# The impact of the building structure, accumulation and distributive infrastructure of the "Ujmani" reservoir in the effectiveness of catchments

ILIR MORINA[1], AGIM NEZIRI[2], ANDINA VLLAHIU[3], NASER BAJRAKTARI[1*], VALMIR ZOGAJ[1], MERITA MEHMETI[3],
[1]Public University "Haxhi Zeka", Faculty of Agrobusiness, Department of Agroekology and Environment Str. "UÇK, 30000 Peja, Kosovo
[2]Agim Neziri, PE Iber-Lepenc Hidrosystem, Prishtina, Kosovo
[3]Kosovo Environmental Protection Agency, Str. Luan Haradinaj, 10 000 Prishtina, Kosovo
[*]Corresponding author

ilir.morina@unhz.eu, agim_neziri@hotmail.com, andina.vllahiu@rks-gov.net, naser.bajraktari@uhnz.eu, valmir.zogaj@unhz.eu, merita.r.mehmeti@rks-gov.net

***Abstract:*** -The state of Water remains the main subject of this century and undoubtedly of the upcoming centuries. This happens because the world population increases daily, whereas the natural resources diminish (UNIP 2007). Currently, water is facing critical conditions due to the abuse, mismanagement, and the neglect of our society. This paper focuses on water of Kosovo. This, in the future, will be one of the major factors for the economic development of our country. In the average humidity year, in Kosovo, the flowing reaches, approximately, up to 121.2 m3/sec. The distribution of the water resources is uneven and inadequate in comparison to the needs. Moreover, Kosovo has a small number of natural and artificial lakes, thus, maintaining these sources is one of the biggest challenges. This study is based on the "Ujemani" accumulation and its distributive structure, within the competent enterprise, Iber – Lepenc. The "Ujemani" Lake is the largest artificial accumulation in Kosovo. Its area is 11.9 km2, with a depth of 105 meters. Out of this accumulation, more than half of Kosovo is supplied with water, 20000 hectares of farmland are irrigated, and it supplies the main energy and mining industry and produces hydro-energy from 2x17MW/h(kosst2008) . The structure analysis of the "Ujemani" accumulation and its water distributive structure, incurred damages, their reconstruction, amount of water loss due to the damage from the mismanagement and non-maintenance of the infrastructure, international models of water management are the key topic discussion in this study.

*Key-words:* -Ujamnai, accumulation, main canal, irrigation, hydro-system. agriculture, industry

## 1 Introduction

The strategic plans of Kosovo, during the 60's, have been oriented in constructing several of catchments (artificial accumulations) in accordance to 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 water accumulations are supposed to be built (Tab. 1) where one of the largest accumulations has been the "Ujemani" Lake.

Tabela 1. The main accumulations in Kosovo (Water Report, KEPA, 2008)

| **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 105 meters. It is the largest lake in Kosovo and one of the greatest assets of Kosovo. “Ujemani” supplies more than half of Kosovo with water, irrigates 20 000 hectares of land, and can also serve as a recreational 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 years 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.

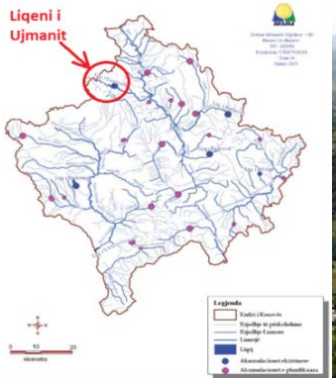



Fig.1 Map of Kosovo

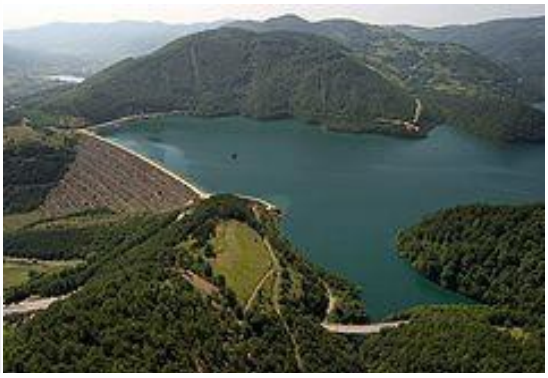


Fig.2 Ujemni artificial Lake (acummulation)

“Ujemani” today serves as a Hydro-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.

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.

## 2 Materials and Methods

Study area: The study was conducted from September 2014 until November 2015, in the “Iber – Lepenc” hydro-system (Fig. 1) 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.

## 3 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 in 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:

**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 the 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. Parts in the upper or lower leakage are generally in a good condition. The increasead 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 increasead the sedimentation, is considered a phenomenon.

**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. 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].

**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 result, 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].

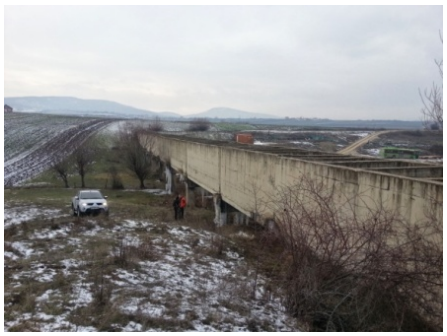
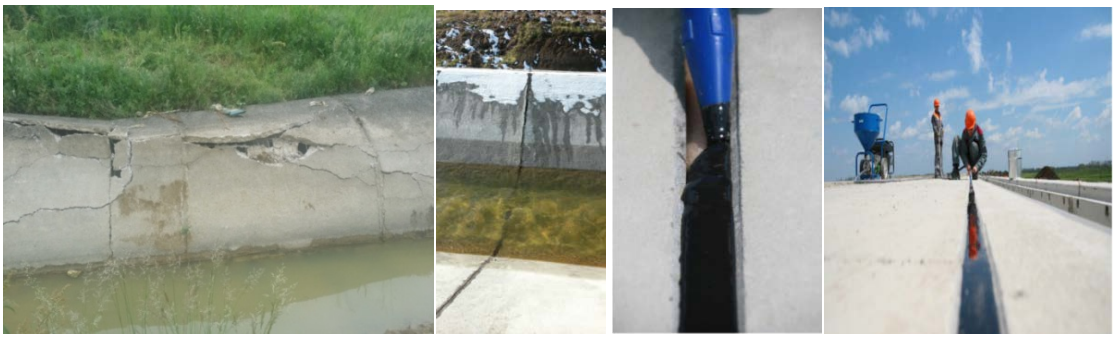



Foto 2&3. The canal condition belore the repairmen

## 4 Discission 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 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 4,5,6&7).



Pictures 4, 5,6&7. Current status of a partially restored canal and the rehabilitacion canal with the Fuga materials

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;

## 5 Recommendations

Based on the studies of this project, 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;

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