deep and are rich with sulfur - gas. They are upwards springs of hydrodynamic deep areas to mingle with karstic freshwater of upper area. This is confirmed by the very changeable regime of springs at a flow rate in different seasons and not high temperature of their (t = 17-22ºC). Even those drillings have captaged, the limestones of this structure at depth 500 m (drilling of Zheji), have given mineral - waters rich with H_2S (Spring of "I qelbur", that flow near

the Lac- Mamurras road). Spring in the Zheja village has a at a flow rate that varies from 50-200 l/sec. It was used recently as drinking water for Mamurras city supply.
Springs of fissures with freshwater drinking with small at a flow rate and sweet karstic springs with great at a flow rate, which is from 60-70 l/sec up to 4 l/sec. They are are encountered in Shperdhet - Mamurras sector.

With medium water bearing

In compact rocks with average water bearing including depositions:
Middle Jurassic deposist - ó J_2, õJ_2, õJ_2(n), õJ_2(d), õJ_2(T), äJ_2,öJ_2,óJ_2, óJ_2(S), óJ_2(H), óJ_2(D), óJ_2(Lp), óJ_2(HL).
This water bearing complex is composed by ultra basic rocks, hartzburgite, dunite, serpentines, wehrlite etc, from basic - gabbros rocks, gabbros-norite, troctolite, and gabbro-olivinite and by vein rocks. Basin of ultra basic complex builds massif of Martanesh, Bulqiza, Lura, massif of Skanderbeg and the presence of ultrabasic rocks in the central part of Mirdita Zone, highlighted on separate outcrops some ultrabasic rocks between gabbroid or volcanogenic rocks as seen in Geziq - Malaj, Bulshe, Bulshar, Piste, Kaptiner, etc. Their surface feeders are encountered more in peripheral parts of the ophiolitic zone of Mirdita where they build eastern and western belts with "centriclinal" enclosure in the massif of Bulqiza for the half northern part of Mirdita Zone.
On the other hand in the lithological section of different ophiolitic sectors from the bottom up to the ground surface passed by ultra basic rocks in gabbroid rocks, place place in plagiogranites and above of volcanogenic covering, while in other sectors of the Mirdita zone are simplified and transferred directly from ultra basic rocks in those of volcanogenic. In the massif of Lura usually dominated hartzburgite sections in the upper parts where we are encountered dunites levels, also are present coarse grained pyroxenes of Lura - Kumbull lakes, while in the eastern side of massif passed by hartzburgite section in hartzburgite with dunites lentils in hartzburgite which through amphibolites belts are covered by the Jurassic sedimentary volcanogenic formations with early flysch coverage (sectors Lure - Murtaj). In the massif of Bulqiza, in south - western sectors (Martanesh - Kraste) and northwestern Qaf Mes- Qaf Dardhe) of massif, was passed by hartzburgites kind through a thick horizon of dunites, with or without pyroxenes, in troctolite – gabbro-olivinite up to gabbros with Jurassic volcanogenic coverage or early flysch. In the central sectors of the massif are encountered hartzburgites section that passes in combination dunite - hartzburgite and still follows in hartzburgite that were apparently covered by Jurassic volcanogenic rocks. Puka massif with an area of 210 km2 belongs to the western ophiolitic belt in Albania and is located in the northern part of this belt. In the upper part of the section are encountered hartzburgite - plagioclases lercolites or dunite lens besides the presence of troctolite widely distributed in the upper levels of the Kaçinar massif, while in the periphery south - east and north - eastern of massif passed by hartzburgite with or without plagioclase through a narrow amphibolites belt in basic vulcanite of lower section, the section of series volcanogenic - Jurassic. In the exit of the ultra basic rocks of the Reje - Veles - Rubik region, the top of the

section composed by hartzburgite with some dunite lents that often pass in the troctolite, gabbro-olivinite or contact through the belt of amphibolites with Jurassic vulcanite (Raja's Black).

Ultrabasic Massif of Krrabi

It is on the northern edge of the western ophiolitic belt and occupies an area of 187 km2, in north and northwest contacts with volcanogenic - sedimentary rocks through cross fracture, in the west is thrust on Maachtristian flysch of Paleogene of Cukali subzone.
In the southern part between transversal fold of Gomsiqe - Kabashi relates with ultra basic massif of Puka, in the east and southeast contacts with the gabbros of Kaptene massif too, while in Trun - Dardhe contact tectonically with quartz micro diorites.

Ultrabasic Massif of Skanderbeg

It has an area of 116 km2. In the western part contacts tectonically with breaking nearly vertical that is clearly expressed to Shkopeti location, with limestones of Triassic - Jurassic and depositions of Titoniane, Lower Cretaceous. Together with limestones on the periphery is thrust over Maachtristian flysch - Paleocene of Krasta subzone. To the east contact tectonically with basic vulcanite's and depositions of Titoniane - Lower Cretaceous, while at the south is covered transgressively by the Tortonian molasses. The section of massif is as follows:
In the north part of Scanderbeg massif are encountered gabbros in the form of small massifs and in the vein shape. In the north and northeastern side of massif receive development the formations of basic and average – acid structures. Magmatic formations are estimated with average water bearing in view of the considerable quantities that drainage by springs, and from mining conducted in these formations. Although their specific at a flow rates are low, they guarantee for quantities of water significant and stable.
Although they have fissures, their dimensions are small, the quantity of groundwater that circulates in them is small, only in rare cases in zones with greater fissure circulate significant quantities of groundwater's. In depth fissures reduced, thus decreasing the quantity of groundwaters. Very important for this complex is tectonic that is the main circulate routes of the water. The at a flow rate of springs of this water bearing complex have different at a flow rates of 0.01 to 5-7 l/sec. there are are encountered more are encountered springs with at a flow rate less than 1 l/sec but that does not deplete. It is to be noted that the biggest at a flow rates are encountered in the ultra basic massif of Martaneshi and Bulqiza.
At these massive has enough springs with at a flow rate on 1 l/sec. Klosi gallery is a mine in ultra basic massive of Bulqiza, drains about 1.5 m3/sec while during the summer arrive up to 500 l/sec. The opening of this gallery had a very large hydrogeological effect for the region surrounding, leading to the exhaustion of all springs to flow in the quote above the gallery level. The quality of this water is very

good and it show springs without used that should be evaluated for the future. Also, from ultra basic massive flow a series of springs with water in very good quality that are with interest for water supply for surrounding zones.
These waters are widely used by villagers for drinking and irrigation.

- ***With low water bearing***

In compact rocks with low water bearing included depositions:

- Depositions of Lower - Middle Jurassic Pg_3^2
- Depositions of Maachtristian - Cr2m
- Depositions of Maachtristian (transitional package) - Cr2m(pk)
- Depositions of Lower Cretaceous, Albian-Upper Cretaceous, Cenomanian - Cr1al – Cr2cm
- Depositions of Lower Cretaceous Aptian – Albian - Cr1ap-al
- Depositions of Upper Jurassic Titonian – Upper Cretaceous Cenomanian - J3t- Cr2m
- Depositions of Upper Jurassic Titonian – Lower Cretaceous Valanginian - J3t- Cr1v
- Depositions of Middle Jurassic - ãJ2
- Depositions of Middle Jurassic - ëJ2
- Depositions of Middle Jurassic - ëJ2(a)
- Depositions of Middle Jurassic - âJ2
- Depositions of Middle Jurassic - â T2- J1
- Depositions of Middle Jurassic - ìsJ2
- Depositions of Middle Jurassic - áJ2
- Depositions of Neogene – Quaternary - N2 – Qp.

Depositions of Lower – Middle Jurassic Pg_3^2
Flysch clay – siltstones – sandstone with slumping horizon and conglomerates.
Depositions of Maachtristian - Cr_2m
Flysch combination- clay – sandstone – limestone
Depositions of Maachtristian (transitional package) - Cr_2m (pk)
Transitional package carbonate – clay – marly.
Depositions of Lower Cretaceous, Albian-Upper Cretaceous, Cenomanian - Cr1al - Cr2cm
Limestones with rudiste, carbonates
Depositions of Lower Cretaceous Aptian – Albian - Cr1ap-al
Marly limestone
Depositions of Upper Jurassic Titonian – Upper Cretaceous Cenomanian - J3t- Cr2m
Flysch-sandy-marly depositions with turbidic limestone layers.
Depositions of Upper Jurassic Titoniane – Lower Cretaceous Valanzhinian - J3t- Cr1v
Ophiolitic conglo-breccias, marly-sandy-conglomeratic combination.

The groundwater temperature of this complex is 7 to 12oC. The waters of this waterbearing complex widely are used for drinking

Depositions of Middle Jurassic - ãJ_2

Depositions of Middle Jurassic - ëJ_2

Depositions of Middle Jurassic - ëJ_2(a)

Depositions of Middle Jurassic - âJ_2

Depositions of Middle Jurassic - â T_2- J_1

Depositions of Middle Jurassic - ìsJ_2

Depositions of Middle Jurassic - áJ_2

Basic rocks have relatively significant distributed in Mati basin. They are distributed in spots n the northern and central part and build massive of Vinjolli, Balshari and Gjegjani. Basic rocks have not defined regularity in both, distributed and in form. They are represented by gabbros, gabbros-norite, troctolite, and gabbros and olivinites. In these water bearings depositions are included depositions of two packages of this series. Water bearing complex of deposition of this serie is represented by diabase - spilite – keratophyre, rarely pyroclastic rocks, volcanic limestones, tufe, etc. They have low water bearing.

Water bearing complex of deposition of the diabase - spilite and spilite – keratophyre serie

Diabase Serie (basaltic).

Represents a normal calcium alkaline basaltic serie that has wide distributed across the western part of the Mirdita zone: Field Arrez, Gjazuj - Kaçinar, Gziq, Rubik, Derven. In the composition of the diabase series participate the basic volcanic rocks undifferentiated, effusive facie, pyroclastic and less sub volcanic. These rocks types are summarized in two sub packages that are cutting from sub volcanic formations:

The bottom sub package - the diabase massive

Upper sub package – pillow lava diabase and pyroclastic rocks.

The lower sub package – massive diabase (Bardhet).

Distributed mainly in Fushe Arrez - Bardhet – Lumi i Zi with full representation in Bardhet, near Fushe Arrez. According to sub package there are gabbros rocks, while above transferred in diabase pillow lava. In southern direction, this sub package goes straight pinch, apparently facial, leaving the place it of pillow lava.

Upper sub package – diabase pillow lava (Kacinar).

The rocks of this sub package form diabase pillow lava and represent the diabase serie. There are some occurrence of massive diabase and pyroclastic. Often pillow lava are combine with tuffs layers and tuffs of aglomerates.

The sub package of pillow lava together with pyroclastic horizons, with distributed in Tuff - Kaçinar - Gziq – Peshqesh -Bukel sectors, has a thickness of 500 - 1000 m.

Basement of this sub package represented by ultra basic rocks (Kacinari sector) and gabbroid (Shtufi sector). In the upper part of cutting of this sub package over the pillow lava we can see the placing of package of mélange. This water bearing complex contains groundwater in small quantities. Mainly these waters are associated with fissures of effusive - sedimentary rocks. Depending on the fissure, at

a flow rate of springs varies from 0.01 to 0.5 l/sec. The springs flow in different elevations of streams escarpments in contact zone with different fissures.
The waters of this water bearing complex are widely used for drinking, but their at a flow rate are barrier for regular supply because they are often insufficient.

7.7 Brief description of hydrogeological conditions Drini Basin

Lithological - stratigraphical character of depositions of the Drin basin. We will list them as follow:

- Waterbearing complex of volcano rocks of Lower Triassic (ëT1)
- Waterbearing complex of rocks (ó J)
- Waterbearing complex of basic rocks (ó J)
- Waterbearing complex of average high-acid rocks (ÓPz)
- Waterbearing complex of Permian unbounded depositions (P)
- Waterbearing complex of the Lower- Medium Triassic depositions (T_{1-2})
- Waterbearing complex of carbonate depositions of ages T_3, J_1, J_3-Cr_1, Cr_1b al, Cr_1b-ap- ap Cr_1al and Cr_2.
- Waterbearing complex of deposition of flysch “Krasta”, “Xhani” and “Vermoshi” suite (Cr_2 - Pg_2 k, xh, v)
- Basins of deposition Neogene Water bearing complex(N1 and N2p)
- Complex quaternary basins of Neogene depositions (N2-Q1)
- Waterbearing complex of alluvial depositions, not Quaternary (Q4d, Q4pl)
- Waterbearing complex of Quaternary alluvial depositions (Q4al)

Waterbearing complex of volcano rocks of Lower Triassic (ëT_1)

Represent this complex rocks which have been identified in a limited distributed of our basin. It is exposed in Qafe-Mali, Iballë, Has, Vas-Pac.
This complex lies in basins in average absolute elevation of 500-1397m in Qafa e Malit. Erosion is quite evident, in rocks are created deep streams with steep slopes, but with the little cutting, a fact which speaks for the little waterbearing, flow rates’ of these springs varying from 0.01-0.3 l / s.

Waterbearing complex of rocks (óJ)

Rocks of this complex are widedistributed in our basin. These rocks consist predominantly of hartzburgites, lercolites of dunite, and serpentines, less pyroxene.
These rocks are widedistributed in the individual or massive form, outcrop in form of dots between the basic rocks. We have in our massive some important basins build from ultra basic which are: Massif of Tropoja, Krrabit, Kukesit and Pukes.
These rocks are are associated with small breaks which serve as water bearing factors for this waterbearing complex. Groundwater flow from the waterbearing

complex is big, particularly at the time of rain and snow. But at the time of drought they decrease their at a flow rate.
Distribution of springs that are are encountered in this complex is not has similar for every ultra basic massifs as result of a number of factors that influence in the waterbearing massifs (elevation of massif, the density of breaks, snow cover, etc.). For this complex with interest is only Krrabi massif where the springs flow rates Q = 5-25 l/s.

Waterbearing complex of basic rocks (ó J)

This complex is very similar with ultra basic complex. Their essential difference is only it of their chemical composition, because the waters are mineralized, basic and their flow rates are smaller. Flow rates varies from Q = 0.1 -0.3 l/s.

Waterbearing complex of average high-acid rocks (ÓPz)

Rocks of this complex have limited distributed and consist of quartz diorite, plaggios granite, micro diorites and granites.
These rocks lie in the form of small massifs. Hydrogeological properties of rocks of this complex are not good. These rocks in the area are quite destroyed by both physical and chemical standpoints that are eroded and washed on the surface with a lot of fissures meantime the opposite happens in their depth. Destroyed places range from 10-15 m. The rocks are compact below. As result in this complex are encountered small springs with flow rate that vary from Q = 0.05-0.3 l/s.

Waterbearing complex of Permian unbounded depositions (P)

Depositions of this waterbearing complex have considerably distributed in our basin, as in the Alps and tectonic zones as Gashi and Korabi massifs. These are depositions with older age are encountered. Thus in this small complex are encountered springs with flow rate Q = 0.1-5 l/s.

Waterbearing complex of the Lower- Medium Triassic depositions (T1-2)

Depositions of this waterbearing complex are distributed in arch shape and in tectonic areas they composed mostly by conglomerates, combined with sandy interlayer's and rare with carbonatic conglomerates. These depositions build different parts of the anticline structures in the Alps zone. They encounter in Dukagjini anticline, Valbona, Thethi, Pepaj etc. Underground waters are direct related with deposition of the Lower Triassic and have small flow rate from 0.1-12 l/s. Water regime in this waterbearing complex is moderately.

Waterbearing complex of carbonate depositions of ages T_3, J_1, J_3-Cr_1, Cr_1b al, Cr_1b-ap, ap, Cr_1al and Cr_2

In this complex are including limestone and dolomites depositions. They belonging Upper Triassic age of T_3 to the Lower Jurassic (J_1), Upper Jurassic to lower Cretaceous of (J1-Cr1), the Lower Cretaceous separated by floors (Cr_1b al, Cr_1b-ap,-ap Cr_1al) and that of upper Cretaceous Cr_2. The joining of these depositions in a waterbearing complex was made considering the similarity of their lithology, fissures due to their hydraulic connection.
Depositions of this complex lie almost in all the northwest side, north, but also in the southern part of the central basin and form large mass of carbonate in the so-called Albanian Alps, which form a large structure, a great anticline. Besides this great massif of massive carbonate there are also built smaller one. Following the massive carbonate massif of Shkelzen are encountered and it composed from the anticline of Lukaj and Shkelzen.At the north of the Gashi area, in Vermoshi, etc., are encountered the carbonate flysch massive that built by the Lekgegajt and Cukali anticlines. The massif continues in the northeastern with small spots of carbonate depositions in the Briçes andToplanes anticline. In northeastern are encountered small massifs of Merturi, Shllumi and Listen carbonate anticlines. In south and southeastern part of the region are encountered carbonate Zeba anticline and Kolosianit, Lures, Qafe Thana, and Tushemishti limestone`s anticlines.
Upper Triassic limestones are much destroyed. We observed high activity karst and tectonics. In these depositions and tectonics are associated with such depositions flow powerful springs as springs of Tushemishti, Lin (Pogradec), Kalimash, Skavica (Kukes), springs of Valbona, Dunishe (Tropoje), all springs of the Alps, Petroshan, Syri Sheganit (Shkoder).
Underground waters belonging carbonate depositions and they have large groundwater flow rate that varies from 100-3000 l / s. Water regime in this basin is very changeable in the winter season where they are called springs but in fact are almost Rivers.

Waterbearing complex of deposition of flysch "Krasta", "Xhani" and "Vermoshi" suite (Cr_2 - Pg_2 k, xh, v).

These suite have the same hydrogeological features. Their permeability, discharge and waterbearing are very small. These depositions have limited distributed at Bllata (Peshkopi), Tarabosh, Oblik-Muriqan, Beltoje (Shoder). In these depositions are present clay-sands combinations with some limestone conglomerates interlayer's. Flysch character is clearly seemed for a small waterbearing. Their fissures are generally filled with thin material of clay and siltstones of interlayer's. Pores of sandstones and conglomerates are also filled with thin material. Unfilled fissures that we are encountered in them are few and located in small areas with intensive washing. They accumulate in these fissures belonging to these depositions. These depositions have a little bit waters with limited quantities Q = 0.010.3 l / s.
Basins of deposition Neogene Water bearing complex (N_1 and N_{2p})

Depositions of this waterbearing complex have a very small distributed in western part of zone. Astiani clays are encountered in fluid form in the Dobtac, Koplik villages. Judging only by the lithological composition of these depositions we can say that these depositions are very poor in terms of waterbearing particularly the Astiani clays. These serve as a screen of water of alluvial and proluvial depositions of Kopliku field. So, we can specifically talk about the Kalldrumi village springs. These waters appear on surface near the Shkodra Lake in form of natural springs. As the reason for exit of these springs in this area serve Astiani`s clays which appear in form of the spots on surface. It is possible that the Syri I Zi and Vraka springs are creened by those clays of Astiani formation.

Complex quaternary basins of Neogene depositions (N_2-Q_1)

Pliocene quaternary depositions are encountered at Tropoja, Krumes lowlands. At the first have potency to 130 m and less washed than in Kruma area. In the latter depositions they are presented in the spots form with potency up to 30 m.

Based on their lithological composition we observe mainly reddish conglomerates with ssgrits mixture of all kinds, both in size and composition. It was noted the presence of coarse and fine sands and red clays fractions in Kruma area.

Pore-breaks status of these depositions is good. They have weak cementation or medium to strongcementation (Tropoja area).

Springs in these depositions have a flow rate from Q = 0.1-10 l/s

Waters of conglomeratic depositions of N2-Q1 are feed from atmospheric precipitation and especially by rocks of Rragami-Tropoja area. Flow rates of the springs are from 12-20 l/s.

Waterbearing complex of not Quaternary alluvial depositions, (Q_4d, Q_4pl)

Depositions of this waterbearing complex are are encountered almost in our entire region, but are very distributed in form of small spots. Largest volume in this waterbearing complex is occupied by delluvials depositions. They lie in the oldest depositions mainly in the porous layers form with different lithological water bearing complex of pieces without elaboration. Lacustrine-glacial depositions are distributed to several places in our basin. They represent the little geological interest.

Significance in this complex has waters of delluvials of carbonate rocks (breccias). From water activities such depositions are much karstified. As result the water of precipitations infiltrate immediately, but at the same time go out of them immediately in the form of temporary springs. Another food spring for water depositions are those waters flow from carbonate depositions in their lower bound.These waters, in the area where they drainage can feed sloppy breccias, so can speak that these have some water bearings.

At a flow rate in underground natural water in this complex is up 0.2 l/s.

In other cases the waters belong the basis carbonate depositions, while waters of our complex is used only to cover these above mentioned waters, since the true place until the superficial exit. Delluvials coverage observed in the valleys of Valbona, Shala and Cemi Rivers, etc. Between them appeared numerous springs of limestone with flow rate by Q = 500-600 l/s.

Delluvials rocks have small waterbearing

In conclusion we can say that this waterbearing complex has small waterbearing. The waters that come out from this complex are direct depended with of the lateral feeds, especially in case of delluvials carbonates.

Waterbearing complex of alluvial depositions of quaternary proluvions, inseparable Quaternary formation of (Q4al)

Depositions of this waterbearing complex observed in the River s and valleys in the area of Shkodra, Nen Shkodra and Lezha town.

Proluvions are are encountered in the dry River bed where the maximum thickness arrives 6 m. They are are encountered in the other streams also, but in small quantities. Alluvial depositions are are encountered in valleys of River s of this basin as Drini-Buna, Gjadri, Kiri, Vermoshi, Valbona, Drini i Zi (Bllata, Muhurr).

In the bottom of the River, from the Drishti village to Kiri River, observed three terraces built by the alluvial depositions of old terraces. Two first have depositions cemented by carbonate materials. In Vermoshi River have a very beautiful alluvial area on which is located Vermoshi village. This alluvial terrace builds only a small terrace with 0.5-1 m height. The maximum thickness reaches 3-4 m. Granulometry composition is mostly coarse, medium grain, gravel, and pebbles. These gravels are feeding by the River but should not forget their food from the lateral rocks.

In this complex important places occupy of porous rocks (porous) distributed in Nen Shkoder-Zadrime and Shkoder areas.

This groundwater are associated with their major collectors:

Sandy-gravely (alluvial) depositions constitute richest waterbearing layer or horizon of underground basin of Shkoder –Zadrime and Nenshkoder.

Underground waters in porous rocks (porous).

Shkodra Area

In porous rocks with high permeability included depositions of coarse gravel and sand with differentsizes which make up waterbearing horizons without pressure. They are expanded in the whole area of Shkodra.

Gravel in the eastern part had left the place the limestone rocks numerous caverns and breaks, whereas in the north, a few km in south of Koplik, gravels contact with clay-sandy formations of Piacensiani. The gravels are mostly appeared on surface in eastern and northern parts of the Shtoi field,while moving toward the south and west under depositions under the sub clays coverage, form sub artesian water horizons, and sometimes in the winter season wells provide water with pressure.

During carried out drilling are are encountered between the gravely formations with little water permeability, such as the sub clays with no great potency.

In some places, near Shkodra Lake wells observed provide water with pressure (in winter). This is as a consequence not only of the lowest field elevation, but also because of lithological composition where the gravel and grits near the Lake of Shkodra substituted partly with clay and sub clays which serves as a negative factor for the of groundwater discharge in the lake. It causes the increasing groundwater level.

By pumping tests in the utilization area of Dobraci results that there is a very rich basins horizon with specific flow rate oscillation from 80 l/sec/m to 103.87 l/ sec/m and filtration coefficient 89.9-285.5m/day. In north Dobraci station, about 7 km from the pumping well, drilling conducted in Grizhja, are taken these data:

3:37 m static level, dynamic level of 3.5 m, flow rate 12 l/sec, specific flow rate 92 l/sec, water temperature is 11.5oC.

From the foothills of Dobrac up to Grizhe field we have a very rich sector with groundwater reserves, which constitute the main facility for drinking water supply of Shkodra population.

Conditions of feed, movement and discharge of groundwater's in porous formation

Based on hydrogeological maps and profiles, porous rocks with greater permeability occupy almost the entire area of Mbishkodres.

To the east these gravels contact with base formations such as karstified limestone of Triassic, Jurassic and Cretaceous ages.

Viewing the hydrogeological map, the main role in feeding for this horizon, play the currents of groundwater`s that come up from base formations and infiltration of Rrjolli, Vrakë streams and Kiri River.

Atmospheric precipitation that falling directly on the surface plays a role in groundwater feed wherethe waterbearing horizon lies. Groundwater flow move from highest elevations to lower one, according to inclination of terrain. They move from the northeastern and eastern to southwestern and western part.

Filtration of atmospheric precipitation and groundwater filtration in base formation as well as surface waters of Rrjolli, Vrakë streams and Kiri River , during their movement in the direction of their discharge to the lake of Shkodra, create a good hydric connection between them, which make rich thegravely layers with underground waters.

Underground waters in porous rocks

Zadrime Nenshkoder Zone

According to hydrogeological conditions can be divided into two separate sectors:

Sector of Nenshkodra

Sector Zadrima field

Section of Nenshkodra

It is large distributed in valleys of Buna and Drin River s and their fields. In south, this sector bordered by Zadrima field, while in the north by Mbishkodra basin. It occupies all the lower field area and has the cumulative activity for porous material. Quaternary alluvial depositions of the Buna and Drin River s that constitute strong layer of coarse gravels and sand with high filtration feature, which accumulate substantial quantities of fresh underground water reserves.

Water carried by coarse gravel and sand dominate in cutting and occupy 60-80% of place. Layers thickness vary from 5-10 to 60m in area.

Sub sands coverage ranges from 2-3m to 25-30m. In the area of Mjedes, Kac-Naraçit, Stajkes, gravels outcrop in surface. Sub clays and sub sandy coverage increases from north to south and right to east west flows toward the Buna and Drin River s.

The gravels of underground waters of these alluvial valleys have good hydric connection with the superficial water of Buna and Drini River s, are rich and therefore contain substantial reserves, which are confirmed by the performed drillings.

In the north eastern part of this basin, groundwater are without pressure (in free level), while in southern and western sectors, as a result of sub gravel and sub sandy coverage increasing as result of higher hypsometric position of the area, they gain pressure and drillings in some areas the waters have artesian character as in Trush, Pistull, Paçram, Gocaj villages, etc. However, groundwater levels, in most of the territory are under the surface, but not in great depth as in area of Mbishkodra.

Ratio varies from 1.0 m to 3-3.5 m, rarely go to 5.0 m below surface level. Oscillation is related directly with hydrogeological regime of Buna and Drini River s, which confirms their good hydric relations with underground waters. At a flow rate, permeability of grits, in general, is very high, although there are limited areas with lower average value.

Filtration coefficients vary from 30-50 m/day and specific flows of 5-10 l/sec/ m, in areas of southwestern and western extremes and southern of basin, up to 400-700 m/ ay and 100-150 l/sec/m, respectively in most of its sectors, especially near Buna and Drini River s.

The direction of groundwater flow is mainly toward south and southwest.

The main food groundwater takes from Buna and Drin River s and partly by atmospheric precipitation, in sections where the gravel outcrop in surface.

Groundwaters in this basin are generally fresh and good physical and chemical properties, temperature of 12o-16o C. From work done before, it appears clear that the areas with perspective and rich with waters, are those on the left wing of the Buna River flow, starting from the bridge and up to Dajçi, Bacalleku the Buna Coast, with a front 8-10 km on both sides of the Drin River and it from Shkodra to Mjeda, with front 18-20 km (for both sides together).

From the previous works in this basin have been discovered a water quantity about 1000 – 1200 l/sec. based on made calculations may provide additional reserves of groundwater through new drillings, placing them 300 meters away from each other, parallel with Buna and Drin River s, 100-200 m distance from them.

In this zone we should reach 3000-6000 lit/sec of water if the detailed studies can undertake.

Sector of Zadrima field is not very rich in groundwater which in this area also, are associated with cumulative activity of alluvial loamy material of Gjader cascade. Alluvial depositions of River s are limited in Zadrima field, in extension and have small thickness. Quaternary thickness does not exceed 25-30 m in area and go up to 50 m in areas near the River s. The gravel layers have small thickness up to 2-3 m, and are not are encountered everywhere in extension.

Small interests represent only a certain limited specific sectors in the vicinity of River s as in Mabe, Dajç, Gramsh and Gjader. Ne Zoje and Mabe area are are encountered water bearing gravels, up to 20 m thick and with somewhat high at a flow rate and permeability. In these sectors the filtration coefficient arrives from 35 to 60 m/day, while the specific flow rate 5-14 l/sec/m. In Gramshi, Zoje and Gjaderi sector, near the River s, filtration coefficient ranges from 5 to 30 m/day, while the specific flow rate to 5 l 1-2/sec/m. Other part of Zadrima field, especially sectors of Koter, Kodhel , Baqel, Blinisht, Piraj, Kakariq etc., have values without interest.
Feeding, movement and draining conditions of groundwater in porous formations
As we can see from the construction of the map and cross-cutting hydrogeological, porous rocks with greater permeability occupied almost the entire area of Mbishkodres, in the whole area that we study.
At the east, porous rocks which are represented from the gravels, contact with base formations, such as the karstic limestone of the Triassic, Jurassic
Looking at the hydroisohypse and hydrogeological maps, the main role in feeding of groundwater play the currents that eject from base formation as well as and infiltration of Rrjolli and Vraka streams and Kiri River.

Peshkopia Region

This includes gravels and grits, clay-sandy sandstones that are found at the bed of the Drini I Zi River . They are extended from the Doda Bridge to the vicinity of Maqellara at south which are consisted of rounded rocks different rocks and have different thickness from several meters to 10-15 m in the area of the Muhuri and Fushe-Aliaj zone. These gravels have good hydric connection with the River .For the other areas, there are introduced clearly hydrogeological conditions according to waterbearing complex treated above.
Zadrima area has limit utilization of underground water due to poor water quality.
But last years, in this area, there are drilled in Kakariqi carbonate formations and there are received positive results.

Tropoja Region

For the town of Bajram Curri and for the villages around the town, from the natural spring Shoshani Vrella with discharge Q = 1000 l / sec there is taken about 100 l /sec. The rest is not used.

Pogradeci Region

From Tushemishti natural spring is obtained a quantity of water about 200 l / sec
From Lini natural spring is obtained a quantity of water about 20 l / sec for the Customhouse, 20 l / sec for Lin village and 80 l / sec for the fish-farming. Total Q = 320 l / sec

Kukesi Region

For the Kukesi town it is used Kolosiani natural spring with discharge of Q = 300 l / sec

For Kruma town it is used Kruma natural spring with discharge of Q = 100 l / sec

Peshkopia Town

For Peshkopia town it is obtained about 100 l / sec from Radomira natural spring.

For Peshkopia town there are obtained about 60-100 l / sec from 3 wells, in the gravel of the Black Drin River near Muhurri Field. For Maqellara zone it is obtained Q = 20 l / sec from Blata natural spring. In the area, there are are encountered the underground waters that flow from rocks with small to medium permeability, which are represented mainly by small grit, sand and fine sand covered by fine clay and clay. These waters are used for drinking water by passersby because they are located in the field part. The springs are with discharge that oscillates from 0.15 l / sec to 2.5 l / sec. Because these springs are poor and far from populated areas they have not practical importance.

Water reserves of Tropoja, Kukesi and Pogradeci regions are the most powerful water springs, which are not fully used for the needs of these districts.

CHAPTER 8 Karst aquifer characterization

8.1. Aquifer permeability

The findings in many groundwater wells of karstic rocks testify that the filtration coefficient varies from less than 1 m/day to more than 100 m/day, and transmissibility varies from about 10 to more than 5,000 m²/day.The results of many wells testify that permeability of the carbonate rocks is higher at a depth down to 100 m b.g.s. (below ground surface); at greater depths it usually diminishes.

8.2. Aquifer recharge

Depending by the rate of the limestones compaction there are three models: a) normal infiltration; b) quick infiltration (piston flow model); c) low infiltration (transient model). Two main types of aquifer recharge happen in karst terrain: direct infiltration of precipitation and concentrated infiltration and recharge within shallow holes (ponors). Considerable fracture and porosity of limestone together with high amounts of precipitation caused the occurrences of numerous significant groundwater flows. Precipitations make main resource of recharging (in some parts of Albanian Alps its value is about 3200 mm per year). Rainfall in high degree directly infiltrates in porous karst rocks and flows through complex system of karst channels. A lack of plant cover and surface streams and lakes in many parts of the karst terrains effect on very small amounts of evaporation and transpiration (sometime even less than 25%) and increase the values of infiltration from precipitation. These waters appear on strong karst springs. The occurrence of strong springs is the consequence of contact between permeable (mostly limestone) and impermeable (the Tertiary rocks, in the Upper Triassic and clastites of the Lower Triassic age) rocks or is caused by local erosion base. Ratio between minimum and maximum discharge of stronger karst springs in the external Dinarides karst is usually more than 20.

8.3. Aquifer discharge (springs distribution) in *Alps zone (Dinarides Mountains)*

Permian depositions disappear in belt shape which elongates in southern ledge of Albanian Alps, from Xhani village to Curraj and Valbona villages. These kind of depositions represented from potential carbonate packs which goes in addition toward the east.

The Permian depositions of Albanian Alps are not rich with waters because of the character of rocks themselves. The terrigenous depositions predominant in Permian cutting are not waterbearing. The fissures are fulfilling with terrigenous material or they communicate with each either in small zone, so, don't connect with big collector fissures.

In carbonate packs are really a lot of fissures but them are fulfill with calcite and collected soils as result of terrigenous breaking which bounded the carbonates from two hands, up and down.

The carbonates are situated between the terrigenous layers so, the rainfalls absent. At the same time the thickness of carbonate is small and they discharge quickly the small reserves collected during the precipitations.

The spring discharges in this complex varies from 0.1-0.3l/sec but in eastern part in Valbona valley encounter the other springs with higher discharge as it of no 621, where q = 5l/sec, no 630, where q = 4.5l/sec, no 623, where q = 3.6l/sec, no 619, where q = 1.5l/sec etc.
The depositions of this complex spread in a mountain zone with absolute quote 300-2000m, generally 500-1500m. The flows have not any law and order for disappearing in lower quotes. They seemed in different quotes for instance the spring no 1547 flow in quote 300m and the spring no 228 at quote 1500m. Their disappearing is conditioned by impermeable layers of argicellaous schists and marls situated under the sandstones, clay-limestones and silty-sandstone layers. The chemical-physical features of waters of this Permian complex for Alps zone are good. The waters are without odors, colors and flavour. Their temperature varies 6-14^{0}C, total mineralization = 228-391mg/l, pH = 7.3-8.7, total hardness = 6.44-10.53^{0}g. The waters belong the type of sulphate-sodium and rarely hydro carbonate sulphate-sodium. Some of the most typical springs are: Dragobia Spring, no 621absolute quote 570m, q= 5l/sec, spring of Karoni, no 630, absolute quote 1080m, q= 4.5l/sek, total mineralization = 286.7mg/l, pH = 7.92, total hardness = 6.44°g, type of hydro carbonate potassium.
In Gashi subzone the underground waters have not a big discharge. In this zone the underground waters encounter in destroyed zone by tectonics movements. Flowing of water in high mountainously zones happen in sites with low to medium inclination where the terrain configuration changes. These springs flow in different forms: concentrated in one point as Spring the spring no 305 with 3.5l/sec or in form of small springs spread in linear way along the streams where at the distance about 50-70 collected a quantity by 10-15l/sec. So, in Sublica place, collected in this form a water quantity by 10-12l/sec. the zone surround the Proska village has small inclination and marshy character. More typical are these seconds which can be named as the initiation of streams in this zone. They discharge their waters in Gashi River (Molla-Rjeka) and in it of Tropoja (Lukojt). It is important to note that in this zone there are some lakes with glacial origin. These are small and shallow. As we mentioned above in this zone are a lot of small springs with small discharges. These springs which disappear in high altitude collected in small streams which flow down along steef slopes with high velocity. They often create the waterfalls, especially in their lower part with a discharge that varies from 3-20l/sec rarely to 50l/sec. the precipitation in Gashi zone are about 3000/year but the storage capacity is small as result of the rocks compound and their hydrogeological features. The bigger springs in Gashi zone there of springs no 606, 610, 608, 305, 316, 306, and 315.Absolute quotes of zone where extend the Permian depositions of Gashi zone are 950-2500m. the outlets of the springs occur in absolute quote 1000-2150m. This shows clearly that the rocks in lower part are more compact.
The physical-chemical features are good. Total mineralization varies from 60.5-205.5mg/l, total hardness =1.45-6.83 °g, pH = 6.4-7.4. The hydro chemical type of waters is hydro carbonate-potassium (HCO3-Ca). The underground waters of this

complex are tectonic fissures waters or erosional, the springs are downhill type, permanent with concentrate outlet, superficial or linear and laminar flow.

1- Water bearing complex of depositions of lower Triassic (T_1)

The depositions of this complex spread from Domen village to Curroj I Eperm village, encounter in Valbona Valley and in Thethi place. They represent from conglomerates, schist's with ophiolitic face, intercalation with sandstones and limestones and conglomeratic interlayer. These depositions construct the part of anticline structures of Alps zone. They encounter in Dukagjini, Valbona, Thethi and Pepaj anticlines. Everywhere in these anticlines over the mentioned carbonatic depositions placed the depositions of medium and upper Triassic. These depositions interrupted from tectonic dissociative line. Generally, this complex is few water bearing; conglomerates which have big thickness are very compact and cemented. As result they had loosen their porosity. The sandstones are very compressed and had loosened their porosity. Anyway in zone there are some big springs which flowing from carbonatic Triassic depositions through the tectonic karstic fissures. They disappear in contact of Triassic depositions with them of conglomerates and sandstones. As result of the feeding source for this complex is the above mentioned structure.

In big anticline of Dukagjini are about the 50% of the superficial springs outlets. Between the depositions of this complex and them which surround it encounter numerous fissures which create the hydraulic connection and water mixtures of these complexes, especially with T2 and T3. For these reasons the superficial outlets of underground waters have the different discharges from 0.1-600l/sec.

The underground waters, which belong the lower Triassic, in this zone, have the small discharge while those of upper Triassic (carbonatic depositions) have bigger discharge as spring no 1548 with 12l/sec, no 220 with discharge by 600l/sec, no 221 with discharge by 100l/sec. etc.

In Thethi anticline the depositions of upper Triassic are more waterbearing because of are more fissured and destroyed. Following this anticline these depositions disappear in surface near the Rragami village, at Valbona riversides. These occupy a small surface, about the 15% of the complex. In this anticline there are a lot of tectonic lines which have destroyed these depositions cause the good conditions for water storage. The infiltration water and them of T3 create the big reserves which reflected in springs outlets with big discharges as the spring no 441 with q = 300l/sec, no 444 with q = 100l/sec.the discharge springs in Thethi anticline vary from 0.1-300l/sec, normally it is 0.1-10l/sec and rarely until to 30l/sec. The water discharge is very different during the wet and dry periods. Generally the waters have good quality for drinking using.

Regarding the Valbona anticline the depositions of lower Triassic outcrops in two its hands; in mountainously part they enclose the Permian depositions and self enclosing and cover by upper Triassic depositions. Here met two tectonic lines. In these conditions the underground waters which flow from the depositions of lower

Triassic, in this anticline, have a small discharge which vary from 0.05-0.25l/sec.the absolute quotes for the springs are from 770m to 1525m.as impermeable screen are the schicts. The underground water regime doesn't change a lot.

Conclusions

For this complex we can say that it is not very waterbearing. Expect the destroyed zones by tectonics; the other zones have a small number of water outlets in surface. The discharge of the springs has diverse values beginning from 0.5-100l/sec. the high values of discharges met at Thethi anticline. The waters have good quality and are appreciate for drinking purposes. Total mineralization oscillated in values from 150.1-251.8mg/l, total hardness = 5.2-8.34°g, pH = 7.35-8.35, hydrochemical type is hydro carbonate calcium. The sanitary situation is good.

2- **Water bearing complex of depositions of medium Triassic (T_2)**

a- The depositions of this waterbearing complex are limited in our zone. They encounter almost in Krasta Cukali zone. The lithological compound of medium Triassic from down to up is: combination of clay and siliceous schists with sandstones and limestones, tabulated limestones, flint interlayer's and effusive rocks. The depositions of this complex spread widely in Gashi zone, Marlula Monocline and in Vermoshi, also. Here represented from clay limestones which are tabulated and schistose, white limestones of thin layers etc. In Albanian Alps these deposition encounter in narrow belts form. They represented by conglomerates, micro conglomerate, carbonatic sandstones, clay limestones, clay schists, flints and tabulated limestones. These depositions are situated in different tectonic zones but for their similar lithology we put at the same water bearing complex while their hydro geological features are not the same for three zones. For this reason we will describe as separately.

a- In Krasta Cukali Zone these deposition form the central part of LekGegaj anticline. Encounter at Juban, Guri I Zi and Renx villages, also. Into the zone shown the old important karstic development. The discharges of the springs are diverse from 0.05-0.19l/sec. as screen for the springs outlets in surface serve the siliceous layers and siliceous argillaceous schists. The absolute quotes of springs vary from 700-850m. the waters have good physical features.

b- In Gashi zone the depositions of this complex included in Marlula monocline, composed about 30% of this complex and spread between upper Triassic depositions and them of Vermoshi flysch with tectonic contacts. As result, of fulfills of fissures with terrigenous material, this water bearing complex doesn't create big underground water reserves even though this zone is under the high quantity of atmospheric precipitations. The spring discharged varies from 0.1-0.3l/sec. the springs are permanent, downhills, disappear mainly in limestones where as screen serve the impermeable layers of Vermoshi flysch and siliceous rocks and schists. The absolute quote of the springs is between 1300-2025m.

In tectonic zone of the Alps this complex is very pale. It represents a small interest only in Domni zone. The predominant water type is hydro carbonate calcium (HCO_3-Ca).

Conclusions

This waterbearing complex it is not rich with water outlets in surface. The springs of this complex are less used. Their sanitary situation is good. The chemical characteristics are good so the total mineralization is 183.8-257.8mg/l, total hardness is 5.71-8.48°g, pH = 7-8.3. All these waters are the type of hydro carbonate calcium (HCO_3-Ca).

3- **Water bearing complex of carbonates depositions of Triassic T_3, J_1, J_3-Cr_1, Cr_1^{b-al}, Cr_1^{b-ap}, Cr_1^{al-ap}, and Cr_2.**

In this waterbearing complex are included all carbonatic and dolomitic depositions of T_3, J_1, J_3-Cr_1, Cr_1^{b-al}, Cr_1^{b-ap}, Cr_1^{al-ap}, and Cr_2.
As we mentioned above this joining is made because of similarity in lithology, fissures and waterbearing as Spring as the water mixture in some case particularly in NW of the region because ofhydraulic connections. The depositions of this complex expand almost in all northwestern and northern part of region and composing so-called “Albanian Northern Alps”. Thy form a big structure, a big anticlinorium, which into of it content a lot of anticlines and synclines structures. Beginning from the lower zone toward the higher zone (SW-NE) we encounter the anticlines of Reci, and Papajt; synclines of Shkreli and Veleciku; anticlines of Brigjes, Brojes, Boges and Kozhnjes;synclines of Brushtullit and Vuklit; carbonatic zone of Vila, Koshtica, Lnerti, Sokoli, Mishdaku etc which bounded with Kosovo and Montenegro. There are included the carbonatic zone of the mountains of Sheniku, and Jezerca, Thethi, Dukagjini, dragobia and Rragami anticlines and big anticline of Currojt. Besides of this massif we encounter some smaller massifs composed by one or some structures. At following the big massif in NEwe encounter the carbonatic massif of Shkelzeni and Lukojt. At the north, in Gashi zone, in vermosh, encountered small carbonatic massif of Marlula monocline. At the south, in central part of the region, encounter the massif of Cukali. This massif continues at NE with small plumes of carbonatic depositions in Toplana anticline and the Brice also. Most at the NE encounter small carbonatic massif of Merturi and Shllumi anticlines.
At the south and SE of the region encounter small carbonatic anticline of Munella and a part of Zeba anticline.composed from anticline with the same name. In zone between the Zeba mountain and Kukesi place encounter some small carbonatic massifs.
We describe the hydrogeological characteristics for every of them as below:
Marlula Monocline- included the massive limestones very destroyed. It is evident the karst activity and tectonic development. In this massif are created big fissures, holes, gaps and caverns. Typical is the Joshica cave. The underground waters outflow in

this caves in contact with schists of medium Triassic depositions. Encounter a lot of small springs with a discharge by 0.1l/sec or less. There are some other big springs with high discharge until 100l/sec as them of spring no 463 with 100l/sec, 454 with 20l/sec, 461 with 5l/sec etc. The underground water regime is oscillating. Major outlets with bigger discharge seem during the snow break period. During the other periods the springs of this zone are under the influence of rainfalls and evaporation rocks condensation. In this zone rain falling more than 3000mm/year. The outflows of these waters occur in absolute quote 1300-2000m. The big discharges occur in lower quotes, 1300-1550m in opposite with the springs with small discharges that disappeared in high altitude, 2000m. The outflows of these underground waters create the springs of lithological, litho stratigraphical and lithologo-tectonic-stratigraphical type of contact. The springs are permanent downhill type. The waters are the karstic fissures type and them of tectonic-karstic fissures.The chemical characteristics are good, so the total mineralization is 148.6-235mg/l, total hardness vary from 5.32 -8.23°g and pH = 7.7-7.85. The water type is hydro carbonate magnesium calcium (HCO_3-Mg-Ca).

8.4. Spring flow regime

To this group belong (a) highly productive karst aquifers, and (b) moderately productive fissured (or fissured and porous) aquifers. Highly productive karst aquifers crop out over an area of about 6,500 km², about ¼ of Albania's total surface area. They usually comprise mostly Mesozoic carbonate rocks such as limestones and, to a lesser extent, dolomites. There are some 25 karst massifs outcropping in the country, while over large areas of the Ionian and Kruja Zones and in the Adriatic basin, the carbonate rocks are covered by flysch and molasses deposits. The karst rocks have a well-developed karstic morphology both on the surface and at depth. Karst phenomena are primarily developed over extensive carbonate structures of the Albanian Alps, and in the Mirdita and Ionian Zones. Wide areas of karst basins are occupied by well-developed high elevation karst plateaus.

The surface hydrographic network of karst zones is not well developed, or is even totally lacking. In contrast, the subsurface hydrographic network is intensively developed. Most of the karst areas of Albania have suffered an intense tectonic uplift resulting in formation of vertical conduits which discharge the infiltrated water to quasihorizontal collecting conduits ending in large karst springs located in low-elevation outcropping points of the carbonate aquifer, as isthe case of the Selita spring (Fig. 5). Karst areas of Albania coincide with high-elevation mountains with high hydraulic gradients, which are the preconditions for the conduits being developed more linearly (Bakalowicz 2005).

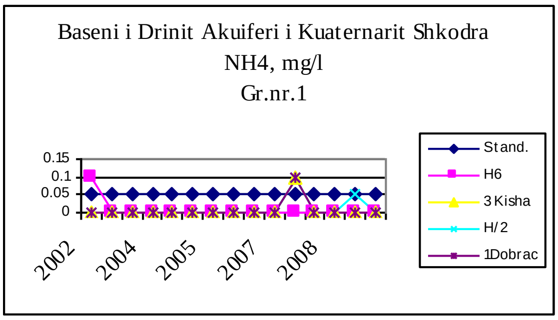
The karst networks in Albania clearly appear different from the fracture pattern of respective karst structures and, as Mandel (1963) and Bakalowicz (2005) have evidenced, they are organised like fluvial systems. This happens even when the direction of bedding plains is perpendicular to that of the hydraulic gradient.

The specific capacities of wells vary from 0.1 to over 20 l/s/m, with the maximal capacity of wells more than 70 l/s.
Effective infiltration, the part of precipitation recharging the karst groundwater, calculated by the Kessler method (Kessler 1967), accounts for about 40 to 55% of mean yearly precipitation. The average yearly efficient infiltration in the Albanian Alps is about 1,500 to 2,000 mm, in Mali me Gropa 1,100 mm, in Mali Thatë 450-500 mm and in Mali Gjerë about 1,175 mm.
Karst waters discharge mainly as large karst springs with greatly varying productivity. There are roughly 110 karst springs with average discharges exceeding 100 l/s. Of these, 17 have discharges exceeding 1,000 l/s. The average yearly discharge of the Blue Eye
Spring, the biggest karst spring in Albania, is about 18.4 m3/s (Fig. 3). Karst springs occur mainly at the lower outcrop of karst rocks, on the fringe of mountain massifs or in deep river gorges cutting the karst massifs. In the Ionian coast karst, where local impermeable barriers develop along the coastline, there are good quality springs like that of Uji Ftohte with an average discharge of 2.5 m3/s. Along most of the coastline there is no impermeable barrier, and saline coastal or submarine springs occur. Estimated total karst water resources drained along the Ionian Sea by the coastal carbonate aquifers amount to about 15 to 20 m3/s (Eftimi 2003a). The discharge curves of karst springs show two maxima and two minima: the main maxima are in April/May in connection with snowmelt, and the second in December is in connection with rainfall. During the summer the karst spring discharges subsequently diminish (recession period), in connection with low precipitation and high evapotranspiration, and the minimum is mainly in October. The second smaller minimum of February is caused by the freezingof the ground in high elevation karst water recharge areas. Usually the recession period is characterised by two laminar flow micro regimes.

Drini Basin

Waterbearing gravelous aquifer of Shkodra

Risk of pollution is high because of small covering of gravels notably in Dobraci Spring. Intensive exploitation can lead in mixing of fresh water and water with high mineralization.



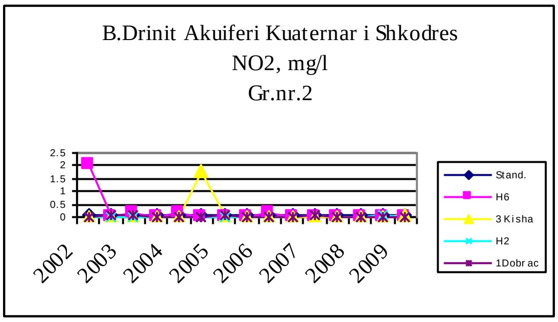


Fig.1 NH_4 Monitoring results 2002-2008 **Fig.2** NO_2 Monitoring results 2002-2009

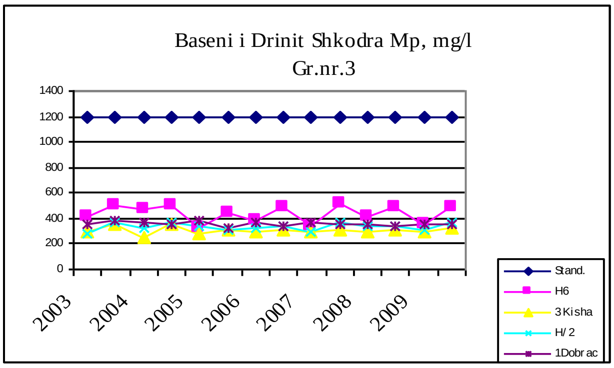


Fig.3 TM Monitoring results 2003-209

At this basin groundwater is with good quality. Total mineralization (TM) is low and the water is in according to Albanian Standard for drinking water.

It is no pollution in Dobraci zone. There is encountered local pollution which is related with sanitary defense of zone around the wells. The pollution is in range values.

CHAPTER 9 Groundwater utilization and demands

Manufacture and sale of water are the best indicators to determine production needs meet the total demand of the population for drinking water supply. For the year 2010, Labour Indicators Monitoring Unit and Comparative Assessment reported that Average water production was 301 liters per capita per day (292 million cubic meters per year) and the average water sale was 110 liters per capita per day (107.5 million cubic meters per year). The difference between these two figures clearly shows the extent of "non-revenue water" by demand, and represents the amount of water "produced but not billed" for any person supply. The above figures show that the non-revenue water in 2010 was 63.2%. However, should not be assumed that 63.2% of water is wasted water. It is a fact that many systems transmission and distribution have a significant number of "illegal "or" unregistered " links which means that a portion of the 63.2% is used and provide a necessary service. Similarly, the placement of the devices remains very low (44.6% of the customers have meters and 46.3% of water sold is measured); it means that there is no clear information nationally to arrive at a realistic figure request.

Average annual capacity of water resources in Albania for 2010 estimated to be about 654 million cubic meters per year, while total demand for water, estimated at a rate of 150 liters per capita per day (rate request applied in Albania) and a tolerance of 20% technical loss of water, it is estimated that there were 197 million cubic meters per year for the population served and 240 million cubic meters per year for the total population in the service area. This showsthat the total resources use as much as 3 times the expected demand for the entire population, served and unserved areas under the administration of enterprises. This will not means that all areas have ample supply. Some specific areas needing investments in water production to meet local demand. These figures prove that the problem in Albania is not that we should produce more water, but produced water demand management.

Water resources are considerable in Albania. River discharge into the sea is estimated to be

around 40km^3/year with an annual specific discharge of 29 l/s/km^2, which is one of the highest in Europe. Groundwater resources represent about 23 percent of the total renewable resources.Groundwater sources are the main source for drinking water and they are also the major source for irrigation. Because of the geological structure of the Albanian mountains with developed karst manifestation and highly permeable gravelly aquifers in the lowland areas, groundwater resources are abundant and of good quality. Due to the ease of extraction, groundwater has often been unnecessarily used in industry and for irrigation in agriculture. The latter has become a reason of concern as 23% of groundwater extracted goes in inefficient irrigation practices. In some areas of Albania, there is a fast depletion of groundwater resources and this disastrous trend is likely to continue in the next decade. This is often associated with increased salinity and alternated hydro-chemical balances in

the aquifer, indicating brackish water intrusion. Population movement toward cities has put additional pressure on the water resources of some lowland areas, where extraction rates are increasing steadily.
Use of groundwater resources:

- Drinking water 42.5%
- Irrigation water 21%
- Industrial water 18.3%
- Water for construction 6.7%
- Other 11.5%

Demand management is identified as one of the key elements to improve water supply services in Albania and increase the revenue generation for the company. Experience shows that in areas where pipes are under pressure for 24 hours per day, water consumption goes up to 500 l/capita per day, compared to 120 l/capita per day in other European countries. Not only does this impose high operation costs on the systems, the water withdrawn by these customers increases the lack of water in other parts of the network. The most important tool in demand management is the introduction of metering accompanied by a water tariff based on the amount of water consumed,which should at least gradually reflect the true cost of the service. Other important tools for demand manage.

9.1. Tapping structures and control of groundwater flow

The utilization of karst water is related mainly to (a) successful results of drilling wells, and (b) the high vulnerability of the karst medium to pollution (Bakalowicz 2005). Several approaches are known for tapping karst water (Milanoviæ 2000), but those most widely used in Albania are drilling wells and pumping from siphons or galleries. Determination of the conduit locations is certainly the main difficulty when intending to drill in karst limestone. Experience in Albania has shown that the most appropriate location for productive wells is close to the natural springs. For example, a well 50 m deep near a karst spring with a maximal discharge of about 20 l/s hasa constant discharge of more than 50 l/s and is currently used to supply the town of Mamurras. Generally speaking, location of the wells in low topographic settings, even small valleys, appreciably affects the yield of wells, as emerges from experience with village water supplies. A common experience in Albania is intensive pumping directly into the siphon of intermittent karst springs, or into karst caves crossing the karst water level. There are two well-known large pumping stations in the Alps karst basin, one situated in the Rriolli spring in Alps and the other in the "Syri i Sheganit" karst cave. In both cases the groundwater exploitation is enabled by the large storage capacity of the karst basin.The difficulties in protecting karst water are related not only to its high vulnerability, but also to the fact that most people are unaware of the special properties of karst aquifers.

9.2. Main waterworks in Albania

Coverage with Service of Drinking Water Supply means the role of water enterprises to be serving the population within the areas under management, in scope as scale and cost efficiently as possible. Analyzes carried out by Unit Monitoring performance, indicators and Comparative Assessment show that the population served by water utilities in 2010 amounted to 2.65 million, a figure which show constitutes 80.3% of the total population in areas under their administration for all water utilities (3.31 million). Based on the data provided, drinking water coverage is 90.7% in urban areas and 57.0% in rural areas. Monitoring Unit should create an instrument that collects data from systems Aqueous Work outside the service area of 58 water utilities, as sanitation systems that function within the service area enterprises, but are not integrated in water supply infrastructure enterprises. All this information should be part of the program for the reporting of data.

No.	Municipality	City, Town	Status of Company	WS&CH/WS
1	**Municipality**	Puke	LTD	WS&CH
2	**Municipality**	Berat	LTD	WS&CH
3	**Municipality**	Bilisht	LTD	U
4	**Municipality**	Bulqize	LTD	U
5	**Municipality**	Burrel	LTD	U
6	**Municipality**	Delvine	LTD	U
7	**Municipality**	Diber	LTD	U
8	**Municipality**	Divjake	LTD	U
9	**Municipality**	Durres	LTD	U
10	**Municipality**	Elbasan (F)	LTD	WS&CH
11	**Municipality**	Elber (sh.p.k)	LTD	U
12	**Municipality**	Erseke	LTD	U
13	**Municipality**	Fier	LTD	U
14	**Municipality**	Fush Arrez	LTD	WS&CH
15	**Municipality**	Fush Kruje	LTD	WS&CH
16	**Municipality**	Gjirokaster (Q)	LTD	WS&CH
17	**Municipality**	Gjirokaster(F)	LTD	WS
18	**Municipality**	Gramsh	LTD	WS
19	**Municipality**	Has	LTD	WS&CH
20	**Municipality**	Kamez	LTD	WS
21	**Municipality**	Kavaje	LTD	WS
22	**Municipality**	Kelcyre	LTD	WS
23	**Municipality**	Korçe (F)	LTD	WS

24	**Municipality**	Korçe (Q)	LTD	WS&CH
25	**Municipality**	Kraste	LTD	WS
26	**Municipality**	Kruje	LTD	WS&CH
27	**Municipality**	Kuçove	LTD	WS
28	**Municipality**	Kukes	LTD	WS
29	**Municipality**	Kurbin	LTD	WS&CH
30	**Municipality**	Lezhe	LTD	WS&CH
31	**Municipality**	**Libohove**	LTD	WS&CH
32	**Municipality**	Librazhd	LTD	WS&CH
33	**Municipality**	Lushnje (F)	LTD	WS&CH
34	**Municipality**	Lushnje (Q)	LTD	WS
35	**Municipality**	Mallakaster	LTD	WS
36	**Municipality**	Malsi e Madhe	LTD	WS
37	**Municipality**	Mirdite	LTD	WS
38	**Municipality**	Novosele	LTD	WS
39	**Municipality**	Orikum	LTD	WS
40	**Municipality**	Patos	LTD	WS
41	**Municipality**	Peqin	LTD	WS
42	**Municipality**	Permet	LTD	WS
43	**Municipality**	Pogradec	LTD	WS
44	**Municipality**	Poliçan	LTD	WS
45	**Municipality**	Puke (F)	LTD	WS&CH
46	**Municipality**	Rrogozhine	LTD	WS
47	**Municipality**	Rubik	LTD	WS
48	**Municipality**	Sarande	LTD	WS&CH
49	**Municipality**	Selenice	LTD	WS
50	**Municipality**	Shkoder (F)	LTD	WS&CH
51	**Municipality**	Shkoder (Q)	LTD	WS&CH
52	**Municipality**	Skrapar	LTD	WS
53	**Municipality**	Tepelene	LTD	WS
54	**Municipality**	Tirane(Q)	LTD	WS
55	**Municipality**	Tropoje	LTD	WS
56	**Municipality**	Ura Vajgurore	LTD	WS
57	**Municipality**	Vau I Dejes	LTD	WS
58	**Municipality**	Vlore	LTD	WS&CH

Table. List of the main water supplies companies in Albania

Note: WS&CH means-water supply and channels, WS-means water supply, yellow color show the place within TDA zone.

Indicators	Unit	Shkodër City WS&CH	Shkodër Village WS&CH	Malësi e Madhe WS&CH
1.1 Water Coverage	%	72.50	43.39	72.25

1.2 Water Coverage-Urban	%	72.50	-1.00	69.23
1.3 Water Coverage-Rural	%	-1.00	43.39	72.98
2.1 Sewerage Coverage	%	64.44	0.00	0
3.1 Water Production (lcd)	l/c/d	332.95	238.29	96.68
3.2 Water Production (m3 conn. m)	m3/conn/m	32.01	43.46	46.23
Energy Consumption Rate (kwh.m3)	kwh/m3	0.73	1.15	-1
5.1 Water Sale (lcd)	lcd	143.30	120.36	71.54
5.2 Water Sale (m3. conn. month)	m3/conn/m	13.77	21.95	34.21
5.3 Household Water Sale (l.c.d.)	l/c/d	123.76	113.24	42.95
6.1 Non Revenue Water - %	%	56.96	49.49	26
6.2 Non Revenue Water (m3.conn.m)	m3/conn/d	18.23	21.51	12.02
7.1 Proportion of metered connections	%	6.89	29.48	0.4
8.1 Proportion of water sold that is metered	%	4.89	9.46	17.8
9.1 DOC per m3 sold (W&S)	Lek/m3	46.56	161.93	21.51
9.2 DOC per m3 produced and purchased (W&S)	Lek/m3	20.04	81.79	15.91
10.1 DOC per m3 sold -W	Lek/m3	42.85	161.93	21.51
10.2 DCO per m3 produced and purchased - W	Lek/m3	18.44	81.79	15.91
11.1 Labor vs. DOC	%	48.56	37.93	84.93
12.1 Energy vs. DOC (W&S)	%	35.89	17.61	0.31
12.2 Energy vs. DOC (W)	%	39.00	17.61	0.31
12.3 Energy vs. DOC (S)	%	0.00	-1.00	-1
13.1 Average Price W&S (m3 sold)	Lek/m3	53.23	35.99	17.25
13.2 Average Revenue W&S (per conn.)	Lek/conn	733.25	789.96	590.26
13.3 Average Revenue W&S (HH conn.)	Lek/HH conn	576.66	742.87	250.42
14.1 Average Water Price - per m3	Lek/m3	43.45	35.99	17.25
14.2 Monthly Average Revenue- W (Hh conn.)	Lek/HH conn	456.91	742.87	250.42
15.1 Billings W&S as % of GNI/c	%	-1.00	-1.00	-1
16.1 Collection Rate- Overall	%	56.61	73.46	44.56
16.2 Collection Rate- Hh	%	51.87	73.45	64.38
16.3 Collection Rate- PE	%	59.33	105.60	35.41
16.4 Collection Rate - IN	%	74.66	60.35	28.77
17.1 DOC Coverage-Revenue	%	114.33	22.22	80.23
17.2 DOC Coverage- Collections	%	64.72	16.32	35.75
17.3 DOC Coverage- Subsidy	%	24.21	36.89	24.38
17.4 DOC Coverage- Coll. and Subs.	%	88.93	53.21	60.13
18.1 Debt Service Ratio	%	0.00	0.00	0
19.2 Fixed Assetss Capita -W	000 Lek/capita	3.46	52.23	0
19.3 Fixed Assetss per capita- S	000 Lek/capita	1.73	-1.00	-1
20.1 Staff per 1000 W&S connections	Ratio	4.94	44.42	24.89
21.1 Continuity of Service Hours day	Hours/day	21.00	14.23	5.87
22.1 Compliance rate (Chlorine residual)	%	100.00	100.00	-1
22.2 Compliance rate (Coliform)	%	100.00	100.00	-1
23.1 Pipe breaks per km	breaks/km	0.07	0.24	0.15
23.2 Pipe breaks per connection	breaks/conn	0.00	0.01	0.01
24.1 Sewerage blockage per km	blockages/km	0.71	-1.00	-1

24.2 Sewerage blockage per connection	blockages/conn	0.01	-1.00	-1
25.1 TOC per m3 sold (W&S)	Lek/m^3	55.95	232.10	25.87
TOC per m3 produced and bought (W&S)	Lek/m3	24.08	117.24	19.14
26.1 TCO per M3 produced and bought	lek/m3	49.67	232.10	25.87
26.2 TCO per M3 produced and bought W	lek/m3	21.38	117.24	19.14
27 Labor as % TOC (W&S)	%	40.41	26.46	70.62
28.1 Energy as % TOC (W&S)	%	29.87	12.28	0.26
28.2 Energy as % TOC (W)	%	33.64	12.28	0.26
28.3 Energy as % TOC (WS)	%	0.00	-1.00	-1
29.1 TOC Coverage by Revenues (W&S)	%	95.15	15.50	66.71
29.2 TOC Coverage-Collections (W&S)	%	53.86	11.39	29.73
29.3 TOC Coverage-Subsidies (W&s)	%	20.15	25.74	20.27
29.4 TOC Coverage-Coll.+Subs. (W&S)	%	74.01	37.13	50

Table. Data related to the enterprices whict lead the water supply and channels in TDA zone.

Note: leke is the country maney, 140 leke =1 euro

9.3. Smaller water users (industrial sector and rural settlements)

Introduction of private sector participation in service provision is expected to improve the
management of the water utilities and thereby achieve better quality of service and higher
operating efficiency. In addition, private sector participation can also provide much needed
capital for infrastructure rehabilitation and extension, although the conditions in Albania havenot reached a level yet where private capital could be attracted on a larger scale. The most suitable PSP option should be selected in each case and it must take into account political,legal, institutional, financial, as well as technical characteristics of the water systems. Albania has a lot of small towns which are not attractive to foreign operators because of their limited size; bundling of towns and developing a market for Albanian operators could help to overcome this obstacle. Unless prompt action is taken, climate change looks set to worsen Albania's energy security over the medium to long term. Climate forecasts project an increase in droughts resulting from global warming and changing hydrology; with runoff being affected both by changes in seasonal precipitation and temperature (including the timing of snowmelt)These changes could reduce annual average electricity output from Albania's large hydropower plants by abou15 percent and from small hydropower plants by around 20 percent by 2050. At the same time, increases in extreme precipitation events could cause spillover and lead to increased costs for maintaining dam security. Current levels of sedimentation in hydropower plants reservoirs are unknown but may be significant. Other energy assets are not immune from climat impacts. Rising sea levels and increased rates of coastal erosion could threaten energy assets in the coastal region. Rising air temperatures can reduce the

efficiency of transmission and distribution networks, as well as the power produced by thermal power plants by about 1 percent each by 2050. Owing to uncertainties in current and future wind speeds, estimates of changes in wind power generation cannot be made. Solar energy production in Albania may, however, benefit from projected decreases in cloudiness it is estimated that output from solar power could increase by 5 percent by 2050. Energy demand is also related to climatic conditions. Higher temperatures due to climate change may reduce demand for space heating, particularly in winter, but increase demand for space cooling and refrigeration in hotter months. The seasonality of Albania's supply demand imbalance raises this exposure: As summer demand rises along with temperatures, hydropower production in summer looks set to be constrained by reduced rainfall. Summer temperatures also coincide with a greater irrigation need in agriculture, which may compete directly with small hydropower plants for limitedwater supplies.

9.4. Agricultural sector

Water use for irrigation

Agriculture is not very well developed sector in Albania but during the last years there is an evidence of improvement of the sector. Water for irrigation is taken from rivers and from 626 reservoirs with a total estimated volume of 562 million m^3. In 2010 irrigated land comprised 194545 hectars which is about 30 percent of the total arable land in Albania (source: *Protection and Sustainable Use of the Dinaric Karst Transboundary Aquifer System, 2011*).

Albania has had a relatively good irrigation network some decades ago, mainly using open channel flow that has resulted in massive waste of water.

Groundwater wells are also widely used for irrigation and this may have a negative impact on groundwater resources particularly in the coastal zone and other aquifers where groundwater resources are almost exhausted (e.g. Tirana, Fushe Kruje, Lushnje).

County	**Arable land**	**Water used for irrigation 2010 m^3/ha/year**		**% of irrigated land; (3/1)**
		Potential	Actual	
Berat	52908	13150	10180	19.2
Dibër	41056	22945	15996	39.0
Durrës	40568	19049	12731	31.4
Elbasan	72872	31768	21103	29.0
Fier	121961	77142	46451	38.1
Gjirokastër	45111	21057	10604	23.5
Korçë	90909	33944	21874	24.1
Kukës	25292	10211	7768	30.7
Lezhë	34736	18914	9168	26.4
Shkodër	50625	34611	16930	33.4
Tirana	56609	14657	1140	19.7

Vlorë	62873	34004	20600	32.8

Table 3.5. Water use for irrigation in Albania in 2010.

Source: Protection and Sustainable Use of the Dinaric Karst Transboundary Aquifer System"

Final Report WG 2 "Socio-Economic and Environment".

Irrigation and drainage infrastructure is highly fragmented since 55 percent of the irrigated land is supplied by small systems covering less than 5,000 ha. Some 170,000 ha are irrigated by the surface waters, and the remaining 2,500 ha - with groundwater. (*source: Draft paper for participatory irrigation management (PIM) national seminar in Albania*).

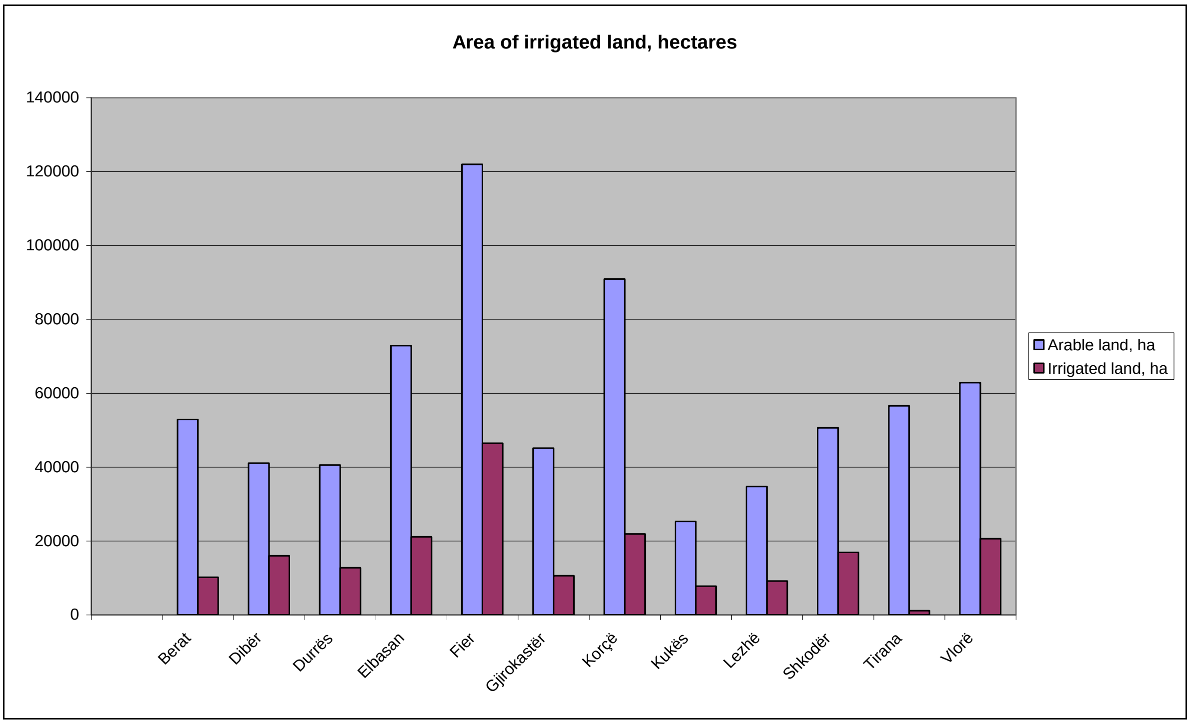
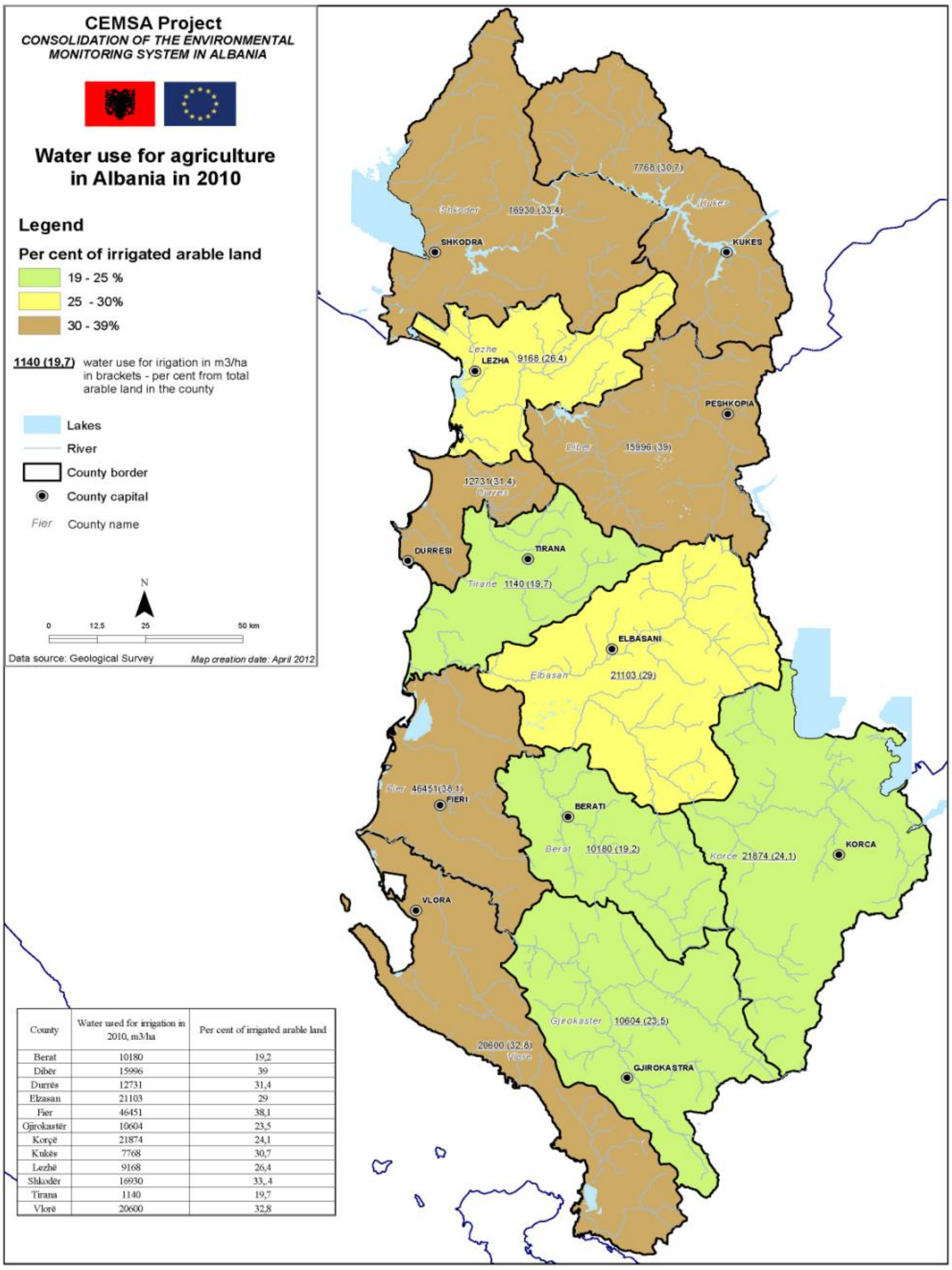


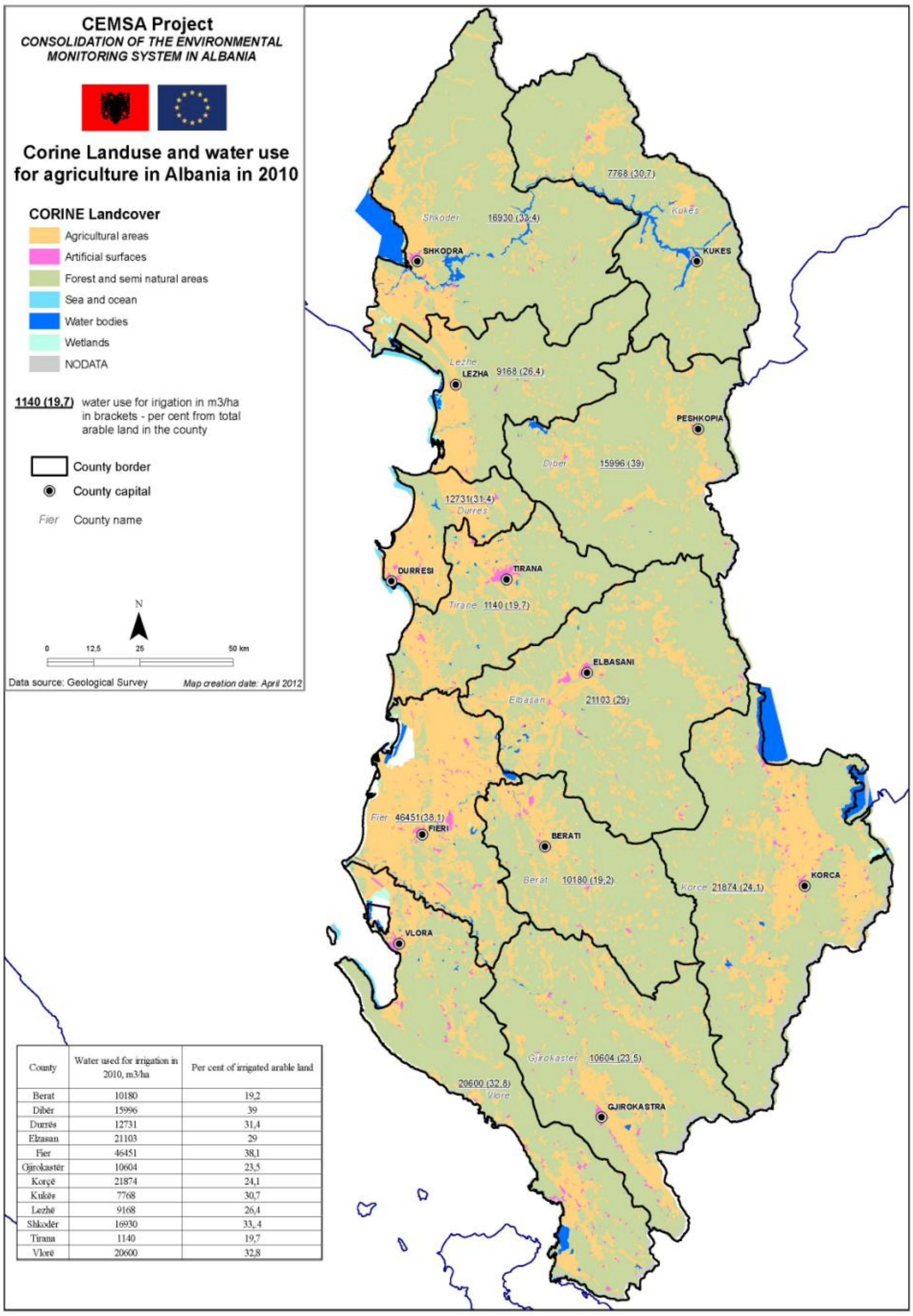
Figure 3.10. Irrigated land in Albanian Countries in 2010 (in persent of total arable land of the Country).



County	Water used for irrigation in 2010, m3/ha	Per cent of irrigated arable land
Berat	10180	19,2
Dibër	15996	39
Durrës	12731	31,4
Elzasan	21103	29
Fier	46451	38,1
Gjirokastër	10604	23,5
Korçë	21874	24,1
Kukës	7768	30,7
Lezhë	9168	26,4
Shkodër	16930	33,.4
Tirana	1140	19,7
Vlorë	20600	32,8

Figure 3.11. Irrigated land in Albania.

Arable land is not uniformly distributed within the couties. This is reflected by the Corine landuse map (figure 3.12).



County	Water used for irrigation in 2010, m3/ha	Per cent of irrigated arable land
Berat	10180	19,2
Dibër	15996	39
Durrës	12731	31,4
Elzasan	21103	29
Fier	46451	38,1
Gjirokastër	10604	23,5
Korçë	21874	24,1
Kukës	7768	30,7
Lezhë	9168	26,4
Shkodër	16930	33,.4
Tirana	1140	19,7
Vlorë	20600	32,8

Figure 3.12. Landuse in Albania (from Corine 2006).

9.5. Mineral and thermal water use

In Albania, rich in geothermal resources of lowenthalpy and mineral waters, new technologies of direct use of geothermal energy are still undeveloped. Large numbers of geothermal energy of low enthalpy resources, a lot of mineral water sources and some CO^2 gas reservoirs represent the base for a successful application of modern technologies in Albania, to achieve economic effectiveness and success of complex direct use. At the present, many geothermal, hydrogeological, hydrochemical, biological and medical investigations and studies on thermal and mineral water resources are ongoing in Albania. The results of the geothermal studiescarried out in Albania are presented in maps and geothermal sections. Temperature maps have been drawn for different levels up to 3000m depth. Geothermal gradient, heat flow density and geothermal resources maps have also been drawn. The natural springs with thermal waters and the geological structures with high water temperature have also been mapped. Generally, these investigations and studies are separated each from the other. These studies and evaluations are necessary to well know at a regional scale the thermal and mineral water resources potential and geothermal market of the Albania. According to the results of these new studies, the evaluation of the perspective level of the best areas in country will be necessary. After such evaluation is possible to start investments in these areas. Integrated exploitation and cascade direct use of the geothermal energy will be realized by an integrated scheme of geothermal energy, heat pumps and solar energy. This scheme gives an environmental benefit by using renewable energies (geothermal and solar energy), new technologies (heat pumps) and energy savings (cascade scheme). Cascade scheme should be used to fulfill the thermal energy demand for the selected area in order to get the maximum benefit from geothermal energy and the minimum energy supply from heat pumps. Direct use of geothermal energy will have a direct impact on the development of the districts, by increasing the per capita income and at improving. Platform for direct use of geothermal energy in Albania thatis presented in the paper is based on the result of geothermal studies carried out in Albania (Frashëri et al. 2004, 2005). The results of these geothermal studies carried out in Albania are presented in maps and geothermal sections. Temperature maps have been drawn for different levels of up to 3000m depths. Geothermal gradient, heat flow density and geothermal resources maps have also been drawn. The natural springs with thermal waters and the geological structures with high water temperature have also been mapped. The studies for the possibility of direct use of geothermal energy in Albania have been presented in different scientific conferences (Frashëri et al 1997, 2003, Frashëri 2001, 2004 etc.).

Geothermal Features

The geological setting of the Albanides creates the premises for the research and exploitation of natural geothermal energetic resources. The greatest heat flow density with a value of $42mWm^{-2}$ is found in the center of the Preadriatic Depression. In the east of the ophiolitic belt heat flow density reaches values of up to 60 mWm^{-2}

(Frashëri et al. 2004). The geothermal gradient has the highest value about 18.7 mKm^{-1} in the center of the Peri Adriatic Depression. Elsewhere the gradient is mostly 15 mKm^{-1}. In the south of the country the geothermal gradient has low values 11.5-13 mKm^{-1} . Towards the northeastern and southeastern regions of Albania, over the ophiolitic belt, the geothermal gradient increases, reaching the value of 23.5 mKm^{-1}. The temperature at a depth of 100m ranges 6.7 to 8.8°C, in average 16.4°C and at a depth of 500m from 21 to 27.7°C.The temperature ranges up to 105.8°C at a depth of 6000m. In the central part of the Preadriatic Depression, there are many deep oil wells where the temperature reaches up to 68°C at a depth of 3000m.

9.6. Groundwater treatment

The GOA adopted a Water Supply and Sanitation Strategy in 2003. The strategy included a short-term priority reform and investment program (2003-2006) and medium-term reform and investment program (2007-2012) to stabilize and improve water supply and sanitation services. The long term objective of the strategy for the water supply and sanitation sector is to achieve sustainable water supply and sanitation services at the EU Standards in urban and rural areas. Implementation of the ambitious strategy was slow, but by 2008, ownership of the utilities had been transferred from the government to local authorities. The utilities are not yet financially self-sustaining. With support from the World Bank, the GDWW provides technical assistance to local government and water supply and sewage companies, including helping the water supply and sewage companies prepare five-year business plans and developing a phased program on the reduction of subsidies covering the gap between tariffs and total cost, with a goal of eliminating subsidies by 2012.

With support from the Japanese Government, the GDWW prepared a study designed to support the regionalization of water supply and sewage utilities. In addition, the water companies serving Berat and Kucova were successfully merged and infrastructure constructed and rehabilitated with a grant by the German Government.

The European Union, Government of Germany, and other donors are supporting the GOA-s effort to prepare an updated National Water Strategy, which is contemplated as part of a new Draft Water Management Law under internal consideration. Other government projects include participation in the Albania-Montenegro Lake Shkoder Integrated Ecosystem Management Global Environment Facility, which is establishing a Bilateral Lake Management framework for the shared water resource.

9.7. Water demands and sustainability

The Government of Albania has begun the preparation of a National Water Strategy (with funding by the EU) to set out polices on the efficient management and protection of water resources, and to specify an appropriate legal framework for the management of water resources. However, the lack of adequate monitoring systems, the rapid changes in economic activities, and the continuous movements in population make it difficult to assess the use of water resources. Available data suggests that irrigation and mining rely mostly on surface water, while households and industry on groundwater from aquifers. Domestic water demand is increasing not only because of population growth but also because of the increase in the level of water losses, estimated to be greater than 50 percent in all cities. The changing pattern of urban and rural water consumers is reflected by the changes in population growth in urban and rural areas. During the totalitarian period (1945-1990) Albania experienced several waves of internal migration, while external migration was prohibited by law. Internal migration was an orderly process carried out for political and socio-economic reasons, and constituted an integral part of the state planning process, Practically no consideration was given to individual preferences. The period between 1945 and 1960 was characterized by the development of some industries and infrastructure, which led to considerable movement of population from villages to the main towns. Substantial Chinese aid in 1964-1978 provided some relief to the economy. Following the political isolation of 1978-1990 and lack of any external assistance the state was unable to generate new jobsand provide housing for the urban population. resulting in decreased levels of migration. The rural population grew at a much faster rate than urban population placing increasing pressure on land use. Removal of restrictions in the movement of population, after 1990, resulted in an accelerated increase in rural to urban migration – becoming uncontrollable – which came to be known as 'wild urbanization'. Rural population accounts for about 60 percent of the total population. Agriculture is the main economic activity. Albania's agriculture potential is focused on the large coastal plains and flatter valleys of the major rivers. However, despite annual rainfall of 600 to 900 mm, the hot dry summers limit agricultural production without irrigation.

Last decades developments in Albania have brought many changes in the water demand
pattern. As shown in the above table, the urban areas are growing rapidly and more drinking
water is needed, while most industries – large water consumers before 1990 – are not working anymore. New industries and businesses are being established demand for water not only is growing steadily, but also its distribution over certain areas and its time pattern have changed. Water demand studies do not provide an accurate picture since the water produced is not metered and there are no measurements in distribution networks. Water meter coverage was substantial a few decades ago, especially in urban areas. Meters were Albanian made and relatively accurate for a limited number of years, but lack of maintenance led to their total dysfunction. Development of tourism in coastal areas, which is an important element of Albanias strategy for economic growth and poverty reduction, requires larger amounts of drinking water availability, especially in summer when demand is also increasing from other customers, but the insufficiency of the water provision infrastructure hampers tourist development.An example is the coastal city of Durres (second-biggest city in Albania with the biggest accommodation capacity for tourists in

Albania) where water is available only for about two hours per day. The situation is similar in other cities which have a lot of tourism e.g., Saranda, Vlora, and Pogradec.If the availability of water at the source is expressed in liters per capita in urban areas, the available sources of water supply is more than enough to satisfy water demand. In many cities, water availability at the source is around 500 to 700 liters per capita per day and in some cases even more. Because of leakage and considerable wastage, only a small part of the water produced goes into necessary consumption. Merely improving water production facilities would not bring about sustainable improvements as experience a has shown in many countries in transition. Moreover, increasing exploitation rates would seriously affect the fragile waterresource balances with future adverse impacts and increase the cost of water supply. In summary, therefore, Albania has a distribution problem and not a production problem. In fact, almost everywhere problems of water scarcity can be considerably mitigated through metering, leakage detection and reduction, network improvements, disconnection of illegal connections andoptimization of storage and supply patterns. Coverage of drinking water in rural areas has not received sufficient attention. This is reflected in the very poor level of service provided. A political campaign 'drinking water 33 action.' highlighted the state of the rural water supply in the early 1980's, which called for a rapid expansion of piped water supply in rural areas. However, this was poorly planned, insufficiently funded, and not organized. and brought only marginal results in terms of coverage and quality of service. In areas where the piped systems are not available, population in rural areas rely on natural springs and domestic wells to satisfy their needs. The rural household spends enormous time and effort in fetching and transporting water to their households from far away places and

not every family has a well or access to it. Water in plastic containers are transported by w men and children with the help of animals, Although detailed data on this process is not readily available, two international NGOs have done basic surveys in rural areas where piped systems were absent . As can be observed from table 2 below, on an average, about 80 percent of the rural families spend about 4 hours per day to fetch water – time which could be used for other productive purposes.

Families fetching water outdoors (in summer)	84% 80%
Families fetching water outdoors (rest of the year)	- 25%
Average distance traveled per day	3.6 km 3 km
Number of trips per day	4.4 trips 3.38 trips
Time spent daily for fetching water (incl. queue)	3-4 hours 4-5 hours
Average water quantity transported per trip	45 lit- 48 lit
Average daily consumption per family	162 lit - 198 lit
Liters/capita a day	32.4 l/c/d - 39.6 l/c/d

Table 2 : Surveys in Some Rural Areas on Time and Efforts Spent in Fetching Water

Source: NGO's fieldwork data

In rural areas, water demand depends largely on agricultural activities and crop production cycles. Household consumption is much smaller. In rural areas most of the water requirements are during summer months. Often, drinking water is misused for irrigation purposes.

10.1. Methodology

Methodology for balancing groundwater of selected TBA

The first and necessary step for legitimate TDA is preparation of a conceptual model for each of seven selected TBAs. Assessment of aquifers geometry, recharge, groundwater flow directions, discharge rate and water share of the common system is essential for any further analysis, water management measures and sustainable development. The technical input should provide base for TDA and facilitate further work on preparation of SAP.

To develop a proper conceptual model of a TBA several issues are to be evaluated:

- *Permeability*
- *Recharge*
- *GW flow direction*
- *Drainage*
- *Hydrodynamic condition*
- *Relationship with surface waters*
- *Relationship with other aquifers*
- *Regime of GW*
- *GW quality*

Concerning the specific regime of karst aquifer drainage, springflow data availability and the purpose of this project, the methodology for water resources assessment could be developed in the two directions:

1. The first is mainly based on the general groundwater balance equation and considers a general groundwater assessment and estimation of available resources under the existing hydrological situation.

2. The second approach includes detailed stochastic analysis of monthly and daily rainfall / discharge data and the creation of a forecasting model which includes other parameters such as air temperature and evapotranspiration. Considering available data and relevant long series, the latter methodology could be applied only on several small catchments within selected major TBAs.

The concept of water budget calculations is presented in Table 3 (Stevanovic, 1995, 2011; Ristic-Vakanjac, 2011). This concept and procedure should be consequently applied on selected TBAs in Dinaric region. The dynamic groundwater reserves (Qdyn) correspond to the summary average annual discharge from all registered springs. The subsurface flow (or underground discharge, Q2) is a difference of Losses minus Evapotranspiration from budget equation as ($E_{1+2} + Q_2 = (P + I_1) - (Q_1 + S_r)$). The static (non-renewable) groundwater reserves (Qst) depend on the aquifer's volume (surface times saturated thickness below minimal groundwater table) and storativity coefficient of that deeper part of karstic aquifer, $F \times H_{av} \times \mu_{av}$. The available (exploitable) reserves are dynamic reserves minus water required for water dependent eco-systems. In the case of additional significant flow from downstream tributaries (out of the aquifer drainage area) the water needed for the dependent eco system can be equalized to average minimal discharges of springs (average monthly values). Therefore, available reserves (Qpotent.avail.) are dynamic - minimal + part of static waters that can be used as a "loan" (Qdyn - Qmin +). The latter should in principle not exceed 10% of the total amount of static waters to be extracted over 20 years ().

Groundwater Balance and Reserves of TDA Albania-MonteNegro																
Groundwater Reserves																
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Av. annual (m^3/s)	Minimum annual (m^3/s)	sum
																10^6 m^3
SQ_{dyn}	12.000	2.456	1.930	2.220	2.750	2.150	2.650	0.940	0.270	0.335	0.530	0.610	2.590	1.619	0.270	51.057
		F (km^2)				$H_{av, karst}$ (m)			m_{av}				$SQ_{st,o}$		$Q_{stat. expl}$ (m^3/s)	
SQ_{st}	a)	39.400				70				0.015				$41.37x10^6m^3$	0.206 $x10^6m^3$	0.007
																0.007
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Av. annual (m^3/s)		
$SQ_{avail (dyn)}$														1.349		
		$SQ_{pot.available (dyn + stat)}$						I_{ef}								
$SQ_{pot avail (dyn + stat GW)}$																
		1.356 (42.762(m3/s)						0.550								
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Av. annual (m^3/s)	Min annual (m^3/s)	sum
																10^6 m^3
SQ_{tapped}														0.300		
		SQ_{ann} (10^6 m^3)						Q_{av} (m^3/s)								
$Q_{active\ use}$		11.03 $x10^6m^3$						0.250						0.350		
C_{use}		11.03 / 42.8						0.250								

Total reserves:

$Q_{available}$ (m^3/s): 1.3

$Q_{potentially\ available}$ (m^3/s): 1.4 (in case of aquifer regulation and over-pumping for certain period of time throughout the year)

Where:

Q_{dyn} - Dynamic groundwater (GW) reserves average flow Q_{st} - Static (geological GW reserves) a) in the open (unconfined) structure below min GW table (F x H x μ_{av}) b) in confined part (F x H x μ_{av}) $Q_{stat.exploit.}$ - Exploitable static GW reserves F - Surface in m^2; H - av. aquifer thickness (saturated zone below discharge points) in m; μ_{av} - av. storage coefficient $Q_{avail.dyn}$ - Available dynamic reserves (dynamic reserves - total minimal discharges of all springs as a guaranteed riverflow for water dependent eco systems):	$Q_{pot\ avail}$ - potentially available in case of aquifer regulation and over-pumping for certain period of time throughout the year - Part of static groundwater reserves to be exploited throuhout 20 years up to limit of 10% of total static groundwater reserves I_{ef} - Effective infiltration of the rainfall Q_{tapped} - Total currently exploited amount of water for drinking purpose (waterworks) $Q_{active\ use}$ - Total currently exploited amount of water (water supply, industry, agriculture...) C_{use} - Coefficient of utilization of reserves ($\Sigma Q_{active\ use}$ / $\Sigma Q_{pot.\ avail}$)

10.2. Ecological flow

Albania is one of the richest countries of Europe in water resources, although its consumption is very small. The national aquatic network comprises rivers, underground waters, lakes, lagoons, and seas. The rivers of Albania are characterized by high average annual water flow, the total flow being about 1,308 m^3/s. The carrying of solid matter within the river water is extremely high, the average annual value being 1,650 kg/sec. Contamination of surface and underground waters is widespread. In a great majority of rivers there is a notable deficit of dissolved oxygen. Generally, in these cases high values of chemical oxygen demand (COD) and of biological oxygen demand (BOD) are also observed. Concerning the safe quality of water, there is a monitoring network managed by the Ministry of Health (the Institute of Public Health and the Directorates for Primary Health Service in districts). They monitor about 15 indicators and the data show that underground water used for drinking has good microbiological and chemical characteristics. The pesticides are not monitored systematically, while the hydrocarbons are not subject to monitoring. During 1997 and 1998, respectively 3,340 and 12,450 tons of liquid wastes were discharged into rivers, water reservoirs, and lakes. The greatest part of these wastes result from industry: cement, leather, ceramics, mechanical, textile, wood processing etc. The oil and gas processing industry accounts for about 22% of the overall liquid waste. A considerable amount of solid and liquid waste is discharged by ore dressing factories into the rivers Great Fan, Little Fan, Mat etc.

10.3. Groundwater reserves and availability

From hydrogeological point of view, Albania territory is divided in these great hydrogeological regions:

- Alps of Albania
- Korabi – Mirdita
- Krasta – Cukali
- Adriatic Depression - Tirana Basin
- Grabens of Korça, Pogradeci, Librazhdi, Burreli, Tropoja, etc.

From lithological point of view and waterbearing potential Groundwater (GW) is localised in these formations:

- Aluvial Deposits
- Conglomerates
- Carbonate rocks (limestone, dolomitic limestone)
- Magmatic rocks (effusive and intrusive)

Groundwater Alluvial deposits

These deposits are characterized from important resources of Groundwater GW. Waterbearing horizons have high values of dynamic parameters.

Conglomerates

They are laid in west part of the country mainly. They are of artesian water type. Waterbearing horizons are localized in sandstones and conglomerate with good hydraulic parameters. So discharge of wells arrived in 10 l/s and water is of good quality from chemical point of view.

Carbonate rocks

Their distribution surface is of 6300 km². These rocks hold important resources of GW. From these rocks flow out many karstic springs such as "Syri i Kalter" in Saranda (18 m3 /sec), spring of Tushemishti in Pogradec (1000 l/s), "Syri i Sheganit" in Bajze of Koplik, spring "Vrella e Shoshanit" in Bajram Curri and many others springs with discharge more great than100 l/s. Acknowledgement scale of their characteristics is very low.

Magmatic rocks

Their distribution surface is of 4200 km². Circulation of GW is realized through faults and tectonics fissures. Springs that are related with these rocks are with low discharge.

Distribution of hydrogeological resources exploitation

Total surface of main waterbearing basins of alluvial deposits in Albania is about 2040 km². From Hydrogeological studies realized till to now, there are distinguished these basins which are reflected at Hydrogeological Map of Albania 1: 200.000, from north to south:

- Waterbearing basin of Drini River: Shkoder- Lezhe
- Waterbearing basin of Mat and Ishmi Rivers: Tirane - Lezhe
- Waterbearing basin of Erzeni River: Shijak - Durres
- Waterbearing basin of Shkumbini River: Elbasan - Lushnje
- Waterbearing basin of Devolli River (together with Osumi and Semani Rivers) included Kuçove, Berati and Semani basin.
- Waterbearing basin of Vjosa River: Permet- Gjirokaster- Çerven-Novosele
- Waterbearing basin of Bistrica, Kalasa Pavllo Rivers and Saranda basin

Malsi e Madhe-Shkoder

This zone is supplied with water from three aquifers: Quaternary alluvial aquifer of Shkodra and Nenshkodra, as well as carbonatic karstic aquifer of west Alps.

a) More important waterbearing aquifer of Shkodra water supply is quaternary alluvial aquifer of Shtoj-Dobraç zone which is represented from gravely deposits of Kiri and Vraka Rivers. Thickness of gravels arrived from 20-100 m in Dobraç. The aquifer is characterized by good hydraulic parameters such as infiltration coefficient which varies 89.9-285.5 m/day and transmessivity varies from 2000-7000 m2/day. So there are taken 100 l/s with one well. Also aquifer is exploited from water Utility of Shkodra city in Dobraci well for the filed part of city. Water quality is very good. So, Total Dissolved Solid TDS varies from 200-400 mg/l, Total hardness varies from 7-150 German degree, water type is bicarbonate-calcium.

Carbonatic aquifer of West Alps

b) It is localized in north and northeast part of Shkodra. The aquifer is used for water supplying of Malesi e Madhe through Rriolli Spring. The water is with good quality.

No	Parameters	Value in (l/s)
1	**Karstic aquifer 1**	
2	Groundwater reserves maximum	H 25000
3	Groundwater reserves minimum	H 4900
4	Actual quantity of GW exploitation by Water Utility of Shkoder village and Communes	H300 150 150
5	Water quantity unused, only visible springs	H4600
6	Exploitation coefficient of GW	K=0.06
Recommendation: It is possible to use all visible water resources of the massif.		

Table17. Evaluation of water resources of carbonatic aquifer of West Alps massif

Tropoje

Population of this zone is supplied with water by two aquifers:

1. **Karstic carbonate aquifer of east Alps**

Another important aquifer which supply with water Bajram Curri town, Tropoje e Vjeter, Lekbibaj, Comune Margegaj etc. is karstic carbonate aquifer of eastern Alps. This massif is localized in north, northwest and northeast part of Bajram Curri town. This aquifer is used for water-service from Bajram Curri Water supplying through “Quku I Dunishes” spring and “Vrella e Shoshanit” spring with discharge 100 l/s. Water is of high quality.

No	Parameters	Value in (l/s)
1	**Karstic aquifer 2**	
2	Groundwater reserves maximum	H12000
3	Groundwater reserves minimum	H6200
4	Actual quantity of GW exploitation through Water Utility of Bajram Curri, Old Tropoja, Lekbibaj Commune.	225 200 25
5	Water quantity unused only visible springs	H 5975
6	Exploitation coefficient of groundwater	K=0.04
Recommendation: It can be exploit all springs which flow out from karstic carbonate massif		

Table18. Evaluation of water resources of Karstic Carbonate aquifer of east and central part of Alps

Waterbearing aquifer of ultrabasic massif of Tropoje is laid in the east part of Tropoja. These rocks are composed by hartzburgites, lercolites and dunites mainly and pyroxenes and serpentines which are fewer.
Distribution of springs which are encountered at this complex is not the same for all ultrabasic massifs. There are some factors that influence in waterbearing massif such as altitude of massif, density of fissures, height of snow etc. This aquifer supplies with water Commune of Paci and some villages of Tropoja. Water quality is very good. Chemical indicators are: TDS which varies from150-250 mg/l, Th which varies from 8-10 German degrees. Water type is bicarbonate magnesium HCO3-Mg, rarely bicarbonate-calcium HCO3-Ca.

No	Parameters	Value in l/s)
1	**Magmatic aquifer 2**	
2	Groundwater reserves maximum	H100

3	Groundwater reserves minimum	
4	Actual quantity of groundwater exploitation Paci commune Out juridiction	H50 25 25
5	Water quantity unused only visible springs	H50
6	Exploitation coefficient of groundwater	K=0.7
Recommendation: It can be exploit all springs which flow out from this massif		

Table 19. Evaluation of water resources of ultrabasic aquifer of Tropoja massif

CHAPTER 11 Aquifer vulnerability and protection

11.1. Aquifer vulnerability

Groundwater, that represents a major source of water for domestic, industrial and agricultural uses in Albania, is recently suffering a deterioration of its quality especially in the regions with extensive demographic and industrial development. Groundwater quality has been recently deteriorating particularly in the most populated zone which represents the most contaminated areas because of the intensive urbanization and industrialization. Groundwater vulnerability assessment was done by using a DRASTIC model (Aller et al., 1987) combined with a Geographic Information System (Arc Gis 9.2 INFO) only for Tirana area and not for any other zone in Albania. It is important the say that does not exist any full study or map for the aquifer vulnerability in Albania.

This model has been widely used in many countries because the inputs required for its application are generally available or easy to obtain. The aim of this study is to assessthe vulnerability of groundwater to contamination for the basin of Tirana - Fushe Kuqe basin which represents the most important alluvial aquifer of Albania because of high dynamic reserves and high demographic density in this region.

In the TDA area, represented by the karstic aquifer, the risk is high because of the thin or the lack of the impermeable layers over the limestones, but from the other hand the risk is lower because not much agricultural or industrial activities are developed. The popullation was moved toward the central Albania and human activity was reduced in maximum. From the hydrochemical point of view, the groundwater mostly belongs to calcium – hydrobicarbonate type.

11.2. Groundwater protection zones

Legal framework

Albania's 1996 Law on Water Resources (No. 8093) (Water Law) is the primary legislation governing the country's inland, maritime, surface, and groundwater and is intended to ensure the protection, development, and sustainable use of the country's water and provide for its proper distribution. The Water Law addresses water rights, water use, and governance of water resources. A new law on water management has been drafted and was being circulated internally for review in 2010 (GOA Water Law 1996; GOA Draft Water Law 2010b). The 1999 Law on Irrigation and Drainage (No. 8518) established the structure for Water User Associations (WUAs), which are private groups that manage water irrigation infrastructure at and below the secondary canal level. Federations of WUAs manage the primary canal networks. The government maintains ownership of the infrastructure (Sallaku et al. 2003). The Law on Organization and Functioning of Local Government (No. 8652) (2000) transferred responsibility of water supply and management of water utilities to local government (communes and municipalities) (Rohde et al. 2004). The 2008 Law on the Regulatory Framework in the Sector of Water Supply and Waste Water Administration (No. 9915) and 2009 Ministerial Order No. 66 provide authority for the establishment of an inter-ministerial working group for the evaluation of projects and issues related to drinking water supply and sewage sector in Albania. The working group is led by the Minister of Public Works (REC 2010; World Bank 2010a).

Tenure issues

Under the 1996 Water Law, the state owns all water resources in Albania. The Water Law provides that surface water may be used freely for drinking and other domestic uses, such as livestock watering, so long as the use is limited to individual and household needs. Water use is also subject to administrative controls imposed by water authorities. Water authorities may restrict free use of water during periods of water shortages or in the event of contamination. The draft Law of Water Management circulating in 2010 retains these provisions (GOA Water Law 1996; GOA Draft Water Law 2010b). Under the 1996 Water Law, non-domestic water users, and users of groundwater for domestic purposes must obtain permission, authorization, a concession, or a license from the appropriate water authority, subject the following conditions:

1. Permission. Water authorities may grant administrative permission for the use of underground water for any purpose, water supplied by permanent installations, and water used for irrigation, livestock, aquaculture, and industry. Permission is also required for planting of trees and crops on river beds and the removal of solid material from river banks. Permissions are granted to WUAs for 10-year periods and 5 years for all other users.
2. Authorization. Authorizations for water use necessary for research, exploration, and study of surface and groundwater are available for periods up to 2 years.
3. Concession. Water authorities may grant concessions for the use of surface and groundwater for public purposes, including hydropower stations, supply of potable water, and irrigation by agricultural enterprises. Concessions are available for initial terms of 30 years with a potential 10-year extension.
4. License. Commercial well drillers must obtain a license and separate permission for every well drilled. (GOA Water Law 1996). 14 ALBANIA— PROPERTY RIGHTS AND RESOURCE GOVERNANCE PROFILE

The draft Water Management Law circulating in 2010 maintains the system of water rights set forth in the 1996 Water Law. In addition, the draft law adopts a national water strategy and establishes river basin districts and a river basin-level management structure (GOA Draft Water Law 2010b)

GOVERNMENT ADMINISTRATION AND INSTITUTIONS

The National Water Council, which is under Albania's Council of Ministers, is the primary authority responsible for water resources management. The National Water Council has responsibility for: proposing legislation; managing the drainage basin plan; approving any water management plans relating to agricultural, urban planning, industrial development or other projects; establishing necessary agencies and organizational units; and approving water concessions. The Technical Secretariat is the executive agency of the National Water Council and has responsibility for: implementing national water policy and the legal framework; creating aninventory of water resources; issuing permissions and authorizations for water use; and promoting research and development. The General Directorate of Water Supply and Wastewater (GDWW) is a public institution established by the Council of Ministers specializing in water infrastructure. The GDWW is responsible for providing technical support to the water and wastewater policies and creating the strategic framework of the water and wastewater sector (GOA Water Law 1996; REC 2010). Responsibility for municipal water utilities was devolved to Albania's local governments (municipalities and communes) under the Law on Organization and Functioning of Local Government (2000). Local governments have four areas of authority: administrative, investment, maintenance, and regulatory. Tariffs are based on the principle of cost recovery under the discretion of local government and within general national policies. Actual transfer of responsibility for water resource governance to local governments was a slow process that took place over several years. Most local governments were ill-prepared to take on responsibility for water distribution; they did not have sufficient human and financial capacity to create and rehabilitate infrastructure or manage the utilities effectively. Water utilities tend to have high losses, low revenues and low collection rates. Illegal connections, especially by poor households, are common (World Bank 2006a; World Bank 2003b; Beddies et al. 2004; World Bank 2010a). Water User Associations (WUAs) can be established at local levels to manage water resources. WUAs are designed to be financially independent entities that create water schedules and distribution plans, maintain water distribution infrastructure, set and collect fees, and resolve conflicts. As of 2007, 489 WUAs had been established (covering 280,000 hectares), of which 316 (about 65%) were fully functional. A national union ofWUAs has been established to represent the interests of WUAs at various institutional levels. Some observers have attributed improved irrigation system management, reductions in farmer disputes and increases in farm production in some areas to the work of WUAs. However, despite some positive outcomes, overall, WUAs have suffered from low membership numbers, poor collection rates and low cost recovery. In many areas WUAs have been unable to maintain infrastructure for the distribution of water or to manage conflicts between different water users effectively (Sallaku et al. 2003; World Bank 2007a).

11.3. Impact of climate changes on groundwater resources

Annual rainfall averages 1485 mm but it is unevenly distributed over time and space: the country's hills receive an average of 800 mm of precipitation annually while its coastal plains and mountain regions regularly receive 2,000 mm per year. Eighty percent of rain falls in the winter months, flooding cropland, while summer and perennial crops are dependent on irrigation. As much as 2/3 of the country's water resources is lost during transportation and distribution because infrastructure is outdated and in disrepair. Efforts to rehabilitate and rebuild the irrigation systems have been ongoing since the 1990s. In 2007, about 340,000 hectares had irrigation infrastructure; roughly two-thirds was functioning (World Bank 2003a; World Bank 2007a; Sallaku et al. 2003; Beddies et al. 2004; World Bank 2010a). An estimated 78% of households countrywide have some access to piped drinking water but service is intermittent and water quality low. The average urban household has water only 6 to 13 hours a day. In rural areas, access is less reliable and many households dig their own wells. In the early 2000s, 73% of such wells were contaminated by bacteria. Gastrointestinal illnesses caused by contaminated water are verycommon (World Bank 2003a; World Bank 2010a). Albania has over 600 reservoir dams for irrigation and power generation. Ninety percent of the country's energy is supplied by hydropower, and demand has outstripped supply since 1998. The country has numerous of aquifers but many are vulnerable to the intrusion of saline water or pollution. Albania has very limited wastewater treatment facilities and both ground and surface water is often contaminated by human and industrial and agricultural waste (Sallaku et al. 2003; World Bank 2006a; Zdruli and Lushaj 2001; World Bank 2010a).

The patterns of change are broadly similar to the change in annual precipitation: increases in high latitudes but decreases in mid-latitudes. But the general increase in evaporation means that a reduction in runoff is probable. The precipitation regime over the Drini River watershed is characterized by snow during winter in the eastern and northern part and rain in the western part of it. For the catchments of most branches (Valbona, Shala, etc.) a major proportion of annual streamflow is formed by snow melting in spring. A rise in temperature would mean that more precipitation falls as rain and therefore winter runoff increases and spring snowmelt decreases. Increased temperatures also increase evapotraspiration and reduce the quantity of water stored in reservoirs during winter.The likely impacts of climate change in the water sector are:

- Increase in long term mean annual and seasonal air temperature and decrease in mean annual and seasonal precipitation (combined with higher evaporative demand) will reduce long term mean annual and seasonal runoff for the Drini water basin.

- There are no significant changes for the winter for all time horizons, up to a maximum of 7% by 2100. The floods will still occurred during this season and the flood of spring time, will shift toward the winter.
- Higher temperatures will shift the snowline upwards; the seasonal patterns of snowfall are likely to change with the snow season beginning later and ending earlier. So, the spring runoff is expected to reduce noticeably. The maximum reduction accounts for 30% and 66% respectively by 2050 and 2100. It must be taken into consideration by the Hydropower industry. Riverine flood risk will generally increase, the time of greatest risk would move from spring to winter. Effects on groundwater recharge (a major resource of this catchment) could increase by climate change.
- Sea-level rise can cause several direct impacts, including inundation and displacement of wetlands and lowlands, coastal erosion, increased storm flooding and damage, increased salinity in estuaries and coastal aquifers, and rising coastal water tables.
- The ground water supply will be affected by decreased percolation of water due to decrease in the amount of precipitation and stream flow, and loss of soil moisture due to increased evapotranspiration.

Reduction of ground water supply in combination with increased salinity of the ground water supply can cause shortage of drinking water of adequate quality.

CHAPTER 12 Transboundary aquifers

12.1. Identification and status

Albania is a water-abundant country, with 362 kilometers of coastline and coastal wetlands, 247 lakes and hundreds of lagoons. Albania shares four natural lakes with Greece, Macedonia, and Montenegro, including Lake Skadar, which is the largest lake in the Balkan Peninsula, and Lake Ohrid, which is the deepest. The country has 721 kilometers of rivers, the most significant of which are the Drin in the north and the Shkumbin and Seman in the south (World Bank 2003b; Beddies et al. 2004; NACFP 2007). With 41.7 billion cubic meters of annual renewable water resources, Albania's water resources exceed its consumption needs. However, the country suffers from shortages of water for drinking and irrigation. Below are shortly descriped northern karstic aquifers of Albania shared with the MonteNegro and Kosovo.

Countries	Albania Montenegro
Type	Karst
Shared boundary length (km)	35
Area (km2)	450 200
Pressure factors	ndustry, waste disposal, Groundwater sanitation and sewer leakage abstraction
Quality problems	Local and moderate pathogens Widespread from waste disposal, and severe, sanitation and sewer leakage increased salinity
Water use	Urban, irrigation, industry

Countries	*Kosova - Albania*
Type	Karst
Shared boundary length (km)	30
Area (km2)	1170
Pressure factors	*Abstraction of Waste disposal, sanitation, groundwater sewer leakage*
Quality problems	*Nitrogen, pesticides, Local and moderate and pathogens pathogens*
Water use	Urban, irrigation, industry

12.2. Possible disputes in groundwater management

The Government of Albania has begun the preparation of a National Water Strategy (with funding by the EU) to set out polices on the efficient management and protection of water resources, and to specify an appropriate legal framework for the management of water resources. However, the lack of adequate monitoring systems, the rapid changes in economic activities, and the continuous movements in population make it difficult to assess the use of water resources. Available data suggests that irrigation and mining rely mostly on surface water, while households and industry on groundwater from aquifers. Domestic water demand is increasing not only because of population growth but also because of the increase in the level of water losses, estimated to be greater than 50 percent in all cities. While Albania has made progress in increasing the provision of safe drinking water and sanitation _ with 78.4 percent of the population having access to potable water and 76.2 percent benefiting from improved sanitation drinking water safety and supply shortages, as well as the pollution of lakes due to untreated sewage disposal, remain important concerns.

Limited resources restrict effective monitoring, and data collection on safe drinking water andsanitation remains weak in rural and suburban communities.

In TDA area the infrastructure of water utilities was creating but only for some main centers as Comunes. The drinking water supply system is based on the natural spring without any expenses during the exploitation. The pumping station for drinking water supply in some case are not preferred because the cost of energy and maintenance. So, in general, the villages are not connected with main pipeline but they work locally, in independent way from the state or the water utilities. They take the water from the local sources and use it as for the drinking as well for the industry or other activities.

The main threats are related with the water quality and their non uniform distribution on TDA area. The recharge zone is located to the top and considerable heights, in high vulnerable zones, where the animals, sewage and other technological remains by the mines can be pollute the waters. Another reason is the lack of landfills, sewage treatment and necessary infrastructure for polluted water discharge.

The using of fertilizers is un controlled and washes water are not discharge in a regular system of drainage. The fertilizers drainage just in nearest hydrographic network as Cemi and Shala Rrivers which flow to the Shkodra Lake. From the other side the polluted waters drainage in the underground karstic system.

CHAPTER 13 Towards optimization of intakes and sustainable use (incl. monitoring status)

Drinking water in rural areas is supplied by public taps for groups of houses. The network was never completed, however, and, even where it exists, it has been poorly maintained and was damaged in approximately 400 villages during the 1991-1992 civil unrest. Villagers often dig their own wells without any monitoring of the water quality or reference to rules of sanitation. In some valleys, the wells are dug on the banks of heavy polluted rivers (e.g. along the Seman and Shkumbin valleys) and fed almost directly with unfiltered water, unsuitable for human consumption. There is therefore a strong need to complete and rehabilitate the water-supply network. [20]

A basic problem for the future in Albania will probably be linked to water supply and sanitation. Good quality water must be found in sufficient quantity to satisfy the human needs, but if asource in use is affected by any pollution it remains unusable, and if the available quantity decreases (because of competing with other uses, for instance) it turns to be insufficient. The protection of the drinking water sources, in quantity and quality, will be an absolute necessity, and sometimes the search for alternative sources may also be necessary. The sustainable use of water resources, from the rivers and the aquifers, will need the limitation of the pollution risks, particularly that caused by untreated urban wastewater. This will need an adequationof the pollutant loads to the self-cleaning capacity of the receiving body and to the downstream uses.

Article 8 of the WFD requires monitoring of both groundwater chemical and quantitative status. A precautionary principle should be used for groundwater quality protection. It comprises aprohibition on direct discharges to groundwater, and a requirement to monitor changes in chemical composition, and to reverse any antropogenically induced upward pollution trend.

Annex V of the WFD indicates that monitoring information from groundwater is required for:

- Providing a reliable assessment of chemical status of all groundwater bodies or groups of bodies;
- Estimating the direction and rate of flow in transboundary groundwater bodies;
- Supplementing and validating the impact assessment procedure;
- Use in the assessment of long term trends both as a result of changes in natural conditions and through anthropogenic activity;

- Establishing the chemical status of all groundwater bodies or groups of bodies determined to be at risk.
- Establishing the presence of significant and sustained upwards trends in the concentrations of pollutants and,

Assessing the reversal of such trends in the concentration of pollutants in groundwater.

Quantity is an important issue for groundwater resources. There is only a certain amount of groundwater annual recharge, and of this recharge, some is needed to support connected ecosystems (surface water bodies, or terrestrial systems such as wetlands). Only that portion of the overall recharge not needed by the ecology can be abstracted and this amount of groundwater is called available resource, and the Directive limits abstraction to that quantity.

Good quantitative status requires that the available groundwater resource is not exceeded by the long term annual average rate of abstraction and that any alterations to groundwater levels resulting from human activities have not resulted, and will not result, in:

- a failure to achieve any of the environmental objectives for associated surface water bodies;
- any significant diminution in the status of those bodies;
- significant damage to terrestrial ecosystems directly depending on groundwater.

The general objectives of groundwater quantity monitoring will be the acquisition of information about groundwater levels (hydraulic pressures), the direction and quantity of groundwater flows, including recharge and discharge areas, and to provide information about groundwater balances.

Groundwater level reference stations should not be infl enced by pumping wells and other human activities (excavation of gravel near the wells, lowering of water tables due to construction works, etc.). On the other hand, groundwater levels also have to be measured at the impacted points of water abstraction to observe development of depression cones, particularly near the coastal zones.

Groundwater monitoring network should consist of:

- A quantitative monitoring network to assess quantitative status in all groundwater bodies, or groups of bodies. Water level measurements and pumping tests are mainly used for assessment of quantitative status;
- A surveillance monitoring network to assess groundwater chemical status and provide information for the assessment of long term trends in natural conditions and in pollutant concentrations resulting from human activity;
- An operational monitoring network to: (a) establish the status of all groundwater bodies, or groups of bodies, determined as being ‘at risk’,

and (b) establish the presence of significant and sustained upward trends in the concentration of pollutants.

The WFD also requires to monitor protected areas. In the context of groundwater these areas may include Natura 2000 sites established under the Habitats Directive (92/43/EEC) or the Birds Directive (79/409/EEC), Nitrate Vulnerable Zones established under the Nitrates Directive (91/676/EEC) and Drinking Water Protected Areas established under Article 7 of the Water Framework Directive.

13.1. Requirements of the eu water framework directive and groundwater directive for groundwater monitoring

The EU Directive 2006/118/EC on the Protection of Groundwater Against Pollution and Deterioration (further referred to as "Groundwater Directive") has been developed for establishment of specific measures to prevent and control groundwater pollution. The Directive sets out criteria for:

- assessing the chemical status of groundwater, as required by Article 17 of the Water Framework Directive;
- identifying significant and sustained upward trends in the concentration of pollutants in groundwater, and
- defining the starting points for trend reversals.

Criteria for the assessment of good chemical status of groundwater include:

- quality standards
- threshold values for those pollutants that put groundwater at risk and that take into account the natural variability of national groundwaters.

Groundwater directive lists substances for which EU-wide standards for groundwater already exist (Table 1).

Name of pollutant	Quality standard
Nitrate	50 mg/l
Active ingredients in pesticides including their relevant matabolites, degradation and reaction products	0,1 □ g/l 0,5 □ g/l (total)*

Table 1. Quality standards for selected pollutants

*'Total' means the sum of all individual pesticides detected and quantified in the monitoring procedure, including their relevant metabolites, degradation and reaction products.

For other substances that put groundwater at risk, participating countries should establish threshold values. The recommended list of pollutants is presented in Table 2 but the countries are free to select other relevant substances that have adverse effects on associated aquatic ecosystems or dependent terrestrial ecosystems.

Natural and human induced components	**Human induced pollutants**	**Pollution indicators**
Arsenic	Trichlorethylene	Specific conductivity
Cadmium	Tetrachlorethylene	
Lead		
Mercury		
Amonnium		
Chloride		
Sulphate		

Table 2. List of recommended pollutants for which the threshold values should be developed

Those threshold values shall be established at the national level, at the level of the river basin district or at the level of body or group of bodies of groundwater. Requirements of both above mentioned directive should be reflected in the proposed groundwater monitoring programme of Albania.

13.2. WFD recommendations for groundwater monitoring

Presently groundwater is monitored by the Albanian Geological Survey (AGS). Eight aquifersof Tirana, F.Kruje, F.Kuqe, Lezhe, Elbasan, Korca, Lushnje and Shkodra, intensively used for public water supply of the cities and surrounding villages, are included into the monitoring programme. AGS carries out analysis of basic chemical parameters (main cations and anions) in their own laboratory. Recently AGS laboratory has obtained atomic absorbtion equipment which allows to analyse also some metals in groundwater samples.

The frequency of sampling in aquifers depends on the available budget and is usualy performed 2 times/year during periods of low and high water levels in May-July and October-November. Of 181 presently monitored groundwater stations 142 are wells and boreholes and 39are natural springs (figure 1). Wells are used for groundwater sampling and water level measurements (hydrochemical and hydrodynamical monitoring) and springs are only sampled forquality analyses. W ter levels are not measured on a routine basis, they are occasionally measured in selected production wells.

It may be appropriate to re-distribute existing groundwater monitoring network more evenly along the aquifers. This can be done by reducing number of sampling points in densely monitored locations and moving them to the less monitored parts of aquifers (see figures 3 and 4).

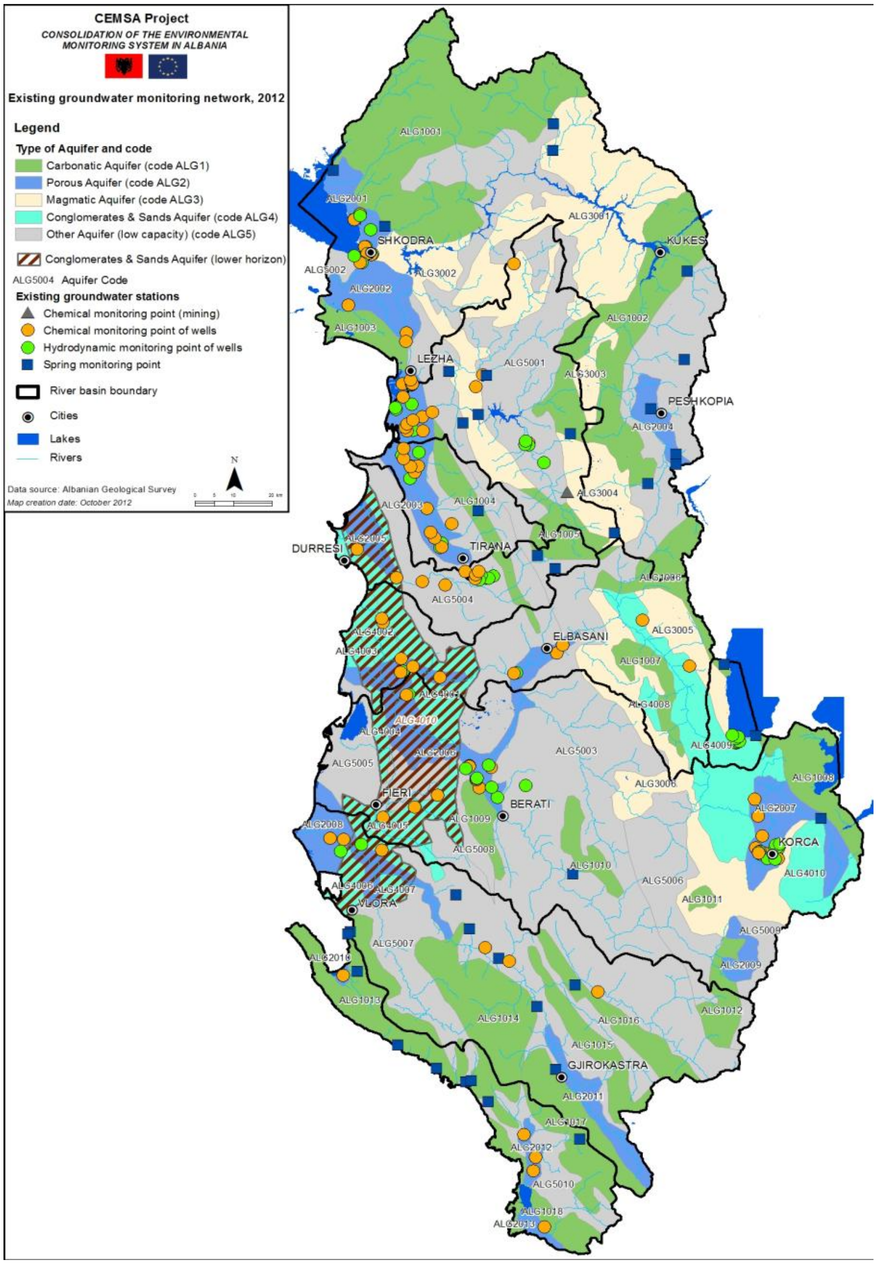


Figure 1. Existing groundwater monitoring network

AGS is reporting annually to the European Environmental Agency some parameters (nutrients) from forty monitoring stations installed into Quaternary porous aquifers. These stations are coordinated with, approved and financed by the National Environmental Agency and they are designated as priority monitoring points and shall be continuosly monitored (figure 2, table 3).

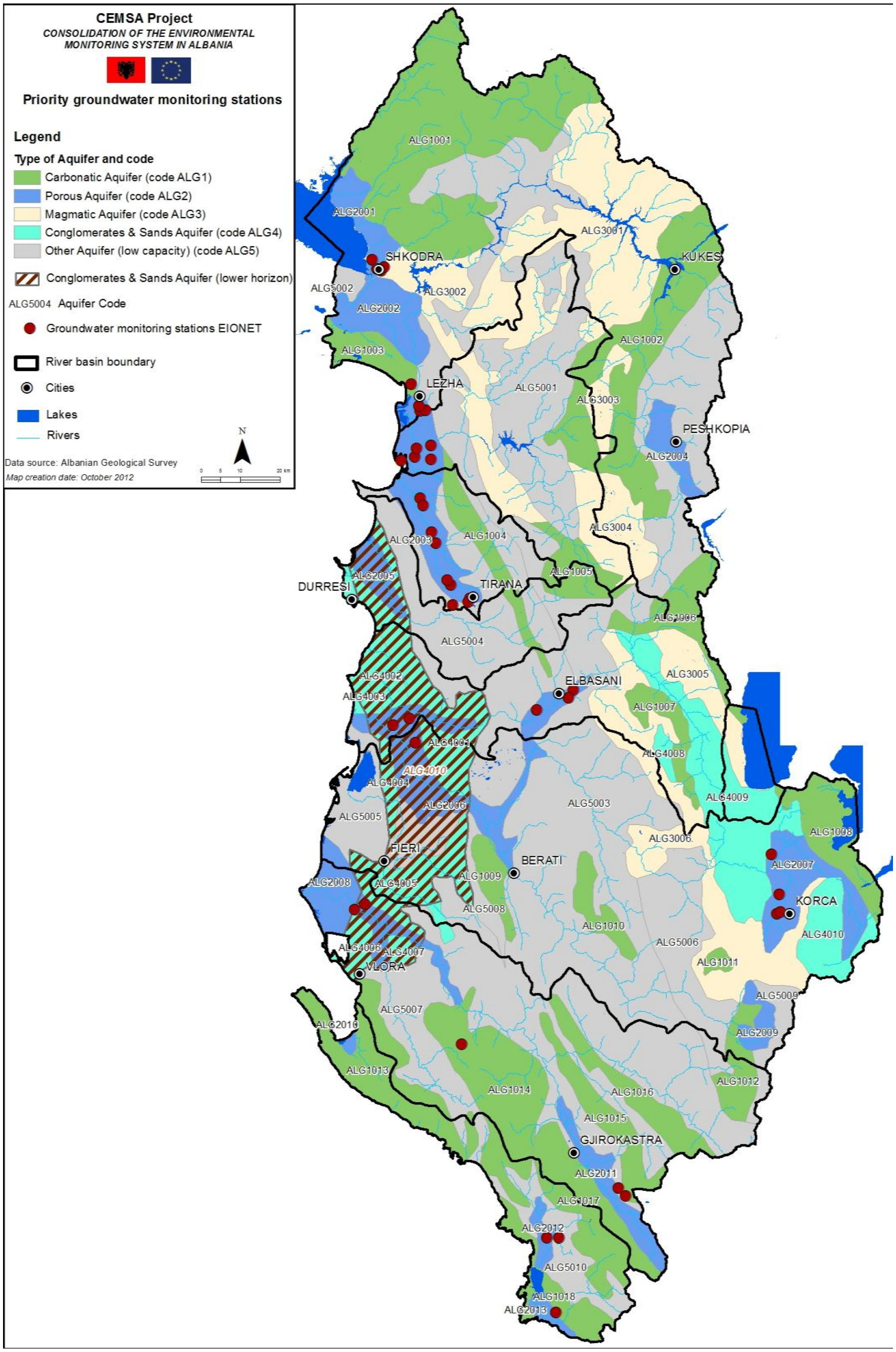


Figure 2. Groundwater monitoring stations reported to EIONET.

No	Code -EIONET	Nationalcode	StationName	Longitude	Latitude	Type of use
1	ALGW_011	GW_011	1 -Dobraç	19º29'35"	42º05'26"	DRW*
2	ALGW_012	GW_012	3 Kisha	19º31'16"	42º03'56	IND**
3	ALGW_013	GW_013	H/2 Fabrika	19º31'49"	42º04'27"	IND
4	ALGW_014	GW_014	H6 Stadiumi	19º30'32"	42º04'12"	IND
5	ALGW_021	GW_021	50 Barbullonje	19º38'54"	41º44'59"	DRW
6	ALGW_022	GW_022	26 Fushe Kuqe	19º37'59"	41º38'42"	DRW
7	ALGW_023	GW_023	46 Hoteli I Gjuetise-Lezhe	19º39'52"	41º45'04"	DRW
8	ALGW_024	GW_024	29 Ishull-Lezhe	19º38'39"	41º45'39"	Irrigation
9	ALGW_025	GW_025	Rrile	19º37'11"	41º48'36"	DRW
10	ALGW_026	GW_026	176 Milot	19º40'58"	41º40'18"	DRW
11	ALGW_027	GW_027	197 Gurrez	19º38'19"	41º39'52"	DRW
12	ALGW_028	GW_028	177 Patok	19º35'30"	41º38'10"	Irrigation
13	ALGW_029	GW_029	509 Lac	19º41'00"	41º38'27"	DRW
14	ALGW_031	GW_031	(5) Kraste -Elbasan	20º07'26"	41º07'18"	DRW
15	ALGW_032	GW_032	(286) Çerme -Lushnje	19º37'49"	41º03'08"	DRW
16	ALGW_033	GW_033	3 Kraste e Vogel	20º06'36"	41º06'13"	DRW
17	ALGW_034	GW_034	17 A Vidhas	20º00'53"	41º04'35"	IND
18	ALGW_035	GW_035	1D Çerme	19º34'51"	41º02'14"	DRW
19	ALGW_036	GW_036	3 Konjat	19º38'55"	40º59'53"	DRW
20	ALGW_041	GW_041	327 Fushe Kruje	19º41'16"	41º28'31"	DRW
21	ALGW_042	GW_042	6 Laknas	19º44'59"	41º21'22"	DRW
22	ALGW_043	GW_043	333 Thumane	19º39'08"	41º33'07"	DRW
23	ALGW_044	GW_044	1 N Gramez	19º39'39"	41º32'09"	DRW
24	ALGW_045	GW_045	2/97 Rinas	19º42'05"	41º27'02"	DRW
25	ALGW_046	GW_046	47 Berculle	19º44'16"	41º22'01"	DRW
26	ALGW_047	GW_047	16/97 Rruga e kavajes	19º48'31"	41º19'39"	DRW
27	ALGW_048	GW_048	1 P Selit	19º48'08"	41º19'07"	DRW
28	ALGW_049	GW_049	24 (5) Kombinat	19º45'20"	41º18'38"	DRW
29	ALGW_051	GW_051	3 Turane	20º44'35"	40º37'04"	DRW
30	ALGW_052	GW_052	108 Bulgarec	20º43'31"	40º45'10"	DRW
31	ALGW_053	GW_053	1 V Irakli terova	20º45'13"	40º37'17"	Irrigation
32	ALGW_054	GW_054	173 Sheqeras	20º44'55"	40º39'41"	DRW
33	ALGW_061	GW_061	Kafaraj	19º30'14"	40º37'48"	DRW
34	ALGW_062	GW_062	Buduk	20º16'23"	39º59'40"	DRW
35	ALGW_063	GW_063	Novosele	19º28'29"	40º37'05"	DRW
36	ALGW_064	GW_064	Valare	20º17'38"	39º58'39"	DRW
37	ALGW_Orikum	GW_065	Orikum	19º48'05"	40º18'58"	DRW
38	ALGW_Karahaxh	GW_066	Cuke - Karahaxh	20º05'48	39º52'50"	DRW
39	ALGW_Vrion	GW_067	Vrion	20º03'42"	39º52'49"	DRW
40	ALGW_Mursi	GW_068	Xare-Mursi	20º05'26	39º42'42"	DRW

Table 3. Priority groundwater monitoring stations

Note: *DRW- drinking water; **IND - industry

Proposed groundwater monitoring network

Before designing groundwater monitoring programmes a conceptual understanding of groundwater systems in the relevant area is needed. Such knowledge will help to find what, where, when and how often to monitor.
Future groundwater monitoring programme shall be organised in a way that it is instrumental for characterisation of main aquifers (groundwater bodies), observation of impact of implemented measures, identifying significant upward trend of pollutants or salt water intrusion and defining the starting point for trend reversals. River basin approach has to be used when designing groundwater monitoring programmes and this in principle is already done by the AGS.
Observations of surface and groundwater interaction is an important task of groundwater monitoring systems. Monitoring data shall allow to observe if abstractions and other anthropogenic alterations are not adversely affecting associated surface water bodies and terrestrial ecosystems that depend directly on the groundwater.
Both groundwater quantitative and chemical status needs to be monitored. Groundwater level reference stations should not be influenced by pumping wells and other human activities (excavation of gravel near the wells, lowering of water tables due to construction works, etc.). On the other hand, groundwater levels also have to be measured at the impacted points of water abstraction to observe development of depression cones, particularly near the coastal zones. Automatic water level meters shall be used for water level monitoring. Recommended measurements for the purposes of quantitative assessment of groundwater include:

- groundwater levels in boreholes or wells;
- spring flows;
- flow characteristics and/or levels of surface water courses during drought periods;
- water levels in significant groundwater dependent wetlands and lakes.

Groundwater monitoring systems shall be developed keeping in mind requirements of the Water Framework and Groundwater directives. Therefore proper groundwater monitoring programme should consist of:

- quantitative monitoring;
- surveillance monitoring network to assess groundwater chemical status and provide information for the assessment of long term trends in natural conditions and in pollutant concentrations resulting from human activity and

- operational monitoring network to establish chemical status of all groundwater bodies, or groups of bodies, determined as being ‘at risk’, establish the presence of significant and sustained upward trends in the concentration of pollutants and defining the starting points for trend reversals.

The decision for reversing a trend shall be based on the environmental significance of the upward and sustained increase in pollutant concentrations. As a recommended value the starting point for trend reversal shall be at a maximum of 75% of the level of the quality standards and/or of the established threshold values.

At present there are no common references (selected pollutants and related thresholds) and no common criteria for groundwater quality. Unless otherwise decided it is proposed to use drinking water standards as a criteria for groundwater quality assessment.

Fulfillment of WFD and Groundwater directive requirements seem to be over-ambitious for Albania but these requirements should serve as guidance for development of a national groundwater monitoring system and programme for the future. Development of monitoring systems and programmes is an itterative process in many countries.

Priorities for installation of groundwater monitoring network

As mentioned before, proper groundwater monitoring stations are not existing in Albania yet. AGS is sampling public water supply wells and natural springs. Doing so AGS can not observe natural chemical and hydrodynamical (quantitative) conditions of aquifers. For apropriate groundwater monitoring it is highly recommended to install true groundwater monitoring wells and equip them with aut matic water level meters.

As a first priority 12 groundwater monitoring wells need to be installed in 4 most vulnerableand mostly used aquifers (Lezha, Lushnje, Vlora and Korca), see figures 5, 6, 7, 8 and 9). Water level fluctuations and chemical monitoring shall be organised in the installed 12 monitoring points.

Additional groundwater information could be obtained obliging water companies to perform groundwater monitoring and send data to AGS. Some changes in environmental legislation should be made in order to enforce this requirement. Water companies may use obsolete, low capacity wells for monitoring purposes. This will not be a costly exercise for the water companies but it will substantially improve information flows on groundwater quality and quantity.

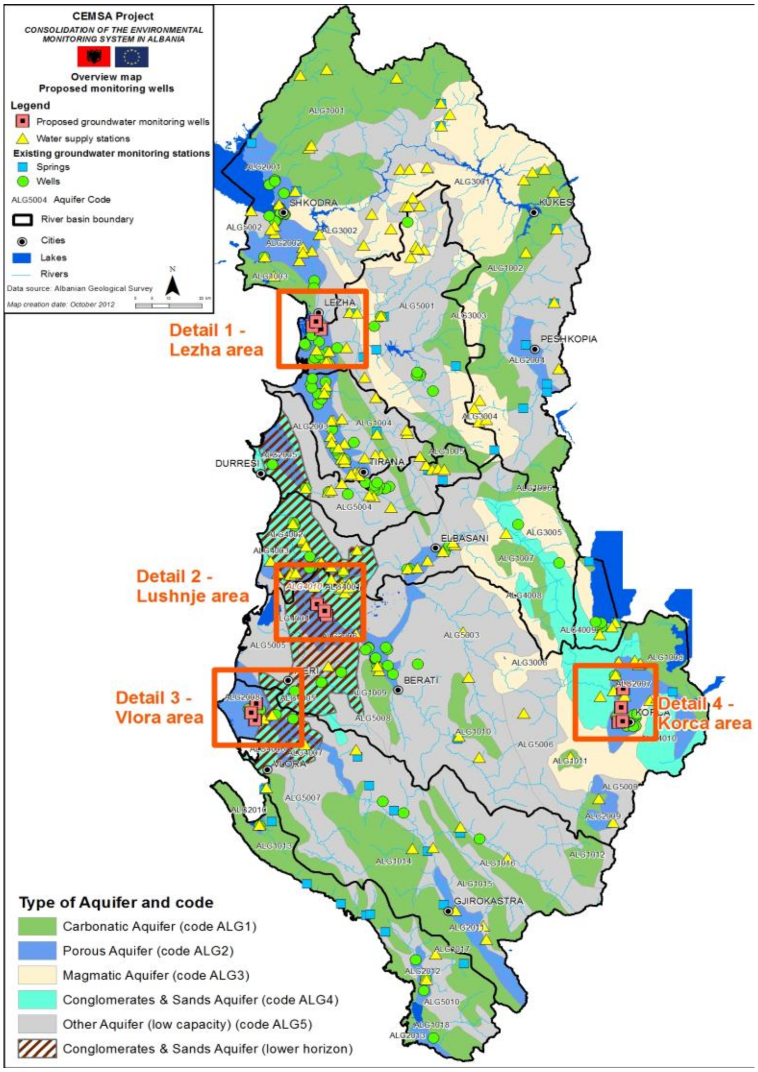


Figure 5. Location of groundwater monitoring wells, Priority No.1.

As a second priority at least 3 groundwater monitoring wells in each aquifer used for publicwater supply shall be installed: one well in groundwater recharge, one well in transition and one well in the discharge zones (totally 24 monitoring wells, table 4). These monitoring points shall also be equipped with automatic groundwater level meters.

No.	Name of the aquifer	Aquifer code on the map (see figure 1)	Number of monitoring wells
1	Shkodra	ALG2001	3
2	Fush Kruje	ALG2003	3
3	Tirana	ALG2003	3
4	Lushnje	ALG2006	3
5	Elbasan	ALG2006	3
6	Korca	ALG2007	3

7	Vlora	ALG2008	3
8	Gjirokaster	ALG2011	3
Total:			**24**

Table 4. Monitoring network, priority No. 2.

According the the WFD requirements for the asessment of groundwater quantitative and chemical status monitoring network shall be installed in each groundwater body. As the **third priority** it is therefore proposed to drill monitoring wells in each delineated groundwater body. At the moment there are 57 preliminary delineated groundwater bodies (GWB). Although it is expexted that the number of GWB will change with the development of river basin management plans, the principle of GWB monitoring will remain. There will be a need to install about 170 monitoring wells as a priority No. 3 (Table 5).

Natural springs can also be more widely used for monitoring purposes untill proper groundwater monitoring wells are installed. There are approximately 110 springs in Albania with an average discharge of more than 100 l/s and 17 springs where the discharge ranges from 100 to 1000 l/s (Eftimi, 2005). Springs are suitable sites for surveilance monitoring as they draw wa ter from large areas and represent large volumes of aquifer. It is therefore recommended to include natural springs into the routine surveillance groundwater quality monitoring network. More springs for the groundwater monitoring should be included in Semani and Shkumbini river basins where monitoring stations are missing at present.

No/No	**Name**	**Code** (see Fig.1)	**Number of proposed monitoring wells**
1	Carbonate Aquifer	ALG1001	3
2	Carbonate Aquifer	ALG1002	3
3	Carbonate Aquifer	ALG1003	3
4	Carbonate Aquifer	ALG1004	3
5	Carbonate Aquifer	ALG1005	3
6	Carbonate Aquifer	ALG1006	3
7	Carbonate Aquifer	ALG1007	3
8	Carbonate Aquifer	ALG1008	3
9	Carbonate Aquifer	ALG1009	3
10	Carbonate Aquifer	ALG1010	3
11	Carbonate Aquifer	ALG1011	3
12	Carbonate Aquifer	ALG1012	3
13	Carbonate Aquifer	ALG1013	3

14	Carbonate Aquifer	ALG1014	3
15	Carbonate Aquifer	ALG1015	3
16	Carbonate Aquifer	ALG1016	3
17	Carbonate Aquifer	ALG1017	3
18	Carbonate Aquifer	ALG1018	3
19	Porous Aquifer	ALG2001	3
20	Porous Aquifer	ALG2002	3
21	Porous Aquifer	ALG2003	3
22	Porous Aquifer	ALG2004	3
23	Porous Aquifer	ALG2005	3
24	Porous Aquifer	ALG2006	3
25	Porous Aquifer	ALG2007	3
26	Porous Aquifer	ALG2008	3
27	Porous Aquifer	ALG2009	3
28	Porous Aquifer	ALG2010	3
29	Porous Aquifer	ALG2011	3
30	Porous Aquifer	ALG2012	3
31	Porous Aquifer	ALG2013	3
32	Magmatic Aquifer	ALG3001	3
33	Magmatic Aquifer	ALG3002	3
34	Magmatic Aquifer	ALG3003	3
35	Magmatic Aquifer	ALG3004	3
36	Magmatic Aquifer	ALG3005	3
37	Magmatic Aquifer	ALG3006	3
38	Conglomerates & Sands Aquifer	ALG4001	3
39	Conglomerates & Sands Aquifer	ALG4002	3
40	Conglomerates & Sands Aquifer	ALG4003	3
41	Conglomerates & Sands Aquifer	ALG4004	3
42	Conglomerates & Sands Aquifer	ALG4005	3
43	Conglomerates & Sands Aquifer	ALG4006	3
44	Conglomerates & Sands Aquifer	ALG4007	3
45	Conglomerates & Sands Aquifer	ALG4008	3
46	Conglomerates & Sands Aquifer	ALG4009	3
47	Conglomerates & Sands Aquifer	ALG4010	3
48	Other Aquifer (low capacity)	ALG5001	3
49	Other Aquifer (low capacity)	ALG5002	3
50	Other Aquifer (low capacity)	ALG5003	3
51	Other Aquifer (low capacity)	ALG5004	3
52	Other Aquifer (low capacity)	ALG5005	3
53	Other Aquifer (low capacity)	ALG5006	3
54	Other Aquifer (low capacity)	ALG5007	3
55	Other Aquifer (low capacity)	ALG5008	3
56	Other Aquifer (low capacity)	ALG5009	3

57	Other Aquifer (low capacity)	ALG5010	3
Total:			**171**

Table 5. Monitoring network priority No.3.

In some aquifers (e.g. Lezha, Lushnje, Vlora, etc.) saline water intrusion is observed and operational monitoring is needed in such places. Operational monitoring has to be established to observe an upward trend of pollutants or saline water intrusion and define the starting point for trend reversal. Concentrated groundwater abstraction is responsible for the development of depression cones in the aquifers, abstraction also facilitates hydraulic connection between the aquifers and surface ecosystems as well as saline water intrusion (figure 10).

Due to abstraction groundwater flow changes direction in the aquifer. Instead of moving toward the natural discharge area, the groundwater within the influence of the pump flows toward the well from every direction. The pumping well creates an artificial discharge area by drawing down (lowering) the water table around the well.

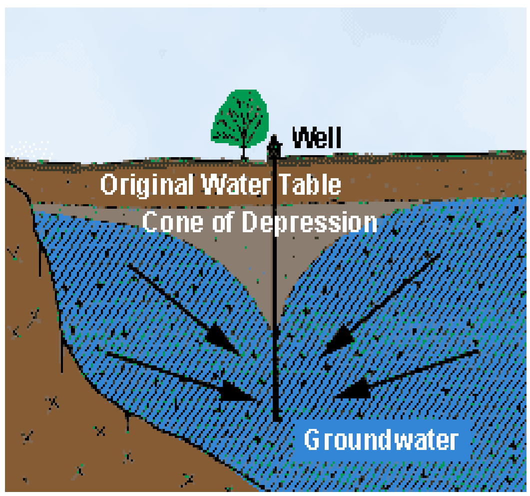


Figure 10. Development of depression cone in the abstracted aquifer

Source: www.rcrc.nm.org/glossary/gl-cone-of-depression.html

There are quite many concentrated groundwater abstraction locations in Albania mainly related to densely populated areas (figure 11). Supplementary operational groundwater monitoring is needed to observe development of water level decrease in such aquifers.

Parameters to be monitored

The following quality parameters reflecting the requirements of the WFD and Groundwater directive are proposed by the CEMSA project:

1. Descriptive parameters - temperature, pH, dissolved oxygen (DO), electrical conductivity (EC);
2. Major ions - Ca, Mg, Na, K, HCO_3, Cl, SO_4, NH_4, NO_3, NO_2;
3. TOC, ionic balance;
4. Trace elements, as required by the Groundwater directive: Arsenic, Cadmium, Lead, Mercury
5. Organic substances - aromatic hydrocarbons, halogenated hydrocarbons, phenols,Chlorophenols, Trichlorethylene, Tetrachlorethylene (GWD requirement); More preci se choice depends on local pollution sources;
6. Pesticides - choice depends in part on local usage, land-use framework and existing observed occurrences in groundwater.

Monitoring frequency

The frequency of monitoring is not specified by the WFD, but it should be adapted to the local hydr geological conditions. As a minimum surveillance monitoring should be carried out once per planning period (6 years). Operational monitoring frequency shall generally be based on the charact ristics of the aquifer and human impact.

In reference monitoring wells it is advised to collect groundwater samples and measure water levels at least 4 times a year in order to determine seasonal fluctuations of groundwater levels and chemistry. Later the sampling frequency can be reduced, but not less than 2 sa pling rounds a year should be undertaken.

The following groundwater monitoring frequency (surveillance monitoring) is proposed for Albanian groundwaters

Table 6. Groundwater monitoring parameters and schedule

Parameters and indices	**Frequency, at least**	**Responsible instit tion**
Main anions and cations (Na, K, Ca, Mg, Fe^{tot}, NH_4, HCO_3, Cl, SO_4, NO_3, NO_2)	Twice a year	AGS
Physical properties (pH, specific conductivity, permanganate i dex, or TOC)	Twice a year	AGS

Trace elements (Fe, As, Hg, Cd, Pb, Zn, Cu, Cr, etc.)	Once a year	AGS
Pesticides	Once per six years	AGS
PAH, BTEX, petroleum hydrocarbons, Phenols, Trichlorethylene, Tetrachlorethylene	Once per 2 years	AGS
Groundwater levels in mon�toring wells, boreholes and natural springs	Automatic monitoring wells – every hour, other monitoring wells&springs- during the sampling programme (2 times/year)	AGS

In the situation when funding is not sufficient monitoring of groundwater quality and of groups of the individual indicators may be conducted using the principle of rotation: water sampling is more frequent in vulnerable aquifers (unconfined, and with high human load), and less frequent – in naturally protected confined aquifers. Such specific chemical components as organic compounds, pesticides, metals with generally very low concentrations can be monitored once in 2-6 years in the wells where these components are likely to be detected.

Groundwater monitoring is performed by the Albanian Geological Survey (AGS) in main production porous aquifers. AGS carries out analysis of basic chemical parameters (main cations and anions) in their own laboratory. Monitoring network consists of 181 groundwater stations 142 of them are wells and boreholes and 39 are natural springs. Wells are used for groundwater sampling and water level measurements and springs are only sampled for quality analyses.

Concentrations of nitrogen compounds (NO_3, NO_2, NH_4) and dissolved oxygen (O_2) from forty monitoring stations installed into Quaternary porous aquifers AGS is reporting annually to the European Environmental Agency. These stations are approved and financed by the National Environmental Agency and have a status of priority groundwater monitoring points in Albania.

Groundwater monitoring programmes shall be developed keeping in mind requirements of the Water Framework and Groundwater directives. Groundwater monitoring network should consist of quantitative monitoring, surveillance monitoring network to assess groundwater chemical status and provide information for the assessment of long term trends in natural conditions and in pollutant concentrations resulting from human activity and operational monitoring network to establish the status of all groundwater bodies, or groups of bodies, determined as being ‘at risk’, establish the presence of significant and sustained upward trends in the concentration of pollutants and defining the starting points for trend reversals.

For quantitative status monitoring wells shall be installed into undisturbed areas of main production aquifers and also around the impacted by pumping areas. Automatic water level meters shall be used for water level monitoring.

Proper groundwater monitoring stations are not installed in Albania yet. AGS is sampling public water supply wells and natural springs. Such monitoring does not allow to observe natural chemical and hydrodynamical (quantitative) conditions of aquifers. For apropriate groundwater monitoring it is highly recommended to install true groundwater monitoring wells and equip them with autꞏ matic water level meters.

As a first priority 12 groundwater monitoring wells need to be installed in 4 most vulnerable and mostly used aquifers (Lezha, Lushnje, Vlora and Korca). Water level fluctuations and chemical monitoring shall be organised in the properly installed monitoring points.

Additional groundwater information could be obtained obliging water companies to perform groundwater monitoring and send data to AGS. Some changes in environmental legislation should be made in order to enforce this requirement.

As a second priority at least 3 groundwater monitoring wells in each aquifer used for public water supply shall be installed: one well in groundwater recharge, one well in transition and one well in the discharge zones (totally 24 monitoring). These monitoring points shall also be equipped with automatic groundwater level meters.

As the third priority it is proposed to drill monitoring wells in each delineated groundwater body. At the moment there are 57 preliminary delineated groundwater bodies (GWB) in Albania. Although it is expexted that the number of GWB will change with the development of river basin management plans, the principle of GWB monitoring will remain. There will be a need to install about 170 monitoring wells as a priority No. 3.

Natural springs can also be more widely used for monitoring purposes untill proper groundwater monitoring wells are installed.

In some aquifers (e.g. Lezha, Lushnje, Vlora, etc.) saline water intrusion is observed and operational monitoring is needed in such places. Operational monitoring has to be established for observation of an upward trend of pollutants or saline water intrusion and defining the starting point for trend reversal.

The following quality parameters reflecting the requirements of the WFD and Groundwater directive are proposed by the CEMSA project

- Descriptive parameters - temperature, pH, DO, EC;
- Major ions - Ca, Mg, Na, K, HCO_3, Cl, SO_4, NH_4, NO_3, NO_2;
- TOC, ionic balance;
- Trace elements, as required by the Groundwater directive: As, Cd, Pb, Hg;
- Pollution source dependent organic substances - aromatic hydrocarbons, halogenated hydrocarbons, phenols, chlorophenols, trichlorethylene, tetrachlorethylene (GWD requirement);

- Pesticides – the choice depends in part on local usage, land-use framework.

Sampling frequency varies from 2 times/year (main cations and anions, and trace elements) to one sample in 2 years (organic pollutants and pesticides). Monitoring of groundwater quality may be conducted using the principle of rotation: water sampling is more frequent in vulnerable aquifers and less frequent in naturally protected confined aquifers.

It is also recommended to introduce and follow standardized procedures for groundwater quality sampling and analyses. Until the national sampling protocols for Albania are developed and approved we recommend using sampling procedures described in the ISO 5667-11:1993 which give the principles for groundwater sampling (equipment, procedures, safety precautions, etc.). Before sampling the well must first be purged to remove the stagnant water from the well casing.

All personnel sampling groundwater is responsible for their safety by preventing exposure to chemical spills or by inhaling the fumes from any chemicals. Personnel should be also trained on the proper use of monitoring equipment.

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ANNEXES

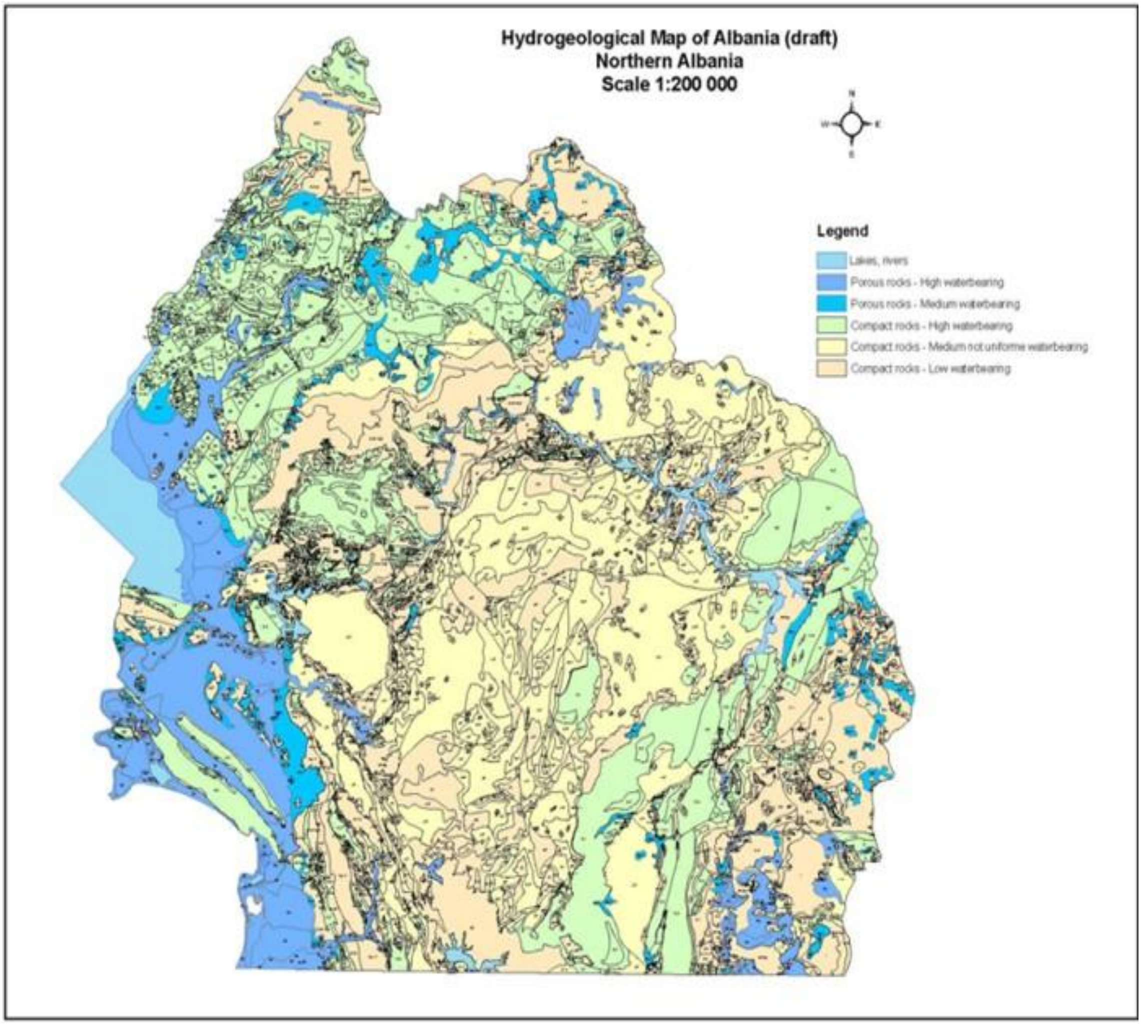


Fig. 6. Hydrogeological Map of Albania – Northern (draft), Scale 1:200000

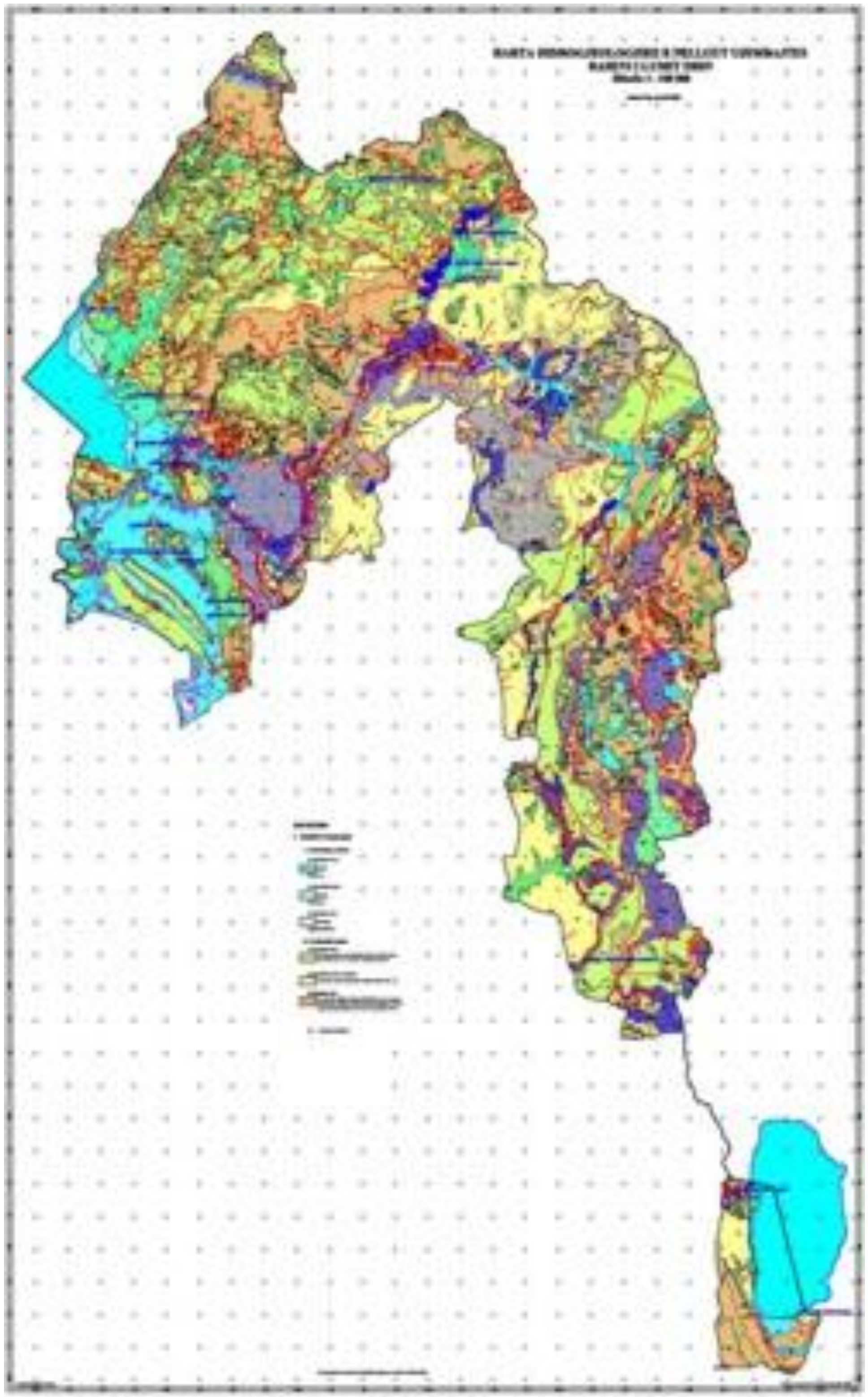


Fig. 9 Hydrogeological Map of Drini Basin, Scale 1:100000

ENVIRONMENT AND SOCIO-ECONOMIC OVERVIEW Suela

PART 1-Environment and Socio-Economic aspects at National Level

1. Socio-economics

General Information about Albania

Location: Albania is situated in the_ Southeastern part of Europe, bordering the Adriatic Sea and Ionian Sea, between Greece in the south and Montenegro and Kosovo to the north.

Coordinates of Albania : 41 00 N, 20 00 E

Area (surface) total: 28,748 sq km

land: 27,398 sq km

water: 1,350 sq km

Land boundaries: total: 717 km**, border countries:** Greece 282 km, Macedonia 151 km, Montenegro 172 km, Kosovo 112 km

Coastline: 362 km

Climate: mild temperate; cool, cloudy, wet winters; hot, clear, dry summers; interior is cooler and wetter

Population: 3,002,859 (July 2012 est.)

Net migration rate: -3.33 migrant(s)/1,000 population (2012 est.)

Urbanisation:

Urban population: 52% of total population (2010)

Rural population_: 48% of total population

GDP - composition by sector

agriculture: 20.7%
industry: 19.7%
services: 59.6% (2011 est.)

Labor force

1.053 million (2010 est.)

Labor force - by occupation

agriculture: 47.8%
industry: 23%
services: 29.2% (September 2010 est.)

Albania has coastline on the Adriatic Sea and the Ionian Sea.

Albania, a formerly closed, centrally-planned state, is making the difficult transition to a more modern open-market economy. Macroeconomic growth averaged around 6% between 2004-2008, but declined to about 3% in 2009-11. Inflation is low and stable .Remittances, a significant catalyst for economic growth declined from 12-15% of GDP before the 2008 financial crisis to 8% of GDP in 2010, mostly from Albanians residing in Greece and Italy. The agricultural sector, which accounts for almost half of employment but only about one-fifth of GDP, is limited primarily to small family operations and subsistence farming because of lack of modern equipment, unclear property rights, and the prevalence of small, inefficient plots of land.With help from EU funds, the government is taking steps to improve the poor national road and rail network, a long-standing barrier to sustained economic growth. The country will continue to face challenges from increasing public debt, approaching its statutory limit of 60% of GDP. Strong trade, remittance, and banking sector ties with Greece and Italy make Albania vulnerable to spillover effects of the global financial crisis.

1.2 - *Population numbers and trends*

Albania has 12 counties (administrative divisions have the same names as their administrative centers (exception is Dibër with its capital of Peshkopi): Berat, Dibër, Durrës, Elbasan, Fier, Gjirokastër, Korçë, Kukës, Lezhë, Shkodër, Tirana, and Vlorë. Albania is further divided in 36 districts (rrethe), the districts are (capitals in parentheses):

1.Berat (Berat), 2.Bulqizë (Bulqizë), 3.Delvinë (Delvinë), 4.Devoll (Bilisht), 5.Dibër (Peshkopi), 6.Durrës (Durrës), 7.Elbasan (Elbasan), 8.Fier (Fier), 9.Gjirokastër (Gjirokastër), 10.Gramsh (Gramsh), 11.Has (Krumë), 12.Kavajë (Kavajë), 13.Kolonjë (Ersekë), 14.Korçë (Korçë), 15.Krujë (Krujë), 16.Kuçovë (Kuçovë), 17.Kukës (Kukës), 18.Kurbin (Laç.), 19.Lezhë (Lezhë), 20.(Librazhd), 21.(Lushnjë), 22.Malësi e Madhe (Koplik), 23.Mallakastër (Ballsh), 24.Mat (Burrel), 25.Mirditë (Rrëshen), 26.Peqin (Peqin), 27.Përmet (Përmet), 28.Pogradec (Pogradec), 29.Pukë (Pukë), 30.Sarandë (Sarandë), 31.Shkodër (Shkodër), 32.Skrapar (Çorovodë), 33.Tepelenë (Tepelenë), 34.Tirana (Tirana), 35.Tropojë (Tropojë), 36.Vlorë (Vlorë). In this report the population number per municipality and per prefectures is presented for three years 2001, 2010, 2011.

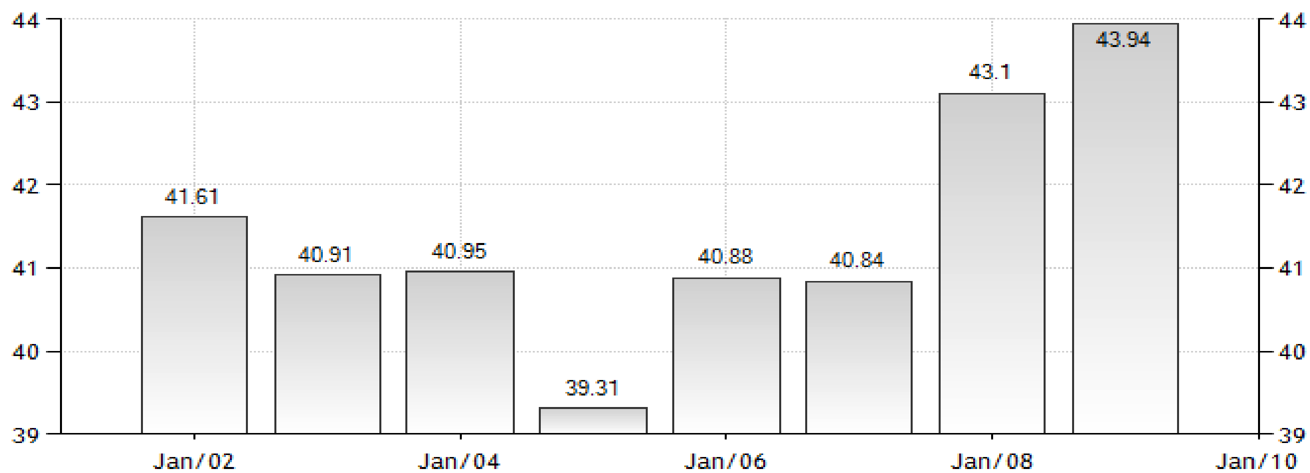
There is a constant increase of the population in rural municipality because they are most developed. The municipality of Tirana and Elbasan has the highest number of population.During the last 20 years, due to the political changes regime, it has been a high level of migration from the rural area to the urban area thus the prefecture of Tirana has the highest number of population.

1.3 Agriculture, industry, other sectors

Agriculture

The Agricultural land (% of land area) in Albania was 43.94 in 2009, (according to a World Bank report, published in 2010) . Agricultural land refers to the share of land area that is arable, under permanent crops, and under permanent pastures.

Agricultural Sector is not very developed sector in Albania during the last years. Based on the fig.3 and fig.4 Anex 1 the prefecture of Fier is the most agricultural prefecture of Albania with the biggest arable area used (105000 ha 2008 and 87000 ha 2007).



Industries and services

23% of labour forces work in industry sector and 29.2% of the labour force work in service sector.

Regarding the source of income, the main source of income in Tirana is the sector of transport, hotels and communication which presents 40%, the second sector is construction which presents 22%. According to the fig.4, in the prefecture of Diber, Shkoder Berat, Fier and Korçe, the main source of income is the sector of agriculture, hunting and fishing. Elbasan is the prefecture where the industry is the most developed sector(see fig 5 Anex 1)

Regarding the source of income, the main source of income in Tirana is the sector of transport, hotels and communication which presents 40%, the second sector is construction which presents 22%. According to the fig.5 anex 1, in the prefecture of Diber, Shkoder, Berat, Fier and Korçe, the main source of income is the sector of agriculture, hunting and fishing. Elbasan is the prefecture where the industry is the most developed sector.

1.4 - Tourism (hot spots, trends, importance as source of income)

Tourism in Albania is characterized by archaeological heritage from Greek, Roman and Ottoman times, unspoiled beaches, mountainous topography, delicious traditional Albanian cuisine, Cold War era artifacts, unique traditions and hospitality, and the wild and peculiar atmosphere of the countryside. Albania's coastline extends to 362 kilometres and the country has more than 2 000 sites and items considered cultural monuments. Three of these - Butrinti, Berat and Gjirokaster - are declared World Heritage Sites and are protected by UNESCO. Albania has a favourable climate and many natural attractions capable of sustaining a diversified tourism sector. Albania was ranked fourth in MSN Travel's 2012 Hottest Destinations. However, tourism is hampered by local management issues such as poor road and public utilities infrastructure, unregulated waste disposal, illegal construction and hunting, uncertain land ownership, and an unqualified hospitality sector. Despite such setbacks most coastal, some mountainous roads and water supply and treatment facilities have been reconstructed in recent years. The private sector and foreign donors are heavily investing in accommodation and renovations at historical sites, while others are expressing interest in building tourist resorts and marinas.

The number of tourists in Albania has an increase (2001-2010) (see the figure 5 anex1). The main Hotspots are the cities: Durres, Tirana, Vlora, Kruja, Gjirokastra, Saranda, Butrinit , Korça, Shkodra,. Tropoja, Pogradec, Berat.

1.5 Roads (main and secondary roads)

Total: 18,000 km

- Paved: 12,920 km
- Unpaved: 5,080 km (2002 est.)

Transport in Albania had been rather undeveloped during the Communist period (between 1945 and 1990), after which the country has had to make significant investment into transport infrastructure.

After the fall of communism in 1991, Albania began to revamp its primitive road infrastructure. Since the 2000s, the latter has significantly improved as main roadways have been upgraded to near European standards. Major cities are linked with new single carriageways or with well maintained roads inherited from communism. Rural segments and some windy state roads continue to be in bad conditions as their reconstruction has only started in the late 2000s.

In recent years, a major road construction spree is taking place on the main state roads of Albania. As a result, extra caution and patience is required from motorists as abrupt ends to paved surfaces with little prior notice, poorly marked temporary signage, gravel surfaces, and sudden stops can be expected.

The biggest road project in the history of Albania was the construction of the Rreshen-Kalimash dual carriageway from 2007 to 2010 linking Albania with Kosovo and part of the A1 Motorway. The segment involved the carving of a mountainous terrain, and the construction of a 5.6 km long tunnel and dozens of bridges.

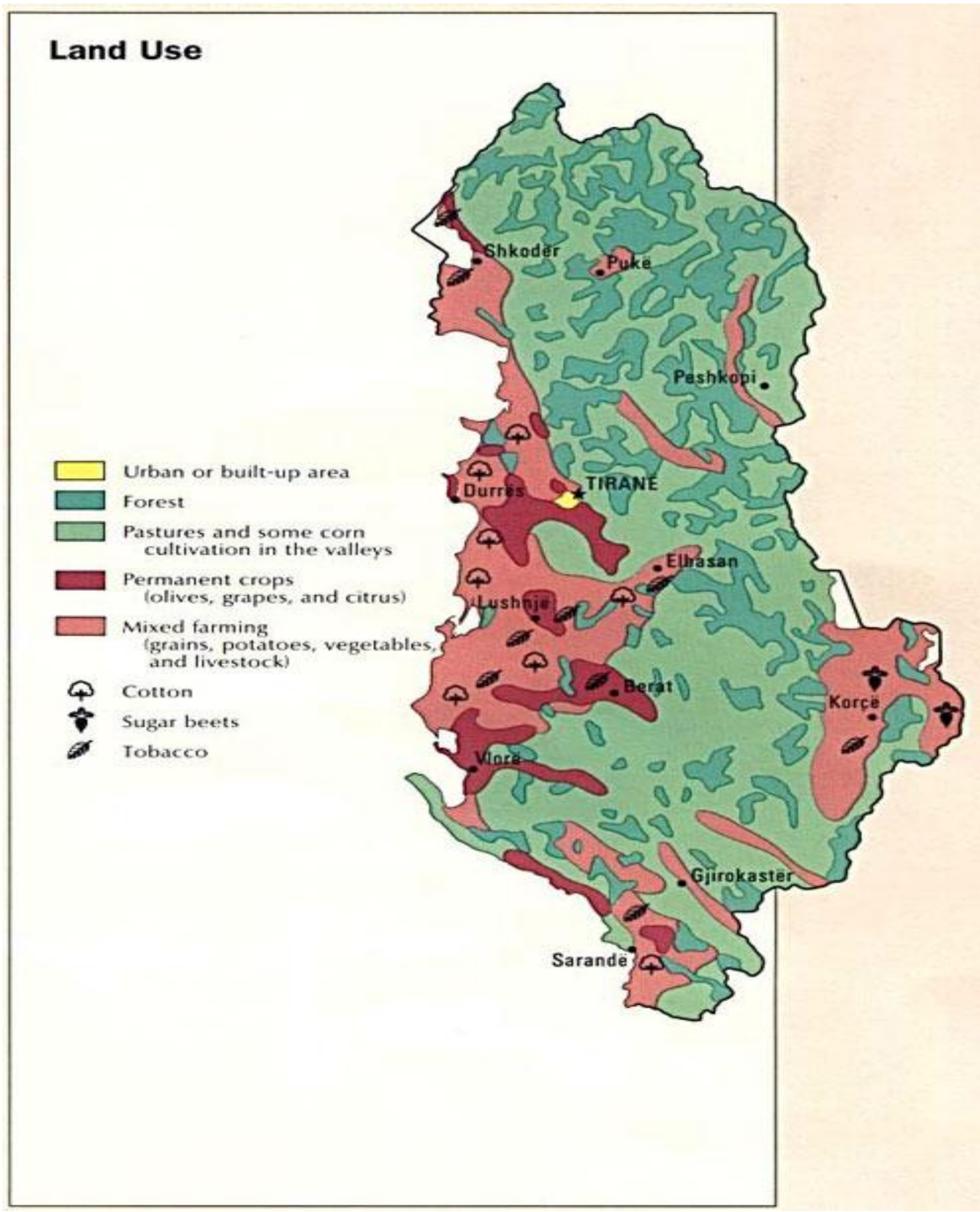
The map of main and secondary roads in Albania

2. Environment

2.1 Water use (Dams, hydroelectric power plants)

There are the 8 hydropower plants in Albania and 5 hydropower plants which operate in the project area. The hydropower plant of Fierza and Koman located in Drini river cascade have the highest level of Electricity generation (MWh), these are the main hydropower plants of Albania.

2.2 Land use Albania



Source: mappery.com/Albania-Land-Use-Map

Land use of Albania includes: Arable Land 20.1%, Permanent crops 4.21%, others 75.69 % (2005 est.) .

Regarding the shapefile of landuse in Albania, the shapefile is done (with the support of hydrogeology expert) and sent to GIS expert.

2.3 Solid waste and wastewater treatment and Waste Disposal (landfills, dumpsites)

The development of the infrastructure and construction in Albania during recent years has caused an increase in urban and construction waste. Due to this unforeseen increase in waste and its weak management, the impact on the environment and human health is considerable. Prevention and reduction of generated waste through recycling and incineration is one of the main standards of the waste management policy. Therefore, to improve waste management, Albania is compiling the National Waste Plan 2010-25. nMunicipal waste increased in 2009 compared to previous years (Figure 1). This is evidence of the increasing consumer behaviour of the population which inevitably leads to more municipal waste.

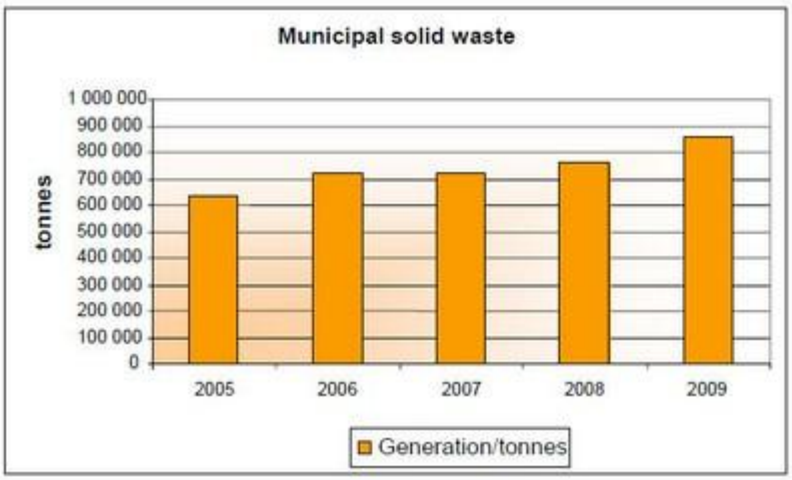


Figure 1: Municipal solid waste 2005-09

The development of the infrastructure and construction in Albania during recent years has caused an increase in urban and construction waste. Due to this unforeseen increase in waste and its weak management, the impact on the environment and human health is considerable. Prevention and reduction of generated waste through recycling and incineration is one of the main standards of the waste management policy. Therefore, to improve waste management, Albania is compiling the National Waste Plan 2010-25.

The waste management system is at a low level because of the weak collection systems in cities and almost no collection systems in rural areas. Private companies, financed by municipalities, clean the cities, and collect and transport waste to landfills. Albania has very few recycling/reusing systems for waste and few engineered landfills for the disposal of waste. The necessary stipulation for waste recycling is the separation of the waste at source; a request to organise and establish separate collection systems of waste from households has been made to local authorities (municipalities). This system will help in the separation of plastic, glass and metallic packaging, paperboard, unrefined aluminates, etc. Most of the waste in rural areas is deposited in undefined places and especially in water courses where waste is then transported to other places. There is no system for the safe management of hazardous waste (neither domestic nor commercial). The main method for waste treatment is the construction of landfills although it should be noted that these landfills are not properly constructed and, thus, cause continuing pollution of the environment. Progress towards better waste management has been made in the construction of new landfills in some regions which comply with environmental standards. Further landfills are under development

2.4 Protected Areas

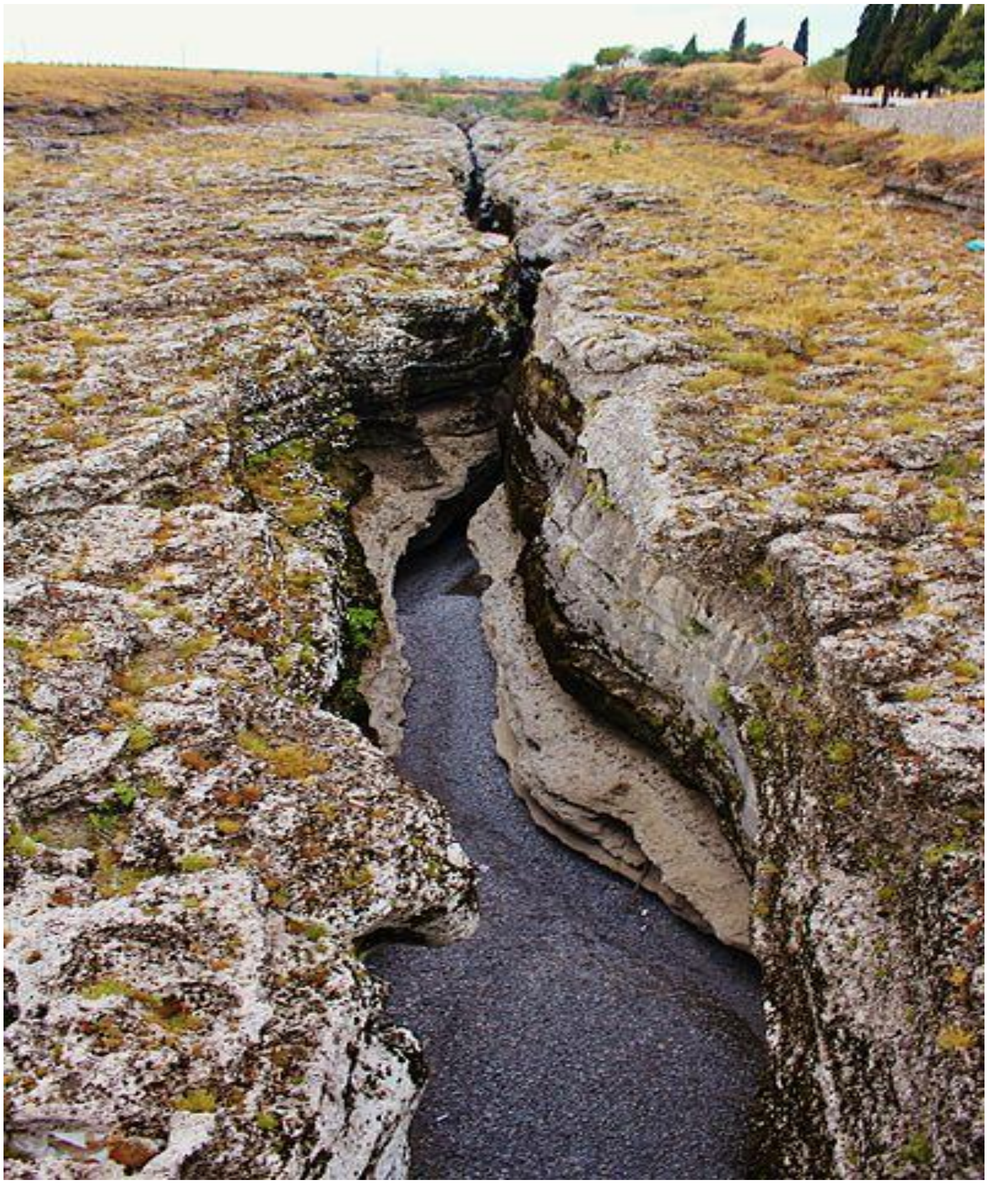
In situ nature preservation in Albania started some 50 years ago, but it was more strongly developed after 1990. There are currently about 802 protected areas, including 750 Nature Monuments, in Albania, covering around 12.57 % of the total land area of the country. The first marine protected area is to be designated shortly.
The administration and management of protected areas is based on Law No. 8906 On Protected Areas, dated 6 June 2002. The object of this law is the declaration, preservation, administration, management and use of protected areas and their natural and biological resources; and the facilitation of conditions for the development of environmental tourism, for the information and education of the general public and for direct or indirect economic profits, by the local population and the public and private sector. The protected areas of Albania include 15 national parks, 5 Protected Landscape Areas, 4 Strict Nature Reserves, 26 Managed Nature Reserves, and other protected areas.The largest national park of Albania is Llogara National Park which covers an area of 1,010 hectares.

PART 2 -Environment and Socio-Economic aspects at TBA Level Cijevna

An overview about Cijevna

The **Cem River** (Albanian: *Cem*, or in its definite form *Cemi*; Montenegrin: Cijevna, Цијевна) is a river that flows through Albania and Montenegro.

It originates in Kelmend Commune , Malësi e Madhe District, Albania. It flows generally southwest through Triesh and Gruda, for some 64.7 kilometres (40.2 mi) before merging with Morača River just south of Podgorica, in Montenegro Its length is 65 km. The coordinates are 42°21′4″N 19°12′20″E



TDA

TBA between Montenegro and Albania is **Cijevna**.

Total surface area of TBA in two countries (km^2) is 39 km^2.

Albania

Socio-economics issues of TBA.

Pressures part has three main topics:

1. DOMESTIC WATER USE: water needs and pollution potential

Thera are 8 villages (settlements of Commune of Celmend belong to TBA .

These villages are:

1) Vermosh, the coordinates : N=42 35 34.72, E = 19 41 16.09;
   Population=1300 habitants
2) Lëpushë, The coordinates: N=42 32 51.33 E=19 42 17.28 Population=750 habitants
3) Selcë, the coordinates: N=42 30 17.00, E= 19 36 16.00 Population=820 habitants
4) Tamarë, the coordinates: N=42 29 05.58, E= 19 31 49.66 Population=920 habitants
5) Brojë, the coordinates N=42 26 20.00, E= 19 33 19.00 Population=760 habitants
6) Kozhnja, the coordinates N=42 27 40.15, E= 19 36 05.84 Population=550 habitants
7) Nikç, the coordinates N=42 28 37.00, E= 19 41 16.00 Population=540 habitants
8) Vukël the coordinates N=42 31 46.88, E= 19 36 05.81 Population=704

Total population in TBA area in Albania is 6344 habitants.

There is no household connected to sewage system/wastewater treatment in TBA area of Albania.

Thus total domestic water use per day in TBA area in country 1 per person (120 l/cap/d rural areas, 160 l/ cap/d in urban areas) is 76.12 m^3/day ,calculated as following: **6344*120l/cap/d rural areas =761280 l/day or 76.12**m^3**/day**

The main pollution potential (potential pollution loads) from untreated domestic waste water are **NO2** and **NH4**, the average loads for nutrients and pathogens is 20 l/day, the total loads for nutrients and pathogens is **126880l/day or 12.6 m3/day.**

The main pollution potential NO2 and NH4 has small; negative impact on GW is registered, but is under control and monitoring.

Regarding the current status of the solid waste disposal, there is no solid waste disposal, no landfills in TBA of Albania.

There are only three cities outside TBA area which dependent on Water Resources from TBA called "Zone of Impact. These cities are Tropoja , Puke , Rreshen. There are 59000 inhabitants in the Zone of Impact who use Water Resources from TBA.

2. AGRICULTURE and ANIMAL HUSBANDRY: water needs and pollution potential

The agricultural area in TBA of Albania is divided into:

1-*Arable land* with the surface 30.5329 Km^2

2-*Permanent crops* with the surface 0.5829 Km^2

3-*Pastures* with the surface 12.1665 km^2

4-*Heterogeneous agricultural areas* with the surface 185.1123 km^2

The Total water use (actual use) for agriculture/irrigation in TBA study area of Albania is 5000 m^3/km^2 x 21.8km^2 =109000 m^3= **0.109 x $10^6 m^3$**

The water demands for agriculture in Albania is 8000 m^3/km^2, the total projected water demands for agriculture/irrigation in TBA study area is 8000 m^3/km^2 x 21.8km^2 =174400m^3= **0.174 x $10^6 m^3$**

Total number of animals (cattle, pigs, sheep/goats) is **18526**. The large numbers of animals are Sheep/goats.

Total water use for animal husbandry in TBA study area of Albania is 213.460 **l/day.** The sheeps and goats consume the largest water quantity.

Albani has an economic growth of 5% thus , the total projected water demands for animal husbandry in TBA study area of Albania is **224103.5 l /day** .The calculation was based on actual water used + 5% as projected water demand.

3.INDUSTRY: water needs and pollution potential

In TBA study area of Albania there are :

29 market units* 0.1 l/s (water use) =2.9/s

3 medical center * 0.5l/s (water use)=1.5l/s

45 tourism houses * 1 l/s (water use)=45 l/s

5 factories (minerals) 5l/s (water use)=25 l/s

7 schools *1l/s (water use)=7 l/s

The total water use for industries is calculated as follows:

Total =2.9+1.5+45+25+7=81.4 l/s

81.4l/s*0.2+81.4l/s=97.68l/s

TOTAL “PRESSURE” ON TBA in Albania

Sum of present water demands as listed above (human needs + agriculture - industries)

1. Human water demand =6344*160l/cap/day=1015040l/day=**11.75 l/s**

2. Agriculture water demand= 0.174 x $10^6 m^3$/an= 174000m3/ha/year.
174000m3/ha/year/365 days =476.7m3/ha/day

476.7m3/ha/day /864400=0.0055m3/ha/s= **5.5l/s**

3 .Industries water demand =**97.68l/s**

Total =**11.75l/s +5.5l/s +97.68l/s=114.93 l/s**

Definition on Data required (In Diktas Area)

Working Group Environment and Socio-Economical Assessment

1. Definition of data required
2. Gathering of existing data
3. Identify data gaps and how they can be filled

Definition of data required (within the boundaries of the Dinaric Karst as defined by the Hydrogeology group)

Demographic data

- Number of people per administrative unit (to the lowest level possible)
- Demographical trends
- Migration
- Number of tourists/visitors (for hot spots only)

Land Use and sources of income

- Land use (shp file)
- Sources of income per sector (agriculture, fishery, industry, tourism…)
- Agricultural data (crops being grown, fertilizers, pesticides…)

Infrastructure and potential sources of pollution

- Roads
- Wastewater treatment plants
- Sanitary landfills/dumpsites
- Industries (specify potential pollutants)
- Mining sites (specify potential pollutants)
- Military sites

Protected areas

- All types (national parks, bioshere reserves, nature parks, etc - shp file)
- List of species (including endemic species, endangered species)
- Groundwater dependant ecosystems
- Karstic caves

- References

-Annual reports and yearbooks of Institute of Statistics Albania, 2011, 2010

-Annual Report 2010 of Albanian Energy Corporation

-Annual Report of Ministry of Communication, Transport and public works

-Reports of Hydrogeology Department of Albanian Geological Survey

-Reports of Ministry of Environment and Forests

-European agency of Environment reports and website

-Reports, research papers and studies of Albanian Geological Survey

-Different websites

List of Figures

Figure .1- Population and Demography Albania (municipaties and prefectures)- Source: Census 2001,2010, 2011

Nr.	Prefecture	Census 1991	Census2001	Census2011
1	Berat		193,020	140,964
2	Diber		189,854	136,630
3	Durres		245,179	265,630
4	Elbasan		362,736	296,082
5	Fier		382,544	310,989
6	Gjirokaster		112,831	75,172
7	Korçe		265,182	220,438
8	Kukes		111,393	85,239
9	Lezhe		159,182	135,609
10	Shkoder		256,473	217,375
11	Tirane		597,899	769,634
12	Vlore		192,982	184,279
	Total		**3,069,275**	**2,838,041**

Figure 2- Population per municipality (Census 2010)

Nr.	Municipality/City	Census 2010
1	Municipality of Berat	62,850
2	Municipality of Ura Vajgurore	11,825
3	Municipality of Kucove	30,105
4	Municipality of Çorovode	6,728
5	Municipality of Poliçan	8,451
6	Municipality of Peshkopi	18,660
7	Municipality of Burrel	16,926
8	Municipality of Klosi	10,257
9	Municipality of Bulqize	12,533
10	Municipality of Durres	201,947
11	Municipality of Manez	10,906
12	Municipality of Sukth	25,344
13	Municipality of Shijak	12,930
14	Municipality of Kruje	16,149
15	Municipality of Fushe Kruje	24,566
16	Municipality of Elbasan	123,884
17	Municipality of Cerrik	14,711
18	Municipality of Belsh	13,675
19	Municipality of Gramsh	13,243
20	Municipality of Peqin	9,150
21	Municipality of Librazhd	9,760
22	Municipality of Prrenjas	8,459
23	Municipality of Fier	84,794
24	Municipality of Rosokvec	8,474
25	Municipality of Lushnje	53,403

26	Municipality of Divjake	6,083
27	Municipality of Ballsh	11,946
28	Municipality of Gjirokaster	33,975
29	Municipality of Libohove	3,439
30	Municipality of Tepelene	8,189
31	Municipality of Memaliaj	7,300
32	Municipality of Permet	10,495
33	Municipality of Kelcyre	5,107
34	Municipality of Korce	87,199
35	Municipality of Maliq	7,957
36	Municipality of Erseke	2,655
37	Municipality of Leskovik	2,655
38	Municipality of Pogradec	38,958
39	Municipality of Bilisht	9,998
40	Municipality of Kukes	22,547
41	Municipality of Krume	7,466
42	Municipality of Bajram Curr	8,188
43	Municipality of Lezhe	27,415
44	Municipality of Rreshen	14,114
45	Municipality of Rubik	7,991
46	Municipality of Lac	29,596
47	Municipality of Mamurras	22,168
48	Municipality of Shkoder	113,719
49	Municipality of vau I Dejse	12,509
50	Municipality of Puke	5,046
51	Municipality of Fushe Arrez	4,945
52	Municipality of Koplik	11,087
53	Municipality of Tirana (the capital)	**548,588**
54	Municipalityof Kamez	79,404
55	Municipality of Vore	19,393
56	Municipality of Kavaje	39,304
57	Municipality of Rrogozhine	11,580
58	Municipality of Vlore	135,278
59	Municipality of Himare	13,391
60	Municipality of Orikum	11,344
61	Municipality of Selenice	7,014
62	Municipality of Sarande	40,368
63	Municipality of Konispol	3,068
64	Municipality of Delvine	6,723

Figure 3: Agriculture data 2008

Prefectures 2008	Arable Area used (000 ha)	Planted Area (000 ha)
Albania (Total)	**578**	**386.6**
Berat	**39**	**27.2**
Diber	**34**	**21.2**
Durres	**35**	**25.3**
Elbasan	**61**	**49.2**
Fier	**105**	**88.8**
Gjirokaster	**37**	**21.3**
Korce	**81**	**44.4**
Kukes	**21**	**12.6**
Lezhe	**34**	**21**
Shkoder	**43**	**28.5**
Tirane	**45**	**32.8**
Vlore	**43**	**14.3**

Figure 4
Agriculture
data 2007

Prefectures 2007	Arable Area used (000 ha)	Planted Area (000 ha)
Albania (Total)	**578**	**400**
Berat	**39**	**30**
Diber	**34**	**22**
Durres	**35**	**26**
Elbasan	**61**	**49**
Fier	**105**	**91**
Gjirokaster	**37**	**22**
Korce	**81**	**48**
Kukes	**21**	**13**
Lezhe	**34**	**23**
Shkoder	**43**	**29**
Tirane	**45**	**33**
Vlore	**43**	**16**

Figure 5. number of tourists , 2001-2010 (in 000)

		95	96	97	1998	1999	2000	2001	2002	2003	2004	2005	2006	20007	2008	2009	2010
	Total	211	394	108	154	215	326	395	532	277	243	344	459	547	490	539	610
	Foreigners	83	144	66	73	96	98	92	143	118	90	130	136	172	170	170	185
	Albanians	123	250	42	81	119	228	303	389	159	153	214	323	375	369	369	425

Figure 6 – Source of income (by sector)

Year 2009

	Prefecture	Units	Agriculture, Fishery, forestry, hunting (%)	Industry (%)	Construction (%)	Wholesale, retail trade,household goods hotels and rest, transport and communications (%)	Financial, real-estate business activities (%)	Other service activities (%)
1	**Dibër**	*Mill Lek (local currency) (%)*	35.5	9.2	4.5	18	17.3	15.6
2	**Durrës**	*Mill Lek (local currency) (%)*	14.5	14.8	9.3	38.7	12.7	10
3	**Kukës**	*Mill Lek (local currency) (%)*	26.6	2.6	18.2	20.8	17.7	14.2
4	**Lezhë**	*Mill Lek (local currency) (%)*	24.9	5.4	13.1	25.3	18.3	12.9

5	**Shkodër**	*Mill Lek (local currency) (%)*	27.2	9	9.4	22.2	18.8	13.4
6	**Elbasan**	*Mill Lek (local currency) (%)*	23.6	17.8	7.5	27	10.9	13.3
7	**Tiranë**	*Mill Lek (local currency) (%)*	4.3	6.2	22.2	40	12.8	14.5
8	**Berat**	*Mill Lek (local currency) (%)*	32.1	9.1	11.4	25.8	10.5	11
9	**Fier**	*Mill Lek (local currency) (%)*	39.1	15.6	6.3	18.6	11.8	8.6

10	**Gjirokastër**	*Mill Lek (local currency) (%)*	29.8	5.9	6.3	17.1	30.9	10.2
11	**Korçë**	*Mill Lek (local currency) (%)*	31.6	16.8	5.8	18.2	14.6	13
12	**Vlorë**	*Mill Lek (local currency) (%)*	25.2	8.1	15.6	23.4	16.7	10.9

Figure 7
Year 2001 Source of income (by sector)

Prefecture	Units	Agriculture, Fishery, forestry, hunting (%)	Industry (%)	Construction (%)	Wholesale, retail trade,household goods hotels and rest, transport and communications (%)	Financial, real-estate business activities (%)	Other service activities (%)
Dibër	*Mill Lek (local*	45.3	4.4	2.9	18.4	6.116.5	12.5

	currency) (%)						
Durrës	***Mill Lek (local currency) (%)***	**17.8**	**10.3**	**6.1**	**49.5**	**9.9**	**6.3**
Kukës	***Mill Lek (local currency) (%)***	**31.9**	1.7	**11.1**	**26.9**	**16.2**	**12.1**
Lezhë	***Mill Lek (local currency) (%)***	**31.7**	**3**	**10.6**	**29.1**	**15.3**	**10.2**
Shkodër	***Mill Lek (local currency) (%)***	**34.5**	**6.5**	7.8	**23.9**	**16.9**	**10.5**
Elbasan	***Mill Lek (local currency) (%)***	**29.5**	**11.1**	**6.1**	**35.9**	**9**	**8.4**
Tiranë	***Mill Lek (local currency) (%)***	**5.9**	**4.8**	**17**	**49.5**	**11.3**	**11.4**
Berat							

	Mill Lek (local currency) (%)	41.1	5.4	8.2	29.6	8.1	7.7
Fier	*Mill Lek (local currency) (%)*	46.6	12.3	4.1	20.5	10.3	6.2
Gjirokastër	*Mill Lek (local currency) (%)*	33.5	5	3.9	20.4	25.8	11.5
Korçë	*Mill Lek (local currency) (%)*	37.3	12.9	4.6	22.3	13.1	9.8
Vlorë	*Mill Lek (local currency) (%)*	29.6	7.1	11.5	27.2	15.5	9.2

Figure 8 - Hydropower Plants Albania

Name of hydropower plant	Electricity generation (MWh) 2010	Electricity generation (MWh) 2009	Status of Plant
Drini river cascade	**7,022,648**	**4,681,588**	
Fierza	2,667,440	1556248	Operational
Koman	2,845,012	2040982	Operational
Vau I Dejes	1,510,196	1084358	Operational
Mati River Cascade	**281,894**	**56,476**	Operational
Ulëz	156,468	31837	Operational
Shkopet	125,426	24639	Operational
Local hydropower plant	**40,634**	**6,399**	Operational
Lanabregas	40,634	6399	Operational

Figure 9. Dams in Albania

Nr.	Name of reservoir	Village	Commune	Coordinate East	Coordinate North	Built Year
1	**2**	**3**	**4**	**5**	**6**	**7**
1.Prefecture of Berat						
1.District of Berat						
1	Belesove	Belesove	Lumas	20 02'	40 49'	1977
2	Goriçan i Ri	Gorican	Kutalli	19 48'	40 47'	1987
3	Manastir	Poshnje	Poshnje	19 48'	40 46'	1978
4	Malas-Grope	Syzes	Poshnje	19 48'	40 48'	1980
5	Sadovica	Gjoroven	Velabisht	19 55'	40 40'	1981
II. Prefecture of Diber						
1.district of Bulqizes						
1	Bllace	Bllace	Shupenz	21 23' 30"	41 34'	1974
2.district of Matit						
1	Bazi-2	Baz	Baz	19 57'	41 38'30"	1977
III. Prefecture of Durres						
1. District of Durres						
1	Rubjeke	Rubjeke	Maminas	19 35'	41 23'	1967
2	Tarin	Shkafone	Ishem	19 35'	41 29'45"	1962
3	Shkalle	Shkalle	Manze	19 34' 45"	41 25'	1971
4	Topana	Rotull	Ishem	19 33'	41 31'	1978
2. District of Kruja						
1	Verion	Veron	Hikel	19 46'	41 27'	1965
IV. Prefecture of Elbasan						
1. District of Elbasan						
1	Funari 3	Funar	Funar	20 04'	39 58'	1988
2	Shales1 (Kashta1+2)	Shales	Shales	19 58'	39 59'	1972
3	Tregan	Tregan	Shirgjan	19 57' 30"	41 02'	1983
2. District of Peqin						
1	Vashaj	Vashaj	Gjocaj	19 47'	41 01'	1985
IV.Prefecture of Fier						
1. District of Fier						
1	Zharrez	Zharez	Zhares	19 47'	40 38'	1970
2	Cerven	Cerven	Kurjan	19 44'	40 42'	1960
3	Kurjan	Kurjan	Kurjan	19 43'	40 42'	1963
2. District of Lushnje						
1	Divjak	Divjake	Divjake	19 33'	40 59'	1975
2	Kasharaj	Kasharaj	Hysgjokaj	19 44'	40 57'	1987
3	Miza	Mize	Divjake	19 33'	41 02'	1968
4	Xengu= 1	Xeng	Divjake	19 33'	40 59'	1960

	5	Xengu= 2	Xeng	Divjake	19 33'	40 58'	1960
VI. Prefecture of Gjirokaster							
1. District of Gjirokastra							
	1	Dhoksat	Dhoksat	Lunxheri	20 10'	40 07'	1988
	2	Mingul	Mingule	Lunxheri	20 09'	40 07'	1969
2. District of Permet							
	1	Kosina	Kosine	Piskove	20 17'	40 17'	1969
3. District of Rrethi Tepelena							
	1	Dukaj	Dukaj	Memaliaj	19 51'	40 18'	1970
VII. Prefecture of Korca							
1. District of Korce							
	1	Leminot	Leminot	Pirg	20 41'	40 48'	1972
	2	Petrushe	Petrushe	Vreshtas	20 41'	40 49'	1969
2. District of Devoll							
	1	Grace	Grace	Hocisht	20 55'	40 37'	1984
	2	Poloske 2	Poloske	Bilisht	20 57'	48 38'	1977
	3	Selca	Trestenik	Bilisht	21 01'	40 35'	1982
	4	Verlen	Verlen	Hocisht	20 55'	40 36'	1969
	5	Tresenik	Trestenik	Bilisht	21 01' 30"	40 35' 10"	1970
VIII. Prefecture of Kukes							
1. District of Tropoja							
	1	Kasaj	Kasaj	Tropoje	20 11'	42 26'	1983
IX. Prefecture of Lezha							
1. District of Lezha							
	1	Kallmet	kallmet	Kallmet	19 41'	41 52'	1969
	2	Fishte	Fishte	Blinishte	19 40'	41 53'	1966
2. District of Laç							
	1	Zheje	Zheje	Zheje	19 47'	41 32'	1987
3. District of Mirdite							
	1	Geziq	Geziq	Rreshen	19 56'30'	41 50' 45"	1976
X. Prefecture of Shkoder							
1. District of Shkoder							
	1	Shtoder	Myselim	Postribe	19 34'	42 05'	1967
2. District of Malesi Madhe							
	1	Grizha	Grizhe	Kopliku	19 28'	42 11'	1965
3. District of Puke							
	1	Kukaj	Kukaj	Puke	19 53'	42 02'	1984
XI. Prefecture of Tirana							
1. District of Tirana							
	1	Mustafakoç	M.Koc	Baldushk	19 49'	41 13' 30"	1973
	2	Zelaj	Zelaj	Baldushk	19 48'	40 12'	1973
2. District of Kavaja							
	1	Ceta	Cete	Helmes	19 35'	41 12'	1966
	2	Helmes Kazas	Helmes	Helmes	19 36'	41 10'30"	1967
	3	Liz 1	Nasuf	Helmes	19 37'	41 12'	1987
	4	Shardushke	Shardushke	Kryevidh	19 30'	41 07'	1987

Figure 10 . Wastewater Treatment plants Albania

Area/ Municipality
Area of Shkodra
Velipoja Beach
Shiroke and Zogaj
Lezhe
Lezhe-Shengjin (Shengjin is a beach area(
Durres
Shenavlash (village of Durres, 4 km far from Durres(
Kavaja
Kavaja
Golem Beach
Pogradec
Ohri Lake
Korçë
Korçë

Figure 11 . The network of protected areas in Albania

Table 1. The network of protected areas in Albania

VITI 2011-Dhjetor

Nr.	Category	Region	District	Name of PZ (Protected Zone)	Approved by DCM	No.ZM	Surface. Ha
1	**I**	Kukës	Tropojë	River of Gashit	DCM no.102,date 15.01.1996	1	3,000.0
2	**I**	Gjirokastër	Gjirokastër	River of Kardhiq	DCM no.102,date 15.01.1996	1	1,800.0
	Sum I	**Strict Natural Reserves/Scientific parks**				**2**	***4,800.0***
3		Shkodër	Shkoder	Thethi	DCM no. 96,date 21.11.1966	1	2,630.0
4	**II**	Dibër	Dibër	Lura	DCM no. 96,date 21.11.1966	1	1,280.0
5	**II**	Vlorë	Vlorë	Llogara	DCMno. 96,date 21.11.1966	1	1,010.0
6	**II**	Korçë	Korçë	Bredhi i Drenovës	DCM no. 96,date 21.11.1966	1	1,380.0
7	**II**	Berat	Berat	Mountain of Tomorrit	DCM no.102,date 15.01.1996	1	4,000.0
8	**II**	Kukës	Tropojë	Valley of Valbonës	DCM no.102,date 15.01.1996	1	8,000.0
9	**II**	Durrës	Kruje	Qafë Shtamë	DCM no.102,date 15.01.1996	1	2,000.0
10	**II**	Dibër	Mat	Zall Gjoçaj	DCM no.102,date 15.01.1996	1	140.0
11	**II**	Korçë	Korçë	Prespa	DCM no. 80,date 18.02.1999	1	27,750.0
12	**II**	Vlorë	Sarandë	Butrinti	DCM no. 693, date 10.11.2005	1	8,591.2
13	**II**	Tiranë,Durres		Mountain of Dajtit	DCM no.402,date 21.06.2006	1	29,216.9
		Tirane	*Tirane*				*26,772.7*
		Durres	*Kruje*				*2,444.2*
14	**II**	Fier, Tiranë		Divjakë-Karavasta	DCM no.687,date 19.10.2007	1	22,230.2
		Fier	*Lushnjë*				*19,411.1*

		Fier	*Fier*				*2,074.5*
		Tirane	*Kavaje*				*744.6*
15	**II**	Elbasan, Diber		Shebenik-Jabllanice	DCM no.640,date 21.05.2008	1	33,927.7
		Elbasan	*Librazhd*				*33,760.1*
		Diber	*Bulqize*				*167.6*
16	**II**	Gjirokastër, Korce		Forest of Hotovës-Dangelli	DCM no.1631,date 17.12.2008	1	34,361.1
		Gjirokaster	*Permet*				*33,165.3*

LEGAL AND INSTITUTIONAL FRAMEWORK AND POLICY

1. Introduction

This report summarizes legal and institutional framework and policy part of the Albanian national report. It contains the following:

1) Updated report on legal, institutional and policy framework in Albania.
2) Filled questionnaire on the current status of the implementation of EU directives into national legislation, including instruments and mechanisms for implementing measures for the protection of quantitative and qualitative status of groundwater, particularly in transboundary aquifers.
3) National SWOT analysis on management, use and protection of water, particularly groundwater.
4) Bilateral agreements and koint projects for management of TB groundwaters.

Updated report on legal and policy framework in the Republic of Albania

1. National Legal and Regulatory Setting (Water Policy, Water Law and Institutions)

1.1. Overview on institutions involved in the management of water resources

The water issues are covered by different ministries and institutions in Albania. The Ministry of Environment, Forestry and Water Administration is the responsible Ministry in charge of water administration and water quality monitoring in Albania. Within the MoEFWA the Directorate of Nature Protection Policies, Sector for Water Policy, the Directorate of Pollution Prevention Policies, and the Directorate for Environmental Impact Assessment & Permitting deal with water administration, water use, including permits and monitoring of water quality.

According to the Law on water resources (1996) the National Water Council and River Basin Councils are established. National Water Council (NWC) is the main inter-institutional body in charge of determining the water policy and for taking the major related decisions. The NWC is chaired by the Prime Minister. It includes the several stakeholder ministries: Ministry of Environment, Forests and Water Administration; Ministry of Economy, Trade and Energy; Ministry of Public Works, Transport and Telecommunications; Ministry of Agriculture, Food and Consumer Protection; Ministry of Health; Ministry of Interior; and six prefects of the Regions , who are the heads of 6 river Basin Councils. The NWC represent a high level forum within which water resources management issues can be discussed, and decision can be taken.

The National Water Council can propose draft laws and by-laws on any kind of activity in the field of water reserves. It can establish the legal, technical and regulatory framework for application of the framework legislation, as well as it can issue guidelines and undertake other actions necessary for implementation of the water reserves national plan. The NWC is responsible for supervising and reviewing the river basin management plans. It is responsible for reviewing and approval of inter-regional and national plans and projects in the field of agriculture, urban issues, industrial and territorial development, to the extent that these plans and projects are related to planning, management and preservation of water reserves.

The NWC is responsible for approval of concessions on water reserves when these reserves are of a national importance.

The Technical Secretariat (TS) of the NWC is as the “executive agency” of the NWC. Technical Secretariat is functioning and is responsible among the others for implementing the national policy on water reserves approved by the NCW; compiling the central inventory (of quantity or quality) of water reserves according to the rules decided by the NCW; issuing permits and authorizations for the use of water and for discharges when the activity is performed outside the border of a single basin; promoting participation of water users in the management of water reserves.

The Technical Secretariat is responsible for collecting information from different line ministries and institutions relating to water state assessing it and publishing reports.

This technical secretariat is a special unit in the Ministry of Environment, Forestry and Water Administration under the Directorate of Nature Protection Policies as the Water

Policy Sector. This Sector is composed of three employees, chief of water sector and two specialists.
River Basin Councils: For water management purposes, the NWC has established 6 River Basin Councils (RBCs) as the “local authorities responsible for managing water resources in the relevant basins”. As regard their activities RBCs issue water permits to use specified quantities for a specific purpose for a specific time, and concessions for water use, for gravel extraction.
According to the above mentioned law, there are six watershed councils that are responsible for the implementation of the law and the duties charged by the NCW
For administration reasons since 1998 Albania is divided in 6 river basins:

- Drini-Buna basin, with a total surface of 19,582 km2, having a minimal annual flow of 680m3/sec (of which 360 from Drini and 320 from Buna). The annual volume of discharges is 11,100 million m3. The main reservoir is Fierza with a volume of 2,700 million m3.
- Mati basin has a surface of 2.441 km2 with a minimal annual flow of 103 m3/sec. The annual volume of discharges is 3,250 million m3. The main reservoir is Uleza with a volume of 240 million m3.
- Ishem-Erzeni basin has a total surface of 1,439 km2 and annual volume of discharges of 660 million m3.
  -Shkumbini basin, has a total surface of 2,445 km2 and annual volume of discharges of 1.900 million m3.
  -Semani basin with its tributaries Devolli and Osumi, has a total surface of 5,649 km2 and annual volume of discharges of 2,700 million m3.
  -Vjose basin that includes also Palasa, Bistrica and Pavlla, as well as the south coastal area has a surface of 8.100 km2 and annual volume of discharges 5,550 million m3.

The other Ministries and institutions responsible for water management are as following:
Ministry of Agriculture, Food and Consumer Protection (MAFCP) is responsible over water utilization for irrigation purposes and for drainage issues. In regional level the level, MAFCP cover this duty through its regional directorate of Agriculture and through drainage boards.
Ministry of Public Works, Transport and Telecommunication is in charge of elaboration of the policy on water-supply and sewerage systems. These services are now being transferred to the local authority in the framework of decentralization reform.
Ministry of Health is responsible for setting drinking water standards and monitoring the quality of drinking water and bathing water quality. Through its Institute for Public Health it is responsible for water chemical and biological monitoring
Local Authorities have the responsibility for the management of water supply and waste water collection, drainage and flood protection.
For each River basin Council there is a River Basin Agency. These agencies are executive units and are part of the MoEFWA structure. They are legal and technical bodies of the River Basin Councils. They are responsible for preparing the water resources plan, for drawing up the inventory of water resources, in terms of quantity and quality, They are involved in the issue of permissions, concessions and authorizations

for water use and for discharges of wastewaters to water bodies. They are responsible for the implementation of the law, and the decisions of the NWC, the preparation of the water inventories and the reports for water management as well as for the encouragement of the stakeholders to participate in the management of water resources. They are responsible also for the preparation of the meeting of Watershed councils. The Agencies are responsible for the collection of the water tariffs. They proclaim the sanitary areas around the water resources. The total number of the staff of the 6 Agencies is 18 people.

The environmental monitoring of waters has been carried out by different Scientific Institutes contracted by the MoEFWA on annual basis: Institute for Energy, Water and Environment (ex-Hydrometeorology Institute) for surface water quality and quantity, Agency of Environment and Forestry (ex-Institute of Environment) for wastewater discharges, and Institute of Public Health for water biological monitoring. The Albanian Geological Survey is the institution responsible for groundwater quality and quantity monitoring. They are operating according to the law on Geological survey of Albania. The Law on Geological survey, article 6, mentions that the geological survey of Albania is responsible inter alia for research, assessment of ground water resources, drinking, thermal and industrial waters. It is also charged with the watershed hydro geological studies and the elaboration of the measures for the protection and management of water resources.

Water Sector Regulatory Entity is a state entity which has been established in 1998 according to the law 'On the Regulatory Framework for Water Supply and Waste Water Management'. The main tasks of the entity are issuing licenses for different operators to operate in the water supply and sewage sector, establishing the water tariffs for water supply and sewage sectors.

At regional and local levels, according to the Law on the Organization and Functioning of Local Government (2000), local authorities have the responsibility for the management of water supply and waste water collection, drainage and flood protection from the beginning of 2002.

1.2. Overview on legal and regulatory frameworks for water and particularly Groundwater

The Law No. 8093 dated 21.3.1996 'On Water Resources' (as amended in 1998, 2000, 2001, and 2007 provides a comprehensive framework for water resources management in Albania. The LWR defines the legal status of water and water state, the activities and organization of water management, conditions for water use, water protection, development, sustainable use and distribution of water resources, protection from pollution and other issues relevant for water management.

Other primary legislation includes:

- Law No 8934 dated 5.9.2002 'On Environmental Protection';
- Law No. 8102 dated 28.3.1996 'On the Regulatory Framework for Water Supply and Waste Water Management';
- Law No. No. 8515 dated 30.7.1999 'On Irrigation and Drainage';

- Law No. 9115 dated 24.7.2003 'On the Environmental Treatment of Polluted Waters';
- Law No. 8905 dated 6.6.2002 'On Protection of the Marine Environment from Pollution and Damage';
- Law No. 9103 dated 10.7.2003 'On the Protection of Trans-boundary Lakes';

The Law on water resources contains provisions on the preparation of a national water strategy (NWS) and requires the preparation of national and river basin water resources plans. The goals and objectives of the national water strategy have been laid down in the law as follows:

The NWS is the definition of national objectives in the field of water resources and institutional structures for implementation of the strategy; It indicates the way how to fulfill the requirements of the different water uses; It identifies program and priority projects, while promoting water resources conservation and sustainable use of water resources.

River Basin District Management Plans: According to Law on water resources, a river basin water resources plan must be prepared for each basin. However, the procedures for drafting, reviewing and approving plans, which should have been defined through a special regulation, have not been adopted yet and no river basin water resources plans have been prepared so far.

Law on water resources set out the provisions for the control and preservation of water resources quality. However, these are only provided for the setting of standards for drinking water quality, while a regime for the regulation of sewerage works and the discharge of wastes to water on the basis of consents is included.

Law on water resources provides the designation of protected areas and the coast, andcontain provisions on the protection of banks. The issue of water quality is further addressed in Law No. 9115, dated 24.7.2003 "On the environmental treatment of polluted waters" ('the Water Pollution Law'). However, the focus is only on the discharge of pollutants to surface water bodies, and not on water quality overall.

The law on water resources states that its purpose is to protect the environment and human health from the negative impact of polluted waters by specifying binding rules for their treatment. Law on the Environmental Treatment of Polluted Waters requires the treatment of polluted industrial waters depending on the type of industry involved and outlines in general terms the process of treatment. Once they have been treated, used waters may be discharged provided they comply with purification norms and the issue of treatment must be considered from the design stage. DCM No. 177 on Permitted Rates of Discharge and Zoning Criteria of Receiving Water Environments was issued pursuant to Law on the Environmental Treatment of Polluted Waters on 31 March 2005. The second chapter of the DCM addresses the emission or discharge standards from industrial activities by reference to three attached annexes, while in one part of the law is concerned with 'permitted rates of urban discharges' and the treatment of urban waste water. The Law 'On Protection of the Marine Environment from Pollution and Damage' adopted on 6 June 2002 has the purpose to protect the marine environment from pollution and damage through the prevention of damaging human activity in the sea and coastal zone.

Water Permits: A permission to use water is required for the 8 main purposes: Use of water by means of permanent installations;

- Irrigation;
- Livestock;
- Aquaculture;
- Industrial use of water;

Use of underground water for different purposes, including the domestic use;

- Planting of trees and crops on the banks of rivers and creeks, when they hinder the natural use of water;
- Removal of solid material from banks and bed of rivers, streams and reservoirs, with or without water;

The Law provides that uses of water for public purposes, including potable water supply, hydropower generation as well as for the bottling of water are to take place on the basis of a concession issued by the NWC. Water use permits are issued by the RBCs and are issued for a period not exceeding 5 years, except for permits for water use for users in a water users association which are issued for not longer than 10 years.

Surface waters are severely affected by urban and industrial pollution. There is only one waste water treatment plant in the country, but it is not yet operational. Four others are in the final stages of construction. Pollution of bathing waters remains a serious problem in some places due to direct discharges from sewerage systems or from industry. The DCM No. 103 "On Environmental Monitoring in the Republic of Albania, 2002 establishes the legal, institutional and technical basis under which existing environmental monitoring activities are undertaken in Albania, including water monitoring. It sets out a list of 'environmental indicators of condition' and 'environmental indicators of 'environmental impact'. The Decision lists a number of indicators under both headings for inter alia surface to heavy industrial or agricultural activities.

Overall responsibility for designing the National Program of Environmental Monitoring lies with MoEFWA which is also responsible for coordinating the monitoring program. Various institutions operate the water monitoring program on the basis of contracts held with MoEFWA and the operative budget for this program is covered by the budget of the MoEWA approved in the line 604 of the budget.

Law on water resources regulates incomes in water management. It makes provisions for the payment of fees for water use, at rates to be set by the Council of Ministers. The Council of Ministers has adopted the water fees in January 2008 for all the water use purposes, for ground and surface waters. Tariffs are established also for gravel exploitations, and tariffs for administrative procedures such as for permitting and licenses. Law sets out penalties for violations of the law and subordinate legislation such as fines and other administrative penalties such as suspending and cancelling the permit for water use.

Water prices are established not only by council of Ministers but also by the Water regulatory entity. The council of ministers has established the water tariffs for the raw surface and ground waters for drinking purposes, industrial activities, thermal water, and aquaculture. For agriculture purposes the water tariff is according to the surface irrigated.

The Water regulatory Entity decides for the water tariffs for the water delivered by the water supply, and for the tariffs of wastewater removal. The tariffs of water set-up by the water regulatory entity are higher than the tariffs set up by the Council of Ministers.

Tariffs are also established for administrative procedures for licensing, concession and authorization. Those tariffs are lower than water use tariffs. The responsible authorities for the collection of the fees and tariffs are the River Basin Agencies.

Legislation regarding the urban planning is based on the law for urban planning. The physical planning is the responsibility of the local authorities, municipalities and the regional councils. In the national level the national Council for territorial adjustment is the main body headed by the Prime Minister, responsible for urban planning in national level.

Around the wells used for domestic and municipality uses, there are restricted areas which there are limitation for other activities. According the Law on water resources the Minister of Environment and the Minister Public Works have issued a guideline to the water supply enterprises and River basin Agencies for completing the procedures and designing the area for proclamation of protected areas around the wells.

Hydro energy

The total capacity installed in the rivers of Albania is around 1446 MW. 1350 MW or 93 % of the total hydro energy produced is established in Drini River, which the biggest river in Albania. For hydro energy the water tariff is zero, apart from the concessionary fee. Last two years the government has elaborated the legal and regulatory framework for increasing the energy produced by hydropower plants. In this regards around 60 small scale HPP are approved and some of them have started the construction phase. The total capacity for this small scale HPP is around 250 MW. Three medium-large scale HPP are planned to be constructed in Albania with a total capacity of 750 MW.

1.3. Known gaps in the policy and legal framework

The law on water resources, even established the structures and the regulatory framework dealing on water issues, still has not filled gaps on the coordination among the institutions especially between the central level and the local level and the problems on the water use, and the water quality monitoring.

The NWC and its structures are in charge with the management of surface, ground and coastal water resources. They draw up national and basin strategies and implement them partly through permissions for use. Still there is no any river basin management plan elaborated.

The River basin Council is composed of officials from central and local government, one third from business community representatives, each being chaired by the Prefect of the region. In other words, users are largely un-represented; while such a big number of representatives from the business community may result in there being a potential risk for conflict of interests; especially for water use permits and concessions. In addition the River Basin Agencies suffer from a lack of offices, staff and basic office equipment.

Since the main focus of the Ministry of Economy, Trade and Energy has been on the production of energy from hydropower plants, where there are many decisions taken all over the country, in the future it may create problems for other purposes of water use.

Regarding water monitoring even there is a system established all over the country still the monitoring program, doesn't cover all the river basins. The methodology, indicators and the data assessment are not at the contemporary standards. The institutes dealing with water monitoring are not accredited yet.

There are problems on law enforcement. Even there are several inspectorates which are in charge of law enforcement still there is proper coordination among them. The River basin Agencies only can evident the problem but has no power to stop the illegal activities or to collect the fines or tariffs. This power can be found in other inspectorate, which are under the other Ministries and very often it has been difficult to have them on the right place and in the right momentum.

The local authorities, which now cover the water supply and waste water treatment issues, have no enough capacity and resources to manage this duty.

1.4. State of law enforcement

The level of law enforcement has been not very sufficient. Each of the law includes administrative sanctions such as non-compliance fines, but the ratio of collection has been very law. The Ministry of Environment has drafted several legal acts, which aim at bringing the Albanian closer to the European environmental law. The enforcement of environmental legislation is the responsibility of the inspectors from the 12 Regional Environmental Agencies, 6 River Basin Agencies, and other line ministries inspectorate. For specific issues task-forces are established with the participation of other inspectorate and with the police of State. The main focus for the law enforcement are the issue of unauthorized activities, wells, gravel exploitation, tariffs collection etc. Most of penalties have been taken for the gravel extraction activities and in some cases for the water polluters and non authorized activities.

The 2002 Law on Environmental Protection states that "physical or legal persons who use produce with high pollution potential and who discharge into the air, water and soil are subject to environmental taxes". The economic instruments in force include taxes: on environmental pollution, on the extraction and use of natural resources, user charges for municipal services for water supply, sewage collection, etc. The taxes are incorporated in the Law on Taxation and are the responsibility for national and local tax collection structures. Certain violations of existing legislation are managed by administrative procedures by Environmental Inspectorate, where are imposed with fines, closure or suspensions of the activities the total amount of money is around 500,000 USD per year, but the rate of collection is very low. According to the law "On administrative contravention", when the payment of the fine is not done voluntary within the administrative deadlines, the collection of fines is charge of the local authority. In this respect, all the uncollected fines are sent for execution to the respective local authorities.

1.5. On-going and planned activities to improve/update the current legal and regulatory framework and Link to implementation of EU water framework directive

According to the National Strategy for Environment protection adopted in November 2007, the legal and regulatory framework has been foreseen to be elaborated according to the European legislation. The Government has approved the national plan for the legal approximation for each for the sectors. The WFD 2000/60 of October 2000 is the main directive foreseen to be transposed in the national legislation. Several legal acts will be elaborated in order to transpose this directive. The timetable for this process is up to 2014. The work has started with the elaboration of the plan for approximation and with the revising of the basic law on water resources.

A draft concept on elaboration of river basin management plan is elaborated and it will be adopted as a by-law by the Council of Ministers.

In this process the Ministry of Environment Forestry and Water Administration is being assisted by a project financed in the framework of IPA program of EU. The elaboration of the plan of approximation, draft concept of management plan, a pilot river basin management plan, are the main components of the project related with water legislation.

2. International Cooperation (Bilateral, Regional, International)

The Republic of Albania has adopted and ratified a number of International Environmental Agreements, especially the Convention on protection and use of Trans boundary watercourses and international lakes since in 1994. The three main international lakes on the borders of Albania (Prespa, Ohrid and Shkodra) are subject to international co-operation agreements established with FYR of Macedonia and Montenegro, and Greece. The Albanian parts of these lakes are additionally regulated by Law No 9103 dated 10.7.2003 'On the Protection of Trans-boundary Lakes'.
The issues regarding trans-boundary waters in the Republic of Albania, are dealt with by the law on water resources and the Decision of the Council of Ministers (DCM) no. 337, dated 15.07.1999, "On the establishment of the Governmental Commission on water issues with neighboring countries" last amendment 2006.
Based on this decision a governmental commission between Greece and Albanian has been established and gathered three times to discuss the issue of cooperation and specific issue related to Prespa lake and Vjosa River. An agreement between the government of the Republic of Albania and the government of the Republic of Greece for the setting-up of a permanent Albanian- Greek commission on trans-boundary fresh waters" has been signed and entered into force in 2005.
The framework document "For the approval in principle of the agreement between the government of the Republic of Albania and of the government of (neighboring country) on water issues" has been submitted to the FYR of Macedonia. The Macedonian party first has suggested for the establishment of a joint commission to and than this commission should discuss the Albanian draft-proposal and to hand it further for discussion to the respective governments. Issues to be discussed between the two parties are those related to the administration of the water reserves of Ohrid lake and of its watershed, problems of effective exploitation of waters for the production of hydro energy, problems of water use for irrigation etc. The above framework agreement has been signed between the Government of Albania and the Government of Montenegro. The water commission has been established in 2001.

2.1. Existing bilateral or regional agreements on both surface and groundwater management schemes, international (transboundary) cooperation and water-related arrangements in the region

On water and related issues, Albania has signed several MoU and agreements with neighboring countries. The first agreement was signed with Yugoslavia since 1956, which covered all the transboundary waters issues between Albanian and Yugoslavia.
Several MoU have been signed with Macedonia, Kosovo, Montenegro, for the cooperation in the field of Environment protection and sustainable development. Apart from environmental issues, specific attentions have been paid to the water issues
So Albania has signed MoU with Macedonia in 2000, with Greece 2003, with Montenegro 2003 and Kosovo 2008. Those MoU are in the ministerial level
A joint declaration has been issued by the Prime Ministers of Albania, FYR-Macedonia, and Greece in February of 2000, declaring the Prespa Lakes and their surrounding

watershed as unique ecosystem in terms of geomorphology, ecological wealth and biodiversity. They declared the Prespa Lakes and their surround watershed as the first trans-boundary protected area in South Eastern Europe.
An agreement for the Protection and Sustainable Development of Lake Ohrid and its Watershed has been signed and ratified by the parliaments of Albanian and Macedonian in June 2005. Based on this agreement a joint Secretariat and Lake Ohrid Watershed Committee is established. An agreement " for the Protection and Sustainable Development of the Lake Shkodra, has been signed between the Ministry of Tourism and Environment of Montenegro and Ministry of Environment, Forestry and Water Administration of Albania in 2008. A joint secretariat and Committee has been established between two countries. The main objectives of the above MoUs and Agreements related to water issues are to prevent, control and reduce pollution of the waters.

2.2. Perceived trans-boundary issues of concern

There are several problems in the trans-boundary waters form quantity and qualitative aspects. Water quality in Lake Shkodra of the lake is generally good but there are some localized pollution "hotspots", such as Aluminum Factory in Podgorica and wastewaters from Municipalities of Shkodra and Podgorica etc. Regarding the quantity issue in lake Shkodra, there has no big problems , but it will appear in the near future such as needs for drinking water in Montenegrin part. One potential problem from quantity aspect was the plan for construction of a Hydropower plant in Albanian side which was suspected to have consequences in the water level of the lake, but this plan was cancelled. River Drini i Bardhe coming from Kosovo in general is in good state, but there are evidence of pollution coming from waste water and solid waste. A potential issue of concern may be the use of water for Hydropower plant in the Kosovo part
Lake Ohrid issues of concern are mainly from pollution especially in Albanian site , this issue is being solved by construction the waste water treatment plant in the City of Pogradec in Albanian Site . Prespa lakes waters possess the problem of water level which has been decreased in the last years. River Vjosa coming from Greece in general is in good state with evidence of pollution from discharges and solid waste.

2.3. Completed, on-going and planned international bilateral or multilateral activities

Several projects are being implemented in Albanian related to water issues.
Projects on integrated ecosystem management are being implemented in lake Shkodra and Prespa lakes with close cooperation of neighboring countries. The project in Lake Shkodra is being financed by GEF and Albanian government with the implementing agency WB, while in Prespa the project is being financed by GEF, KfW and the respective governments with the implementing agency the UNDP.
The total funds fro lake Shkodra is 5, 30 million USD for the period 2008-2012. The main Objective of the project is to maintain and enhance the long-term value and environmental services of Lake Shkoder and its natural resources. The project will help to establish and strengthen institutional mechanisms for trans-boundary cooperation,

through joint efforts to improve sustainable management of Lake Shkoder. Water monitoring and management and reduction of the pollution, will be the topics to be covered by the project among the other environmental issues.
The project on the Integrated Ecosystem Management of the Prespa Lakes watershed has started since 2006 and it will end in 2011. The total founds is 12 million USD.
The main objective of the project is to catalyze the adoption of integrated ecosystem management in the area shared by the three countries, to conserve globally significant biodiversity, mitigate pollution of the trans-boundary lakes, and provide a sustainable basis for the watershed's further social and economic development.
Other project being implemented in Albania is in the framework of IPA program of the EU called "The implementation of the National Plan for Approximation of Environmental Legislation in Albania" the project duration is 2008-2011, with a financing of 2 million EURO. Among several components of the project two are related with water, elaboration of the national plans for approximation of the water framework directive, and nitrate directive, and the second one is related with the management plan of a certain river basin. A project financed by the Italian government in the framework of the bilateral cooperation agreement is "The Project for Monitoring of water Resources in Erzeni River Basin in Tirana". A Project financed through CARDS program has been on the environmental monitoring, where the water has been a important component of the project. Monitoring equipments and training for the monitoring institutes have been provided during the implementation of the project.
A project Improved Water Monitoring and Assessment Program in Albania his being implementing through the support of the Swedish Environmental Protection Agency. Training in monitoring and assessment of freshwater and ground water are being conducted. The Albania Government in cooperation with other donors is investing in Shkodra region for construction of the regional landfill for urban waste, and in Pogradeci town for waste water treatment plant, which will contribute in the reduction of the pollution in these lakes.

2.4. Main achievements and obstacles

The ratification by Albania of the international agreements in field of environment, participation in many international and regional activities and initiatives has influenced in the elaboration of the national policy according to their objectives and responsibility. The elaboration of strategies, legislation and establishment of the structures dealing with water and water related issues has been followed by a number of steps and measures that have assisted in better understanding of the water resources management and protection.
The establishment of the national and regional structures such as National water council and River basin water Councils are considered as major steps for the coordination of several stakeholders related with water. Establishment of the water tariffs and other economic instruments influenced that water to be assessed and considered as the other goods. Other achievement to be mentioned is the cooperation with the neighboring countries by setting up the joint commission and by implemented joint environmental projects for trans-boundary ecosystems.

The decision taken by the Government of Albania to abandon the idea of construction the hydro power plant in Bushati area which should have had impacts on lake Shkodra is another achievement on water issue in Albania.

Other measures such as the study for the assessment of the environmental state hydro geological issues and rehabilitation of the river beds, which resulted on the banning the gravel exploitation from several river beds is considered as a right measure.

Training and study tours have influenced on the strengthening of the capacities of the staff dealing with water issues in Albania.

Monitoring program for waters and ground waters implemented for almost 10 years has created the basic information on the environmental state of the waters in Albania.

Concrete investments for reducing water pollution are a major achievement which impact on transboundary lakes.

The most problematic issue is the law enforcement. Even there are legal acts with specific duties and incentives still there are problems of not collecting tariffs and fines in general.

The structures dealing with the law enforcement are neither well qualified, nor well equipped. Staff is not well trained and very often is changed.

Regarding the water use planning, there is a run for using water for hydro-energy, even there are efforts to take into consideration other purposes or environmental issue still the decision taken for using water for hydro-energy are predominant .

Actually the agreements are not so strong legal binding mainly the agreement are as MoUs and try to construct friendly relationship. The frequency of the meeting with neighboring countries is very rare.

2.5. Lesson-Learned and Recommendations

Water resources in Albania are a main supply source for many applications. It plays a major role in the national economy, in drinking purposes, in agriculture, energy, industry and other activities.

The demand for water is expected to increase creating potential problems among competing users. At the same time waters are at risk of pollution because of untreated wastewaters, industrial waste and other urban activities. These are not only affected by the activities in Albanian but also by neighboring countries, since one third of the watershed lays out side of the borders of Albania.

Shared natural ecosystems have been a good example for trans-boundary cooperation in last ten years. They have raised the performance of the areas by attracting the attention of the central governments and assuring more funds. The trans-boundary cooperation has influenced in improving the governance and promotes collaboration of different stakeholders at national and local level. Trans-boundary water ecosystems management projects such in Ohrid, Prespa, Shkodra lakes, have given a positive impact on the cooperation between countries. They have contributed in strengthening capacities for water and water related ecosystems management, establishing permanent joint management structures as a forum for reviewing, assessing of the actions taking place in both countries and predicting measures for national implementation. It has brought an increase of political willingness for future and permanent cooperation and in more intensive manner.

In order to have an efficient cooperation there is a need for harmonizing the national water policies, involving stakeholders as many as possible, and promoting communication and exchange of information between countries

The aim of water policy harmonization is to bring into line national water policies with joint cooperation goals. There is a need for a further cooperation for national water legislation, institutional frameworks in line European legislation, since that Albanian and neighboring countries aspiration is to join the EU.

Bilateral agreements and MoUs that Albanian has signed with neighboring countries have proven to be an effective platform for institutionalization of water ecosystems cooperation. They set up the platform for joint activities and measures. According to the existing experience, involving as many relevant stakeholders as possible, it may increase the acceptance of the cooperation agreements and MoUs and facilitate its subsequent implementation.

Communication and exchange of information between Albania and neighboring countries is considered to be an important element in the cooperation. Joint activities and projects can not be implemented without data and information. Frequent exchange of experience, dialogue between experts and local authority is very important and should be intensified.

At national level, in order to better manage and protect the water resources a set of priority actions should be undertaken such as:

- Approximation of the water legislation according to the principles of the Water Framework Directive.
- There is a need for a national water assessment, evaluation of water resources, demand inventory and water quality;
- Elaboration of management plans for each of river basins.
- Strengthening the institutional of the water administrative especially for enforcement and for preparation of river basin management plans.
- Cooperation framework should be well designed for institutions dealing with water issues in national and regional levels.
- A common monitoring and databases system should be in place based on the harmonized methodology for both quantity and qualitative aspects.

1. Questionnaire on GW management issues

1. Is the national strategy for water management defined? Does it include groundwater?

a. If, yes, please specify the goals and requirements regarding groundwater

The National Strategy for water management is drafted on 1997 and is approved by the National Water Council on 2004.
The goals of the strategy are as follows:

- Definition of national objectives in the field of water reserves, institutional structures for implementation of the regulatory framework including the technical and scheduling coordination mechanisms;
- Completion of water requirements, balanced and integrated with the national development;
- Identification of programs and primary projects for implementation of short-term, medium-term and long-term strategies;
- Conservation and rationalization of water use according to the environment and other natural reserves.

The Strategy deals with great caution issues such as:

- Supply drinking water for tourism development in order to increase the requirements for water quality and quantity, but also the strengthening of measures for wastewater treatmentand solid waste.
- Preservation of the quality and quantity of agricultural water
- Defining the standards of urban and industrial dirty water discharges, assurance of protective zones around them
- Protection of the riverbed through a permitting and regulatory system for the extraction of sand and gravel.

b. If yes, does it include goals for transboundary waters, particularly groundwater?

No, it does not include goals for transboundary waters, and groundwater in particular.

c. If yes, does the Water Management Strategy comply with the requirements set in EU Water Framework Directive and of the Groundwater Directive?

It does partly comply with the requirements set in the EU Water Framework directive.

d. Is it fully or partly harmonized with other sectoral related strategies (agriculture, environment, tourism …)

It lacks harmonization with other sectoral related strategies

e. If not, can you identify any long-term planning document which sets out the vision, mission, goals and tasks of state policy in water management, particularly groundwater management?

Not applicable

1. To what extent was performed transposition of European water directives, particularly the Water Framework Directive, new Groundwater Directive and Nitrate Directive into national legislation? What is the state of the implementation of these directives?

In the existing law "On Water Reserves", some of the requirements of the Water Framework Directive are not fully transposed. Comparing the existing law with this Directive, some shortcomings are noticed such as inclusion of terrestrial or coastal waters in the relevant or nearest river basin, identification and monitoring of water bodies, which are used for the extraction of potable water, control of discharges by means of the combined way and the key measures for flood risk management.
In order to overcome the above shortcomings, as well as for the purpose of achieving an integrated management of water reserves as well as the harmonization of national legislation with the relevant EU legislation, drafting of a new law on water has already been prepared, to comprise all aspects of management such as (i) use of water resources, (ii) protection and control against pollution, (iii) protection against harmful effects of water *and* (iv) management of sustainable water planning. The draft of this law is supposed to be ready by the end of 2010.
The draft-law will transpose the requests of the following EU Directives in the area of management of water resources:

- Directive of the European Council and Parliament 2000/60/EC establishing a legal framework for actions that the European Community should undertake in the field of water policy;
- Directive of the European Council and Parliament 98/83/EEC, in determining water quality for human consumption;
- Directive of the European Council and Parliament 76/160/EEC, related to quality of bath waters (bathing);
- Directive of the European Council and Parliament 1991/271/EEC, related to Environmental Treatment of Waters;
- Directive of the European Council and Parliament 86/278/EEC in protection of environment and particularly the land, when mud waste is used in agriculture;
- Directive of the European Council and Parliament 91/276/EEC regarding protection of waters against pollution caused by agricultural nitrates.

The draft law will provide the basic legal framework for the inclusion of standards, basic principles, rights, duties and powers of local government units, associations, legal entities and natural persons, in the area of water management.

The draft law is expected to regulate issues related to management of surface water and ground water, marine waters and coastal waters, units that cover water services, financial organization as well as conditions and procedures for the use of water and the discharges of water used in aquatic environments, institutional collaborations in this area.

The draft-law refers to the law provisions on environmental protection in relation to access to information, public participation, Environmental Impact Assessment of some projects, assessments of impacts of different plans and strategies, prevention and control of industrial accidents in the field of waters including pollution by hazardous substances.

The draft law "On waters" will establish the legal basis for the approval of the relevant secondary legislation, which will regulate in detail various conditions, procedures, standards and measures, or based on which the existing ones should be changed, in order to reach compatibility with the new goals, standards and measures defined in the relevant EU Directives.

To meet the obligations of Albania for the approximation with the European Legislation, it is anticipated that by 2010 a Draft Council of Ministers' Decision for river Basin Management Plans is drafted, which is expected to realize full transposition of the Water Framework Directive. Also, River Basin Management Plan will create conditions for transposing the Groundwater Directive. Part of RBMP will also be plans on the risk of floods (as provided in the **Flood Directive 2007/60/EC**).

The drafting of a draft CMD on water quality standards is also foreseen, which provides for the transposition of technical standards as set out in the Directive 2008/105/EC for the environmental standards of the water quality.

2. Can you explain how the “user/polluter pays principle” and the principle of recovery of the costs is promoted in the legislative framework of your country?

There exist partial legal determinations in Albania. Thus, article 4 of law no.8934, dated 5.9.2002, “On Environmental Protection” (Official Gazette: Year 2002, No. 60, p 1673; Date of publication: 16-10-2002) provides that one of the key principles of environmental protection is the principle “the polluter pays”.
Article 5 of law 8934/2002 provides for the key strategic elements of environmental protection:

a. prevention and reduction of water pollution, air, soil and other pollutants of any kind;
b. conservation of biological diversity according to the natural and biogeographical basis of the country;
c. rational use of mineral and natural resources and avoidance of their overexploitation;
d. ecological restoration of damaged areas contaminated by human activity and destructive natural phenomena;
e. maintenance of ecological balance and improvement of quality of life.

Law no. 8990, dated 23.01.2003 "On Environmental Impact Assessment" and the Guidelines of the Minister no.1, dated 7.1.2008 "On the required documentation for environmental permits" requires the subjects, which would like to perform a business activity requiring the use of river gravels or mining activities, to submit and respect an action plan for rehabilitation of the surfaces that they will harm. Rehabilitation plan has specified activities, timelines and costs required. The environmental inspectorate has the obligation to monitor the conditions of implementation of rehabilitation plans and the performance of such licensed activities. However, we can say that there exists an integrated and comprehensive national system for monitoring and following the implementation of these rehabilitation plans.

The Ministry in collaboration with the project “Implementation of legislation approximation plan” (project INPAEL, EuropeAid/124909/C/SER/Al) financed by the EU Delegation has prepared a new draft “On Environmental Protection”. This draft law provides in a special chapter about the environmental responsibility, its essence being the principle “the polluter pays”. The draft law says that the purpose of the liability for damage is:

- Prevention and correction of all damage caused to environment;
- Rehabilitation of environment; and
- Presentation of measures and practices for minimization of damage risk in environment.

The draft law stipulates that the responsibility for the damage in environment is determined on the basis of damage caused by performance of dangerous activities, as well as potential threats of such damage, and / or causing damage to protected species and natural habitats from any other professional activity that are not hazardous, as well as from any potential threat of such damage as a result of the performance of these activities, due to the errors or negligence of companies.

The Draft Law provides, as responsible for bearing the costs and conducting the rehabilitation of environment, the company of a hazardous activity or another activity, which may cause damage to environment. The company is responsible when no necessary preventive and corrective measures have been taken, and when it does not report for the damage caused in environment. The Albanian State has the obligation to cover the supplementary costs or/ even in the case when the company that caused the damage is not identified or the damage is caused by a source from a state. The draft law defines the REA and the Ministry of Environment as the authorities to follow the process for the supervision of damaging companies to repair the damage caused to environment. This law is expected to be approved during 2012. Finally it can be said that the Albanian Government has begun work to establish the legal basis and procedures for the implementation of accountability in environment. The Chapter for accountability in environment under the new draft law "On Environmental Protection" and be in accordance with Directive 2004/35/EC (OJ L143, 30.4.2004, p. 56-75) as amended by 2006/21/EC. "On the environment accountability, in taking measures for prevention and rehabilitation of environmental damage".

3. Can you specify any legal or policy document containing provisions on integration of environmental and resource costs into the development of pricing policies?

There is no legal or policy document that defines and prescribes the integration of environmental and resource costs into the development of pricing policies.
The new draft law "On Environmental Protection" has a modern and advanced appearance of the principles, on which environmental protection is based. In this draft law presentation of principles is given a separate chapter, in which each principle is addressed in a separate article, giving the name, content, and its main features.

4. Has your country implemented the approach for defining (qualitative and quantitative) status of groundwater bodies, according to the WFD and GWD? Does it include:

a. some specific provisions on karstic areas?
b. provisions on the methodology for defining threshold values and/or groundwater quality standards, according to the GWD?

Prevention of source pollution, control of emissions and water quality standards are important elements of the Intersectorial Strategy on Environment dated 29.11.2007.
The existing legislation comprises special principles of prevention of source pollution, control of discharges of waters and establishment of water quality standards, which are expressed in the following legal basis:
Law no.8934, dated 5.9.2002 "On Environmental Protection" provides for the prevention and reduction of water pollution as one of the key strategic elements of environmental protection.
Law no.9115, dated 24.7.2003 "**On environmental treatment of polluted waters**" intends to provide the rules of environmental treatment, as well as obligations of legal entities and natural persons, the activity of whom discharges polluted waters. The relevant reference regarding the European legislation is the directive 91/271/EEC as amended by 98/15/EC and decision 93/481/EEC, 91/676, 82/176/EEC as amended by 91/692/EEC, 84/156/EEC as amended by 91/692/EEC, 84/491/EEC as amended by 91/692/EEC, 86/280/EEC as amended by 88/347/EEC 90/415/EEC and 91/692/EEC, 76/160/EEC. The approximation scale is partial (50%).
The permissions specifying the conditions and manner of discharge of waters, as well as the measures to be undertaken for the prevention of pollution are instruments for application and prevention of source pollution and for the control of emissions.
Law No.8102, dated 28.03.1996 "On regulatory framework of the sector of water supply and sewerages" is intended to establish the regulatory framework and setting up of the independent Regulatory Entity for the elimination and treatment of sewerages.
Law No.9594, dated 27.7.2006 "On adhesion of the Republic of Albania in the international marine convention "On prevention of pollution by ships, 1973", as amended by the protocol of 1978 (MARPOL 73/78)" prohibits the discharge of hazardous substances and especially every substance controlled under this convention.

Law No.7643, dated 02.12.1992 "On public health and State Sanitary Inspectorate", defines that the State Sanitary Inspectorate controls the purity of surface waters, as well as the supply of population with hygienically clean water.
Law no. 8518, dated 30.7.1999 "On irrigation and drainage" considers infrastructure an indispensable element for the prevention and elimination of water pollution.

DECISIONS OF THE COUNCIL OF MINISTERS

The Decision of the Council of Ministers No.177 dated 31.03.2005 "On allowed norms for liquid discharges and zoning requirements of receiving water environments " is intended to prevent, reduce and avoid pollution from hazardous substances, that are discharged through sweet waters, defining the limit values of allowable elements. This CMD (Annex 16) refers to directive 91/271/EEC as amended by 98/15/EC and decision 93/481/EEC. This decision excludes the influences that cause the discharge of polluted waters in the underground waters. The approximation scale is partial (50%). The Decision provides:

- Allowed norms of hazardous substances and allowed parameters in discharged waste waters from industrial activities.
- Allowed norms for urban liquid discharges, which go through a preliminary environmental treatment through the sewerage system, divided from other liquid discharges.
- Zoning requirements for receiving water environments, grouped in sensitive and less sensitive. Also, this chapter determines the treatment according to the access load in the collector system.
- The monitoring, which is carried out in compliance with the procedures according to annex no.2 of the decision.

This CMD also stipulates an obligation for pre-treatment of industrial waste water before its discharge in the collection and treatment systems of urban waste water.

Decision of the Council of Ministers No.145 dated 26.02.1998 "On approval of the hygienic-health Regulations for the control of the quality of drinking water, projection, establishment and supervision of drinking water supply systems." stipulates the standards for drinking water. These standards have been prepared in approximation with the Council Directive 80/778/EEC of 15 July 1980 regarding the quality of consumption water for humans as well as based on the Instructions of Drinking Water Quality of WHO.
Decision of the Council of Ministers No.1189, dated 18.11.2009 "On the rules and procedures of drafting and application of the National Program on Environmental Monitoring " stipulate the necessity of monitoring from the local institutions, methodology for measuring and calculating of all environmental indicators for surface waters (rivers, lakes), for the sea and coast as well as the groundwater.

5. What is the status of development of the national river basin management plans?

According to Law on water resources, a river basin water resources plan must be prepared for each basin. However, the procedures for drafting, reviewing and approving plans, which should have been defined through a special regulation, have not been adopted yet and no river basin water resources plans have been prepared so far.

6. Is the program of measures that will be applied within the river basin management plans already defined? If not, can you identify any legal or policy document in which such program of measures exists?

According to the Law on water resources (1996) the National Water Council and River Basin Councils are established. National Water Council (NWC) is the main inter-institutional body in charge of determining the water policy and for taking the major related decisions. The NWC is chaired by the Prime Minister. It includes the several stakeholder ministries: Ministry of Environment, Forests and Water Administration; Ministry of Economy, Trade and Energy; Ministry of Public Works, Transport and Telecommunications; Ministry of Agriculture, Food and Consumer Protection; Ministry of Health; Ministry of Interior; and six prefects of the Regions , who are the heads of 6 river Basin Councils. The NWC represent a high level forum within which water resources management issues can be discussed, and decision can be taken.

The National Water Council can propose draft laws and by-laws on any kind of activity in the field of water reserves. It can establish the legal, technical and regulatory framework for application of the framework legislation, as well as it can issue guidelines and undertake other actions necessary for implementation of the water reserves national plan. The NWC is responsible for supervising and reviewing the river basin management plans. It is responsible for reviewing and approval of inter-regional and national plans and projects in the field of agriculture, urban issues, industrial and territorial development, to the extent that these plans and projects are related to planning, management and preservation of water reserves.

The NWC is responsible for approval of concessions on water reserves when these reserves are of a national importance.

The Technical Secretariat (TS) of the NWC is as the “executive agency” of the NWC. Technical Secretariat is functioning and is responsible among the others for implementing the national policy on water reserves approved by the NCW; compiling the central inventory (of quantity or quality) of water reserves according to the rules decided by the NCW; issuing permits and authorizations for the use of water and for discharges when the activity is performed outside the border of a single basin; promoting participation of water users in the management of water reserves.

The Technical Secretariat is responsible for collecting information from different line ministries and institutions relating to water state assessing it and publishing reports.

7. If existing, how the program of measures relates to the WFD requirements, specifically to the need for defining the basic and supplementary measures?
   a. Can you specify the most important measures which are or are planned to be implemented for groundwater protection?
   b. Can you specify whether and how the measures necessary to prevent or limit (direct or indirect) input of pollutants into groundwater are implemented?

c. Does the program of measures contains the obligation of controlling and reducing water pollution from point and diffuse sources of pollution?

The degree of compliance of local legislation with the legislation of the European Community is estimated to date as partial. Currently we are working to complete the approximation of legislation in the field of water. The trend will be the completion of existing legislation with the necessary bylaws as well as the institutional strengthening to reduce /eliminate water pollution from emissions to guarantee their quality standards during the year 2010 according to the following legislative initiatives:

- Integral new draft law "On waters" (which will transpose the Water Framework Directive and the Directive on Treatment of Urban Waste Water) and will replace the current law "On water resources." The law will fully transpose the above directives.
- Draft CMD that transposes the technical requirements of the Directive on Treatment of Urban Waste Water.
- Draft CMD “On Water Quality Standards”, which will transpose the Directive 2008/105/EC Environmental Standards of Water Quality.
- Draft-regulations “Quality of Drinking Water”, prepared for approval in the Council of Ministers, which approximates the Council Directive 98/83/KE “On quality of water intended for consumption purposes for humans”.

Approximation will be 80% with the tendency of full approximation based on the terms provided in the draft-regulations and in its further amendments.

8. Do you think that the existing system of protection of the well fields and springs is good in your country, or it requires some changes?
    a. Can you specify the legal base for the existing practice of groundwater protection in the karstic areas?
    b. Is the requirement for implementation of any kind of remedial measures in the zones of sanitary protection legally defined (e.g. implementation of BAT, removal of illegal facilities etc.)
        i. If yes, does it include also the remediation measures of contaminated soil and groundwater?

The Law No. 8093 dated 21.3.1996 ‘On Water Resources’ (as amended in 1998, 2000, 2001, and 2007 provides a comprehensive framework for water resources management in Albania. The LWR defines the legal status of water and water state, the activities and organization of water management, conditions for water use, water protection, development, sustainable use and distribution of water resources, protection from pollution and other issues relevant for water management.

Other primary legislation includes:

Law No 8934 dated 5.9.2002 ‘On Environmental Protection’;

Law No. 8102 dated 28.3.1996 ‘On the Regulatory Framework for Water Supply and Waste Water Management’;

Law No. No. 8515 dated 30.7.1999 ‘On Irrigation and Drainage’;

Law No. 9115 dated 24.7.2003 ‘On the Environmental Treatment of Polluted Waters’;

Law No. 8905 dated 6.6.2002 'On Protection of the Marine Environment from Pollution and
Damage';

Law No. 9103 dated 10.7.2003 'On the Protection of Trans-boundary Lakes';

Law on water resources set out the provisions for the control and preservation of water resources quality. However, these are only provided for the setting of standards for drinking water quality, while a regime for the regulation of sewerage works and the discharge of wastes to water on the basis of consents is included.

Law on water resources provides the designation of protected areas and the coast, and contain provisions on the protection of banks. The issue of water quality is further addressed in Law No. 9115, dated 24.7.2003 "On the environmental treatment of polluted waters" ('the Water Pollution Law'). However, the focus is only on the discharge of pollutants to surface water bodies, and not on water quality overall.

The law on water resources states that its purpose is to protect the environment and human health from the negative impact of polluted waters by specifying binding rules for their treatment. Law on the Environmental Treatment of Polluted Waters requires the treatment of polluted industrial waters depending on the type of industry involved and outlines in general terms the process of treatment. Once they have been treated, used waters may be discharged provided they comply with purification norms and the issue of treatment must be considered from the design stage. COMD No. 177 on Permitted Rates of Discharge and Zoning Criteria of Receiving Water Environments was issued pursuant to Law on the Environmental Treatment of Polluted Waters on 31 March 2005. The second chapter of the DCM addresses the emission or discharge standards from industrial while in one part of the law is concerned with 'permitted rates of urban discharges' and the treatment of urban waste water. The Law 'On Protection of the Marine Environment from Pollution and Damage' adopted on 6 June 2002 has the purpose to protect the marine environment from pollution and damage through the prevention of damaging human activity in the sea and coastal zone.

9. Are there any differences in the approach for groundwater protection in different types of aquifers? If yes, define main differences, related to:
    a. the methodology of delineation of sanitary protection zones,
    b. the types of hydrogeological investigation needed for delineation of sanitary protection zones
    c. the measures applied in different types of aquifers.

Around the wells used for domestic and municipality uses, there are restricted areas which there are limitation for other activities. According the Law on water resources the Minister of Environment and the Minister Public Works have issued a guideline to the water supply enterprises and River basin Agencies for completing the procedures and designing the area for proclamation of protected areas around the wells.

10. Is groundwater in the karstic area specifically treated in the national legislation?

Included in answers 9.a, 10

11. Are the areas intended for the abstraction of water for human use specified in the regulations or strategic documents? How they are treated:
    a. as whole groundwater bodies, according to the criteria set in the WFD, or
    b. as a sanitary protection zones around the well fields and springs?

See answer to question 16. In additions follows:
Water Sector Regulatory Entity is a state entity which has been established in 1998 according to the law 'On the Regulatory Framework for Water Supply and Waste Water Management'. The main tasks of the entity are issuing licenses for different operators to operate in the water supply and sewage sector, establishing the water tariffs for water supply and sewage sectors.

12. Can you identify any other types of groundwater protected areas in your country, which are legally defined (other than the "Drinking water protected areas" (DWPA) or sanitary protection zones, which are specified in the WFD)?

The Law for Water Reserves determines the authorities which can limit the water use in all Albania's territories and in special zones.

Preservation of water reserves quality is expressed in special articles of law 8093 date 21.3.1996. In the 4th Chapter « Preservation and protection of water reserves quality » the need of setting national standards in water's quality which is consumed by humans, is defined. In the 5th Chapter « Protected areas and zones » we talk about sanitary protected zones, water reserves etc meanwhile in the 6th Chapter « Protection of coasts » we talk about refraining building construction along the coasts, and what activities are prohibited in coasts and beaches.
Besides protecting waters because of their nature and use, they're subject to a special protection. So, in accordance to article 8 of law no. 7643 date 2.12.1992 « Public health and State Sanitary Inspectorate » the COMD Nr. 145, date 26.02.1998 « Approval of « Sanitary/health regulations in drinking water quality, planning, construction and monitoring of drinking water supply » » was drafted. Law no. 9103 date 10.7.2003 « Transboundary lakes protection » aims environmental protection for transboundary lakes of Shkodra, Ohrid and Prespa, and to create optimal conditions for development of life and ecosystems in these lakes.

Another legal act which focuses on water protection is law Nr. 8905, date 6.06.2002 "Marine environment protection from pollution". This law aims Albanian marine environment protection form pollution and further damages, prevention and avoidance, caused by human activity in the coastal zones and sea. The human activity ruins water quality, damage sea water, threaten flora and fauna, threaten human health too and also make it difficult for activities to develop normally in this area.

13. In what way is defined (within legislative framework) the need for inclusion of sanitary protection zones and other protected areas in the spatial planning documents?

14. Can you identify the legal base (e.g. law or rulebook) for establishment of groundwater monitoring?
    a. If yes, does it include clear criteria related to:
        i. Conceptual model of groundwater system
        ii. Representativeness of the monitoring places
        iii. Selection of parameters
        iv. Integrated monitoring requirements (e.g. in the case of proved hydraulic connection between surface waters and groundwater)
        v. Frequency of sampling etc.

The environmental monitoring of waters has been carried out by different Scientific Institutes contracted by the MoEFWA on annual basis: Institute for Energy, Water and Environment (ex- Hydrometeorology Institute) for surface water quality and quantity, Agency of Environment and Forestry (ex-Institute of Environment) for wastewater discharges, and Institute of Public Health for water biological monitoring. The Albanian Geological Survey is the institution responsible for groundwater quality and quantity monitoring. They are operating according to the law on Geological survey of Albania. The Law on Geological survey, article 6, mentions that the geological survey of Albania is responsible inter alia for research, assessment of ground water resources, drinking, thermal and industrial waters. It is also charged with the watershed hydro geological studies and the elaboration of the measures for the protection and management of the water resources.

16. Does your national legislation include provisions regulating GW abstraction (quantity) such as permits systems, control on wells, and control on well drillers? Specify.

In law no.8093, dated 21.3.1996 "On water resources", Chapter IV establishes the rights and duties to use water. Pursuant to law, the National Water Council (NWC) has defined the requirements to obtain permits for utilization of surface and groundwaters.

By law, water is used for domestic, municipal, agricultural fishing purposes, shipping, industrial purposes, hydropower, tourism, according to the requirements set forth by NCW. Nobody has the right to use water without a permit, authorization or concession issued by the water authorities. The law provides for these forms of water use:

a. **Free use of water**. Anyone has the right to use surface water resources freely for drinking and livestock. Anyone has the right to use the coastal waters for bathing and sporting activities. Anyone has the right to use the rain water that falls on private property provided that this water is not collected with artificial installations.
b. **Use of water by permit**. Permits the use of water made for drinking, irrigation, livestock, aquaculture, industry (mining), exploitation of groundwater for various purposes. For navigability and construction, permits are issued by the NCW.
c. **Use of water by authorization**. Types of studies, explorations of surface and ground waters are carried out by authorization.

d. **Use of water by concession.** Use of ground or surface water reserves for public purposes such as production and supply of drinking water, hydropower production, irrigation of land from agricultural enterprises, extraction of gases and hydrocarbons by means of using the ground waters was foreseen to be carried out by concessions.

On the use of surface and ground waters and for the use of river gravels in application of Articles 18 and 20 of Law 8093 dated 21.3.1996, NCW starting from 2002 has completed the necessary sublegal basis for issuance of permissions, which require in principle a technical and legal documentation.

The law defines provisions for Permits, Authorizations and Concessions. The priorities are defined in the granting of Permits, Authorizations, Concessions and Licenses for underground drillers while curative, mineral and thermal waters are anticipated to be treated by a special law which so far has not been drafted.

Decision No. 6 dated 16.4.2004 of the National Water Council, "On the approval of the template for the well drilling permit" pursuant to Articles 6 and 24, of the law, NCW, approves the templates for the well-drilling permits.

3. National (Albania) SWOT analysis on effectiveness of groundwater management

Strengths	Weaknesses
- Albania has national strategy for water management - Polluter pays principle is embedded in current legislation and in the new legislation, planned to be approved during 2012. - Albania has setup administrative bodies for water administration at national and local level. - Groundwater reserves that are used for drinking water are identified and protected in the current legislation and also stated in the urban spatial plans at national and municipality level. - Albania has a system for regulation of groundwater abstraction - Albania has got several bilateral agreements at ministerial level for the management of transboundary waters - With the adoption of the new *Integrates Managment of Water Law, planned to happen during 2012* a transposition of the fundamental principles, objectives and measures from the EU Directives, in particular the *Water Framework Directive*, will be substantially completed - *Regulation on the assessment of the impact of the interventions to environment* is harmonized with the Environmental Impact Assessment Directive - Albania has an elaborated system for regulation of groundwater abstraction - The use of EU funds has helped in drafting new legislation in compliance with WFD.	- Gap in coordination among institutions in particular between local and central government. - Lack of any river basin management plan - No legal or policy document define and prescribe the integration of environmental and resource costs into the development of pricing policies - Water monitoring program does not cover all the river basins - Methodology, indicators and data assessment for water monitoring are not at the contemporary standards. The institutions in charge are not accredited yet. - Poor performance of law enforcement with regard to application of the ‘polluter pays' principle. - Principle of cost recovery is not implemented in any legal act. - Strategic reserves of groundwater are not legally defined in the current law of water. - Groundwater protected areas are not clearly defined in spatial planning documents - The water bodies intended for the abstraction of drinking water are not properly defined in legislative documents - Water supply systems are dependent on only one spring or well field, which often endangers the sustainability of the systems - Lack of a common database system based on the harmonized methodology for both quantity and qualitative aspects.

Opportunities	Threats
- Make use of EU funds, particularly structural and cohesion funds (on the basis of well prepared project proposals) for co-financing (ground)water projects - Start implementation of the river basin management plan, once it is approved - Develop education system for for public administration (working on (ground)water management issues) in cooperation with decision-makers, legislators, NGOs and research institutions within Universities. - Develop education system and mechanisms for dissemination of information for water users - Propose and develop interdisciplinary research topics with significant stakeholders in the region in order to meet the transboundary (ground)water policy and (ground)water management needs - Encourage and support NGO activities that contribute to the development and implementation of environmental policy, particularly in the field of groundwater protection - Set up better communication and dissemination of knowledge and experience between decision-makers and legislators and water scientists and experts working on national or international scientific or professional (ground)water projects	- *Water Legislation and Strategies are* partly harmonized with other sectoral (national) strategies, which may threaten the implementation of the groundwater protection measures - The impact of climate change and changes in land use on (ground)water resources is unknown - causes of adverse change in quantitative and qualitative characteristics of groundwater are not fully identified or understood, especially in karst aquifers - Slow progress in preparation of River basin management plan. - Slow progress in approval of the new legal acts on water which will approximate the national legislation with WFD. - Even in the new drafted law on integrated management of water the karstic areas (aquifers) are not specifically treated in (ground)water legislation, which may pose the problems with implementation of the requirements set by EU directives, due to peculiarities of the karstic groundwater systems - Goals for transboundary (ground)waters (aquifers) are not specifically defined in the policy or legislation, which can make it difficult to harmonize the legal framework of protection of transboundary (ground)waters with neighboring countries

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4. Bilateral Agreements in Management of Transboundary GW

The relations between Albania and its neighbours are continuously improving, which creates a favourable political environment for the comprehensive development of cooperation in all areas.

If it is known that water management covers activities and measures undertaken for the maintenance and improvement of the water regime with the aim of providing necessary quantities of the prescribed quality water for specific purposes, protecting waters from pollution and protecting from the harmful effect of waters. Therefore, mutual regulation of these issues deserves careful and thorough attention and immediate and long term actions towards sustainable management and solutions.

4.1. Bilateral Agreement between Albania and Montenegro

Legal Basis

The Bilateral Agreement is signed by the contracting parties on December 31.10.2001 and entered into force after being adopted by the parliaments of the two member states. Albania passed the agreement in parliament on May 2003.

Member States

The contracting parties of Bilateral Agreement Albania and Montenegro. The Agreement is signed by the authorized representatives of Government of Albania and Government of Montenegro.

Geographical Scope and Functions

The Bilateral Agreement covers the water streams forming the state border, and the streams of waters, lakes and hydro systems interrupted by state borders.
The Bilateral Agreement has helpt:

- To consider and resolve by agreement all water problems,
- To consider measures and works that can influence the change of quantity and quality of water, and for which both parties or one of them is interested in,
- To consider the preservation of unity of proportions of water systems, knowing the rights and obligations deriving from this unity.

Provisions of this agreement extend over all water problems, measures and works on the water streams, forming the state border, the sea, river and lake borders, and streams of waters, lakes and hydro systems interrupted by the state border, and for which both parties are interested in, especially on:

a. Use of water energy potential
b. Regulation and channeling of the stream of waters of lakes and maintenance of their beds
c. Irrigation and similar measures
d. Accumulations and retention works
e. Protection from floods
f. Water supply and sanitation
g. Navigation
h. Ground waters
i. Protection of land from erosion
j. Use of waters in agriculture
k. Hydrological studies, preparation of projects and implementation of works
l. Fishery
m. Division of expenses for the study works, projection and implementation works, and from the use and maintenance of works and objects,
n. Exchange of data and projects as well as mutual information on the above issues
o. Exchange of data on problems related to waters.

Glossary

In this agreement, the terms

- "hydro system" means all water streams (above and ground, natural and artificial) objects, workloads, that could influence water streams and objects forming the state border or that are interrupted by the state border.
- "water problems" means everything comprising the problems of sea, lake and river waters.

Organization structure

The issues, measures and works deriving from the provisions of this agreement will be followed and carried by the *Joint Committee* on water problems (further on the Committee), which is established for this goal.

Composition, scope of work and manner of work of the Committee is provided in its statute that is being approved by the Joint Committee.

The Committee will draft common regulations for the use of water electro-energetic potentials, for protection from waters and other regulations according to a schedule, which will be drafted not later than 60 days from the approval of this agreement.

Commitments of the contracting parties

- Maintain regularly the lake and water beds as well as all objects and installations on them, each party to its territory and in multi or unilateral agreement, and all the streams, hydro systems, lakes and other objects interrupted by state border, if both parties are interested in it.
- Use objects and equipment with mutual interest that are in function of the hydro systems.
- Construction of new objects, modification of the existing ones, launching of any new work or measure in the territory of one or the other party in agreement with, which the water economy relations are changed, in the water streams interrupting the state border in the lake and water streams and hydro systems being interrupted by the state border, will be done by preliminary agreement.
- Engage to facilitate the customs operations for the transition of the construction materials as well as the equipment for performance of works according to the legislation in force.
- Preserve and maintain the permanent points of triangulation along the border, which serves for water works, and in case of need, they will complete or rebuilt them. Both parties to the agreement can use these points.
- Notify each other in the fastest way possible on the high water risks and the other threatening risks that can be caused in the water streams, lakes and hydro systems, which are interrupted by the state border.

Dispute resolution

The issues, for which the Committee will not reach an agreement, will be referred for solution to the Government of the parties to the agreements. If such disputes are not resolved by the governments of the parties, each party will refer them to the international dispute resolution bodies, and will notify the other party in writing.

Validity

The agreement remains in force for a period of five (5) years, starting from the date of entry into force. If none of the parties to the agreement will denounce the Agreement one year prior to its expiry, its validity will be extended for five (5) other years.

4.2 Memorandum of Understanding between Albania and Montenegro

Legal Basis

The Memorandum of Understanding is signed by the contracting parties on December 14, 2010 and entered into force in the same day.
The MOU is based on:

- International convetions or agreements signed by both contracting parties;
- International conventions dealing with transboundary water administration;
- Barcelona Convention for the Protection of Mediterranian Sea against Pollution.

Member States

The contracting parties of MOU are Albania and Montenegro. The MOU is signed by the respective Ministers of the contracting parties:
Albania – Ministry of Environment, Forestry and Water Administration
Montenegro – Ministry of Agriculture, Forestry and Water Administration

Geographical Scope and Functions

The MOU covers the Basin of Shkodra Lake, Drini and Buna rivers.
The MOU will help to:

- Undertake investigations, and develop projects and plans for joint boundary and water works;
- Undertake precautions for preventing the environmental and ecological damages caused by floods;
- Maintain the heath and sustainability of the region's rivers and lake systems

Short Term Actions

- To intensify work in setting up a Joint Albania-Montenegro Commission for water administration chaired by the two Ministers responsible for water administration respectively in Albania and Montenegro.
- Draft necessary documents towards a common project for the adjustment of Buna riverbed aiming the control of river discharges.
- Prepare a list of priorities for the completion of necessary works on which both contracting parties shall agree.

The physical works shall include:

- The cleaning of the riverbed and the removal of all artifical barriers like: waste from destroyed bridges, sunken ships, waste from wood and so forth.
- Cleaning of the riverbed near existing bridges to prevent the slowdown of the flow of Buna river.
- Deepening, widening (where it is possible) and the rehabilitation of Buna riverbed.
- Purification of Buna river estuary (delta) in the sea.
- Readjustments of Buna river banks quotes (heights).
- Forestation and recultivation of river sides and river banks.
- Joint applications to funding international and accrediation intitutions.
- Other activities that are demeed to both contracting parties.

Long Term Actions

- Preparation of Buna and Drini riverbasins managment plans.
- Preparation of Shkodra lake basin managment plan.
- Preparation of a complete project for water administration in Shkodra lake, Buna and Drini rivers including their furnishing streams.
- Implementation and execution of the approved projects.

The long term actions shall be implemented through international donors financing, lending instruments through joint applications of the drafted projects.

Both parties express their commitment in exchange of information in all elements of this Memorandum, especially in the exchange of meteorological and hydrological data and information.

4.3 . Integrated Ecosystem Management of Shkodra Lake (LSIEMP)

The project is financed through the donation of the Global Environmental Fund (GEF), while the World Bank is the implementation agency. Direct beneficiaries of the project are the Government of Montenegro and the Government of the Republic of Albania, i.e. line Ministries responsible for the area of environmental protection (Ministry of Sustainable Development and Tourism of Montenegro and Ministry of Environment, Forestry and Water Management of the Republic of Albania).
During the Project implementation phase which will last for 4 years (November 2008 -October 2012), activities defined by the Common Strategic Action Plan will be implemented in relation to integrated protection and sustainable development of the Skadar Lake between the two countries, implementation of targeted monitoring programmes, building institutions for managing protected areas of the Skadar Lake in Montenegro and in Albania, construction of facilities for waste water treatment in selected settlements in the Lake (Vranjina in Montenegro) and co-financing of addressing of urgent ecological problems, in order to improve quality of ecosystems of the Lake and reduce the level of pollution.
Within the framework of the project a Bilateral Commission for the Shkodra Lake is established. The existence of this structure has proved to be an efficient mechanism for the exchange of information, particularly in relation to infrastructural projects which are being implemented in the drainage basin of Skadar Lake. The permanent task of the Commission is to monitor the implementation of the project "Lake Skadar Integrated Ecosystem Management "and agree on the content and dynamics of joint activities. Through the implementation of the World Bank's project, a logistic support is provided to this structure and in the coming period, competencies of the Commission will be reviewed, with the aim of creating a long-term efficient mechanism for the cooperation between Montenegro and the Republic of Albania, so as to preserve the Skadar Lake ecosystem and use the resources in a sustainable manner.
Four bilateral working groups of experts and local stakeholders from both countries were formed as advisory bodies of the Commission: for planning and legislature, monitoring and research promotion, tourism and availability to the public and water management. Meetings of the Working groups are held regularly, where joint project activities are examined and the preparation of project tasks and the work of consultants on the development of certain documents are monitored.

Some of the lessons learnt during the project implementation are:

- The existence of transboundary structures such as the Skadar Lake Commission and joint Working groups is of huge bilateral importance and in the next period, possibilities that the Commission obtains greater authority regarding coordinated interstate management of the Skadar Lake ecosystem should be considered.

- Cooperation with line institutions from the Republic of Albania is satisfactory, but it should be continued after the completion of the project (October 2012).

Thus, provisions of the Agreement on the protection and sustainable development of Skadar Lake, signed on the level of Ministers responsible for the environmental protection area in February 2008, as well as the provisions of the Memorandum of Understanding between two line ministries in the area of environmental protection and sustainable natural resources management (from 2010), could be continuously improved, particularly through strengthening the role and impact of the existing interstate Skadar Lake Commission and thereby the bilateral cooperation between the two countries in the area of this common resource management.

STAKEHOLDER ANALYSIS

Part A. Introduction

1. Stakeholders Analysis in the framework of the DIKTAS project

Stakeholders Analysis (SA) at transboundary level is prepared to produce the necessary information to be used:

(i) for the revision and adaptation of the preliminary SPPS by means of identifying the Stakeholders at national and transboundary levels and analysing their characteristics and positions
(ii) in support of the preparation of the TDA by identifying the issues and problems with regard to the management of the Dinaric Arc aquifer system as these are perceived by the stakeholders in Albania.
(iii) in support of the preparation of the Shared Vision; information regarding the expectations and aspirations of stakeholders pertaining to the future of the transboundary Karst Aquifers management can be taken into consideration while the draft document Shared Vision is prepared

The preparation of the SA it is based on a combination of sources of information; Information was collected between October 2011 and June 2012.

Part A. Introduction

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1.1. Methodology

The basic methods for gathering and processing information for this stakeholder analysis include:

- Expert opinion and Expert knowledge (provided by the International and Country experts);
- Web-based survey;
- Workshops;
- Structured interviews.

Information collected from interviewees and workshop participants represent their perceptions and views, and have been used as such in conjunction with background research and expert knowledge.

Part B. Analysis

The analysis presented here is structured in two sections as follows:

1. Stakeholder Analysis.
2. Analysis of the significant issues, as these are perceived by the stakeholders, regarding the management of the shared Dinaric Karst aquifer system.

1. Stakeholder Analysis

General

This section presents information for Albania, that will be used for the revision of the preliminary SPPS; to define the level and means of participation of the stakeholders in the project and its activities – who to inform, consult, involve, when in the project implementation period and how.

This information is structured, for each country, around the three methods[5] used to acquire related input:

1. Online survey
2. Workshops during National Consultation Meetings
3. Interviews

1.2. Albania

1.2.1. Albania On-line Survey Results

Only four stakeholders from Albania participated in the on-line survey, answering all questions. One of the respondents represents a Ministry, one a Regional or Local Government body/Authority and two represent NGOs.

Table 1 On-line survey participants

Nature of Organisation	
Ministry or other high level governmental authority	1
Entity / Regional or Local Government body/Authority	1
Protected Area Authority	0
River Basin District Agency	0
State Organisation	0
State owned utility	0
Research institute	0
Land and Water Use Associations / Cooperatives (Farmers'/Livestock Breeding/Fishermen/Water Boards)	0
Public Enterprise (Forest and Water Management)	0
Private sector (land owners, navigation, industry) including Chambers	0
Tourism Agency/Board	0
NGO	2
Civil society	0
Local community	0
International and Regional Institution or Organisation	0
Donor country and development agency	0
International Commission/Committee/Organisation	0
Media	0
Religious Institution	0

All wish to get involved in the management of groundwater in the Dinaric Karst Area and would like to be kept informed about the project. The survey respondents prefer to be informed on a monthly basis, through most of the options provided.

Table 2 Preferred means of information and frequency

Would you prefer to be informed by... (choose all that apply)Answer Options	every month	every 3 months	every 4 months	on outstanding occasions	never	Responses
Information provided on DIKTAS website	2	0	0	2	0	4
Bulk e-mails	3	0	0	1	0	4
Newsletter	2	1	0	0	0	3
Publications (brochures, leaflets)	2	0	0	2	0	4
Personalised e-mails	3	0	0	0	0	3
Information meetings (conferences, workshops, lectures)	2	1	0	1	0	4

All of the respondents wish to contribute information to the Project team and three out of four wish to be consulted and/or contribute to the project implementation. One respondent is also willing to contribute with information provision, public awareness raising activities and by influencing policy and decision makers. Respondents are all able to mobilise their Expertise and Information resources in order to participate to groundwater management. Three out of four indicate that they can also mobilise Human resources and Political power/Lobbying.

Table 3 Preferred means of consultation

Would you like to be consulted by .. (choose all that apply)	
Answer Options	Responses
participating in consultation meetings	2
providing feedback in electronic or other form	3
participating in on-line surveys	2
Other (please specify)	1

Three out of the four respondents consider their contribution to the improvement of groundwater management to be valuable. In this regard, one respondent indicates that the institution/organization it represents can offer serious commitment to the project, access to the public and the policy and decision makers and contribute with their years of experience in water-management and transboundary dialogue.

2.2. Tirana National Consultation Meeting Results – Stakeholders Map and Evaluation

The participants in the Albanian National Consultation Meeting evaluated a list originally containing a hundred and fifty (150) stakeholders relative to the reference transboundary area between Albania and Montenegro. Removing those non-important to the project and the management of the shared karst resources and including others that were missing, the participants updated the list, resulting to sixty-one (61) important stakeholders. The slightly lower number of stakeholders, in comparison to the other three countries (respective numbers to be found later in the document) is justified by the smaller extent of the transboundary area of interest, compared to those of the other beneficiary countries. The participants, following extensive deliberation, produced a stakeholders' map, indicating twenty-four (24) stakeholders as actors of high influence and high interest, fifteen (15) stakeholders of high interest and low influence, seven (7) stakeholders of low interest and high influence and fifteen (15) stakeholders of low interest and low influence. These are presented in the Tables 4, 5, 6 and 7 below.

One thing to point out from the selection of the stakeholders in the four different categories is the lack of some of the primary users such as agriculture and livestock breeding. Household users are represented by the respective municipalities which are indeed characterised as having high interests in the management of the resource, and varying influence according to their geographical position, (i.e. the municipalities closer to the transboundary aquifer are attributed with higher influence).

Ministries are perceived to have high interest, apart from high influence and importance. On the other hand, NGOs, but also UN agencies such as UNDP, are attributed little influence and forest management authorities little interest in the management of karst aquifers.

Category 1 – High interest/ high influence

Seventeen (17) of the stakeholders under this category, are of high importance and eight (7) are estimated to have medium importance. All high importance stakeholders have a positive attitude towards the DIKTAS project with only one exception. This is considered to be the Albanian Electro-power Corporation (KESH) which, according to NCM participants may have different attitude depending on the issue at hand. All medium importance stakeholders are thought to be supportive of the project and its objectives.

This category includes stakeholders such as ministries, regional authorities and research institutions that may provide indispensable support in the efforts of the project for enhancement of karst aquifers management. Therefore, these are stakeholders that should be approached, consulted and kept closely informed of the DIKTAS project, its objectives and activities.

Table 4 Category 1 – High interest/ high influence

Albania - Stakeholders	Importance	Attitude
World Bank Office in Albania	HIGH	SUPPORTER
Lake Skadar-Shkoder Commission	HIGH	SUPPORTER
Ministry of Agriculture, Food and Consumer Protection	HIGH	SUPPORTER

Ministry of Environment, Forestry and Water Administration	HIGH	SUPPORTER
Ministry of Economy, Trade and Energy	HIGH	SUPPORTER
Shkodra District	HIGH	SUPPORTER
Shkodra Fishery inspectorate	HIGH	SUPPORTER
Municipality of Malesia e Madhe	HIGH	SUPPORTER
Municipality of Shkoder	HIGH	SUPPORTER
Drini-Buna Basin Water Authority	HIGH	SUPPORTER
Faculty of Civil Engineering	HIGH	SUPPORTER
Albania Geological Survey	HIGH	SUPPORTER
Drainage Board Shkoder	HIGH	SUPPORTER
Polytechnical University	HIGH	SUPPORTER
Agency of Environment and Forestry (AMP)	HIGH	SUPPORTER
Regional Agency of Environment Shkoder	HIGH	SUPPORTER
Albanian Electropower Corporation (KESH)	HIGH	depends on the case
Mati Basin Water Authority	MEDIUM	SUPPORTER
Ministry of Public Works & Transport	MEDIUM	SUPPORTER
Ministry of Health	MEDIUM	SUPPORTER
Directorate of Supply and Sewerages (DPUK) - Shkoder	MEDIUM	SUPPORTER
General Directorate of Water Supply and Sewerage(DPUK)	MEDIUM	SUPPORTER
Shkodra University (research institutes), Faculty of science, Biology dept	MEDIUM	SUPPORTER
TVSH	MEDIUM	SUPPORTER

Category 2– High interest/ low influence

The fifteen (15) stakeholders under this category are almost equally divided between high (7) and medium (8) importance stakeholders. All are estimated to have a positive disposition toward DIKTAS. Among others, the category includes a number of NGOs and three public authorities. Some of the stakeholders in this category may prove valuable for the good publicity of the project. Stakeholders in this category should be kept informed and consulted on issues of their specific interest, especially in view of a potential change of influence.

Table 5 Category 2 – High interest/ low influence

Albania - Stakeholders	Importance	Attitude
REC	HIGH	SUPPORTER
UNDP	HIGH	SUPPORTER
USAID	HIGH	SUPPORTER
Regional Agency of Environment Kukes	HIGH	SUPPORTER
Regional Agency of Environment	HIGH	SUPPORTER
National Agency for Natural Resources (akbn.gov.al)	HIGH	SUPPORTER
Protection and preservation of natural environment - Shkoder (ppen shkoder-shrmmnsh)	HIGH	SUPPORTER
GiZ	MEDIUM	SUPPORTER
Municipality of Kukes	MEDIUM	SUPPORTER
Municipality of Peshkopia	MEDIUM	SUPPORTER
Chamber of Commerce of Shkodra	MEDIUM	SUPPORTER
Ecologist for the region Kukes Drini	MEDIUM	SUPPORTER
Association of tourism and environment	MEDIUM	SUPPORTER
ProgeoNGO Albania	MEDIUM	SUPPORTER
Eco Environment	MEDIUM	SUPPORTER

Category 3 – Low interest/ high influence

This is the smallest among the four categories; nevertheless, it contains stakeholders perceived to have various levels of importance. Most (5) of the stakeholders in this category are believed to be supportive towards the project and its objectives and two (2) are thought to be neutral. Having high influence, this group of stakeholders should be kept well informed. Effort should be put to raise awareness about the project as appropriate and necessary; this is especially true regarding the two neutral stakeholders as the aim should be to gain their support.

Table 6 Category 3 – Low interest/ high influence

Albania - Stakeholders	Importance	Attitude
Ishem-Erzen Basin Water Authority	HIGH	SUPPORTER
Enti Rregullator i Ujit	MEDIUM	SUPPORTER
ECAT(Environmental Centre for Administration and Technology Tirana)	MEDIUM	SUPPORTER
Institute of Public Health	MEDIUM	SUPPORTER
Rainbow environmental association	LOW	SUPPORTER
Directorate of Forest Service - Shkodra	LOW	NEUTRAL
RA KROM TIRANA (SBM GROUP Construction and Mining)	LOW	NEUTRAL

Category 4 – Low interest/ low influence

This category does not include any stakeholder of high importance. Although most (13) are estimated to be supporters or neutral (1) towards DIKTAS, it includes the only probable opponent of all the sixty-one evaluated stakeholders. This is the Union of Chambers of Commerce for Albania. This stakeholder should be dully kept informed as it also represents one of the few stakeholders from the private sector.

Table 7 Category 4 – Low interest/ low influence

Albania - Stakeholders	Importance	Attitude
Municipality of Puka	MEDIUM	SUPPORTER
Municipality of Has-Krume	MEDIUM	SUPPORTER
Directorate of forest service in Kukes	MEDIUM	SUPPORTER
Directorate of forest service in Peshkopi	MEDIUM	SUPPORTER
Drainage Board Burrell	MEDIUM	SUPPORTER
Schneider Electric Industries SAS	MEDIUM	SUPPORTER
EDEM	MEDIUM	SUPPORTER
CEP(Civic Education Project)	MEDIUM	SUPPORTER
TVD1(Peshkopi)	MEDIUM	SUPPORTER
Union of Chambers of Commerce for Albania	MEDIUM	OPPONENT
National Association of Communal Forest & Pastures	LOW	SUPPORTER
Water Supply Enterprises (communal level)	LOW	SUPPORTER
Council of Europe, Office in Tirana	LOW	SUPPORTER
Kukes Prefecture	LOW	SUPPORTER
FIIA (Foreign Investment Agency)	LOW	NEUTRAL

1.2.3. Results from interviews

In this analysis, stakeholders are considered at institutional or organisation level, which implies that divisions or departments of an organisation would not be considered as separate stakeholders. However, in the case of Albania the selection of the interviewees has been made upon the advice of the Albanian DIKTAS Experts, using the tables of stakeholders produced in the National Consultation Meeting and includes representatives of different departments of the same organisations. The following twenty-two (22) organizations and institutions were interviewed in Albania between 24 of April and 13 of July 2012:

Table 8 List of Key Stakeholders interviewed

	Stakeholders Interviewed
1	Ministry of Agriculture Food and Consumer Protection, Irrigation Department
2	Ministry of Agriculture, Food and Consumer Protection, HR management and services sector
3	Ministry of Environment, Forestry and Water Administration, Water Directorate
4	Ministry of Environment, Forestry and Water Administration, Water Management and Planning Directorate
5	Ministry of Environment, Forestry and Water Administration, Waste and Industrial Accidents Directorate
6	Ministry of Environment, Forestry and Water Administration, Water Policy Directorate
7	Ministry of Environment, Forestry and Water Administration, Nature Protection Directorate
8	Ministry of Public Works & Transport, Investment, Monitoring of directorate of supply and sewerage
9	Ministry of Public Works & Transport, Directorate of regionalization and water supply and sanitation policies
10	Municipality of Shkoder
11	Municipality of Shkoder, Public services directory
12	Municipality of Shkoder, Local authority sector, Prefecture
13	Shkodra district
14	Drini-Buna Basin Water Authority
15	Drainage Board Shkoder
16	Albania Geological Survey, Hydrogeology Department
17	Albania Geological Survey
18	DPUK- Directorate of Supply and Sewerages
19	DPUK-General Directorate of Supply and Sewerages
20	Shkodra University
21	Institute of Geo-science(IGJEUM) + Polytechnic University
22	Regional Agency of Environment ARM-Shkoder

1.2.3.1 Level of knowledge

Out of the twenty-two (22) stakeholders interviewed, sixteen (16) were familiar with the WFD's objectives. More than half (13 out of 22) feel that are not sufficiently informed about issues related to groundwater management. Key stakeholders interviewed are using a variety of information sources, with the Ministry of Environment being by far the most preferred source of information. It has to be taken under consideration though that many of the interviewees work in departments and directorates of the Ministry. Other popular sources include relevant legislation, such as the Law on Water Resources, and the Albanian Geological Survey.

Only twelve (12) out of the twenty-two (22) interviewees are aware of the DIKTAS project, whereas twenty interviewed stakeholders wish to be kept informed about the project and its activities; this stresses the need for DIKTAS related communication and publicity activities in Albania. The preferred means of information are printed material (brochures), workshops organised occasionally and capacity building events. Communication of information through electronic based media comes next in the stakeholders' preference, with monthly personalised e-mails being the most selected option, and electronic newsletters and DIKTAS website coming next. Regarding the content of information, most seek information regarding Best practices and guidelines (13 responses), Water management policy issues (11 responses) and news from the DIKTAS (10 responses).

Table 9 Content of Information

Information Content	Responses
News about the DIKTAS project	10
Karst aquifer management issues	9
Water management policy issues	11
Water management practical issues	8
Best practices and guidelines	13
How to participate in the DIKTAS activities	7

2.4. Desired Capacity and willingness of Stakeholders to contribute and desired level of participation to the DIKTAS Project.

The vast majority of the interviewees (19) are strongly supportive[1] to the improvement of the management of Transboundary Karst Aquifers through enhanced cooperation; three (3) interviewees are somewhat supportive.

Human resources are mentioned by the respondents as the means mostly available; this can be easily or very easily mobilized to influence decisions related to the management of the Transboundary Karst Aquifers. Expertise and information follows next, while the least available and the most difficult resource to mobilise are Political power / Lobbying and Financial resources.

Table 10 Resources available to stakeholders and ability to mobilise them

Which resources are available to your organization/institution/authority and how easily can these be mobilized to influence decisions related to the management of the Transboundary Karst Aquifers?								
Resource	Not easily	Easily	Very easily	A	B	C	D	E
Financial resources	6	2	0	3	3	1	0	0
Expertise / Information	1	7	2	0	0	4	4	1
Political power / Lobbying	6	4	1	0	5	5	2	0
Human resources	3	11	4	0	4	1	9	2
Other (please specify)				0	0	0	0	0

(A) VERY LITTLE (B) LITTLE (C) SOME (D) ENOUGH (E) A LOT

Table 11 Stakeholders' opinion on improved management of Transboundary Karst Aquifers through enhanced cooperation

Which of these categories best describes your opinion about the improved management of Transboundary Karst Aquifers through enhanced cooperation?	
a. I strongly support it	19
b. I somewhat support it	3
c. I do not support nor oppose it	0
d. I somewhat oppose it	0
e. I strongly oppose it	0

1.2.3.3 Expectations from participating in the DIKTAS implementation

Eighteen (18) of the stakeholders interviewed, state they wish to participate in the implementation of the project. When asked to indicate the most preferred form of participation in the DIKTAS activities most of the key stakeholders (15) selected to be involved in and contribute in the implementation of the project activities. Being consulted on the preparation of the TDA and SAP was the reply followed next (9 responses); the least preferred answer (5 responses) was contributing information related to their domain/business.

Table 12 Preferred form of participation in the DIKTAS' activities

What is the preferred form of participation in the DIKTAS' activities?	Responses
Contribute information related to my domain/business to be used through DIKTAS for the sustainable management of the transboundary karst aquifers	5
Consulted on the preparation of the document that analyse the aquifers systems state / on the transboundary problems and issues. Consulted regarding the identification of policy, legal and institutional reforms and investments needed to address the problems?	9
Involved in and contribute in the implementation of the project activities	15

Accordingly, on the subject of the stakeholders participation in the management of the transboundary karst aquifers, consultation on the proposed decisions and measures at the transboundary and national levels were the most preferred responses followed by being involved in the decision making and involved into the implementation of decisions mostly at national level. Most respondents list Economic cost as the main constraint keeping them from participating in the management of the transboundary karst aquifers, followed by Work load and to a lesser degree by Lack of training/education.

Table 13 Preferred form of participation in transboundary karst aquifers management

What is the preferred form of participation in the management of the transboundary karst aquifers?	Responses	International/ transboundary	National	Regional	Local
Informed about decisions and measures	12	5	4	2	1
Consulted on proposed decisions and measures	21	6	6	4	5
Involved into decision making	16	4	6	3	3
Involved into implementation of decisions	15	5	7	2	1

Table 14 Constraints to participation in the management of the transboundary Karst Aquifers

What constraints exist, that would hinder your participation in the management of the transboundary Karst Aquifers?	Responses
Economic cost (fees/taxes implied by measures, travel, equipment etc)	13
Work load (limited human resources)	9
Working with other stakeholders	3
Access to information	2
Lack of training/ education	5

In order for stakeholders to participate meaningfully in the management of the transboundary aquifers, they would mostly need financial support, but also opportunities for information exchange with other stakeholders. The latter gives an additional value to the efforts of DIKTAS to engage stakeholders, and indicates the vital role the project could play in the wider field of groundwater management in the area as a platform for information exchange. Training/Education and /or more human resources are also viewed as important in facilitating participation.

Table 15 Support for participation in the management of the transboundary Karst Aquifers

What kind of support would you need to overcome these constraints and participate/ be involved?	Not Important	A bit important	Quite important	Important	Very important
Financial support	0	0	1	6	5
Training/Education and/or more human resources	0	0	1	6	0
Opportunities for information exchange with other stakeholders (e.g. conferences, meetings)	0	0	3	6	1
Legal advice	0	1	2	2	1
Access to information	0	1	1	2	3

2.4. Expectations and aspirations for the future of the transboundary Karst Aquifers management

All of the interviewed key stakeholders are interested to participate fully in all the stakeholder engagement activities proposed by the DIKTAS and make a productive contribution to the

project outcomes and efforts for shared karst aquifers' management. They indicate the need for economic development of the area for the benefit of the local population. Tourism is the main activity that is proposed (mentioned 22 times) as a development option, including different forms, such as ecotourism and agro-tourism, followed by the development of agriculture and livestock breeding (mentioned 9 times). Also the development of sustainable industry is put out as an option (5 references).

Most of the interviewees are hoping for future improvement of Transboundary Karst Aquifers management with the adoption of specific measures and the enhanced protection of the resource. Many propose specific solutions such as wastewater management, floods protection infrastructure and reforestation of surrounding ridges and slopes. Development of new and implementation of existing legislation and regulations and cross-border cooperation are also mentioned. Finally some stakeholders indicate specific activities as causes of impacts in the area and would like to see specific interventions in this regard i.e. such as reduction of the pollution from KAP-Aluminium Processing Plant in Montenegro and the dredging of the Buna River.

Most stakeholders interviewed are very positive in exchanging information and expertise in order to contribute to the DIKTAS efforts for the improvement of karst aquifers' management. The majority is also eager to participate in the preparation and implementation of management plans, project activities and proposed solutions. One stakeholder states willingness to commit human resources and another one to assist in lobbying and awareness raising activities.

Finally, many key stakeholders would like to see the issue of karst aquifers and the management of the resource gaining more publicity aided by the knowledge, information and data volume produced by the DIKTAS. They consider the project as an opportunity to improve the management of water resources, through the implementation of the project outcomes. Additionally, one stakeholder sees the project as an opportunity for cooperation and "integrated exploitation" of the resource by both countries in the transboundary area.

1.2.4 Conclusions for Albania

The analysis fails to identify some of the primary users such as agriculture and animal husbandry stakeholders, mostly because these are not organised at institutional level and remain small in size. However, the project should make an effort in engaging representatives of these sectors, especially since these are economic activities prescribed by the key stakeholders as developmental options for the area. This would require activities at a local level.

Water management related Ministries, regional authorities and research institutes are perceived as having high interest and influence in the management of the karst aquifers. They also appear to be a good pool of expertise and significant points of information dissemination. The project should seek to actively engage with such stakeholders. Most of the NGOs on the other hand appear to have low influence on the matter, however since they are categorised as having increased interest, it would be advisable to engage them.

Besides, there is a great eagerness of stakeholders to participate and contribute to initiatives such as the DIKTAS project. Key stakeholders, although not aware of the project, attest to their commitment to participate in the project activities. They are not only interested in being informed and contributing information; advanced forms of participation are preferred by the stakeholders with regard to both the Project implementation as well as the management of shared karst aquifers, especially on national level. They are willing to mobilise their human resources and expertise, of which they appear to be a good source of, and they are interested in capacity building events and policy matters. The constrains to meaningful participation they quote, refer mostly to financial costs and increased workload. The project should aim to involve them, providing an opportunity to exchange views and information between stakeholders. It should act as a platform for capacity building, communication and cooperation among the different actors.

Publicity and communication activities related to the project and the management of karst aquifers as means to raise awareness in Albania are necessary, and the DIKTAS is seen as an opportunity for such activities. More traditional and direct communication methods are better suited to the country in this regard.

2 Perceived Significant Issues Analysis

General

This section elaborates on the significant issues, as these are perceived by the stakeholders, regarding the management of the shared Dinaric Karst aquifer system. This information will feed in the preparation of the TDA, assisting in the prioritization of the identified therein issues.

The analysis of information from each method used to acquire input (on-line survey, workshops, interviews) for each of the project countries are given in Annex 1.

The combined results have been deducted and issues have been prioritized using input from all methods. The input from interviews is considered more accurate, due to the nature of the method and the stakeholders interviewed[15], hence has had more gravity in our analysis. In addition interviews provided a considerable level of detail with regard to the issues at hand. This input was combined and informed with that coming from the NCMs, which incorporates the collective knowledge and perception of the NCM participants.

In the case of discrepancies between the two, the input from interviews was given priority. The results of the web-based survey were used to verify the prioritisation;.
The combined results of the analysis are given below in the document and are structured as follows:

5. The perceived significant groundwater related management issues for Albania are given in sections 2.1.1

   The issues are given in two parts:

   The first includes the list of issues indicated by stakeholders in all three survey methods.

   In the second part there are the issues that were indicated through the two survey methods; indicated through the interviews (open questions) and validated (and supported) by the analysis carried out during the National Consultation Meetings.

   In the case of Albania as the web-based survey was not considered, issues are given in one list.

- The results of the analysis related to the hot spots i.e. the specific areas or water bodies that the stakeholders indicate to be affected by specific issues are presented in sections 2.2.1.

2.1.1 Perceived Significant Issues in Albania

In Albania stakeholders highlight primarily the issue of surface waters and groundwater pollution. They indicate organic and bacteriological pollution as the main relevant problems, while unsustainable/insufficient municipal solid waste management is viewed as the main cause, followed closely by unsustainable municipal waste water management. Industry and construction are also viewed as contributors to pollution, together with tourism related activities and agricultural practices.

Apart from pollution, the decline of water levels and the respective effects on groundwater flows is indicated as significant; water abstraction for drinking water and irrigation are pointed out as the causes.

According to stakeholders, water resources management should be improved and more research should be conducted in order to generate more data and information. Exploitation of resources should be rationalised and the law enforced. A harmonised scientific and legal framework should be established with Montenegro, in order to ensure effective monitoring of the quantity, quality on the one hand and sustainable management of the resource on the other.

2.1.1.1 Issues

a. Pollution

Pollution is an outcome of different activities. The stakeholders indicated the following sources of pollution; these are classified in terms of perceived significance.

Pollution from solid waste

Unsustainable/insufficient solid waste management is identified as the most important pollution related issue. Municipalities/households, illegal landfills, industry, construction (aggregates) and tourism related activities are specified as main sources. The latter calls for special attention since tourism is the most often quoted, by the key stakeholders, activity for future development in the area.

Waste water pollution

Pollution caused by unsustainable or insufficient waste water management is indicated by key stakeholders as the second most significant issue. Bacteriological pollution is believed by the interviewees to be a problem originating mostly from domestic wastewater and exacerbated by urbanisation and unsustainable tourism development.

Pollution due to Manufacturing / Industry

Pollution from industry/manufacturing is the third most recorded significant issue by interviewees. Stakeholders mention specifically the KAP-Aluminium Processing Plant in Montenegro.

Pollution due to Unsustainable Agriculture

Although it is rarely mentioned during the interviews with key stakeholders, unsustainable agricultural practices are considered by participants of the NCM to contribute to water resources pollution. The use of agrochemicals is thought to impact groundwater quality. On the other hand, sustainable agriculture is an activity proposed by many stakeholders in the interviews as a development option of the area, second only to tourism.

Pollution due to Mining and quarrying

According to stakeholders interviewed and NCM participants, pollution from mines is one of the issues contributing to the decline of the quality of water resources, both surface and udnerground.

b. Enhanced transboundary water management

Enhanced transboundary water management is considered the most important issue for the participants of the NCM and the second most frequently mentioned in the interviews with the key stakeholders. A list of issues have been mentioned in both cases under this general title, referring to instruments related to the comprehensive management and protection of the shared karst aquifers, and the cooperation and coordination between stakeholders at different levels. Transboundary management plans, harmonised legislation, bilateral agreements and transboundary bodies are proposed as solutions by the interviewed stakeholders.

c. Data and scientific knowledge / Further research

Lack of data and scientific knowledge is the third most frequently mentioned issue in the interviews with key stakeholders, while it is quoted as the cause of many of the issues in the most important group of issues in the NCM, Transboundary Management. Issues stipulated include: lack of scientific research and technical studies for the understanding of the karst aquifers and the vulnerable areas, and the determination of its characteristics; lack of data exchange and systematic transboundary monitoring.

d. Flooding – Deforestation - Erosion

Flooding is mentioned in the interviews with the same frequency as lack of data and scientific knowledge and is listed as an impact in the National Consultation Meeting in Tirana caused by deforestation and degradation of the vegetation cover. The latter results in erosion that is believed to affect the permeability of soil layers above the aquifers.

e. Groundwater over-abstraction

Over-exploitation for household use and irrigation of crops is believed to influence water levels. Lack of awareness and failure to implement and enforce protective legislation are among the causes. Lack of comprehensive understanding of the resource exacerbates the problem.

f. Hydro-technical infrastructure

Hydropower infrastructure causing hydro-morphological changes that affects groundwater recharge patterns is mostly mentioned by interviewed stakeholders. The degradation of traditional water management infrastructure in rural areas such as the rain water-collecting reservoirs used for agriculture was mentioned as an issue by the NCM participants.

2.1.1.2 Hot Spots

The interviewed stakeholders indicated several "hot spots", areas where specific issues manifest:

1. The KAP-Aluminium Processing Plant in Montenegro is believed to impact both Shkodra Lake and the aquifers in the area.
2. It is commented that in the areas surrounding the Shkodra Lake, the Buna and Drini Rivers, the vegetation has been reduced resulting to increased erosion.
3. The possible exploitation of the Moraca River waters in Montenegro for generating electricity has been commented in the interviews as a potential source of disturbance of the hydrological regime in the area affecting the aquifers, besides the Shkodra Lake.
4. The "Nenshkodra area", the area of Shkodra Lake and the Buna River have been mentioned as areas impacted by flooding.
5. It is pointed out as an issue, that water resources in Vermosh and Puka are yet to be exploited.

Finally the key stakeholders interviewed draw the attention to the protection and management of the following water bodies:

1. Shkodra lake
2. Cem River
3. Valbone River
4. Shales River
5. Theth River
6. Drini River with its water catchments
7. Water resources in Aplin, in the area of Rrjoll of Malesi e Madhe.
8. Shegan Eye in Vermosh area

2.2.1 Hot Spots

<u>Albania and Montenegro</u>

- Stakeholders from Albania and Montenegro both report pollution and the need for protection measures as prevailing issues in Cem/Cijevna River.

Annex 1- Perceived Significant Issues in the four project countries per method used.

A.1.a Albania

Results from On-line Survey

Four respondents participated in the on-line survey in Albania (information regarding the nature/competences of organizations/ institutions participated in the on-line survey are given in Table 1).

The participants to the survey were requested to indicate the water management pressures and problems they were most aware of. The pressures selected most were Unsustainable / Insufficient management of solid waste, together with Tourism and Climate Variability, followed by Changes in the hydromorphology of watercourses, Unsustainable Agriculture and Unsustainable / Insufficient waste water management. Surface water Pollution from municipal wastewater and Flooding were the most reported issues/problems, followed by Groundwater Pollution from industrial wastewaters and Loss of biodiversity in surface waters and water-related ecosystems.

Table 60 Water management related pressures chosen by the stakeholders

Answer Options	Responses
Hydromorphological changes (e.g. regulation of waterways, construction of dams, diversion of rivers)	2
Unsustainable Agriculture	2
Unsustainable Forestry	1
Mining and quarrying	1
Manufacturing / Industry	0
Illegal discharges from industries	1
Unsustainable / Insufficient waste water management (e.g. lack of sewerage untreated/insufficiently treated urban wastewater)	2
Unsustainable / Insufficient waste management (e.g. controlled and un-controlled dump sites)	3
Transportation (road, pipelines)	1
Storage (including tailing dams for mining and industrial wastes)	0
Industrial accidents	0
Groundwater abstraction	1
Tourism	3
Climate variability	3

Table 61 Water management related issues/problems chosen by the stakeholders

Answer Options	Responses
Surface water Pollution from municipal wastewater (e.g. BOD, COD, nitrogen, phosphorus)	3
Groundwater Pollution from municipal wastewater (e.g. BOD, COD, nitrogen, phosphorus)	0
Surface water Pollution from agriculture (e.g. nitrogen, phosphorus, pesticides)	1
Groundwater Pollution from agriculture (e.g. nitrogen, phosphorus, pesticides)	0
Surface water Pollution from industrial wastewater (BOD, COD, heavy metals, hydrocarbons)	1
Groundwater Pollution from industrial wastewater (BOD, COD, heavy metals, hydrocarbons)	2
Viruses and bacteria from lack/inefficiency of wastewater treatment facilities	1
Decline of groundwater levels (or piezometric levels), reduced baseflow and springflow of groundwaters	1
Sea water intrusion in groundwaters	0
Salt water upconing	0
Salinisation	0
Land subsidence	1
Flooding	3
Scarcity and droughts	1
Eutrophication/Nutrification	1
Loss of biodiversity in surface waters and water-related ecosystems	2

Results from the Tirana National Consultation Meeting

During the National Consultation Meeting participants identified a number of groundwater management related issues in the transboundary karst aquifers of interest shared between Albania and Montenegro and grouped them in four (4) clusters; the clusters were ranked according to their perceived importance as follows:

1. Management
2. Water Quantity
3. Pollution, and Climate change

Pollution and Climate Change were thought by the participants to have the same level of importance.

- Management

The participants have chosen to rank first the cluster that includes what they believe to be the causes of the problems (further analyzed in the clusters below) related to the karst system affecting the associated ecosystems and uses. The table prepared by the stakeholders during the NCM is transcribed in Table 62.

Most of the issues included in the table refer to the instruments related to the management of the shared karst aquifers.

Table 62 Management

Causes	Issues	Impacts
Lack of transboundary water management plans	Non rational exploitation	Damage to water sources
	Lack of water balance	Damage to aquifers
	Freedom of action/ use in illegal activities	Damage to quantity and quality of aquifers
	Lack of vision in development	Unsustainable use
	Local and regional coordination	Local one in regional utilization of waters
Cooperation between institutions-National levels	There is no cooperation at the local and central governments and between institutions	Unfamiliarity with real problems
	No harmonization in legal framework	Conflicting arising in diverse activities
No scientific exchange		Problems with development and competences
No exchange of data (or little).No combined database		Overlapping of issues and projects
Lack of trans boundary monitoring programs	No operational structure	Lack of data on quantity and quality of aquifer waters
Lack of joint monitoring reports	There is no scientific and legal framework concerning the monitoring activity	Lack of scientific data intended for third parties: 1. Decision makers 2. Stakeholders
All springs must be protected by law		

The following list is an effort to codify the issues that stakeholders included under this cluster; the discussion during the NCM has assisted in this regard. The issues are presented in descending order following the related prioritisation made by the participants in the tables:

1. Non rational exploitation / Lack of water balance in terms of abstractions/recharge of the aquifer;
2. Illegal activities / law enforcement;
3. Lack of vision in development;

4. Lack of cooperation and coordination among institutions at the local, regional and central levels;
5. Non harmonized karst aquifers related legal framework between the two countries (Albania, Montenegro);

6. Lack of operational structure;
7. Lack of legal as well as scientific framework concerning monitoring[2].

These issues are thought to arise from the lack of cooperation among institutions at the national level, lack of cooperation between Albania and Montenegro in the field of monitoring and data exchange and by the absence of management plans. According to the participants these contribute to the unsustainable use of the aquifers and water sources and their deterioration in terms of quantity and quality, and act as an impediment to the development of the area.

- Water quantity

Some of the issues included in the water quantity cluster, are linked to the unsustainable use of the resource.

The following list is an effort to codify the issues under this cluster; the discussion during the NCM has assisted in this regard. The issues are presented in descending order following the related prioritisation done by the participants:

1. Lack of knowledge about the resources and more particular about the depth of geological layers and the boundaries of the aquifers;
2. Unsustainable exploitation of groundwaters, including uncontrolled drilling;
3. Damage to the rain water-collecting reservoirs used for agriculture.

These issues are believed to stem from the lack of information, lack of awareness and the failure to implement legislation that would protect the resource and prevent general mismanagement. As a result the water level is affected and water resources are not used in an efficient way.

Table 63 Water quantity

Causes	Issues	Impacts
Lack of source inventories and wells being pumped Lack of thorough, up-to-date and detailed information	Identification of depth of geological layers Boundary of aquifers	Lack of efficiency in planning and using efficiently the water reserves
Enforcing and respecting legislation. Lack of awareness	Artesian wells Unsustainable exploitation	Influence at the water level

[2] Monitoring in Albania has been suffering from lack of adequate financial resources earmarked for this cause as well as from problems linked with the overall organization of the monitoring scheme in the country (different institutions have been appointed by the Ministry of Environment, Forestry and Water Administration during the past years to carry out monitoring). This has led in lack of adequate time series of data due to the lack of consistency in the monitoring stations used, analyzing parameters etc.

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	Drilling with no criteria in place from population (too many illegal users of sources)	
Lack of maintenance. Mismanagement	Damage to the rain water-collecting reservoirs sued for agriculture	Flooding. Upsetting soil structure

Note: This table is a transcription of the table prepared by the stakeholders during the NCM; the content has been translated from the national language.

- Pollution

This cluster incorporates pollution from a variety of different sources all of which impact gravely on the water resources quality. Lack of waste and wastewater management infrastructure, limited sanitation areas, unsustainable agricultural practises and illegal drilling are listed as the main identified causes. Furthermore, NCM participants pinpoint the operations of KAP-Aluminium Processing Plant as a source of transboundary pollution.

The following list is an effort to codify the issues under this cluster; the discussion during the NCM has assisted in this regard. The issues are presented in descending order following the related prioritisation done by the participants:

1. Pollution from sewage
2. Pollution from agricultural activities
3. Pollution from mines
4. Transboundary pollution through shared surface and groundwater
5. Urban solid waste pollution
6. Pollution from illegal activities.

Table 64 Pollution

Causes	Issues	Impacts
Lack of infrastructure Lack of waste water treatment Limiting the sanitary areas of protection	Pollution from sewage	Quality of ground water/ Quality of surface water
Use of: 1. Pesticides 2. Chemical fertilizers	Pollution from agricultural activities	
Lack of waste water treatment	Pollution from mines	
Aluminium factory in Montenegro	Protection of inter-border lakes and artificial ones (river muds)	
Lack of landfills	Urban solid waste pollution	
Damage to river beds Illegal drilling	Pollution from illegal activities	

Note: This table is a transcription of the table prepared by the stakeholders during the NCM; the content has been translated from the national language.

- **Climate change**

This cluster is equally important according to the participants with the previous one, Pollution.

Although this cluster has been labelled by the participants "Climate Change", looking closer to the issues included in it, as well as the respective analysis done, one may notice that participants refer to the deforestation and the diminishing vegetation cover that:

(i) affects the microclimate in the area;

(ii) results in erosion that in turn has an effect on the soil cover, hence on the permeability of soil layers above the aquifers, and floods.

Climate change, and the resulting disturbance of precipitation patterns, exacerbates the aforementioned effects. Altogether this impacts the aquifers in terms of water quantity.

Table 65 Climate change

Causes	Issues	Impacts
Lack of vegetative cover and its resulting damage	Climate changes bring along impacts on quantity	Changes in rainwater patterns
Flood related issues Risk damaging the Aquifers Permeability from rivers : Rivers Lakes and seas with no permits attached	Climate changes bring along impacts on quantity - Deforestation	Changes in temperature Damage to the protection layer of aquifers Erosion and floods

Note: This table is a transcription of the table prepared by the stakeholders during the NCM; the content has been translated from the national language.

Results from Interviews

According to the interviewees, pollution is the most significant issue, mentioned considerably more times than the next significant issue. Different sources are indicated, including urban waste and wastewater, construction waste and pollution from the KAP-Aluminium Processing Plant in Montenegro.

The second most significant issue which is a cause of many problems, according to the stakeholders interviewed, is the lack of integrated water (surface water /groundwater) resources management plans. Lack of data and scientific knowledge and flooding are the next most frequently mentioned issues. Finally, the issue of hydro-morphological changes to water courses also preoccupies the interviewed stakeholders.

Other issues indicated include:

- Exploitation of water resources for hydropower
- Illegal logging
- Erosion of surrounding land

What are the impacts, how are they expressed, how do they manifest?

The impacts become mostly evident in the decline of the quality of water resources and the loss of biodiversity. Negative impacts have been reported for the rivers of Buna and Cem and the lake of Shkodra. Furthermore, interviewees report negative impacts on the local economy and hindrance of local development. Finally, one of the stakeholders interviewed, advocates the positive impacts to development from the embankment of Shkodra, and to navigation of ships from the dredging of the Buna River.

How this issue/problem could be addressed in your opinion – what needs to be done in order to avoid or address the problem?

Enhanced cooperation in the preparation and implementation of integrated management plans including protection measures are proposed as solutions. Improved infrastructure and more research regarding the issues and the nature of the resource are also thought to contribute towards better management. Stakeholders also mention raising of awareness and implementing measures with an orientation towards the welfare of the local population as important ingredients towards effectively addressing these issues.