The analysis of the building structure situation, accumulation and distribucion of the "Ujemani" watersheds and its impact on the effectiveness of catchments

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Abstract: There are only 1600 cubic meter water per year per capita or approximately up to 121.2 m³/sec, in Kosovo[9]. This results in insufficient reserves, which will have an impact, in the future, for economic and social development [7]. One of the largest accumulations, in Kosovo, is the Ujemani reservoir and dam, which provides water accumulation – the amount of which is used to supply the raw water in the Kosovo Energy Corporation, Ferronickel, and Trepca. The Iber-Lepenci supplies the regional water supply of Mitrovica and Prishtina with raw water (for Drenas) and it is also used for electricity generation in HP Ujeman 2x17.5 MW – 95GWh/year. The public company of Iber-Lepenc is responsible for the water management. The Iber-Lepenc facilities are expanded in seven municipalities – Zubin Potok, Mitrovica, Vushtrri, Obiliq, Prishtina, Fushe Kosova and Drenas. The height of the Ujemani dam is 107.5m, with an area of 11.9km². The enterprise is responsible for the accumulation of 375 million m³ of water for Ujeman, which also includes the Ujeman hydropower[1]. Out of this accumulation, more than half of Kosovo is supplied with water. Furthermore, 20.000 hectares of farmland are irrigated, and it supplies the main energy and mining industry and produces hydro-energy from 2x17MW/h [12]. The structure analyses of the "Ujemani" accumulation and its water distributive structure have incurred damages; their reconstruction, amount of water loss are due to the damage from the mismanagement and non-maintenance of the infrastructure. The international models of water management are the key topic discussion in this study. The previous researches have been analyzed critically, regarding the total cumulative infrastructure, as the Ujemani catchment system. The essence of this paper is to analyze the amount of water flow in the river, by analyzing and comparing the amount of the average monthly, annual and multi-year rainfalls. The inflow from rivers that flow into the river, building a model for researching the situation of the infrastructure setters, efficiency, supply of water industry and economic and social needs for the next few years, have had an impact on the problems and challenges, constructions of channels, and their expansion. Using the model to formulate hypotheses, regarding the impact of these factors on the value of the system as a whole and the channel in particular, to provide recommendations on the rehabilitation of special facilities, such as aqueducts, tunnels and siphons. The rehabilitation of these channels is in the form of trapeze and rehabilitation of joints on the rehabilitation, maintenance of drainage, etc.

Key-Words: -Ujamnai, accumulation, main canal, irrigation, hydro-system, agriculture, industry

1 Introduction

Water is a key resource in the production of goods and services, including food, energy and production of various products. The water supply, in the place where the user is located, should be predictable, in orden of financially supporting theviable investments in economic activities. A wise investment, in infrastructure, should be financed adequately, containing relief operations affecting the structural changes necessary to make advances in highly productive areas of the economy. The purpose of this study is to analyze the condition of the building structure, accumulation and distribution of the "Ujemani" reservoir and its impact on the effectiveness of the catchment. Knowing the potential and impact of this reservoir on Kosovo's economy, it is necessary to analyze the current situation, in detail, and provide solutions for its improvement. Despite the enormous importance, this topic has not been discussed much, therefore, it is an interesting research topic.

Kosovo's economy is highly dependent on its waters. As a geographical position, it is more likely to develop agriculture. This is due to the fertile soil and climate suitable for the cultivation of crops [8]. For the development and growth of these yields, the main factor, together with the soil and climate, is water, which needs irrigation in developing and yields. The infrastructure of the hydrosystem has a key role in the normal functioning of hydro, no regulation (remediation) of an adequate infrastrukture, which can result in different technical anomalies. No sanitation of these anomalies can come to snivels of the structure and, in certain cases a f alure in structure, where the consequences would be too great for the economy of Kosovo and will come to the power plants malfunction, flooding across the territories, which crosses the canal infrastructure, lack of supply of drinking water to a population of close to half a million inhabitants and the consequences in the industry (especially in major industrie, such as, Ferronikel, Trepca, etc.).

Competing requests continue to impose tough decisions on sharing and limit the expansion of critical sectors sustainable for the development, in partikular, the production of food and energy. Water scarcity is often the result of old-fashioned use of natural resources and governments that use the resources for economic growth, which is regulated and undertaken without adequate controls. The underground water supplies are reduced by, approximately, 20% of the world's aquifers, which are currently overused [4]. The destruction of ecosystems through urbanization are shrinking, unfitted agricultural practices, deforestation and pollution are among the factors that have weakened the environmental capacity. Persistent poverty, unfair access to water supply and sanitation services, inadequate funding and incomplete information about the state of water resources, their use and management impose further restrictions on water and influence to have water crisis worldwide [13].

The demand for water is growing in the world, while water resources are decreasing. Water loss from water networks is one of the major problems, even in countries that are developed in the infrastructure and organization. In comparison, in underdeveloped countries or those that are under development, this problem is wider. This combines the underdeveloped infrastructure, poor remediation and interruption of water supply, which causes serious health risks to the population [14].

Water loss is not only the result of underdeveloped infrastructure, but also leaking pipes. Water losses in the distribution network, the abuse of water use and other details are the result of a bad situation in some countries. The key to developing strategies for halting the loss of water is the awareness of the key reasons that affect water loss. Subsequently, different techniques must be developed in order to improve the specific situation of the water network [14].

The irrigation strategies have different effects on the cultivation of planted crops, biomass and irrigation demand. For instance, in the Mediterranean regions, the crop irrigation requirements range from 1220 mm/year up t o 171 mm/year. Absoulte irrigation requirements are higher in the Mediterranean and lowest in the northern region, reflecting the general climatic characteristics of these regions. Cultural yields, are given as r elative changes in connection to the irrigation strategy, averaged over all crops and all cultural regions. The highest irrigation area is in the Mediterranean (81%), while, in the Atlantic, Alpine, and the Northern Region, is lower than 20%. This reflects the essential requirement for irrigation in the Mediterranean agriculture, while other parts of Europe receive sufficient rainfall for crop cultivation [9].

Table 1, Relative yield change with respect to the irrigation strategy S0 and irrigation requirement (mm/yr) by crop region.

Yield change compared with S0	**S0**	**S1**	**S2**	**S3**	**SX**
Mediterranean	0	-0.04	-0.16	-0.66	-0.81
Alpine	0	0.01	-0.02	-0.09	-0.15
Continental	0	0.01	-0.01	-0.13	-0.26
Atlantic	0	0.05	0.01	-0.10	-0.16
Boreal	0	0.05	0.05	0.00	-0.02

Irrigation (mm/yr)	S0	S1	S2	S3	SX
Mediterranean	1220	886	724	171	0
Alpine	456	189	127	59	0
Continental	569	273	205	105	0
Atlantic	521	215	147	54	0
Boreal	355	148	96	42	0

If we focus on the geographical position of Kosovo, it lies in the central position of the Balkan Peninsula. Consists of mountains with average height and of high and low plains [7].

Fig.1, Balkan Peninsula

All rivers, except one derive in their territory [9]. However, like many countries, Kosovo has many water problems. The biggest problems are due to the mismanagement and inability to get the best of this very important resource for the population.

In hydrographic terms, Kosovo is divided into four river basins: the White Drin, Iber, Morava and Lepenci. The Kosovo river flows poured into three sea basins: the Black Sea, the Adriatic Sea and the Aegean Sea. The main rivers, which belong to the Black Sea basin are: Ibri, Sitnica branches; (Llapi, Drenica) and Binca Morava. In the Adriatic Sea there are: the White Drin branches (Lumebardh of Peja, Lumebardh of Decani, Lumebardh of Prizren, Klina River, Erenik, Mirusha, Toplluha and Plav). Wheeras, the Lepenci river with its main branch (Nerodime) belongs to the Aegean Sea [9].

The Ibri river basin constitutes of hydrological and economic unit, which represents the central Kosovo and is divided into three sub-basins, each with a main reservoir, created by dams [13].

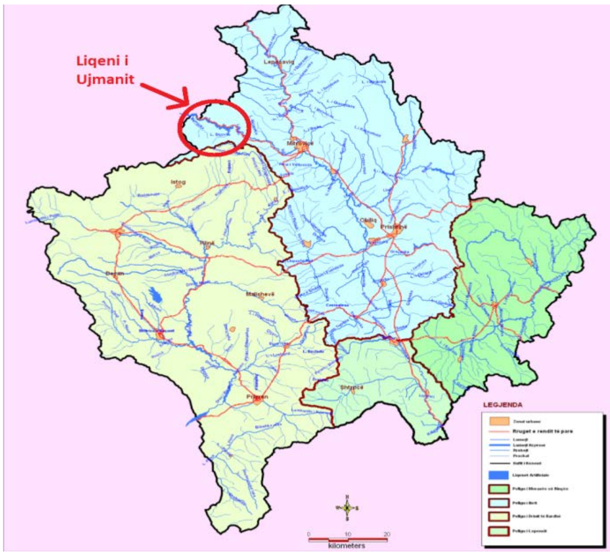

Fig.2, Map of ponds and rivers in Kosovo [9].

If we analyze the strategic plans of Kosovo, during the 60's, theyhave been oriented in constructing several of catchments (artificial accumulations), in accordance with the rivers in Kosovo, in order of supplying the population with drinking water and the supply of industry, energy, agriculture, and economy, in general. This has been proved by a very convenient configuration of a hilly country. With this curriculum, 6 w ater accumulations are supposed to be built (Tab. 2) where one of the largest accumulations has been the "Ujemani" Lake.

Table2,The main accumulations in Kosovo [9]

Name of accumulation	Water flow	Basin area [km^2]	Average flow [m^3/sek]	Accumulation volume /Million [m^3]	
				Exploiter	Total
Gazivoda	Iber	1060	13.5	350	390
Pridvorica	Iber	-	-	0.435	0.49

Batllava	Batllava	226	1.06	25.1	30
Badovci	Graçanka	103	1.05	20	26.4
Livoçi	Livoç	53.6	-	-	-
Radoniqi	Lumbardh Deçan	130	0.16	102	113

The "Ujemani" accumulation lies in the northwestern part of Kosovo. It has an area of 11.9 km² and a maximum depth of 107,5 meters. It is the largest lake in Kosovo and one of the greatest assets that we have. "Ujemani" supplies more than half of Kosovo with water, irrigates 20000 hectares of land, and can also serve as a r ecreational part [1]. The construction of this system is planned to be done in two phases. The first phase "IBRI" (completed in 1986) and the second phase "LEPENCI" which is non - existent. The catchment has been built, in order of the water accumulation to supply the population with the drinking water, for agricultural irrigations, for the supply of Iber – Lepenc, for the supply of TCA and TCB plants, for water supply of the "Badovci" lake, for the supply of the "Feronikeli" smelter, "Trepca" Combine and other operators of the industrial and economic development. However, its construction has more than 30 y ears and the infrastructure, without the regular and adequate maintenance, has brought a lot of unsolved issues to the table, such as: huge water loss, basin and canal cracks and their water flow, aging of the sensitive parts of the canal, outdated technology, poor maintenance, etc. The "Ujemani" HPP, with the production capacity of 2x17 MW, has also been built in this catchment.

Fig. 3, Hidrologic Map of Kosovo[9]. Fig.4, Ujemani artificial Lake (acummulation) [1]

"Ujemani" today serves as a H ydro-Economic Enterprise "Iber – Lepenc", Joint Stock Company. According to the Law on Public Enterprises [2], the "Iber – Lepenc" is one of the central public enterprises of the Republic of Kosovo, organized as a joint stock company, which, through the Board of Directors, is accountable, as the only stakeholder, to the Government of Kosovo. The current number of employees, in this enterprise, is 270 [1].

The aim of this study is to verify the impact of the infrastructure construction, accumulation, and distributive accumulation of the "Ujemani" catchment in its effectiveness, problems and challenges, reconstruction of canals, repairing, cleaning, and enlargement, in providing recommendations on the building rehabilitations, such as, aqueducts, tunnels, and siphons. The rehabilitation of canals in a trapeze shape and the rehabilitation of joints, maintenance of drainage canals, etc. With the minimum amount of words, we should not lose the accumulated and valuable water because of the damaged infrastructure.

Especially in agriculture, the water conservation can be done with irrigation improvements and greater use of technology. If the irrigation system will be improved, it will retain 10-25% of the water use. Saving water by improving the efficiency is expected to be from 15% to 60% of water use. Additional water storage can be done by improving the irrigation system (30% saving). Potential storage in the irrigation sector would reach 43% of the volume of water that is used for agriculture today [15].

Industries that use large amounts of water can be used to recycle the water, which would offer storage of 15-90% and reach a total savings of 43% of the water use today. A sub-sector, among the most important in the industry, is the production of electricity. This sector uses huge amounts of water; however, most of this water is used to generate electricity flows back into the environment, so this report does not include the potential savings from this sector [15].

Life water system is usually based on factors associated with each other, such as technical, community, environmental factors and legal and institutional organization. Technical factors usually affect the maintenance and longevity of the whole system, including technology, its capacity to respond to demands and their impacts on the environment. Moreover, the technical skills to maintain and work the system should be used. The environmental factors that can affect the system and its maintenance are water quality, quantity and its continuity. Water resource management, pollution control and water management system are key components for the longevity of service water system. This includes maintenance and operation. All of these factors should be have legal and institutional system and laws must be followed during the operation and maintenance [16].

2 Materials and Methods

Study area: The study was conducted from September 2014 until November 2015, in the "Iber – Lepenc" hydro-system (Fig. 2,3,4) located in the northern of Kosovo, in the "Ujemani" accumulation. Every research, measurement, analysis, calculation and protective measurement maintenance, including the accumulation of all the accompanying infrastructure and comparative changes over the years has been taken into account.

The comparisons have been made from the surveys, photos, taking samples, analyzing them, comparing the damages, etc. The measurements were taken from the field, where the samples were collected, from the cultivated areas up to the laboratory, and which are:

- Geotechnical measurements (EN-1997-1:2004, EN 1997-2:2007);
- Geodetic measurements (such as: length, width, height, etc.) using GPS devices;
- Concrete solid measurements with a Sclerometer or Schmidt's Hammer;
- Solid Reinforcement measurements (EN 1993-1-1:2005);
- Measurement of the concrete solidity under pressure (EN-1992-2, EN 206-1, EN 12190);
- Measurement of the solidity in flexion (EN 196/1);
- Elasticity module (EN 13412);
- Measurement of the performance of the insulation materials (elasticity module, climate changes, water permeability, etc).

The variables taken into consideration for this study have been categorized in performance planning, management, maintenance, repair, restructuring, and investments, in general. In the qualitative methods (research methodology, theoretical analysis, as well as, research on the internet) and empirical studies and statistical processing of the data obtained in the field, has made it possible to examine infrastructure accumulation, structural building, distributive accumulation in water. The data were compared to the data of the previous surveys and researches conducted in the field. The statistical process has also been done and the data obtained are presented in a tabular form, with diagrams, maps, and photos taken from the field.

In addition, in this study we have used all of the possible stakeholders, who have participated in the construction, development and management of this Hydrosystem. All current participants, such as, the Director of Planning and Development, Head of Capital Investments, Chief Operating and Maintenance, Engineers, and Surveyors are involved in providing all the necessary information on this study, including the entire infrastructure of the Hydrosystem, as a whole, and most importantantly the ones described below:

The management and hydrosystem infrastructure, the company's facilities extend to the territory of seven municipalities, such as: Potok, Mitrovica, Vushtrri, Obilic, Prishtina, Fushe Kosova, and Drenas. Through these methods, these objectives of the study are met in this paper:

- Analysis of the state existing channels;
- Analysis of the importance of air quality;
- The research infrastructure of the Ujemani and Iber-Lepenc reservoir; accumulation and distribution infrastrukture of the Iber-Lepenc;
- The research of the state of the irrigation system;

- Analysis of organization and management;
- Analysis of results for the materials used;
- Testing the laboratory materials;
- Demonstration of the special insulation materials (joints);

3 The Canals and Irrigation Systems

Since the time of the construction, the Iber-Lepenc is divided into two parts: the Iber phase and the Lepenc phase. Iber, with about 1,000 hectares, irrigated by surface irrigation, while the rest, with approximately 19,000 hectares, irrigated by artificial rain. Iber is divided into four subsystems. These appear as a sep arate unit, as in the case of construction, as well as, towards the organizational ways. See the following table.

Table3,Irrigation surface in ha [1]

Irrigation Surface	Area [ha]
Iber Field	880
Northern Area of Kosovo I	7300
Southern Area of Kosovo II	6100
Drenica Field	5620

The subsystem of Iber field includes land surface extending between the village of Lower Zhabar and Pridvorica dam. The subsystem in the Northern part of Fushe Kosova includes all areas that lie between Mitrovica in the morth, and Llap river in the south.

The subsystem on t he Northern part of Fushe Kosova II include the areas of Llap river in the north and Gracanke river in the south, through the village of Dobreva.

The Subsystem of the Drenica Field includes the field of Drenica. Every subsystem has a determined number of fields, as a smaller unit for irrigation. The Iber System includes landmasses of four municipalities: Mitrovica (1480 hectares), Vushtrri (5700 hectares), Prishtina (7100 hectares), and Gllogovc (5620 hectares) [1].

The irrigation system consists of the following items:

3.1 Water Source

The great dam of the Gazivoda, which is in the Iber River, helps its water accumulate and form artificial lakes, with a capacity of 370 milion cubic meters, of which 20,000 hectares are irrigated within the Iber system.

3.2 Canals

The canals, which convey water from the basin compensatory, precisely the Pridvorica dam and until the highest peak of the Iber system, with a height of 150 km, from which the water is taken in certain countries for irrigation and with the help of the stationary pumës or aggregated mobiles, pressurized water enters the underground pipe network.

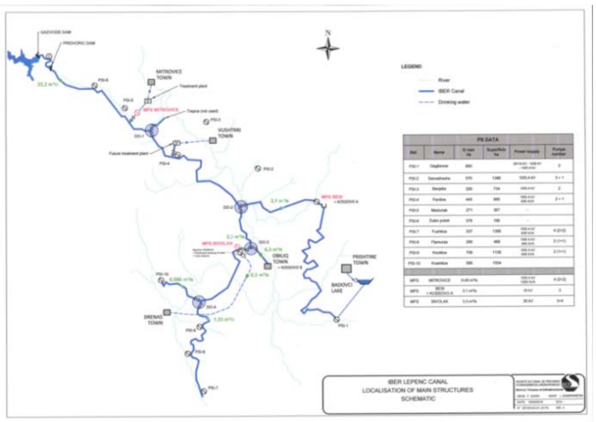

Fig. 5,The Ibër-Lepenc structure [1].

The canal consists of:

- **The main canal "Pridvorica – Obiliq"**with a height of 53.2km', capacity 22.2m3/s;
- **Road "Verbnica- Mitrovica"**with a height of 2.8km', capacity 3.5m3/s;
- **Canal "Mihaliq-Besi"**with a height of 14.4km', capacity 3.1m3/s;
- **Canal "Besi-Graqanke"**with a height of 35.5km, capacity 3,1m3/s;
- **Canal "Hamidi-Drenicë"**with a height of 12.2km, capacity 3,3m3/s;
- **The left canal of Drenica**with a height of 18.5km, capacity 1.33m3/s;
- **The right canal of Drenica**with a height of 10.0km, capacity 0.586m3/s;

The main canals are open, have a trapeze shape and are paved with concrete. However, depending on the terrain conditions, the main canals are:

- Open canals with a trapeze shape;
- Closed canals;
- Tunels;
- Siphons;
- Aqueducts;

Fig. 6&7, The open canal and aqueducts

Besides the main buildings, within the hydrosystem, numerous facilities were built for irrigation and drying, the road traffic and the exploitation, facilities for the protection from the torrential waters and erosion, and the river flows have been regulated.

3.3 The network of underground pipes
From the land of water occupying the main canals, the water enters an underground pipe with larger dimensions, which is then divided into pipe bounds of smaller dimensions. These pipes with smaller dimension tubes, are called the II order and III order.

3.4 Facilities of irrigation
The facilities for irrigation comprise aluminum tubing with a standard length, which are connected among themselves and form the required length, in which they are set to spray water distribution across the surface of the earth in the form of rain.

The lands included within this system are light soils that absorb water quickly, but have a smaller water capacity and soils that absorb water slowly, but have greater water capacity.

Fig.8, Details of irrigation from the Iber field

Iber irrigation system is semi-stationary, so it is partially deployed underground, while the carrier is partially above the ground. It is imperative that every user should know and possess the technique of using the system, so, that this system is used successfully for irrigation [3].

With the construction of the great dam of “Ujeman” in the “Iber” river basin', the accumulated Iber waters form the largest manmade lake, which have a volume of 370 million cubic meters, of which about 20,000 hectares are irrigated, within the "Iber" system approximately 65 million m^3 will be used [1].

The canals, which convey water from the basin compensatory, of the "Privodrica" dam are wide in "Iber" with a length of 150 km, from which the water is taken in certain countries, irrigated and with the help of stationary or mobile pumping aggregates, water pressure (pressure) are inserted into the underground pipe network, while in those places where the canal has sufficient domination (over 30 m) on the surface for irrigation is issued in underground pipe bounds and are found under natural pressure.

From the land of water occupying the main canals, the water enters an underground pipe with the largest dimension (pipe order I), which is divided into pipe bounds with small dimensions (with the pipe order II and III). These pipes have diameters of 800 m m (order I) in 125mm wide (order III).

Facilities for irrigation comprise aluminum tubing with standard length (6m), who are related to the properties and form the required length, in which the sprayed water is distributed across the surface of the earth, in the form of rain [1].

4 Results
According to the research done, the quality of the infrastructure assets of the accumulation and Water transportation canal is in a bad condition and needs rehabilitation, and also the protection against accidental blockages, pollution, and other causes to this disorder [3].Water loshes are high in the transmission systems and can be reduced, significantly, with a relatively low cost. Despite this, the mudslides, debris, and animals that end up i n these unprotected canals of the “Iber – Lepenc” and the pollution from the sorrounding areas and streets, all jeopardize the reliability and quality of the industrial Water supply[4]Bacteorological and chemical pollution, as well as, waste, are also evident.

Based on the results from the research done, we can that:

4.1 Dams – are in an acceptable condition. The main issue relates to the supervision and monitoring of dams, things that were cut in between, since 1997. Based on t he examination, the dam has deviated, except for the part where the part of the reduction can be seen with a naked eye, some concrete parts are damaged or missing.

Fig. 9, Current status of a partially restored canal

Parts in the upper or lower leakage are generally in a good condition. The incresead vegitation is the main concern. A gate of the discharged canal is not in function. The maintenance of the gallery is at the appropriate level and the accumulation which has incresead the sedimentation, is considered a phenomenon[10].

4.2 Distributor canal–almost 30 years have passed, since the construction of the distributive canals, where their current situation consists of a huge loss of Water, due to the againg of the amortization structure. Physical damages have caused losses, where we see large cracks, which are measured up to 0.50m. The main infrastructrual objects of the canal, such as, tunnels and siphons have not been rehabilitated and the damages can be easily seen in these structures, which are done because of the aging, as well as, physical injuries, which represent a potential risk, in the future, for the normal functioning of the canal [5]. The maintenance of buildings, in emergency cases, is not at the rigat level. In some parts, the erosion soil is easily seen. As a result, the final point of the canal reaches up to 60%, of which half are due to the mismanagement of Water (this includes the issuance of larger quantities of Water than needed) and the other half are due to the factors that we have mentioned above. Starting from the open canal with a trapeze shape, the canal passes through the U-Profile cutting rectangular, which as a holder starts with a distance of 12.00m in frame. The walls of the canal, on the upper side, are made of a reinforced concrete with 0.30x0.30m dimensions, at a distance of 2.80m. The walls and floor are made of reinforced concrete with a thickness level t= 40.00cm, the filling of the trench with Water, depends on the issuance and spending, as well as, the needs of hydro-meteorological conditions. You can easily observe the surface degradation, from the inside, as well as, minor damages in the wall, hanging at a Water level.

Fig.10, Current status of a partially restored canal

This level reaches the Water with low temperatures, due to freezing, the concrete structure gets damaged and, with time, it may face bigger damages with larger consequences (Foto 2&3). Due to freezing and external Water flow, the pillar holders may also get damaged. The damages are evident and, mostly, in the protective layer of armor, where we can easily notice a reinforced degradation[6].

Fig. 11, The damage of pilar holders and canals from freezing and water loss

4.3 Properties and the environmental impact

In many cases, the construction waste materials and various types of solid waste are disposed in uncultivated areas, near the Iber – Lepenc canal, which pollute the soil on the shore of the canal, with metal components and oil. Deforestation, fire, and wood diseases have an impact on the forest cover and soil stability[7]. Many of the houses are built on agricultural land within the perimeter of irrigation. Property problems and the recreation of land registry are underway, but, in the meantime, the ownership of some plots of land is insecure. The usage of pesticides and artificial fertilizers are, also, representatives of local sources of pollution. All of these contamination levels, significantly, exceed the EU thresholds. As a r esult, the "Sitnica" river is polluted with heavy metals, suspended solid matters, sulphate, nitrate, and chlorine. It is, in fact, the most polluted river, in Kosovo, thus, this pollution has an impact on the "Iber" river, to the point of confluence [8].

Fig.12&13, The rehabilitation canal with Fuga materials

5 Discussion and Conclusion

In order of preventing the risks for the future generations, the old infrastructure needs the first repair. Repairs on aqueducts, canals with the form of trapeze, joints and drainage canals, have given positive impacts on the water supply of the request of the economic operators. Therefore, the repairs made within time, result positively. The water quality, in the storage, is considered as good, but during the transmission, throughout the canals, we were able to find pollution, which, are mostly caused from the human factor and the other ones from the rainfall and snow. The main problem in the water distribution is the technical loss of water, this happens as a result of the depreciated system, where the repairs have not made key facilities in a professional way, while using modern technology.
The greatest losses are seen in the distribution canals, which are composed in Table 4.

Table. 4, The details of the distributive composition canals

Type of Structure	Amoun t	Height (m)
Open Canals of Type “A”		18 913.85
Closed Canals of Type “B”		11 645.96
Open Canals of Types"B"and"E"		2 086.44
Closed Canals"C"		1 355.96
Siphons	11	3 506.58
Aqueducts	20	2 321.58
Tunels	14	9 487.95
Partition Structures	3	90.15
Passing Structures		1 117.33
Total		**49 185.84**

The greatest losses are in the distributive canals. These structures are built of concrete. The length of the open canals, aquedutes, and cross-overs from the starting point of the canal, are approximately 24500m. The length of the canal with a trapeze shape is 18913.85m, where, up to this moment, 80% have been rehabilitated, of which the failure of modern material technology is easily noted, specifically in the material joints (see picture 9,10&11).

Pictures show the rehabilitation of the canals, but the failure of the jonit materials can be easily seen. According to the research done, we have found out that the material used is of new technology. We have found the adequate materials for these issues, such as, Fix-O-Flex – the German manufacturer. With the introduction of this material, the biggest bulk of flows is eliminated. Other facilities are in poor conditions, where we can find Water loss and in certain parts, even the normal Water supply is in danger. Out of all the damaged buildings, the aqueducts are also included, where there is a need of the general overhaul, as soon as possible. In these objects, we can observe a huge Water loss, as a result of the degradation of materials and depreciation. Physical damages are as a result of the terminal side, from the purpose of the Water flow. These impairments have a total length of 50cm. After all of the constructive rehabilitation of the aqueduct, the anti-corrosive protection should be done, with anti-corrosion, paint, with two concrete surface actions, which have been cleaned, previously, with high-pressure Water.

6 Recommendations

Based on t he studies of this project, our recommendations are listed, as below: our recommendations are listed, as below:

- The rehabilitation of special facilities, such as, aqueducts, tunnels, and siphons;
- The rehabilitation of un-restored residuals with a trapeze canal shape and the rehabilitation of joints;
- Drainage maintenance;
- Property definition, as well as, the removal of wild occupations along the canal;
- The structural construction for protecting various earth slides;
- Property usage along the canal, by cultivating fruit nuts or sweet fruits;
- The usage of landfills for fish farming;
- The implementation of mini hydro-power plants will small capacities 0.5-1.0 MW;
- The implementation of the Mihaliq basin;
- The implementation of the digital management system – SCADA;
- The implementation of the second part of the "Lepenci" project[3];

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