Master Plan of Multiple Use of water resources in the watershed of Bistrica e Pejes

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ABSTRACT

The main objective of this paper is to present a preliminary planning of water resources development of Kosova, based on a master plan of multiple use of water resources of the country.

In this century of crisis in water and energy the problem of water resources development is very crucial, especially in countries like Kosova with relatively scarce water resources.

In this context the exploitation of water resources of the country for the production of hydro-energy is essential and very important.

It is known that actually the Energetic System of Kosova is based on termo-energy, so the use of water resources for the production of hydroenergy will increase further the energy production of the country.

On the other hand a master plan of multiple use of water resources, based on the principle of integrated and sustainable management, will insure better services for other users of the country as drinking water supply of urban and rural areas, irrigation, industry etc.

The catchment of the Republic of Kosova can be divided in several basins as follows:

Basin of the Drini i Bardhe River, Basin of Ibar River, Basin of Morava e Binçës and Lepenci Rivers

The watershed of Bistrica e Pejes belongs to to the basin of Drini i Bardhe, which belongs to the Adriatic Sea catchment. The basins of Ibar and Morava belong to the Black Sea Basin and Lepenci Basin to Aegean Sea catchment.

The Basin Bistricae Pejes , which is the subject of this paper, is one of the most important of Mokna Gora (moist mountain) together with that of Vrella, Istok and the source of the Drini i Bardhe. It has an admirable capacity and convenient geographical position in relation to users of water. It has attracted the interest, and therefore should be treated as a complex capacity, in which important economic components of water can be introduced such as:

Drinking Water Supply
Water for irrigation in both sides of valley
Fish economy and recreation
Hydro-Energy etc.

This master plan will not have negative effects on the ecological conditions of valley because the water, after the use for Hydro-energy production will flow in its own bed and can be exploited by other users.

INTRODUCTION

The river of Bistrica e Pejes has its origin from the Bjeshkët e Moknes (Wet Mountains) near the alps of Cakor. One of its tributaries is located at an altitude of 1,849m above sea level and the other at an altitude of 2,000m above sea level.

From its origin to the city of Peja the river flows in a mountainous river bed along 34 km. The Bistrica River in Peja is supplied by many groundwater flows in the mountainous area, namely from Bjeluha and Jezer on the right side and Boga, Drela and Alaga on the left side.

Before the river joins Drini i Bardhë it flows in the terrain of the village Grabanica in Klina, at an altitude of 365m above sea level. The length of this part is around 30 km and it has an average fall of around 0, 47%.

The river is joined in a meadow land with two other flows: creek of Turjaka and creek of Isniq.

Bistrica River in Peja has average annual discharge of 6.37m3/s.

After the Erenik River, Bistrica e Pejes is the second one regarding to the general surface area of the watershed.

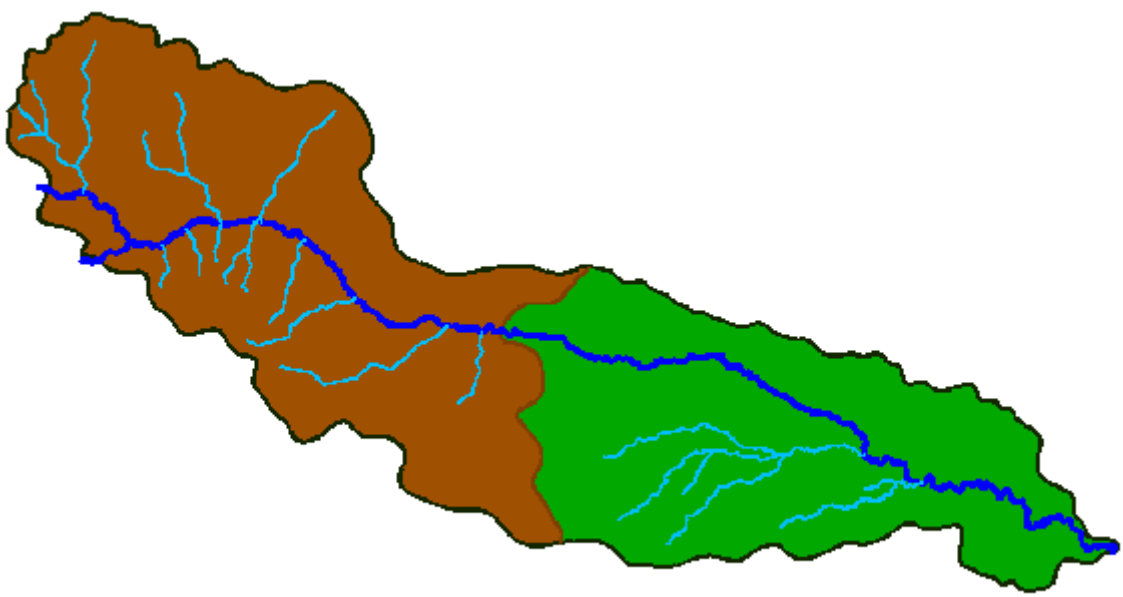
It covers 11.5% of total surface of the Drini i Bardhe basin

Bistrica e Pejes is an important tributary of Drini i Bardhe River. The total area of the watershed up to the rivermouth in Drini i Bardhe is 483km ².

Bistrica e Pejës is mainly a mountainous river. The average altitude of the watershed is 1822.74 m

In the upper and middle part, the Bistrica e Pejes flows through canyons while in the lower part, it flows through meadow and riparian area– fields. The canyon of Rugova is wellknown for its beautifull paysages.

MAP OF THE WATERSHED



Map 1 Bistrica e Pejës watershed

The morphology of the watershed can be expresed by numerical parameters as the surface area of the watershed (F), length of the perimeter of the watershed (O) and the distance from the epicenter of the watershed up to the profile where (U) is analyzed.

In the table 1, the elements and factors of concentration (K) for the hydro-metric stations in Bistrica of Peja are given.

Table 1 Some morphological parameters of the watershed

Hydrologic station	F	L	O	U	K=2F/OU
	(km²)	(km)	(km)	(km)	
Drelaj	164.4	12.2	61.93	7.94	0.676
Pejë	254.7	23.2	87.11	8.76	0.668

The water balance of the watershed

The estimation of water balance of the watershed is important and necessary for an efficient management of water resources. It can provide basic information for planning of the use of water resources: drinking water supply, water for industry, water for irrigation, hydro-energy etc.

Water balance of the watershed depends on natural factors, such as its relief, climate, geological conditions, nature of soil and vegetation. It can be affected also by human activities.

The following table shows the summary on several years in each hydrometric station for which there are sufficient historical data.

Table 2 water balance of Bistrica e Pejes

River	Station	Time period	Surface (km²)	Qmes (m^3/s)	Flow R (mm)	Annual rainfalls P (mm)	E=P-R (mm)
Bistrica e Pejes	Drelaj	1952-1986	166.1	4.33	822	1177	355
Bistrica e Pejes	Grykë	1952-1986	254.7	6.21	769	1168	399

From the table it can be seen that annual rainfall is relatively small but groundwater supply is important and dominates the hydrological regime of the watershed. This is the reason why annual runoff is relatively high and the water deficit (P-R) is small.

Statistical annual flows

The annual flows of the different probabilities are evaluated in the table presented below.

Table 3 Statistical annual flows (m^3/s)

River	Hydro-metric station	Surface **(km^2)**	Dry years		Average years	**Wet years**	
			$Q_{5\%/T=20}$ Years	$Q_{10\%/T=10}$ Years	$Q_{50\%/}$ Years	$Q_{90\%/T=10}$ Years	$Q_{95\%/T=20}$ Years
Bistrica e Pejes	Drelaj	166.1	2.94	3.19	4.23	5.61	6.08
Bistrica e Pejes	Neck/Peja	254.2	4.06	4.44	6.04	8.22	8.97

Flow Duration Curve

Following the evaluation of the water balance, the flow duration curve (FDC) is one of the most important information for the availability of water resources. The flow duration curve can provide also necessary indicators for the identification of the minimum ecological or biological flow (MEF).

Therefore for the hydro-metric station in Drelaj in the river watershed of Bistrica River in Peja we have created FDC from the daily historical data. The results from the existing data are acceptable although those time data ended in 1986.

Three values of the (minimum) flow were presented in each figure:

- 1/10 of average annual flow: 10% of long-term annual flow
- Q90%: flow which is equal or overruns 90% of time period (in one year)
- Q95%: flow which is equal or overruns 95% of time period

The flow duration curve for the hydro-metric station in Drelaj is shown in the following figure:

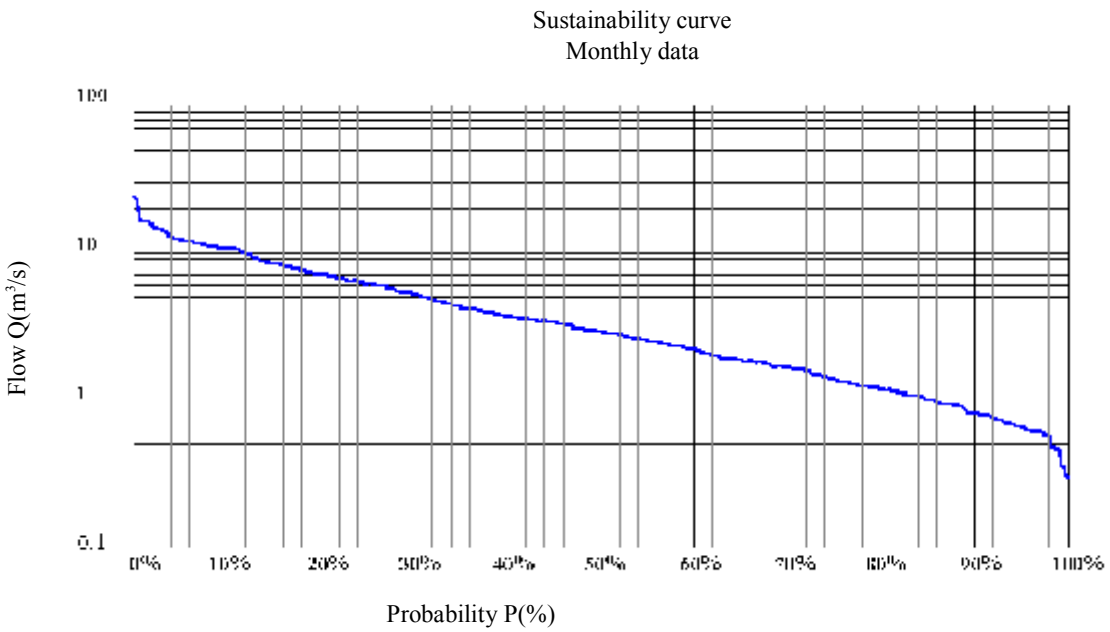


Figure 1
Flow duration curve in Bistria e Pejes in Drelaj

HYDR0LOGICAL RESEARCHES IN THE BISTRICA OF PEJA RIVER

There are two hydro-metric stations in the Bistrica of Peja watershed, in which the discharges in Drelje and Peja are registered. Both two stations are equipped with limnigraf, which in the previous period have functioned well. These stations were modified and actually the water levels are registered with sensors. These sensors were installed in 2003. The levels are registered in a permanent manner each 15 minutes. Afterwards they are registered in the data logger and then are transferred through one computer in the data base of the Kosova Hydro-Meteorological Institute in Prishtina. Given that two stations belong to the entire surface area of the watershed of Bistrica of Peja, namely 483 km^2 (242 km^2 averagely for one station) and we can consider that it is sufficient level of hydro-logical and hydro-metric researches of the watershed.

In the table 4 are given basic elementary technical data as well assessment of the quality of discharges at the hydro-metric stations in the watershed of Bistrica of Peja.

As a general assessment of hydrological studies in the watershed of Bistrica of Peja is that the size-values of the influence in the profiles of hydro-metric stations are sufficiently reliable and hence can serve as a basis for drafting project ideas.

Table 4 Basic parameters for hydro-metric stations

River Station	A(km^2)	Kota "O"	Beginning of work	Type	Stability of riverbed	The period of the data use		Quality of data		Original data from
						Level	measurements	Level	Discharges	
Drelje	164.4	939.37	1957	Limnigraf	Unstable	1957/1986	1958/1986	Good	Good	IHMKosovo
Pejë	254.2	553.28	1953	Limnigraf	Unstable	1953/1986	1954/1986	Good	Good	IHMKosovo

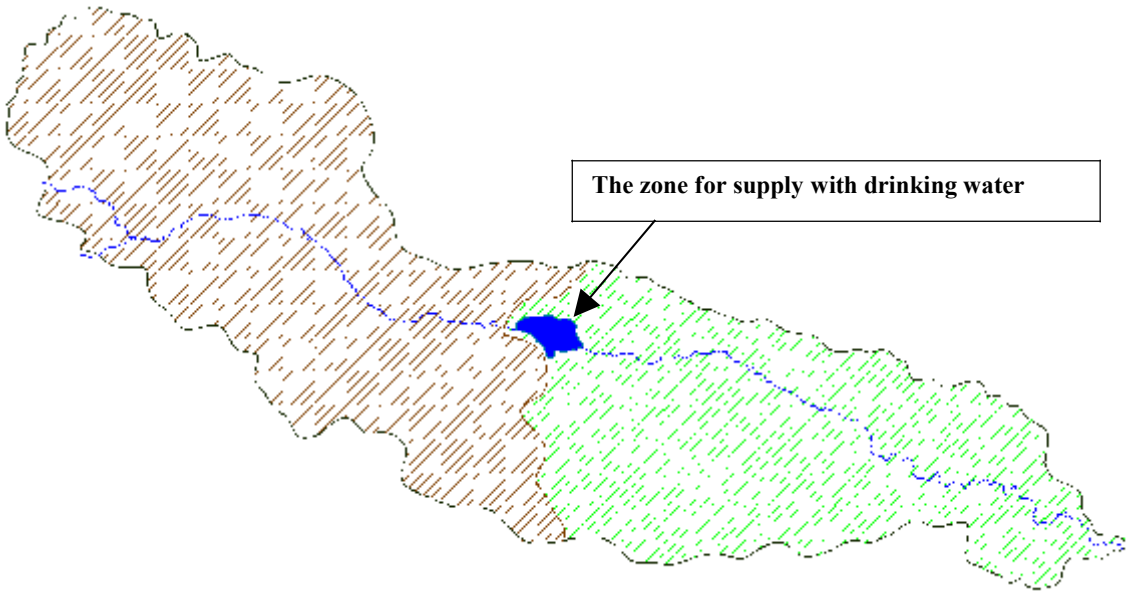
DRINKING WATER SUPPLY

The main purpose of the public services sector is supplying water to the population and industry. To create a consistency of public services with an effective self-management, the protection of public interest by ensuring equitable and reliable provision of services. All effective assessments were based on the actual consumption data, examined in a critical manner, taking into consideration the situation of resources availability as well as verification of excess consumption of water resources, which is given in the rational manner. The total water used for drinking by the company Hidrodrini Bistrica is approximately 50%.

The place where drinking water is ensured from Bistrica watershed, is the source of Uji i Zi which is situated fourth mile from the town of Peja towards Rugova Neck, about 60 feet below the dam no. 1. The source is located on the right side of the River. The average discharge of the spring is about 500 l / s, while

The spring of Uji I Bardhe located on the left side of the Drini I Bardhe River is used only in cases where needs are not met by the Uji i Zi.

THEMATIC MAP FOR DRINKING WATER SUPPLY



Map 2 the zone for drinking water supply

WATER FOR IRRIGATION

Agriculture is considered a major part of Kosovo's economic activity. Agriculture, forestry, agribusiness and food processing are primary and constitute 60% of employees. Addressing the problem with regards to incomes, facilitating major structural changes in rural economy and creating economic structures and instruments that would generate income through the expansion of the agricultural sector presents a challenge. In this aspect, the water economy gives a great aspect and the use of water hydrographic network to the needs of economic and cultural development.

As regards to watershed, the irrigation of lands is made from the concrete weir, such as:

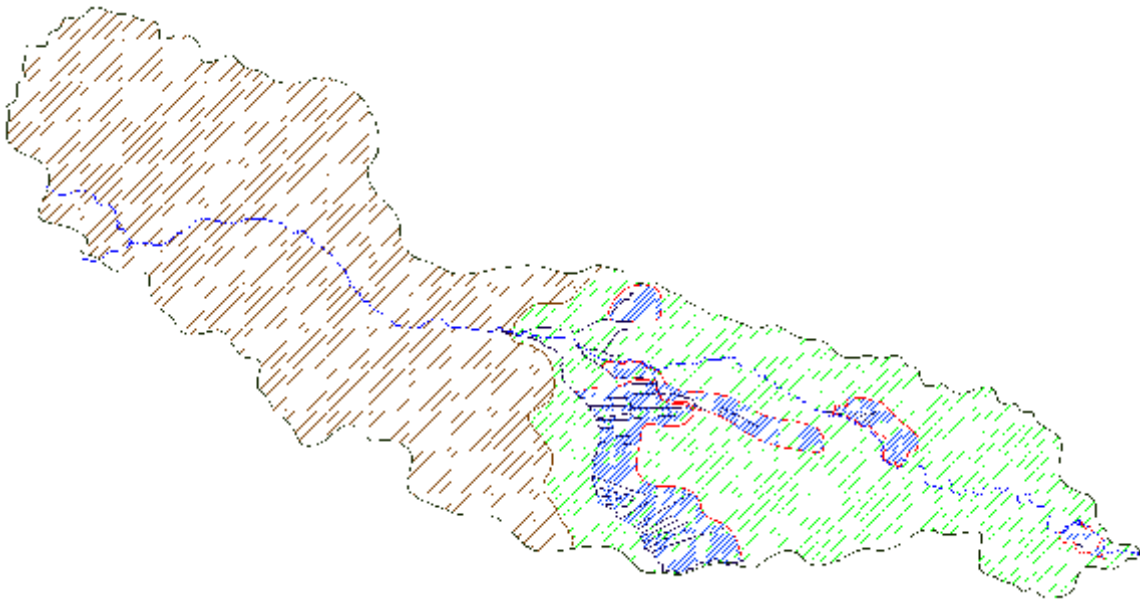
The weir of South Channel; the weir of the Channel of Seravisë; the weir of the Channel of Kastrat; the weir of the Channel of Gllaviqica; weir of Grabanica and seasonal primitive wears.

The water is required in summer period June, July, August and September and during these months the agriculture is the primary sector.

This request is distributed with average monthly discharges in June –September Q average = 2.80 m^3 /sec.

This amount is distributed in all months of the year without changes on the values of discharges.

THEMATIC MAP OF IRRIGATION



Map 3 watered surfaces

FISH ECONOMY, RECREATION AND FACTORY FOR WATER PACKING

Besides use of water from the watershed of Bistrica for drinking from Hidrodrini along the watershed we have the plant which make the packaging of water which is located in Gryka of Rugova with the capacity of V = 1,47 l / s. Water for the factory obtained from source which is located on the right near the building for packing Bistrica. The water of Bistrica e Pejes River is very qualitative. Surrounding mountains give very favorable conditions for mountain tourism development. In recent years in wonderful mountains in this area has begun also the "Camping tourism".

Photo 1: Fish economy

Photo 2: Plant for water packaging

Photo 3: Images of Cursed Mountains (Bjeshkët e Nemuna)

HYDRO-ENERGY

Being in the century of crisis (such as for energy as well as water) in Kosovo, the attention is turned to renewable energy sources. One of these resources is the hydro-energy in Kosovo, even though with few opportunities compared to neighbors. Therefore it is extremely important to study and use it as soon as possible.

1 Based on the pre-evaluations made on the Bistrica River in Peja, the possibility of construction of three small hydroelectric power plants (HCV) was identified:

2 HCV Kucishta

3 HCV Drelaj

4 HCV Shtupeç

5 The construction of these HVC will contribute in improving the energy system in Kosovo, which is currently poor in the HYDRO component.

CONCLUSION

Based on this study it can be concluded:

Based on the obtained results in this study, the general world trend in paying attention to a better and complex use and utilization of renewable resources.

Even though Kosovo compared to neighboring countries is poor as regards to water resources (hydro resources as a consequence) it is an urgent task to initiate studies for all flows aiming towards creation of a master plan with already new conditions by treating water as a vital element and avoid the crisis in the near future.

The proposed solutions for Bistrica River in Peja -construction of three hydropower stations (without prejudicing their components for water economy: The water supply to population, agriculture, fish economy, the ecology of the valley) will greatly help the improving the electricity supply in Kosovo.

Because the existing reservoirs for irrigation do not fulfill the needs for irrigation water in the watershed we propose the design and the construction of three other reservoirs, which could improve the irrigation systems, the drinking water supply and will increase the production of hydro energy.

The details on the design of these three reservoirs will be developed in a complete study which is planned to be carried out in the next months.

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