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LOCAL RESIDENTS' ATTITUDES REGARDING ECOLOGICAL CONDITION AND POLLUTION EFFECTS ON HUMAN HEALTH AND ENVIRONMENT - CASE STUDY OF VELIKI BAČKI CANAL, VOJVODINA, SERBIA

Abstract: Due to excessive pollution, Veliki bački Canal (VBC) was turned into an open collection system for wastewater from food industry, farms and settlements. This lead to classification of the canal as a pollution "black spot" in Danube basin. As there is high percentage of residents living alongside the canal, VBC could represent potential health risk. In order to conduct an environmental assessment of the region, local residents' attitudes are being investigated through questionnaire in ten settlements (500 respondents). The results are indicating that local residents perceive the canal as extremely polluted, mainly due to industry and its by-products. Respondents claim that current state of the canal could have harmful effects to their health, as there are frequent reports of oil spills, dead fish and odor. Extremely negative attitude is reported among the residents of Vrbas, where the most is polluted section of the canal. Questionnaire reveals that most of the respondents are willing to participate in actions of cleaning VBC, which indicates high environmental awareness.

Key words: local residents, pollution, human health, Veliki bački Canal, Serbia

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Introduction

There has always been aspiration to build settlements near water, as it always had crucial part for humans. River systems represent important part of environmental sustainability, especially if they are connected to populated area (Kowalkowski et al., 2006), due to direct human impact to water quality (Ren et al., 2003; Xian et al., 2007). Over couple of past decades there has been an increase of misuse of rivers and canals, as they became recipient for industry and communal wastewater. Alarming amount of wastewater being discharged to surface waters, represent one of the major problems for all watercourses (Alvarez-Vázquez et al., 2009). Many settlements depend on surface water, as it represents the main source of water required for industry, agriculture and public water supply system. Water quality has been seriously degraded, as a direct result of rapid economic growth. Poor water quality and degraded environment are inhibiting sustainable development, and could threaten human health as well (Huanget et al., 2010). 25 million people die every day because of polluted water (Pimpunchat et al., 2009). That is the reason why many empirical researches point out the need for specific definition of water quality (Blanchet et al., 2008; Mustonen et al., 2008; Cabecinha et al., 2009).

Veliki bački Canal (VBC) is a part of hydro system Danube-Tisza-Danube (DTD) and it runs through the central part of Bačka region, connecting the rivers of Danube and Tisza (Pantelić at al., 2012a). It flows from Bezdan on Danube to Bečej on Tisza and its main purpose was to shorten the waterway for salt transport from Romania to Wien in 18th century. Furthermore, it had a major part in draining swamp areas in order to turn them into farmland. In the time of construction it was the greatest construction project of Austro-Hungarian Empire: the canal was dug by hand, and the soil excavated is equal in amount to that when Suez Canal was built. Later, in 20th century, VBC became the main section of HS DTD, one of the greatest hydro systems in Europe (Đivuljski, 2008). Wast network of drainage and irrigation canals was formed around VBC, as well as settlements, along with agricultural complexes. Discharging of untreated industrial and communal wastewater lead to total degradation of several areas, downstream from largest polluters (Andrejev, 1983). Intensive pollution of the canal began in 1960s. The major problem is wastewater from food industry, which is developed to a high extent in this region. With development of agriculture and industry, irrigation canals and streams became recipients for untreated wastewaters, which turned VBC into a main environmental problem in Vojvodina at first, and afterwards in Europe. VBC was officially declared as a pollution "black spot" in Danube basin (Pantelić et al., 2012b).

In decade that the United Nations General Assembly proclaimed as the International Decade for Action "Water for Life", when many of scientific debates concern dealing with the greatest problem of mankind – lack of water resources, residents of central Bačka fear of possible consequences that VBC might have on their health. Nearly 89% of all houses in municipalities around the VBC are located along the canal. Exactly this fact, that nine out of ten houses are located on the bank of VBC, makes this region a "black spot". As local residents are true consumers of the region, this research was based on their attitudes regarding the ecological condition of the VBC and possible effects to their health and environment.

Methodology

Survey was based on a probability sample. Questionnaires were provided to respondents, to fill them voluntarily and independently. As the survey was anonymous, respondents were willing to give sincere answers. This form of research proved to be very good, as local residents agreed to participate as well as to answer to all of researchers' demands. Local residents are aware of poor environmental situation in settlements near VBC and therefore are giving positive feedback to every sort of research that could lead to some improvement in that matter.

Five hundred respondents participated in this research. The sample was made by combining answers, given by residents of different settlements and taking into account distance of house from the canal. Residents from ten settlements participated in this research: Sombor, Mali Stapar, Sivac, Crvenka, Kula, Vrbas, Srbobran, Turija, Bačko Gradište and Bečej (Fig. 1). The short description of the settlements is given in Tab. 1. The sample included about 0.3% of these settlements' residents.

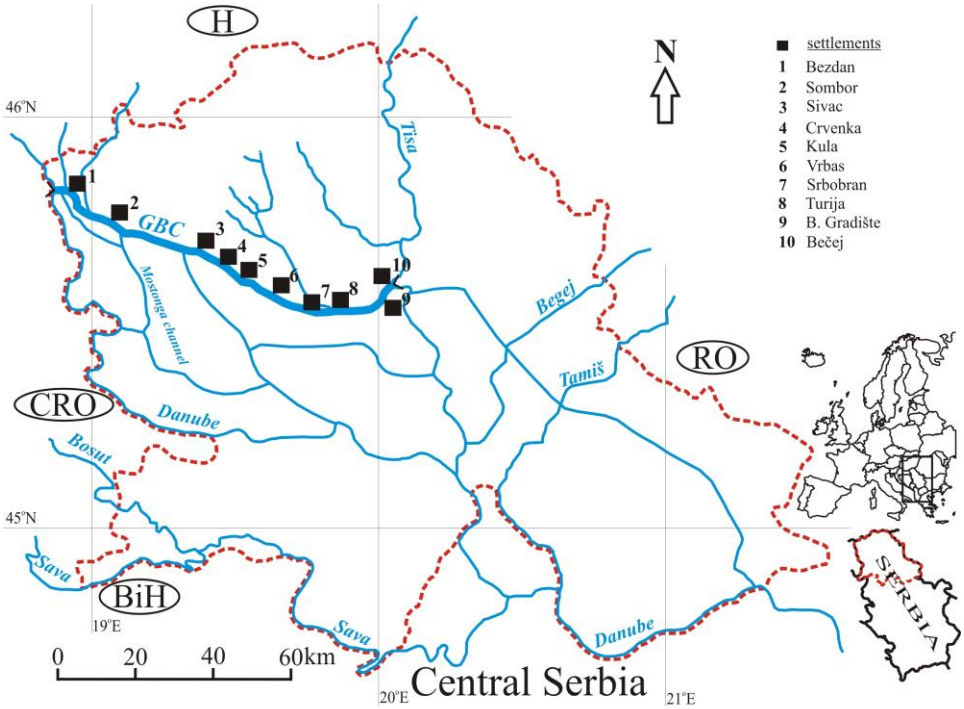

Fig. 1. Map of settlements' distribution and profiles.

Tab. 1. Description of settlements along the VBC by type of settlements and main industrial sector

Number (in accordance to Fig. 1)	Settlements	Number of residents	Type of settlement	Main industrial sector
1	Bezdan	5507	rural settlement	Agriculture
2	Sombor	52648	urban settlement	food industry (oil factory, fruit industry, beverage industry)
3	Sivac	9224	rural settlement	Agriculture
4	Crvenka	10315	urban settlement	food industry (sugar factory, beverage industry, baker industry)
5	Kula	19739	urban settlement	food industry (beverage industry), leather industry
6	Vrbas	26198	urban settlement	food industry (pig farm, oil factory, meat industry, sugar factory, baker industry)
7	Srbobran	13296	urban settlement	Agriculture
8	Turija	2626	rural settlement	Agriculture
9	Bačko Gradište	5519	rural settlement	Agriculture
10	Bečej	26462	urban settlement	Food industry (vegetable industry), mechanical industry

On the base of the answers given by the residents of each settlement the percentages of the opinion offered in the questionnaire for particular question were calculated. Moreover, the same answers were assessed on the base of the distance of houses from VBC and the corresponding percentage values were assessed and also presented. The results are acquired on the basis of Pearson Chi-square test (Williams & Lawson, 2001).

For data from nominal scale, special statistical procedures are exempt from strict assumptions about distribution of data (e.g. assumption about normal distribution). Chi-Square (X^2) distribution is widely used. X^2 serves for testing deviations of acquired (empirical) frequencies from expected (theoretical) values (Turjačanini & Čekrlija, 2006). Chi-Square was used to determine if there are statistically significant differences in attitudes between residents of different settlements and in term of distance of their house from the canal.

$$X^2 = \sum(fo - fe)/fe$$

Where:
X^2 – Chi-Square
fo – empirical (acquired) frequencies
fe – theoretical (expected) frequencies

Similar research was commissioned by Public Water management Company "Vode Vojvodine" Novi Sad, in 2005. The research was about water pollution issues in Vojvodina in relation to level of environmental awareness of local residents. The research was conducted by The Centre for Free Elections and Democracy (CeSID), and it was two-phase (CeSID, 2006). The first phase covered public opinion from every part of Vojvodina, and the second phase was focused only to municipalities of Kula, Vrbas and Srbobran. Results showed that although they are aware of VBC pollution problem and threats to their health, residents of these municipalities were not ready to actively participate in solving this problem (CeSID, 2006).

Results and discussion

Further text reveals analysis and interpretation of the results requested for this research. Data processing gave the results shown. When asked: What is your opinion about condition and water quality of the VBC in area where you live?, more than half of respondents (52.2%) replied that the canal is extremely polluted and almost unusable. High percentage of respondents (43.2%) thinks that VBC could be in better condition, although it is not alarming. The fact that really is alarming is that only 4.6% considers the canal as a clean watercourse.

Tab. 2. The percentages of the answers and the application of the Chi-square test for the questions related to residents' opinion about the condition and water quality of the VBC in area where they live

Opinion about condition and water quality of VBC in your living area							
			I think that the canal is clean to an agreeable extent	I think that the canal could be in better condition, although it is not alarming	I think that the canal is extremely polluted and almost unusable	Pearson Chi-Square - Value	Pearson Chi-Square - **p**
settlement	Bezdan	%	0.4	8.4	1.2	123501	**0.000***
	Sombor	%	1.6	6.4	2.0		
	Sivac	%	0.4	5.2	4.4		
	Crvenka	%	0.2	3.8	6.0		
	Kula	%	0.8	2.6	6.6		
	Vrbas	%	0.2	0.8	9.0		
	Srbobran	%	0.0	2.2	7.8		
	Turija	%	0.6	3.4	6.0		
	B.Grad.	%	0.2	4.6	5.2		
	Bečej	%	0.2	5.8	4.0		
distance from VBC	to 200 m	%	1.4	6.6	11.4	10697	0.030**
	200-1000 m	%	1.6	17.0	23.8		
	over 1000 m	%	1.6	19.6	17.0		

Remark: ***p < 0.01;****p < 0.05;* Pearson Chi-Square - Chi-Square value
Source: made by author on the basis of data analysis in SPSS 20.0.

Analysis of acquired answers is showing significant results (Tab. 2). Based on the data processing we can conclude that differences among the answers exist and that they are statistically significant. Differences are perceived among the residents of Bezdan, Sombor, Sivac and Bečej, with opinion that the canal could be in better condition, although it is not alarming, while residents of Crvenka, Kula, Vrbas, Srbobran, Turija and Bačko Gradište think that the canal is extremely polluted and almost unusable. Based on the Chi-Square value ($p=0.000$) we can conclude that there is a significant difference between there a land the expected data $p<0.01$. The differences in there sponses are the biggest between the residents of Vrbas, where 9% of 10% of residents consider the canal extremely polluted and almost unusable, and residents of Sombor, where only 2% of 10% think of the canal in that manner. The differences in the responses are the least between the residents of Vrbas and Srbobran, because 7.8% out of 10% of Srbobrans' residents think that VBC is extremely polluted and almost unusable.

Data acquired by analyzing answers based on distance of houses from VBC (Tab. 2) shows that majority of residents with houses that are less than 1000 m away from the canal consider VBC as extremely polluted and almost unusable, while majority of people with houses that are more than 1000m away from the canal thinks that the canal could be in better condition, although it is not alarming. Chi-Square value ($p=0.030$) confirms that there is a significant difference between there a land the expected data $p<0.05$.

Respondents are, to a high extent, aware of possible threats coming from VBC. They know that their environment is more endangered than it is in other settlements in Vojvodina. We can compare this data to results acquired in previous research (CeSID, 2006), where residents of this region evaluated condition of their environment with marks that are below average for Vojvodina.

Due to rapid local economy growth in last 40 years, there has been a risk of increased surface waters pollution, because of human activities (Harris & Heathwaite, 2005) such as urbanization (Sim & Balamurugan, 1991), industrialization (Zhang et al., 2011; Wang et al., 2012) and agriculture development (Maloschik et al., 2007). River canals are especially exposed to pollution as they are more populated and influenced by human activity (Owens & Niemeyer, 2006).

When asked What is the main source of pollution in the VBC in area where you live we can see that attitudes among local residents differ to a high extent, as 48.6% consider industry as a main source of pollution, while 46.4% think that human activities are the main cause of pollution. Only 5% sees communal wastewater as a main polluter.

Analysis of acquired answers (Tab. 3) are showing that residents of Bezdan, Sombor, Sivac, Kula and Bečej consider human activities as a main polluter of the canal, while residents of Crvenka, Vrbas, Srbobran, Turija and Bačko Gradište think that main source of pollution is industry with its negative by-products. The answers given from Crvenka' and Vrbas' residents were expected, because those are industrial centers of the region, while residents of Srbobran, Turija and Bačko Gradište are affected by this as their settlements are located downstream of the industrial centers. Based on the Chi-Square value ($p=0.000$) we can conclude that there is a significant difference between there a land the expected data $p<0.01$. The differences in there sponses are the biggest between the residents of Bezdan, where 9.4% of 10% of residents consider that the canal is mainly polluted because of human activity, and residents of Vrbas, where only 2.2% of 10% agree

with that statement. As for the statement that industry is the main source of pollution, the biggest difference in the responses is between residents of Vrbas and Srbobran, where 7.4% of 10% agree with the statement, and residents of Bezdan, where only 0.4% of 10% think in the same manner.

Data acquired by analyzing answers based on distance of houses from VBC (Tab. 3) show that residents with houses 200 m and 200-1000 m distanced from the canal consider industry as a major source of pollution, while residents that live more than 1000m apart from VBC think that human activities have the greatest impact on the canal. There is no significant difference between real and expected data, as the differences are not statistically significant (p=0.083).

Tab. 3. The percentages of the answers and the application of the Chi-square test for the questions related to residents' opinion about the main source of pollution in VBC in area where they live

The main source of pollution in VBC in your area							
			Industry and by-products	Negative human activities	Communal wastewater	Pearson Chi-Square - Value	Pearson Chi-Square - **p**
settlement	Bezdan	%	0.4	9.4	0.2	134.129	**0.000***
	Sombor	%	1.6	8.0	0.4		
	Sivac	%	2.6	6.6	0.8		
	Crvenka	%	7.0	2.4	0.6		
	Kula	%	4.4	5.0	0.6		
	Vrbas	%	7.4	2.2	0.4		
	Srbobran	%	7.4	2.2	0.4		
	Turija	%	6.0	3.2	0.8		
	Bačko Gradište	%	7.4	2.4	0.2		
	Bečej	%	4.4	5.0	0.6		
distance from VBC	to 200 m	%	10.4	7.8	1.2	8.242	0.083
	200-1000 m	%	22.4	17.8	2.2		
	over 1000 m	%	15.8	20.8	1.6		

Remark: ***p < 0.01;****p < 0.05**;** Pearson Chi-Square - Chi-Square value
Source: made by author on the basis of data analysis in SPSS 20.0.

In attempt to solve environmental issues, media usually plays important role in channeling the pressure of citizens pointed toward the government and polluters. Media have mentioned the canal only when accidents occurred, such as dead fish, oil stains and major protests. Lack of journalists' expertise in the field of environmental issues, as well as everlasting lack of media space for this theme is quite noticeable. Media support is very important for the Action plan implementation process, as well as for defining the need of this implementation, its goals and last but not least, raising the environmental awareness level. Moreover, it is crucial that citizens are properly informed about real condition of their environment.

When asked what is your source of information regarding the pollution in VBC, most of the respondents, even 75% declared that most of the information is collected

independently, through conversations with friends and acquaintances. Minority of the survey participants, 12.8% answered that they acquire information through media (radio, television, newspapers), and 12.2% stated that most of information comes from local self-government and institution in charge.

Analysis of acquired answers (Tab. 4) is showing that residents of all settlements included in the survey, agree that most of the information are collected independently, through conversation with friends, colleagues and neighbours. However, residents of Bezdan, Crvenka, Kula, Turija and Bečej state that most of the information are provided by local self-government and institution in charge, while residents of Sombor, Sivac, Vrbas, Srbobran and Bačko Gradište think that media provides more information than local self-government. There is no significant difference between real and expected data, as the differences are not statistically significant (p=0.083), at the level of significance p<0.05. Data acquired by analyzing answers based on distance of houses from VBC (Tab. 4) show that all of residents acquire most of the information independently, and there is no difference between real and expected data (p=0.394).

Tab. 4. Descriptive statistics and the application of the Chi-square test for the questions related to residents' opinion about sources of information regarding the pollution in VBC

Means of gathering information regarding the pollution in VBC							
			Media	Local self-government	Independently, through conversation with friends	Pearson Chi-Square - Value	Pearson Chi-Square - **p**
settlement	Bezdan	%	0.6	1.2	8.2	29.776	0.040**
	Sombor	%	1.6	1.2	7.2		
	Sivac	%	0.6	0.4	9.0		
	Crvenka	%	1.2	1.6	7.2		
	Kula	%	1.0	1.4	7.6		
	Vrbas	%	2.6	1.0	6.4		
	Srbobran	%	2.2	0.4	7.4		
	Turija	%	1.0	1.8	7.2		
	Bačko Gradište	%	1.4	1.2	7.4		
	Bečej	%	0.6	2.0	7.4		
distance from VBC	to 200m	%	2.8	1.6	15.0	4.092	0.394
	200-1000m	%	5.4	4.6	32.4		
	over1000m	%	4.6	6.0	27.6		

Remark: ***p < 0.01**;**p < 0.05; Pearson Chi-Square - Chi-Square value
Source: made by author on the basis of data analysis in SPSS 20.0.

Harmful mater in water and sludge has negative impact on canals' environment, and human health as well. This statement is confirmed through statistical data analysis that shows increased number of patients with malignant diseases that usually affect lungs and respiratory and urogenital system. This increased number is especially noticeable along the canal, as well as in the entire city of Vrbas in relation to population of Bačka and Vojvodina in general (NIVA, 2005). Based on pollution parameters and identified harmful

mater in water and sediment, the Dekonta Institute conducted a simulation of negative impact for human health. They concluded that bacteria have the most dangerous impact (Dekonta, 2004).

When asked Do you think that pollution of VBC could affect your health and health of your household, the majority (76%) of respondents answered affirmatively. Minority (22.8%) think that the pollution could affect their health only if they get in direct contact with polluted water, and only 1.2% of respondents do not see the pollution as a potential health threat.

Analysis of acquired answers (Tab. 5) is showing that residents of all settlements included in the survey consider that pollution of VBC could affect their health and health of their household. This opinion is especially noticeable in Sivac and Srbobran, where 8.4% of 10% answered in this manner. Alarming is the fact that none of the residents of Sivac, Srbobran, Turija and Bačko Gradište gave negative answer regarding the impact of pollution on human health. There is no significant difference between real and expected data, as the differences are statistically significant (p=0.050), at the level of significance p<0.05.

Tab. 5. The percentages of the answers and the application of the Chi-square test for the questions related to residents' opinion about pollution of VBC and its affect on their health

Do you think that pollution of VBC affects your health							
			yes	Yes, in case we get in direct contact with contaminated water	no	Pearson Chi-Square - Value	Pearson Chi-Square - **p**
settlement	Bezdan	%	6.6	3.2	0.2	28.825	0.050**
	Sombor	%	8.0	1.8	0.2		
	Sivac	%	8.4	1.6	0.0		
	Crvenka	%	8.2	1.6	0.2		
	Kula	%	8.0	1.8	0.2		
	Vrbas	%	8.2	1.6	0.2		
	Srbobran	%	8.4	1.6	0.0		
	Turija	%	8.2	1.8	0.0		
	Bačko Gradište	%	6.2	3.8	0.0		
	Bečej	%	5.8	4.0	0.2		
distance from VBC	to 200m	%	164	2.8	0.2	5.124	0.275
	200-1000m	%	31.6	10.2	0.6		
	over 1000m	%	28.0	9.8	0.4		

Remark: ***p < 0.01**;**p < 0.05; Pearson Chi-quare - Chi-Square value
Source: made by author on the basis of data analysis in SPSS 20.0.

Data acquired by analyzing answers based on distance of houses from VBC (Tab. 5) show that there are no significant differences (p=0.275) in residents' opinion, as they all

agree that the pollution of the canal could affect their health. Moreover, residents with houses that are less than 200 m apart from VBC pointed this out in far greater percentage.

One of the major researches regarding the affect of pollution in VBC on human health was conducted in 2004. Department of urology, at Vrbas hospital conducted an analysis regarding the prevalence of malignant tumors of urogenital tract in Vrbas, in relation to distance from VBC. Medical records from 1991 to 2003 were analyzed, as well as records from Oncology institute of Vojvodina in Sremska Kamenica (Prof. drsc med. Marica Miladinov Mikov, Institute at Sremska Kamenica).

Observed period of 13 years revealed 435 registered cases of urogenital tract tumor, 230 urinary bladder tumors, 67 kidney tumors, 119 testicular tumors and 10 cases of tumor on other organs in Vrbas. The city of Vrbas is divided into three zones, where the first zone represents area less than 200 m distanced from VBC, the second zone is more than 200m away from the canal, and the third zone is more than 400 m from VBC. Phenomenon of urinary tract tumor was analyzed. Out of total of 154 registered cases, 51 were registered in the first zone, which makes 33%. As one quarter of Vrbas' residents live in this area, it was concluded that frequency of the disease' appearance is high and it can be directly related to distance from the canal. These results are taken with caution, due to lack of statistical data from longer period of time. Nevertheless, it cannot be denied that results clearly show connection of malignant disease' appearance to the nearness of the canal. Furthermore, more detailed records are needed for all sorts of malignant diseases, especially in this endangered zone, because there is increasing number of soft tissue tumors (liver and lung tumor) as primary tumors. There is also increased number of bronchitis, asthma and allergic diseases recorded among pre-school and school children (NIVA, 2005).

Oil spills, odor and dead fish are usual scene at the canal, due to the pollution and poor quality of canal water. When asked Have you ever seen changes on the surface of VBC, such as oil spills, the largest percent of respondents (49.2%) answered that oil spills are often seen on the surface of the canal. 35.2% answered that oil spills are visible only at specific time of year, while only 15% declared that they have never seen oil spills on the surface of VBC.

Answers gathered in different locations are of high relevance for this question (Tab. 6). The results show that residents of Sombor, Crvenka, Kula, Vrbas, Srbobran and Turija claim that they often notice changes in form of oil spills, while residents of Bezdan, Sivac, Bačko Gradište and Bečej in highest percent claim that this kind of changes are visible only at certain time of year. Based on the Chi-Square value ($p = 0.000$) we can conclude that there is a significant difference between the real and the expected data $p<0.01$. The differences in the responses are the biggest between the residents of Srbobran where as much as 7.8% of 10% confirmed that they often notice changes in form of oil spills and residents of Bečej, where only 3.2% of 10% answered in that way.

Data acquired by analyzing answers based on distance of houses from VBC (Tab. 6) show that there is no difference between real and expected data ($p=0.306$). Moreover, residents with houses that are less than 200 m apart from VBC pointed this out in far greater percentage.

Tab. 6. The percentages of the answers and the application of the Chi-square test for the questions related to residents' opinion about whether they have seen oil spills on the surface of the canal

Have you ever seen oil spills on the surface of the canal							
			Yes, very often	Only at certain time of year	No, never	Pearson Chi-Square - Value	Pearson Chi-Square - **p**
settlement	Bezdan	%	3.4	4.4	2.2	64.022	**0.000***
	Sombor	%	4.4	3.8	1.8		
	Sivac	%	3.6	5.0	1.4		
	Crvenka	%	5.0	2.2	2.8		
	Kula	%	5.0	4.0	1.0		
	Vrbas	%	7.8	1.2	1.0		
	Srbobran	%	7.8	2.0	0.2		
	Turija	%	5.4	3.4	1.2		
	Bačko Gradište	%	3.6	4.6	1.8		
	Bečej	%	3.2	4.6	2.2		
distance from VBC	to 200 m	%	11.2	6.0	2.2	4.827	0.306
	200-1000 m	%	20.8	15.2	6.4		
	over 1000 m	%	17.2	14.0	7.0		

Remark: ***p < 0.01;****p < 0.05**;** Pearson Chi-Square - Chi-Square value
Source: made by author on the basis of data analysis in SPSS 20.0.

When asked Have you ever noticed odor coming from VBC, the largest percent, 62% answered affirmatively, 30.8% of respondents answered that odor appears only at certain time of year. Fact that only 7.2% of the respondents answered that they have never sent any odor from the canal is certainly concerning.

Analysis of acquired answers (Tab. 7) is showing that major of residents of Bezdan and Turija confirm that they notice odor only at certain time of year, while majority of residents of other settlements answered that they often notice odor, with no regard of what time of year it is. Based on the Chi-Square value (p=0.000) we can conclude that there is a significant difference between the real and the expected data p<0.01. The differences in the responses are the biggest between the residents of Srbobran, where 8.4% of 10% and residents of Bezdan, where only 4% of 10% confirms this statement. The least difference is between residents of Srbobran and Vrbas, as in Vrbas 8% of 10% declared that they often notice odor coming from VBC.

Data acquired by analyzing answers based on distance of houses from VBC (Tab. 7) show that majority of respondents confirms the fact that odor from the canal is often being noticed. It is especially observed that residents with houses that are less than 200m apart from VBC pointed this out in far greater percentage. There is no significant difference between real and expected data, as it is shown from the result of Chi-Square test (p=0.064).

Tab. 7. The percentages of the answers and the application of the Chi-square test for the questions related to residents' opinion about whether they have ever noticed odor coming from VBC

Have you ever noticed odor coming from VBC							
			Yes, very often	Only at certain time of year	No, never	Pearson Chi-Square - Value	Pearson Chi-Square - **p**
settlement	Bezdan	%	4.0	4.6	1.4	64.389	**0.000***
	Sombor	%	4.4	3.8	1.8		
	Sivac	%	5.8	3.4	0.8		
	Crvenka	%	7.4	1.6	1.0		
	Kula	%	6.4	3.2	0.4		
	Vrbas	%	8.0	1.4	0.6		
	Srbobran	%	8.4	1.4	0.2		
	Turija	%	4.6	5.2	0.2		
	Bačko Gradište	%	5.4	4.0	0.6		
	Bečej	%	7.6	2.2	0.2		
distance from VBC	to 200 m	%	14.0	4.2	1.2	8.898	0.064
	200-1000 m	%	26.8	13.2	2.4		
	over 1000 m	%	21.2	13.4	3.6		

Remark: ***p < 0.01;****p < 0.05**;** Pearson Chi-Square - Chi-Square value
Source: made by author on the basis of data analysis in SPSS 20.0.

Minimal concentration of dissolved oxygen required for fish is 30% of supersaturating value (Murphy, 2007), and it determinates tolerance of pollution. When asked Have you ever noticed large quantities of dead fish on the surface of VBC, the majority of respondents, 44%, claim that they see dead fish only at certain time of year. Fewer of the respondents, 29.8%, answered that they often notice this phenomenon, while 26.2% claim that they have never seen dead fish on the surface of the canal.

Analysis of acquired answers (Tab. 8) is showing that residents of Vrbas, in highest percentage, answered that they often see dead fish, while majority of Crvenka' residents claimed the opposite. Residents of other settlements declared that they notice this phenomenon only at certain time of year. Chi-Square value (p=0.000) confirms that there is a significant difference between the real and the expected data p<0.01. The differences in answers are significant and are most noticeable between the residents of Crvenka, where 4.8% of 10% of respondents claim that they have never seen dead fish and residents of Srbobran, where only 0.6% of 10% confirmed this statement.

Data acquired by analyzing answers based on distance of houses from VBC (Tab. 8) also show that there are no statistically significant differences (p=0.593) between answers given by respondents.

Tab. 8. The percentages of the answers and the application of the Chi-square test for the questions related to residents' opinion about whether they have ever noticed large quantities of dead fish on the surface of VBC

Have you ever noticed large quantities of dead fish floating along the VBC							
			Yes, very often	Only at certain time of year	No, never	Pearson Chi-Square - Value	Pearson Chi-Square - **p**
settlement	Bezdan	%	3.4	4.2	2.4	54.872	**0.000***
	Sombor	%	2.2	5.0	2.8		
	Sivac	%	2.6	4.0	3.4		
	Crvenka	%	2.2	3.0	4.8		
	Kula	%	2.8	4.2	3.0		
	Vrbas	%	5.0	3.0	2.0		
	Srbobran	%	4.6	4.8	0.6		
	Turija	%	2.8	5.2	2.0		
	Bačko Gradište	%	2.4	6.4	1.2		
	Bečej	%	1.8	4.2	4.0		
distance from VBC	to 200 m	%	6.6	9.0	3.8	3.111	0.539
	200-1000 m	%	12.6	18.0	11.8		
	over 1000 m	%	10.6	17.0	10.6		

Remark: ***p < 0.01;****p < 0.05**;** Pearson Chi-Square - Chi-Square value
Source: made by author on the basis of data analysis in SPSS 20.0.

When asked Would you participate in action of cleaning the canal near your settlement, the majority of respondents, even 70.8% claimed that they would be glad to participate in that sort of action. Percentage of 15.4% declared that they would not participate in action of cleaning, while 13.8% confirmed their participation only if they would get paid for it.

Analysis of acquired answers (Tab. 9) is showing that there is no significant difference between the real and the expected data (p=0.465). In all of the settlements involved in the survey, more than 50% of residents answered that they would be glad to participate in action of cleaning the canal. This opinion is especially noticeable in Sivac, while residents of Sombor are not particularly interested in this kind of action, unless it is paid.

Data acquired by analyzing answers based on distance of houses from VBC (Tab. 9) (p=0.597), as well as analysis by settlements (p=0.465) show that there is no significant difference between the real and the expected data.

Results of this survey reveal different conclusions than survey conducted in 2005 (CeSID, 2005), as residents today display more readiness to participate in environmental actions, while previous research showed that residents of this settlements are passive, and not ready to engage in this sort of action. This is positive change, and it may be concluded that environmental awareness is raised to a higher level.

Tab. 9. Descriptive statistics and the application of the Chi-square test for the questions related to residents' opinion about whether they would participate in action of cleaning the canal near their settlement

Would you participate in action of cleaning the canal near your settlement							
			yes	Only if the action would be paid	no	Pearson Chi-Square - Value	Pearson Chi-Square - **p**
settlement	Bezdan	%	7.0	1.2	1.8	17.861	0.465
	Sombor	%	5.6	2.4	2.0		
	Sivac	%	8.4	0.8	0.8		
	Crvenka	%	7.0	1.0	2.0		
	Kula	%	7.2	1.4	1.4		
	Vrbas	%	6.4	1.4	2.2		
	Srbobran	%	7.8	0.8	1.4		
	Turija	%	6.8	1.8	1.4		
	Bačko Gradište	%	7.4	1.2	1.4		
	Bečej	%	7.2	1.8	1.0		
distance from VBC	to 200 m	%	14.0	3.2	2.2	2.769	0.597
	200-1000 m	%	29.4	6.2	6.8		
	over 1000 m	%	27.4	4.4	6.4		

Remark: ***p < 0.01;**p < 0.05; Pearson Chi-Square - Chi-Square value
Source: made by author on the basis of data analysis in SPSS 20.0.

Conclusion

Organic pollution is typical for VBC. The most important industrial objects are located in central part of VBC, in Vrbas municipality, where the greatest pollution is registered. Pig farm, oil factory and meat industry are hot spots that have the greatest affect on poor environmental condition of the canal. Pollution of VBC is not just a local problem that affects only the health of local residents. Pollutants from VBC are through confluence getting into river of Tisza, and further to river of Danube, polluting them as well.

Based on the results of this survey, we can conclude that local residents conceive the canal as very polluted, and that industrial activities and its by-products are to be blamed. The statement that VBC could affect health of residents is justified, as majority of respondents answered that they often notice changes on the surface of the canal, in form of oil spills, dead fish and odor. Analysis of this question showed significant difference between answers from residents of Vrbas and Srbobran, who claimed to notice this phenomenon quite often, and residents of Bezdan and Sivac, who claimed to see the same only at certain time of year.

Polluters who discharge their wastewater to VBC are degrading its' condition to a high extent. Although there are numerous techniques for emission reduction,

construction of central wastewater treatment plant and prohibition of direct discharge of untreated wastewaters to the canal are pointed out as an ideal solution for this problem. When main pollution sources are under control, improvement of the situation can be conducted by releasing larger quantities of water from the system of floodgates. Only than VBC could become healthy environment and could fulfill the needs of water consumers in that area. There is a long period up ahead, until the final solution. Lot of effort, work and material resources, and what is the most important, change in way of thinking for all the people involved in this complex problem, unfortunately the great environmental problem of Europe.

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СТАВОВИ ЛОКАЛНОГ СТАНОВНИШТВА ПО ПИТАЊУ ЕКОЛОШКОГ СТАЊА И УТИЦАЈА ЗАГАЂЕЊА НА ЊИХОВО ЗДРАВЉЕ И ОКОЛИНУ - СТУДИЈА СЛУЧАЈА ВЕЛИКИ БАЧКИ КАНАЛ, ВОЈВОДИНА, СРБИЈА

Резиме: Велики бачки канал (ВБК) је део хидросистема Дунав-Тиса-Дунав (ДТД) у Србији. Због интензивног загађивања које је почело још шездесетих година XX века, ВБК претворен је у отворени колектор отпадних вода прехрамебне индустрије, фарми и отпадних вода околних насеља. Због великог загађења, ВБК проглашен је "црном тачком" загађења у сливу Дунава. Како је у насељима у околини ВБК велики проценат кућа непосредно уз Канал, он представља велику опасност по њихово здравље и животну средину. У циљу сагледавања стања животне средине у околини ВБК, анкетним истраживањем испитаће се ставови локалног становништва.

Локално становништво је свесно лоше еколошке ситуације у насељима у околини ВБК и зато позитивно одговара на сваку врсту истраживања која би могла да утиче на побољшање еколошког стања. У истраживању је учествовало 500 испитаника. Састављање узорка је вршено тако да испитивана лица буду из различитих насеља, и да им стамбени објекат буде на различитој удаљености од ВБК. У узорку су учествовала лица из десет насеља, Сомбора, Малог Стапара, Сивца, Црвенке, Куле, Врбаса, Србобрана, Турије, Бачког Градишта и Бечеја. Узорак је обухватио приближно 0,3% становника ових насеља. Резултати који су представљени добијени су на основу дескриптивне статистистичке анализе и примене hi-квадрат теста.

На основу резултата анкетног истраживања видимо да локално становништво сматра да је Канал изузетно загађен и да је овакво стање проузроковала индустрија са својим штетним продуктима који се на овом простору годинама испуштају. Испитаници сматрају да нису добро информисани о овом проблему и да до већине информација долазе самостално. Оправдано се сматра да загађеност Канала може утицати на њихово здравље, јер је већина изјавила да веома често по површини каналске воде види масне мрље, угинулу рибу или осећа непријатне мирисе. У анализи ових питања посебно се истичу становници Врбаса и Србобрана, који тврде да се ове појаве манифестују веома често, и становници Бездана и Сивца, који тврде да ове појаве виде само у одређеном периоду године. Велики проценат испитаника изјаснио се да би се радо укључио у еколошке акције чишћења Канала, што се може позитивно оценити и сматрати да је еколошка свест грађана подигнута на један виши ниво.

Загађивачи који своје отпадне воде испуштају у ВБК доводе га у веома деградирано стање. Иако постоје многобројне технике за смањење емисија, као идеално решење за смањење загађења ВБК наводи се изградња и употреба централног постројења за прераду отпадних вода и забрана директног испуштања отпадних вода у реципијент односно Канал. Кад се главни извори загађења доведу под контролу, побољшање ситуације се може остварити и пуштањем веће количине воде из система устава. Тек тада би ВБК могао да постане здрава водена средина и да испуни интересе корисника вода на том подручју.