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Sustainable Solutions to Wastewater Management:
Maximizing the Impact of Territorial Co-operation

IMPACT OF DOMESTIC WASTWATER ON SURFACE WATER QUALITY IN SOME RESIDENTIAL SETTLEMENTS OF ARMENIA

Liana Margaryan, Basin Management Planning Specialist

AMERICAN UNIVERSITY OF ARMENIA

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Clean Energy and Water Program

Community

When the wastewater treatment is needed?

Domestic Wastewater

Treat or not?

Water body

The aim of study work

Investigate domestic wastewater's impact on water quality of rivers, depending on seasonal and human activity periods:

Community:		*River:*
Hankavan, Aghavnadzor and Meghradzor villages	→	Marmarik River
Tsaghkadzor Town	→	Tsaghkadzor River

Study area

Marmarik River

37 km length

427 sq.km watershed area

4.83 cubic m/sec average discharge

34 L/sec average sewage flow from villages

Tsaghkadzor River

12 km length

23.1 sq.km watershed area

0.019 cubic m/sec average discharge

30 L/sec average sewage flow from Tsaghkadzor Town

The rivers basins are the likely places for family rest and recreation zone. The several rest houses, several little summer camps, hotels and cottages are located in these areas.

Variation of Population Number in settlements of Tsaghkadzor and Marmarik Rivers Basins

Time Period	Tsaghkadzor River	Marmarik River		
	Tsaghkadzor Town	Hankhavan Village	Aghavnadzor Village	Meghradzor Village
Non-tourist season	1,608	147	2,226	2,747
Tourist season	7,100	830	12,466	3,022

Sampling and Analysis

Marmarik River

№57- 0.5km upstream Hankhavan

№58- river mouth

Tsaghkadzor River

№311- 0.5km upstream Tsaghkadzor

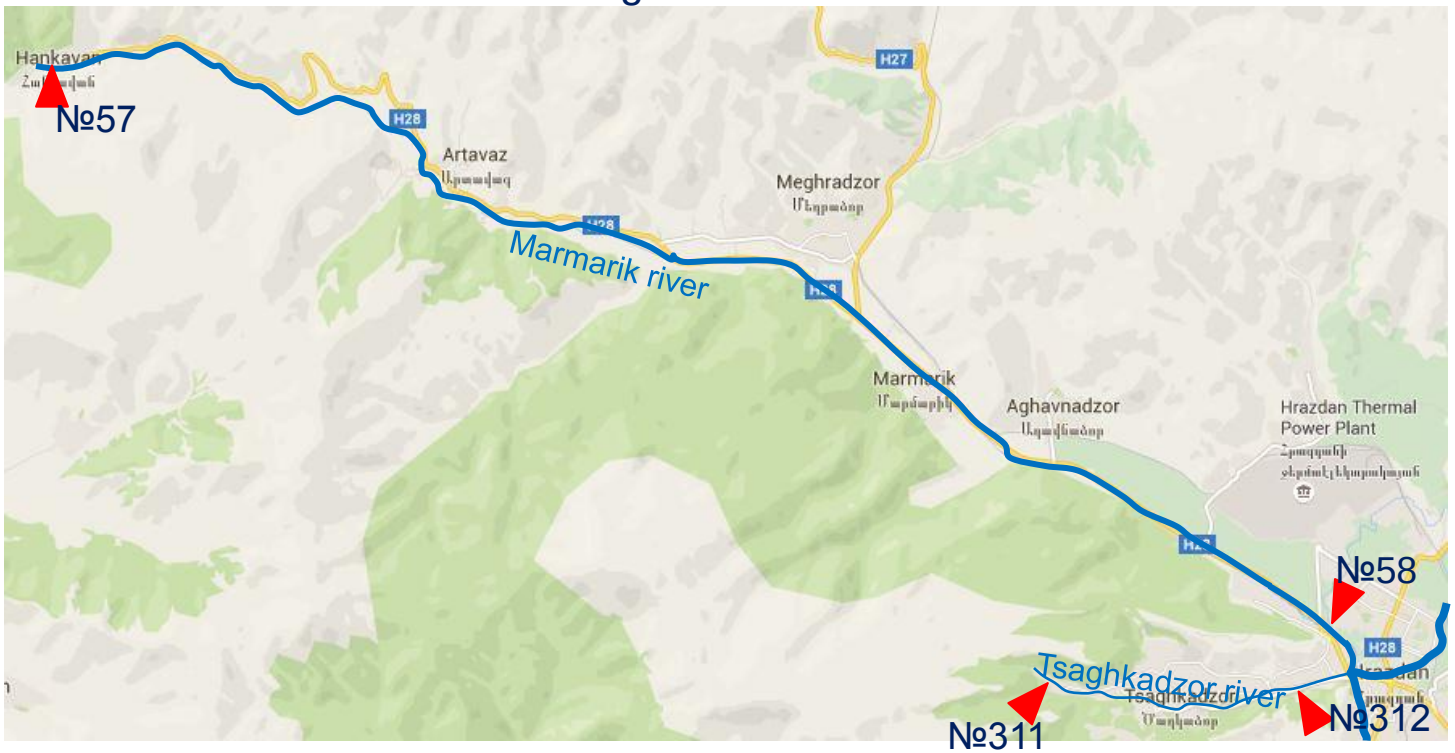
№312- 0.5km downstream Tsaghkadzor

Observed period

2008-2014 and Human Activity period

Marmarik River – Jun, Jul, Aug, Sep., Oct.

Tsaghkadzor River – Jan, Feb, Mar, Apr, Nov, Dec



Observed parameters

pH, DO, SS

BOD_5 , COD

$N\text{-}NH_4^+$

$N\text{-}NO_2^-$, $N\text{-}NO_3^-$

T-P, PO_4^{3-}

EU Urban Waste Water Treatment Directive (91/271/EEC)

Population equivalent	Domestic wastewater treatment type
< 500 p.e.	Not required
500 – 2 000 p.e.	Appropriate treatment, such as biological ponds, etc.
2 000 – 10 000 p.e.	Primary (mechanical) treatment
> 10 000 p.e.	Primary (mechanical) and secondary (biological) treatment

Domestic wastewater treatment type required in Marmarik and Tsaghkadzor Rivers Basins

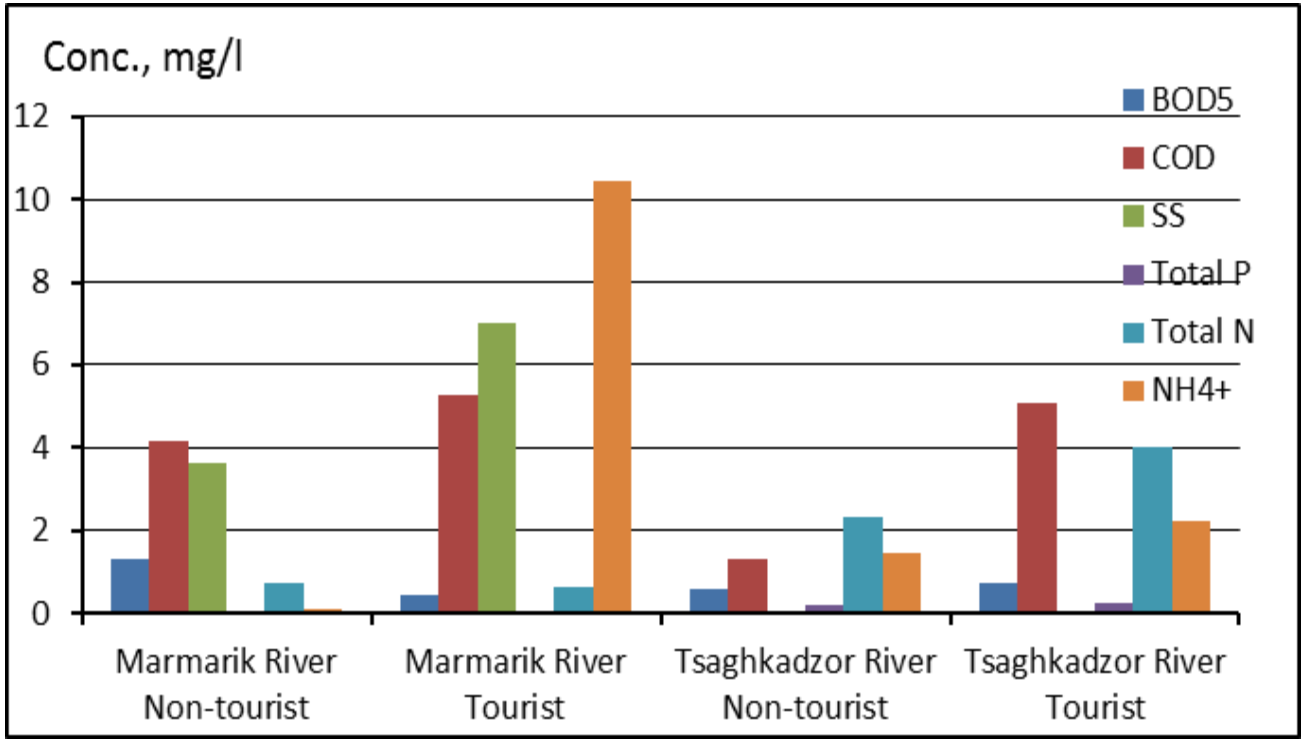
Number of Population, people		Wastewater Treatment type
Tsaghkadzor Town on Tsaghkadzor River		
Non-tourist season	1,608	Appropriate treatment
Tourist season	7,100	Primary treatment is mandatory
Hankhavan Village on Marmarik River		
Non-tourist season	147	Not required
Tourist season	830	Appropriate treatment
Aghavnadzor Village on Marmarik River		
Non-tourist season	2,226	Primary treatment is mandatory
Tourist season	12,466	Biological treatment
Meghradzor Village on Marmarik River		
Non-tourist season	2,747	Primary treatment is mandatory
Tourist season	3,022	Primary treatment is mandatory

Impacts of domestic wastewater discharge on Tsaghkadzor and Marmarik Rivers

Time period	BOD_5, mg/l	COD, mg/l	SS, mg/l	T-P, mg/l	T-N, mg/l	$N\text{-}NH_4^+$, mg/l
Tsaghkadzor Town on Tsaghkadzor River						
Non-tourist season	22.33	33.50	33.50	1.12	5.77	3.83
Tourist season	98.61	147.92	147.92	4.93	25.47	16.93
Hankhavan Village on Marmarik River						
Non-tourist season	0.85	1.28	1.28	0.04	0.22	0.15
Tourist season	4.80	7.20	7.20	0.24	1.24	0.82
Aghavnadzor Village on Marmarik River						
Non-tourist season	11.04	16.56	16.56	0.55	2.85	1.90
Tourist season	61.84	92.75	92.75	3.09	15.97	10.62
Meghradzor Village on Marmarik River						
Non-tourist season	13.63	20.44	20.44	0.68	3.52	2.34
Tourist season	14.99	22.49	22.49	0.75	3.87	2.57

Equation: $C_{cal.}=(P_{Norm}*N*1000)/ (24*60*60)$ mg/l

The actual increase of concentrations of the parameters on the rivers' mouth during the touristic and non-touristic seasons.



Water quality assessment, according to the provisions of Resolution #75-N of RA

(I) excellent	(II) good	(III) Moderate	(IV) Poor	(V) Bad

River	Time period	NO_3^- mg/l	NO_2^- mg/l	NH_4^+ mg/l	Total N mg/l	PO_4^{3-} mg/l	BOD_5 mg/l	COD mg/l	Total P mg/l
Marmarik	Non-tourist	I - II	I - II	II	II	II	II	II	II - III
	Tourist	II	II	II	II	III - V	II	II - III	III
Tsakghadzor	Non-tourist	I - II	I - II	II	III - IV	I - II	II	II	I - II
	Tourist	II	II	IV	IV - V	II	II - III	III	I - II

CONCLUSIONS

- Due to small population in the villages of Marmarik River Basin and in Tsaghkadzor Town of Tsaghkadzor River Basin, the domestic wastewater discharge is small, and the impact on the water quality of the rivers is offset by the self-purification capacity of the rivers. But, during human activity period (summer or winter holidays), because of population increase by 5-7 times, the water quality of the rivers deteriorates from “good” (II) “bad” (V) water quality class.
- Since 2010, because not sustainable tourism development, the water quality of the Tsaghkadzor River reduced from “moderate” to “bad” water quality class. The concentrations of nutrients are continuously increasing on water of the river, which has led to slow the self-purification processes in the river.
- The Marmarik River is more protected, than Tsaraxbyur River. The Marmarik is abounding in water and the discharged domestic wastewaters are diluted in the river water. So, the domestic wastewater impact is reduced. However, the water quality of Marmarik River was reduced in the last 7 years.

Thank you!