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**SHKUMBINI RIVER AT THE ENDING FLOW THE  
RROGOZHINA BRIDGE - RIVERMOUTH, DEGRADATION AND  
PROTECTION**

**ABSTRACT**

Shkumbini is among the greatest rivers of the country, with a length of 181 km and the surface of the watershed up to the spill 2464 km<sup>2</sup>. In the plain area of Elbasan, the riverbed is extended up to the vicinity of Rogozhina, where in the last 40 kilometers it flows in a flat area.

Just in the ending flow, at the segment from Rogozhina to the rivermouth, are identified the biggest problems of flooding, river erosion, damage of engineering works and embankments, forest cover, massive exploitation and without criteria of inert materials (sand and gravel mining) over a period of almost 30 years, coastal erosion, change of position to the river mouth.

Also, the river transports contaminated materials and pollutants (urban wastes) from the former Metallurgical Combine. A spreading phenomenon is the salting up of soils and river water in the last 5 km with salt content 2-4 times higher than allowed limits. Near the river mouth the sulphate content in the soil varies from 30 to 147 mg/kg and the dry residue, chlorine (CL) and sodium (Na) are above the permissible limits.

In this presentation will be presented the characteristics of the river in the ending segment (from Rogozhina to the river mouth), characterized by high erosion of riverbanks, environmental and degradation problems, environmental and economic impacts, surfaces and points of flooding where the water stands for 1-10 days in the Cermes, Sulzotaj area and river mouth,

also due to the poor operation of the drainage network and demolition of embankments, as well as of insufficient measures for the rehabilitation of damages and protection.

In the ending part of the Shkumbini watershed, ecological and morphological balances have been destroyed due to the misuse of the sand and gravel from the riverbed, the lack of sediment transport for the protection of the coastal line from erosion, the water near the rivermouth with high salt content that is not suitable for irrigation.

***Key words:** river, erosion, flooding, rivermouth, embankment, inert materials, morphological changes*

## **I. INTRODUCTION**

Shkumbini is among the greatest rivers of the country with a length of 181 km and with the surface of the watershed 2464 km<sup>2</sup> (Albanian Encyclopaedia Dictionary 1985). The segment selected for research from the Rogozhina Bridge to the estuary passes through the boundary between Lushnja and Kavaja districts. In this segment of 31,5 km long, the river flows into a completely flat terrain and many meanderings (map number 1). The width of the bed varies up to 250 m and the depth is about 2.5-3 m. Alluvial lands, formed by river deposits with undifferentiated horizons, but formed in layer form, prevail around the river.

Agricultural lands are cultivated with vegetables, watermelon, beans, wheat, etc. While on the seashore, on both sides of the river mouth, predominate sandy soils (arsenols) formed on old and new deposits. In the last 25 years, the Shkumbin River, as well as other rivers in the country, have been influenced by informal activities such as uncontrolled use of river inertia, loss of protective structures with consequences in increasing the river's aggressiveness expressed by the risk of bridges, damaging protection structures, floods, changes in the natural state of the river, morphological

changes, river and coastal erosion, extreme impacts on agricultural production, etc.

Rainfall in this segment varies from 1000 to 1300 mm /year. From the geological point of view, the Shkumbin River basin is covered by ultrabasic rocks, carbonic rocks about 13%, flysch, molasses and quaternary deposits, while in the lower flow the alluvions prevail.

The benefits of the Shkumbin River in the segment from the Rogozhina Bridge to the rivermouth consist of: it serves as a water resource for irrigation in agriculture, rich biodiversity and fauna development, fascinating landscapes, fish stocks that are exploited by the inhabitants, inert materials, nourishes the groundwater. Along the river there are several objects of natural and monumental and historical value such as Bashtova Castle, Divjaka Pine National Park, rare beasts (buffaloes), which are located only in this area (Divjake).

## **II. STUDY METHODOLOGY**

The study was carried out in the segment from the Rogozhina Bridge to the river mouth in 2 phases. In the first phase (2001-2002), the identification of long-term river basin indicators such as erosion, floods, coastal line change and rivermouth, state of protection structures, manner and intensity of use of river inertia were assessed. The field and laboratory methods were used to identify field problems, using topographic maps 1: 10,000 and 1: 25,000 of 1960, 1970, 1980, 2000 and 2014, updating of rivermouth changes, field measurements, delta changes, study of soil characteristics and types through analysis of soil and river water samples.

In addition, in a segment of 3.5 km, in parallel with the detailed identification of the problems were implemented a set of river protection measures for the reduction of degradation phenomena: construction and repair of damaged embankments, afforestation of bare riverbanks, definition of areas with inert reserves, rehabilitation of dikes, afforestation of sediment depositions for reduction of erosion and floods etc. To see the effectiveness of river works and changes, monitoring has been done in the following years until 2014.

### III. STUDY RESULTS

#### 3.1 Identification of problems on the Rrogozhina-Rivermouth (Map no.1)

During the assessment of the environment situation of the Shkumbini River from Rrogozhina Bridge to the Rivermouth, there were identified several degradation sources of the river channel and coastline, such as: river erosion, exploitation of river inertia from the riverbed without studying the reserves, land sliding on the riverbanks, soil and water salinization on the ending part of the river, chemical and urban pollution of the water, change of coastline, increase of erosion on the erosion/accumulation ratio, land flooding, damage of river protection structures like embarkments, dikes, cover of riverbanks with forest trees on 50-60%.

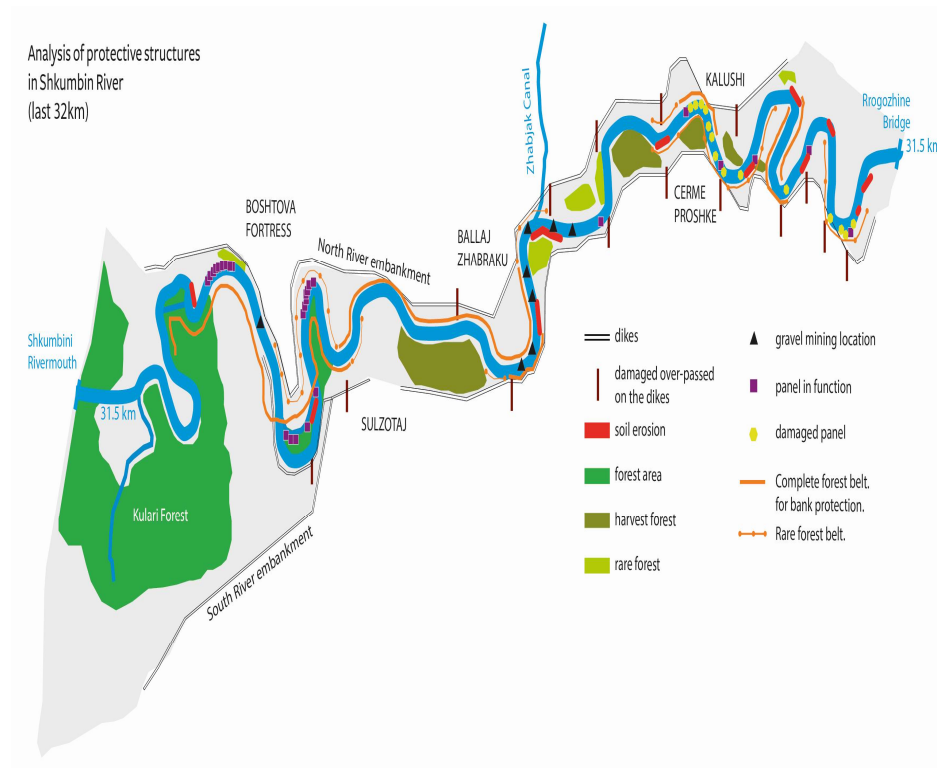
Since 1991, with intensification of constructions, exploitation of inertia without studying the reserves, exploitation under the water mirror for gaining qualitative sand, cultivation of arable land on riverbanks have caused high erosion of banks, low inertia transport to the rivermouth that negatively impacts on coastline and coastal erosion that is evident in a high degree during the last years.

As a consequence of interventions on the river bed extracting gravel and sand, even in this segment have been damaged the river protection structures (especially the embarkments and pumping stations for irrigation), riverbanks in a considerable length have been uncovered by forest vegetation, and have been cut the forest trees cultivated for the protection from erosion and flooding.

From the field observations and measurements resulted that from Çerma to Sulezotaj was identified a river erosion on an area of 65,000 m<sup>2</sup> (Lushaj, Muharremaj, Alikaj, 2003) and in entire segment 105,000 m<sup>2</sup>. In parallel with erozion, were identified places with sediment depositions in 16,000 m<sup>2</sup>, suitable for cultivation of vegetation on riverbanks like willow, poplar and reed.

The meandering (ratio between the river length toward that of the valley) measured on topographic maps of 1:25000 scale for the Rogozhina-rivermouth segment resulted 1.5-2.3, which means a meandering character related to the granulometric constitution, where the sand and silt prevail.

From the study of 12 soil profiles till the 1.5 m depth and the structure analyses resulted that in both river sides the alluvium soils prevail, formed by river depositions in form of layers with high content of sand and silt. The sandy soils (arenosole) prevail at the seashore with high content of sand and salt. The cultivable horizon on Çerme e Siperme varies around 30 cm, the first layer at 30-60 cm, the second layer on 60-87 cm, the third layer on 87-110 cm and the fourth layer on 110 - 160 cm, while in depth the presence of sand and silt is increased. As a result of uncontrolled gravel mining on the riverbed, there is observed a change on natural state of the river.



Map no.1

**Flooding:** during the high discharges, the Shkumbini River at the Rogozhina Bridge-Rivermouth segment overpasses the bed, flooding the land on both river sides (soils of Lushnja and Kavaja districts). The main identified points during the flooding are: Rogozhina Bridge, Çerme-Sulzotaj segment, Copani Bridge, Gose- Zhabjak, Kular, Boçove. The most massive flooding on both riversides have happended by 1937, 1946, 1956, 1962, 1971, 1981, 1983, 1996, 2010 and 2012.

The main causes of flooding are identified like: (i) damage of river protection structures (longitudinal embarasements); (ii) gravel mining without any criteria; (iii)

damaged dikes by vehicles that transport gravel; (iv) poor operation of the drainage system on cultivated agricultural soils; (v) damaging interventions on riverbanks; (vi) lack of restauration of exploited zones; (v) infiltration of water on eroded points and without forest cover.

**River erosion.** Along all the river segment under study from Rogozhina Bridge to the Rivermouth can be observed the eroded, damaged or tending to be eroded banks. By 2002, there were identified around 105,000 m<sup>2</sup> of eroded soil. The most damaged part of the river is observed at the Cerma-Sulzotaj segment, while from Sulzotaj to the rivermouth the banks are more protected due to forest cover.

During 2002, there were identified 10 focal points of eroded riverbanks and some points tending for erosion. While, the observations in 2014 show that this number was doubled.

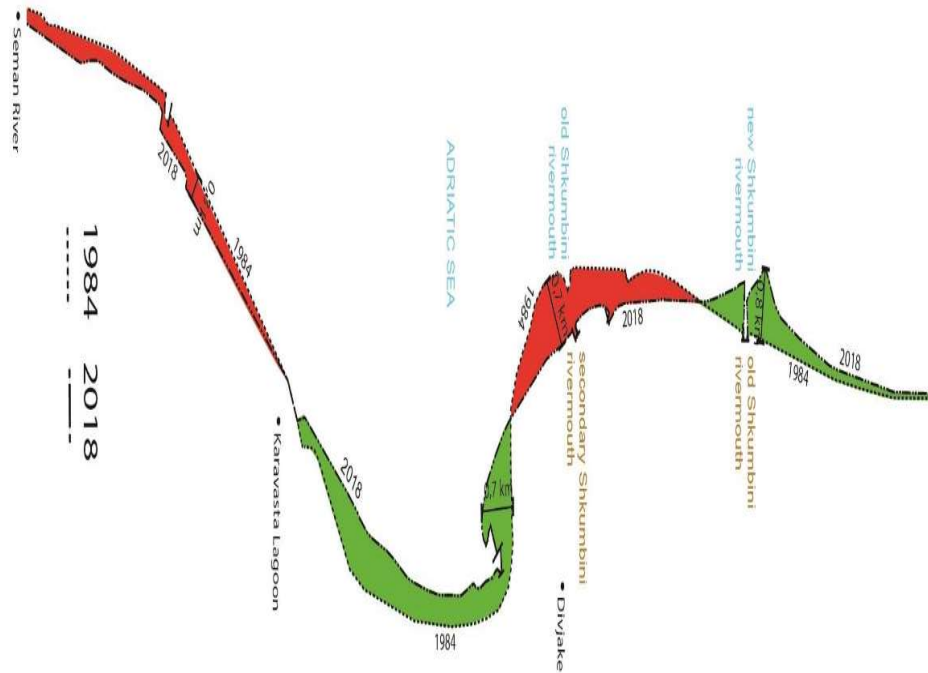
The main causes of erosion are: (i) gravel mining on river bed without any criteria and under the water mirror, opening deep holes (C.A. Troendle, 2002); (ii) collapse of the riverbanks in deep for filling the holes; (iii) the forest cover of riverbanks varies 41-50 %; (iv) partly funksioning of the drainage system; (v) mechanical composition of the soil, were prevails the sand and silt content on over > 80 %, decreasing the banks stability, as defined in 12 soil profiles on 0-30 cm, 30-60 and 60-90 cm depth. The authors write that; a landslide is a mass movement occorring on steep slopes under the action of gravity. Four types of mass movements can be

recognized: topple, rocfall, avalanche, landslide (Wang zhao-yin, Lee J, Melching Ch, 2015, page 192)



*Photo no : Shkumbin river erosion*

**Rivermouth position.** During diverse periods, the rivermouth has changed its position as follows (reflected on maps of 1960, 1970, 1980, 2000, 2017)-Map 4. By 1960, the rivermouth was situated north of Divjaka (on the place called Kular). After 1960, the rivermouth on last 5 km has been moved at a distance of 1.7 km toward Lushnja. By 1966, the rivermouth has been moved 4.9 km from the previous position toward Kavaja. The deviation of Shkumbini rivermouth toward north on a distance of 4.9 km accompanied by a shortage of distance of spillage has caused the decrease of meandering and increase of river energy and banks erosion. By 1970, the land has gained advantage over the sea compared to 1960. By 1980, both forms of gainig advantage and losing have occurred compared to 1970. By 2000, the sea has occupied the land. Looking over the coastal line, it is clear that objects like bunkers constructed by 1968-1970 on sandy land, actually are situated immersed in the depths of the sea (Lushaj Sh, 2000)



Map 4

### 3.2 Planng of measures for the river rehabilitation from Rrogozhina Bridge to the Rivermouth (Map 2

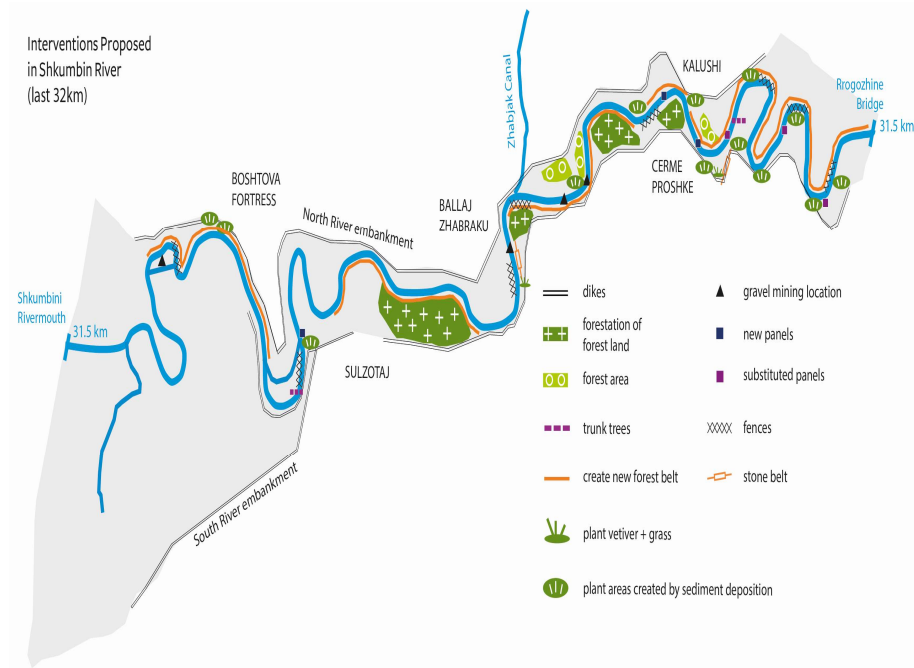
The rehabilitation of river damages and protective measures is intended to ensure the sustainable management of the river through the implementation of planned measures and to prevent the consequences of the presence of negative phenomena. In the river restoration writet that “river restoration is now often required to achieve multiple objectives, by balancing the natural functions of the river with specific human needs (GIWP, WWE, 2016). The measures envisaged are complex, simple, effective and at minimal cost to restore conditions that minimize damage to riverbanks, flood phenomena, through the creation of protected areas with sustainable vegetation along the riverbanks and the construction of necessary protective structures.



Table – composition of soil fractions

Nr. of sample	Depth	Fractions, in %						Sand %	Silt %	Loam %
		> 0.05	0.05-0.02	0.02-0.01	0.01-0.005	0.005-0.002	< 0.002	> 0.05	< 0.002	
1	0-30	32.94	29.12	11.28	6.68	19.26	0.72	32.94	66.34	0.72
	30-60	35.68	27.96	7.52	7.04	19.08	2.72	35.68	61.6	2.72
	60-90	30.32	34.04	7.68	11.6	11.68	4.68	30.32	65	4.68
2	0-30	43.76	20.92	14.92	1.8	13.12	5.48	43.76	50.76	5.48
	30-60	28.08	29.2	8.8	15.12	18.04	0.76	28.08	71.16	0.76
	60-90	37.68	28.28	6.76	8.4	12.48	6.4	37.68	55.92	6.4
3	0-30	37.12	27.92	17	6.04	6.04	5.88	37.12	57	5.88
	30-60	49.24	28.56	12.4	7.4	1.76	0.64	49.24	50.12	0.64
	60-90	41.96	39.44	10.12	0.84	6	1.64	41.96	56.4	1.64
4	0-30	24.68	27.08	13.96	3.72	25.92	4.64	24.68	70.68	4.64
	30-60	23.32	20.32	16.64	4.48	25.4	9.84	23.32	66.84	9.84
	60-90	17.6	18.72	23.96	1.56	37.84	0.32	17.6	82.08	0.32
5	0-30	15.6	3.32	16.64	4.92	35.04	24.48	15.6	59.92	24.48
	30-60	14.8	38.68	15.8	4.28	11.12	15.32	14.8	69.88	15.32
	60-90	61.44	6.04	12.8	6.48	6.6	6.64	61.44	31.92	6.64
6	0-30	45.8	18.76	7.4	10.12	14.04	3.08	45.8	50.32	3.08
	30-60	32.28	10.84	23.48	16.16	13.44	3.8	32.28	63.92	3.8
	60-90	27.88	25.96	14.12	4.2	4.2	23.64	27.88	48.48	23.64
7	0-30	17.8	39.16	14.92	9	14.84	4.28	17.8	77.92	4.28
	30-60	12.64	40.16	20.08	5.72	19.88	1.52	12.64	85.84	1.52
	60-90	13.92	50.72	13.92	16.2	2.44	2.8	13.92	83.28	2.8
8	0-30	12.4	4.6	8.8	0.04	34.36	39.8	12.4	47.8	39.8
	30-60	18	27.68	20.12	2.92	24.28	7	18	75	7
	60-90	40.04	19.16	15.96	5.2	19.19	0.45	40.04	59.51	0.45
9	0-30	14.04	26.68	21.24	8	25.32	4.72	14.04	81.24	4.72
	30-60	24.04	23.8	21.4	7.8	22.76	0.2	24.04	75.76	0.2
	60-90	18.6	27.32	22.68	11.36	15.04	5	18.6	76.4	5
10	0-30	12.36	12.44	19.4	0.92	25	29.88	12.36	57.76	29.88
	30-60	21.08	6.96	14.92	0.76	31.72	24.56	21.08	54.36	24.56
	60-90	1.72	19.48	23.32	0.6	31.16	23.72	1.72	74.56	23.72
11	0-30	12.08	2.6		3.32	39.16	32.32	12.08	55.6	32.32
	30-60	17.8	38.36	19.4	2.44	12.24	9.76	17.8	72.44	9.76
	60-90	22.48	35.4	11.56	10.8	8.96	10.8	22.48	66.72	10.8

From the identification of problems and damages caused to the river bed and banks, the main measures for rehabilitation and protection of the river are listed as follows:



Map 2

**1. Creation of a new protective forest belt** and densification of the sparse shore forests, planting on sediment deposition sites with mixed plants in the first waterbase with reed, willow and poplar on the shore, construction of protection fences with knitting, placing of poplar boles with natural branches and leaves on river edges for the erosion protection, placement of stones in the inner river escarpments, construction of new dikes and repair of damaged ones, determination of the site where to mine the gravel based on the determination of possible reserves, raising of embankments and rehabilitation of embankment crossings.

Throughout the length of the segment, the need for the creation of a new shore forest belt and densification was estimated to be 19 ha, the improvement of forestation in the forest lands and within the embankments 170 ha, the planting of sediment deposit sites of 5.7 ha, construction of protection fences warp knitting for the riverbanks protection 280m<sup>3</sup>. A new economic and ecological practice was the placement of poplar stems with entire vegetation mass in 80 ml that was returned to a strong mass associated with sediment, which limits the erosion impact. Placement of stone bricks in the interior of the river skirts, which are covered with sediment and store the earth from rubble, stone embankment construction + wire gabion, rehabilitation of damaged embankments (Lushaj, Sh, Muharremaj V, Alikaj N, 2003).

The afforestation of the riverbanks and forest lands, especially in the interior of the embankments, is of particular importance in the protection of the shore by erosion. This is made possible thanks to the powerful root system that by connecting with the ground makes it more stable by the water force. Also, the forest cover of the shore collects organic and inert materials, the shore rises and becomes more stable to the water streams. Along the banks of Shkumbini from Rrogozhina Bridge, the poplar, willow, tamarisk and reed can grow normally. Through the assessment of the forest cover conditions, it results that the creation of the new shore forest protection belt is calculated on 19 ha. Planting of forest trees and shrubs (poplar, willow, tamarisk and reed) is realized during the period of December to March.

In some areas, the forest cover of banks is scarce. Therefore, they are more susceptible to erosion. One of the important measures proposed is the densification of sparse forests through planting trees and shrubs. In accordance with the forest cover condition, it is estimated that this process has to be realized in 4 ha distributed throughout the entire length of the segment. Planting will be carried out with poplar, willow and reed.

**2. Planting the sediment deposit places.** Throughout the length of the river, especially at the eroded places, sedimented surfaces are created, which can be planted with shrubs, mainly tamarisk. According to Owens,

in many river basins in Europe and world the studies have demonstrated that much of the sediments will be derived from agriculture land (Owens, 2008, page 229)

From Rrogozhina Bridge to Bashtove, this process has created an area of about 73,500 m<sup>2</sup>, of which 57,000 m<sup>2</sup> can be planted with shrubs to increase riverbanks stability. In planting practice, the first belt will be planted with tamarisk, the second with willow and further with poplar. The first rows near the river are planted with reed, using rhizomes, then tamarisk and willow, planting with sprouts and further the poplar with sprouts in the deposit places and the reforestation with seedlings, densification of sparse forests and the creation of a protective forest belt.



Photo no- reforestation of sediment deposit places  
the river



Photo no Planting tree trunks on

**3. Protective fences construction with knitting.** The construction of protecting fences with knitting is intended to keep the eroded materials away from the river and to limit further thawing. The fences are made by placing stakes 1.5-2 m depending on the ground and the depth of the erosion. Stakes stick to the ground at a depth of 50-80 cm, while remaining

60-70 cm above ground. Among the stacks is knitting fence with branches in order to create an impenetrable grid by eroded soil particles.

**4. Planting tree trunks with all plant mass.** Large poplar stems with all the plant mass are placed on the side of the river water line, when the depth is gradual (shallow) the bottom part is tied, while the trunk extends into the river. This limits the water speed, collects sediments by making a mass that stops erosion and serves as the ground where vegetation grows. In our country, this practice has been used for the first time in the Cerme pilot segment, while it is applied already in other countries (Stream Corridor Restoration).

**5. Placing stone belts in the inner river escarpments.** Placement of stones at the banks of the river in the form of a cobble is an effective measure, especially on the riverbanks with a small slope and with a shallow bed near the bank. The stones are placed in belts of 1-2 m wide embedded in the ground, depending on the territory and on the slopes of the bank. The stone is covered by sediments, where aquatic plants survive and erosion is limited.



Photo no : embankments protection



Photo: Placing stone belts

**6. Exploitation of inert materials and environmental consequences in river morphology.** During the last decades (after 1991), the river segment has been intensively exploited without criteria, below the water mirror, on riverbanks and informally. According to a study carried out (M. Cukalla, 2000), in the segment from Rogozhina to the rivermouth, by 1999 about 456,000 m<sup>3</sup> of inert was exploited in 1999 compared to 41,000 m<sup>3</sup> in 1998 or 390,000 m<sup>3</sup> in 1997. At the channel spill point of the high water of Zhabjak in the river, the inertes have been exploited with high intensity, the river bed has suffered degradation, lack of stability of the river causing flooding and massive sediment movement.

As a result of the intensive exploitation and without criteria of inert materials there has been the collapse of riverbanks, damaging the embankments, the hydro-technical regime of river water flow has been destroyed, ruining the functioning of the dikes built on the river bed. The exploitation of inertes in the depths of the riverbed has also destroyed the irrigation and drainage works such as water pumps in Rogozhine, bridges, creating pits at the bottom of the river, and sediments replenish the holes without being transported to the rivermouth. The degraded river forms the new profile by bare sideways and shattering the banks. This causes the addition of floods and sediments. According to the study carried out (Cukalla and CO, 2000), it results that, from the interventions at the river bed in Rogozhina, the total solid flow (the sum of the flow of suspended alluvions, the solid bottom flow and the dissolved matter in the water) is  $7730 \times 10^3 \text{ t/yr}$ . The excessive amounts of current small materials that are carried in the lower part of the Shkumbini River have caused filling of the river mouth and delta changes. From the verification carried out in 2002, from the Bridge of Shkumbin to the rivermouth, only 24 constructed dikes out of 41 were in full function, others out of function. By 2014, the number of dikes out of function has increased, especially in the end part.

The consequences are long-lasting, as the gravel mining without criteria has continued even after the decision of the National Water Council no. 3, dated 4.06.1998 on "Suspension of permits for the use of gravel and sand as inert

material from river beds". From a field observation (2014) it resulted that deep pits and deformation of the river channel have been carried out by the intensive use of inerts.

For the elimination of negative phenomena of inert use it is necessary that through topographic works to determine the possible points and inert stocks on the basis of accurate projects, excluding the use of inert materials near the riverbanks, and in the depths of the river, as they affect the alteration of the river channel morphology and favor the erosion of the river bed bottom and the collapse of its banks. For a long-term perspective, the river inertia can be replaced by stone quarries.

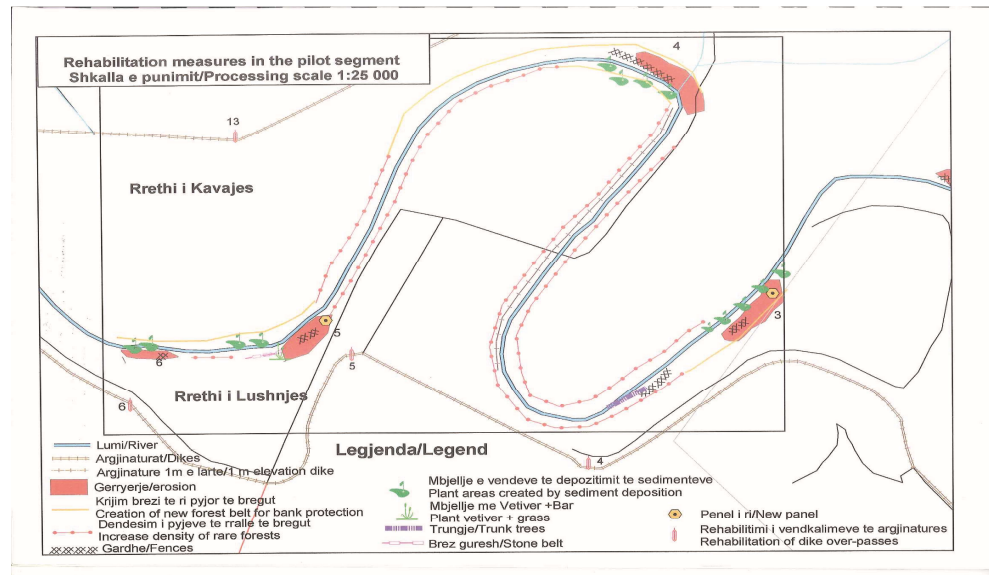
In order to protect the riverbanks from the erosion and regulation of the river bed, the completion with corrective works is required, including the dikes and reinforcement works of the banks (vegetation cover, fence construction, stone pavement, tree and trunk lying in the river, etc.). The construction of protective dikes on the riverbed is a practice used before, which aims to reduce the speed of water and the deviation from the strong collisions on the riverbank. Dikes help to stabilize and protect the eroded banks.

The first project for Shkumbini River was designed in 1957 for the protection of Terbuf area on the Lushnja side and Kavaja field through the construction of embankments from Rrogozhina to the fields of Sulzotaj and from Rrogozhina to the Hills of Ballaj. By 1976, the revision of the embankments was made in accordance with the new conditions created, for example, the considerably decreasing the river's ability of water lifting because of the filling with sludge of the banks within the dikes.

Since the time of construction the embankments height has decreased as a result of self-compression. In some places the height has been reduced to 1-1.5 m, which have become as roads from the village to the river. The passage of vehicles has caused the deformation of embankments crown and the initial project quotas have been reduced. Thus, the width of the crown in a portion of the length resulted 3-4 m, against 2.5 m initially in the project.

### 3.2 Implementing measures:

Fundamental objectives of basin planning need to address a broad range of issues: environmental benefits, economic benefits, reduced costs because of the ‘river’– enhanced flood management, benefits beyond the ‘river’– catalysing wider cooperation and economic integration (ADB, GIWP, WWF, page 46). In a pilot segment of 3.5 km, following the identification of the problems, the following measures were implemented (Map 3) :



Map 3

- repair of existing weirs;
- construction of a new stone pen + wire weir with a length of 21 m and a volume of 650 m<sup>3</sup> stone for the protection of three large erosion points on the surface of about 1 ha;
- establishment of forest protection belt with trees in 1 ha and densification of sparse forest in 1.5 ha;
- afforestation of 1.2 ha with reed + willow + poplar on surfaces created by alluvial deposits throughout the length of the segment;



- construction of protection fences on a length of 80 ml in 3 damaged areas;
- placement of tree trunks in a length of 20 ml and trees with branches in order to limit the speed of water and the impact on banks;
- placement of stone belts along the bank at Çerme Proshke in 30 m<sup>2</sup>, aiming its protection by erosion; the stones are placed in the sform of belts of 1.5 m width;
- rehabilitation of embankments in 4 points damaged by vehicles that pass over them, raising them up to 4 m in height.

### **3.4 Monitoring the efficiency of works**

In 2014, a survey was carried out on the sustainability of the works and the efficiency on river protection from floods, erosion, etc. Generally, the works carried out have been effective in protecting against phenomena. The places of sediment deposits planted with willow, poplar and reed have been developed and provide maximum protection of river banks by erosion and flooding. The stone belts are covered by sediments, the riverbank is protected and covered with vegetation. Embankments, in addition to partial damages, have functioned to divert the water stream and rehabilitate the damaged land (Lushaj, Sh, Muharremaj V, 2014)

### **Conclusion and Recomandation**

1. At the bottom stream of the Shkumbin river (Rogozhina- river mouth) is characterized as a typical field river, with many mounds and alluvial, marine, lagoon and wetland deposits, conglomerates and gravels (5-20 mm), sands deposit (up to 5 mm), with perennial flow (57 m<sup>3</sup> / sec and maximum flow 824 m<sup>3</sup> / sec), of which 75 per cent in the period from November to May.

2.The destruction of engineering protection construction, public infrastructure works including panels, embankments, bridges, irrigation stations as well as low scale operation of the drainage system from high density water and high level of sediments in the Shkumbin River have caused floods on agricultural lands, inhabited areas mainly in the bottom stream especially in the 1960s, 1971, 1979, 1981, 1996, 2011, on the surface of 3300-5600 ha. In specific years (1962-1963), the maximum inflows 2000 m<sup>3</sup> / sec and floods per 10000 ha have been record

3.The mismanagement of rivers where the inert materials were taken from the riverbed, during a 25-year period without conducting the inert stock study monitoring, the use of meanders, the high content of sand and lymph > 80%, is caused by massive erosion of river banks, landing of the river bed 0.3-0.4 m, deviation of river channel stream, destabilization of the bed and river banks, division of ecological corridors and forests and damage of natural balances and ecosystem.

4.During the intensive river exploitation period, the amount of gravel material utilized in the Peqin-Rrogozhine segment is bigger than the bottom flow of the river. We have limited transport in the area (source data INTP Minerale, 2002), causing marine erosion and changes of the coastal line and the river mouth.

5.In the geomorphologic point of view, the shore of the sea 30-35 years ago was mostly accumulative, but after interventions to exploit gravel since 1991, the coast turned to erosion and loss of land space. In 2018, compared to 1984, coastal erosion has been deepened, leading to accumulation. High erosion driven by impact of inert s material, crème, Sulzotaj, Kalush, Boshtove and so on.

6.The discontinuation of natural balance in the river and sea relations occurs in the low transportation of inert materials in the river mouth and the manner of their exploitation

## **Recommendations**

- 1.To protect the morphological balance of the rivers, try to substitute the river inert materials with the use of quarry inert materials. River material inert shall be exploited based on the study of reserves by topographic works as well as the preservation of the ratio between exploitation and the rhythms of the river inert materials rejuvenation at the river mouth.
- 2.In order to prevent damaging the banks of the river and flooding agricultural lands, damaged engineering works such as (embankments, longitudinal and transverse panels), river coverings of river banks, planting of landfills of river inert materials with cane, willow and poplar as well as the surrounding methods also the construction of engineering works in the sea. To avoid damaging the embankments and the river mouth, it should be prohibited the inert materials processing plants within the embankments at the river mouth.
- 3.To guarantee the drainage of agricultural lands around the river (channels I and II) as well as the first canals of Lushnje and Zhabjak that collect the waters from the general drainage system.
- 4.Cleaning of drainage of river and drainage collectors flowing into the Adriatic, to avoid the blocking of the delta and the transport of gravel in the depths of the sea and to avoid the graveling of the beaches.
- 5.Maintenance of the drainage of the river mouth and the drainage collectors flowing into the Adriatic sea, to avoid the delta block and the inert transport to the depths of the sea and to avoid the graveling of the beaches.
- 6.Construction of hydro-technical protection works, construction of sea-going scullers for transport in depth of river inert.
- 7.River management, limited use of inert materials and reservoir study, to permit sediment transport at river mouth.

## **Literature**

- 1) Wang zhao-yin, Lee J, Melching Ch, 2015 “River Dynamics and integrated river management”
- 2) GIWP, WWE, 2016 “River restoration: A strategic approach to planning and management”
- 3) Owens P, 2008 “Sustainable management of sediments resources”, 2008
- 4) ADB, GIWP, WWF “River Basin Planning Principles, Procedures and Approaches for Strategic Basin Planning”
- 5) C.A. Troendle, 2002- Report of watershed assessment.
- 6) M. Cukalla and CO, 2000- Study of River Gravel in River Shkumbin
- 7) Lushaj, Sh, 2000–Study of Shkumbin rivermouth and pplaning of rehabilitation from rrogazhina to rivermouth
- 8) Lushaj, Sh, Muharremaj V, 2014, study of “Monitoring the efficiency of works”
- 9) Lushaj, Sh, Muharremaj V, Alikaj N, 2003, study of “Planng of measures for the river rehabilitation from Rrogzhina Bridge to the Rivermouth”
- 10) USDA, Natural resources conservation service, 2002- west fork Kickapoo River watershed.
- 11) Wisconsin university – Work plan for watershed protction and flood provention.
- 12) Stream corridor restoration (principles, processes and practices), 1998.
- 13) Albanian Academy 1985, Albanian Encyclopaedia Dictionary
- 14) Zeedyk y val Nicholson – Extraccion de area y grava de los rios.