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MINISTERO DELL'AMBIENTE E DELLA TUTELA DEL TERRITORIO E DEL MARE

STUDY

Water, Sanitation and Hygiene (WASH) in Rural Schools in Šumadija and Pomoravlje in the Republic of Serbia

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Summary

The situation analysis of access to safe drinking water and sanitation for children in primary schools of the rural regions in the territories of Šumadija and Pomoravlje is a unique water, sanitation and hygiene (WASH) Project in Serbia. It was implemented in 12 Šumadija and Pomoravlje municipalities, from June to November 2016, in all 238 school facilities in rural environments attended by approximately 11 thousand children between ages 6 and 15. The Study shows that drinking water supply, adequate sanitation, hand-washing facilities, waste disposal and general hygiene conditions are provided in almost all examined schools. Certain technical issues were detected, for which relatively simple solutions can be found and at a reasonable cost. The schools in Serbia have been categorised for the first time according to the so called service ladders, showing the WASH level that the schools have to provide to pupils. 235 school facilities meet very strict criteria of the basic level of water supply, 203 schools meet the sanitation criteria, while 222 school facilities meet the criteria of the basic hygiene level. Improved WASH standards should be achieved by providing safe drinking water, investment in toilet hygiene, education of children on personal hygiene, particularly menstrual hygiene management, as well as the construction of suitable drinking water, toilet and hand-washing facilities according to standards that enable access to children with disabilities or health condition. Also, this research includes interviews of school pupils and the majority expressed their satisfaction with conditions in toilets and hand-washing facilities, with cleanliness level of sanitation facilities and showed good hygiene habits while using the toilet, hand-washing facilities and drinking water at school. However, it has been established that younger pupils have better personal hygiene habits than the older pupils; thus, it is necessary to work in higher grades of primary schools on pupils' permanent education and on correcting their habits regarding the personal hygiene issues.

Contents

1. Introduction

The Project “The Situation Analysis of the Access to Safe Drinking Water and Sanitation for Primary School Children in the Šumadija and Pomoravlje Rural Regions“ (hereinafter referred to as the Project) was funded by the Italian Ministry for the Environment, Land and Sea (IMELS) within the Agreement with the Ministry of Agriculture and Environmental Protection of the Government of the Republic of Serbia.

The Project Leader is the Regional Agency for Šumadija and Pomoravlje Economic Development from Kragujevac, on the basis of contract with the Ministry of Agriculture and Environmental Protection.

The Republic of Serbia supports, participates and implements joint initiatives of the United Nations (UNECE) and the World Health Organisation (WHO), at the global level, for consideration and identification of obstacles as well as incentives in the fields of water supply, sanitation and hygiene promotion, with the aim of setting priorities for the improvement of the situation in these fields as well as the public health protection (1, 2).

One of these initiatives is the Protocol on Water and Health to the 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes (hereinafter referred to as the Protocol). The Protocol is the first international agreement adopted with the aim to protect at all respective levels, national, transboundary and international, health as the fundamental right of every human being, within sustainable development, through the improvement of water management, including the protection of water ecosystems, for the prevention, control and reduction of water-related disease (1, 3).

The Republic of Serbia ratified the Protocol on Water and Health in 2013 (1) and established the National targets and target dates in 2015, thus fulfilling the obligations envisaged under Article 6 of the Protocol (4).

Among the set targets, particularly important are the ones related to the improvement of water supply and sanitation in children’s facilities, in accordance with the Priority Goal 1 under the Parma Declaration adopted at the Fifth Ministerial Conference on Environment and Health in 2010, as well as targets for the improvement of water supply and sanitation in rural environments (4), as follows:

- To estimate investment required for the improvement of water supply in schools and preschools facilities, supplied from individual wells or connected to rural water supply system (SSWS);
- To estimate investment required to improve access to sanitary equipment, proper waste water disposal and regular emptying of septic tanks in schools and preschools facilities;
- To develop a plan for the improvement of sanitation in schools and preschools facilities;
- To improve sanitation in schools and preschools facilities.;
- To raise awareness of teachers, school stuffs and pupils on hygiene of the sanitation facilities in schools:

a) Review of curricula and textbooks related to the content related to water and sanitation,
b) Education planning for educators, teachers and school Education planning for educators, teachers and school administration,
c) Education planning for children, students and parents,
d) Realisation of educational plans related to school staff,
e) Realisation of educational plans related to children and students.

- To improve WASH survey in schools introducing new methodology;
- To raise awareness on adequate water supply and sanitation in schools, especially in those with individual wells.

With this Project, the Republic of Serbia contributes to the implementation of the programme activity of the Protocol for the period 2017-2019 related to institutional WASH, with particular focus on schools and health care institutions (5).

1.1. Area of intervention

Šumadija and Pomoravlje Districts are located in Central Serbia, between The Sava and The Danube Rivers, situated to the north, The Velika Morava River to the east and The Zapadna Morava River to the west.

The total surface area of the region is 5,001 km^2, which makes 5.6% of the total surface area of the Republic of Serbia. In this territory, according to the last official Census, implemented in 2011, live 507,844 inhabitants, and the average population density is 101 inhabitants/ km^2. The share of population of Šumadija and Pomoravlje in the total population of the Republic of Serbia is 7%. The Šumadija and Pomoravlje Region includes two Districts: Šumadija and Pomoravlje (Figure 1).

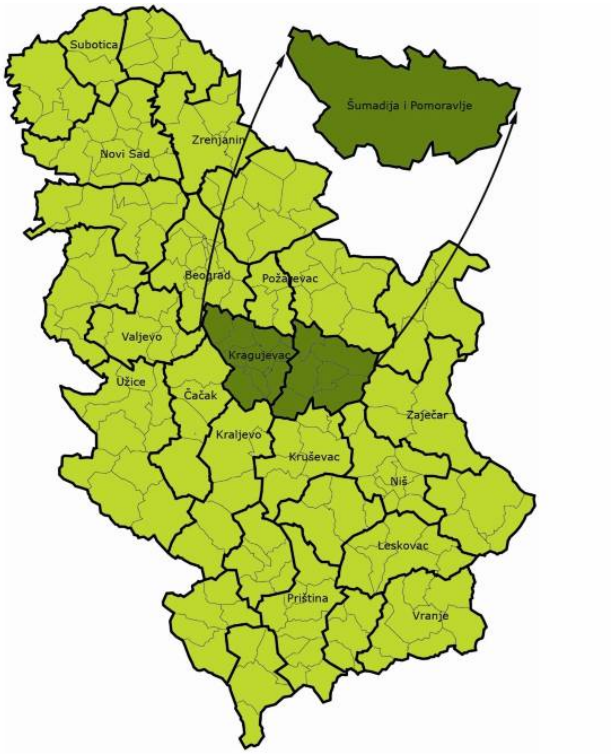


Figure 1 Šumadija and Pomoravlje Districts within the Republic of Serbia

Šumadija District consists of the City of Kragujevac and six municipalities: Arandjelovac, Batočina, Lapovo, Knić, Rača and Topola. Total surface area of the Šumadija District is 2,387 km^2, of which 835 km^2 is the territory of the City of Kragujevac, which is at the same time the biggest city in the whole region. There are 293,308 inhabitants in the Šumadija District, and the average population density is 123 inhabitants/ km^2.

The Pomoravlje District consists of the Town of Jagodina and five municipalities: Despotovac, Paraćin, Rekovac, Svilajnac and Ćuprija. Total surface area of the Pomoravlje District is 2,617 km^2 with 214,536 inhabitants, while the average population density is 82 inhabitants/ km^2.

2. Risk factors to children's health associated with conditions of WASH in schools

Access to adequate conditions of WASH in schools is essential for a healthy growth and development of children. These are pre-conditions for creating a favourable school environment for good health, wellbeing, learning and dignity of pupils (6, 7).

Adequate water supply means healthy and safe drinking water available to all pupils in the school premises in sufficient quantities and at all times when needed.

Drinking water is water intended for human use, cooking and food preparing and maintaining personal hygiene. Safe drinking water does not contain microorganisms (bacteria, viruses, and parasites) or chemical contaminants, including radioactive elements, in concentrations that may endanger human health.

For achieving good learning outcomes it is very important that the pupils drink enough water during their stay in school. If the water intake is not sufficient, water balance in the body may be severely disturbed, affecting cognitive processes and learning capacity, concentration of pupils in the classroom, pupils' mood and accomplishment in the classroom. Research conducted in Italy and Great Britain showed that short-term memory in pupils and the energy level were twice as high with well hydrated pupils compared to pupils that did not drink enough water (6, 7, 8).

The daily amount of water that a child needs depends on several factors, such as: age, gender, weight, air temperature, air humidity, level of activity and child's state of health (9).

Adequate water supply in schools also prevents water-borne diseases and contributes to positive school's performance and promotion of good personal hygiene habits that last throughout children's lives.

Diseases that may be transmitted by water and poor hygiene habits include the following categories:

- When the drinking water contains microorganisms (bacteria, viruses or parasites) that cause contagious diseases, and chemical contaminants, a child who drinks such water may get sick from diseases such as hepatitis A, dysentery and other different intestinal diseases that manifest with high fever, nausea, vomiting and diarrhoea, as well as diseases such as arsenicosis and fluorosis.
- Due to poor WASH conditions, diseases such as helminthiasis may occur (soil transmitted helminths). Furthermore, when there is not enough water for maintaining general and personal hygiene, diseases such as scabies and diseases spread by fleas and lice.
- If one swims in contaminated water, diseases can be transmitted by parasites living in the infected organisms (e.g. freshwater snail infected by parasites can transmit schistosomiasis).
- When insects are found in the water (mosquitoes, flies, and the like), due to favourable climatic conditions (high air humidity, vicinity of water surface), they can carry microorganism that cause malaria, yellow fever, dengue fever, West Nile fever, etc.
- Diseases transmitted by aerosols containing microorganisms, such as *Legionella* (legionellosis) and other (10).

Hygiene relates to conditions and procedures that help maintaining good health and prevent disease spreading (9).

When we talk about hygiene in pre-school and school institutions, what we have in mind is adequate equipment and functionality of sanitary and hygiene appliances (presence of toilets, sinks, showers, proper functioning faucets, adequate ventilation), conditions that enable sense of privacy and dignity (presence of doors on toilet cubicles

which can be closed and locked, toilet waste bins with lid for disposal of menstrual waste, soaps and safe drinking and hand-washing water), as well as regular maintenance of cleanliness. All this, together with good hygiene habits is necessary for preserving physical, mental and social health of children.

As a place to gain knowledge and skills, school has an important role in transmitting messages to pupils on the significance and importance of maintaining sanitary facilities clean, and cherishing good healthy hygiene habits.

Regular hand-washing is a good hygiene habit and one of the most efficient measures for the protection against contagious diseases spread by dirty hands (the so called “dirty hands diseases”), as well as preventing and reducing disease spread. In order to wash hands in a proper and thorough manner, it is necessary to have in place hand-washing facilities, running water safe to drink, soap for hand washing and paper towels or other means for hand-drying. Washing hands before meals and contact with food, before and after using the toilet, after contact with waste materials, after nose cleaning, coughing and sneezing, as well as in all situations after contact with animals and objects in the environment, make good hygiene practices.

Maintaining general hygiene and cleanliness of drinking water installations and sanitary facilities in schools have multiple benefits when children's health is in question. Less absence from school due to intestinal infectious diseases (fever, vomiting, diarrhoea, abdominal pain), whose transmittance is facilitated in the conditions of poor general hygiene, enables acquiring positive habits and health care by using the toilet without unnecessary delay, which all helps improve concentration and good learning results (9, 11).

Adequate menstrual hygiene management is also of utmost importance for preserving both physical health of pupils as well as their mental and social welfare. Lack of sanitary blocks (toilets, sinks, soap), their poor maintenance and poor equipment (lack of bathroom bins without lid, soap, toilet paper) undermines the right of girl pupils to be educated and acquire good habits when menstrual hygiene is in question (12, 13).

2.1. Project main goal

Support to achieving national targets which are part of the Action Plan for the implementation of the Protocol on Water and Health in the Republic of Serbia.

2.2. Project specific goals

- Making the situation analysis (GAP analysis) access to safe drinking water and sanitation for children in primary school s, as well as sanitary control facilities in rural areas of Šumadija and Pomoravlje territory, with a preliminary assessment of the investment,

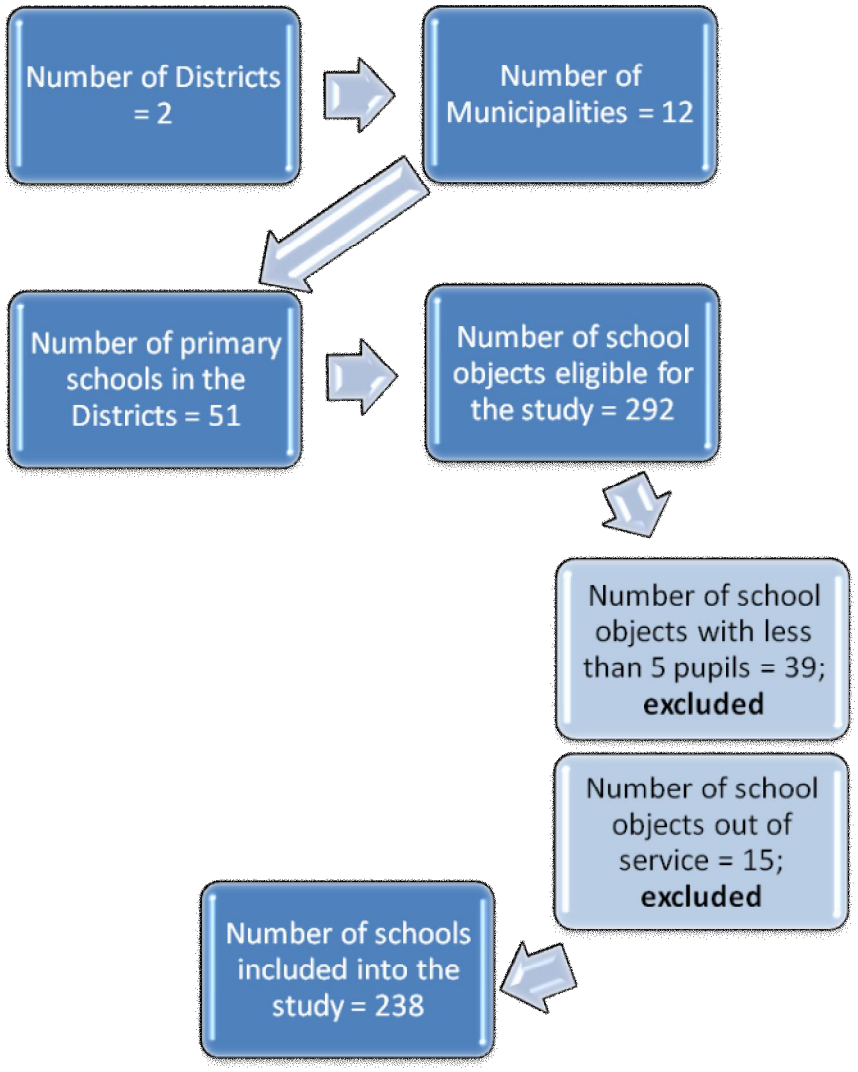
- Development of pilot methodology for assessing water, sanitation and hygiene in schools adapted to local conditions and circumstances, with the possibility of applying even in other Serbian regions, which would ensure the Project sustainability.

- Defining measures and recommendations for the improvement of WASH situations in Šumadija and Pomoravlje rural schools.

3. WASH in rural schools survey in Šumadija and Pomoravlje: Methodology

The Study was implemented in the rural region of Šumadija and Pomoravlje Districts in 2016 (in periods: 1-15 June 2016 and September-November 2016). The rural environment schools are most frequently connected to the rural water supply system or own water supply source (well or spring), where the monitoring of WASH is not performed on a regular basis, with no detailed data on the subject, as opposed to schools in urban environments. This is the reason why the emphasis of the research is on rural schools.

The Project methodology envisages that all schools in both Districts are to be visited. According to available records and data of local self-governments of both Districts, the number of primary schools, including the central primary school and its outposts, in rural environments of both Districts, totalled 292. Before field research, it was established that 6 school facilities were closed; in 39 school facilities 0-5 pupils were enrolled; while in 9 school facilities it was established during field research that they were also closed. The final number of examined school facilities was 238 including 108 in Šumadija District and 130 in Pomoravlje District. Graph 1 shows the procedure for the selection of school facilities for monitoring in the examined Districts and the reason for exclusion of certain schools from monitoring.



Graph 1 The procedure for the selection of school objects for the survey

The research was implemented in three stages:

- Development of methodology and questionnaires adapted to local conditions,
- Field work: monitoring WASH in school facilities (wastewater disposal, toilets, hand-washing facilities), disposal of solid waste and assessment of technical and technological defects and damage in school facilities, as well as sampling and laboratory testing of drinking water, and
- Analysis of obtained results with conclusions and recommendations for improvements.

3.1. Development of questionnaires

Questionnaires were created on the basis of international standards, guidelines and documents related to conditions of WASH. The following data from international strategies and reference documents and consultations were used:

- Parma Declaration on Environment and Health (RPG 1 – Providing each child with adequate access to safe water and sanitation in homes, child care centres, kindergartens, schools, health care institutions and public recreational water settings and revitalising hygiene practices) (14),
- 2030 Agenda for Sustainable Development, whose main goal is to provide availability of water and sanitation and their sustainable management, with particular emphasis on goals 4 and 6 (15),
- UNICEF Guidelines for the improvement of children's health and learning capacities, as well as their families, through the reduction of diseases connected with inadequate water supply and sanitation. Any favourable school environment requires adequate initiative for maintaining conditions of WASH at the level that prevents spreading of harmful bacteria, viruses and parasites (clean school environment without unpleasant odours) (16),
- Questionnaire of the World Health Organisation (WHO) for monitoring WASH in schools and WHO Guide defining minimum conditions for providing schooling in a healthy environment (17),
- Questionnaires for sanitary control in different types of water supply facilities, created for the Project “Rapid Assessment of Drinking Water Quality in rural areas in Serbian“ (project supported in technical and financial terms by WHO for the European Region and UNECE) (18).
- International Water and Sanitation Centre, IRC, Guide providing instructions for designing and creating school environments that promote and cherish good hygiene practices (19, 20).
- National legislative framework and General Interest Programme of the Ministry of Health,
- Consultations with the UNICEF, WHO and Italian partner organisation ICARO experts.

Basic Questionnaire for schools consisted of six Modules/Parts shown in Table 1.

Table 1 Questionnaire contents according to Modules/Parts

Module/Part marking	Topic
Module/Part A	School general data
Module/Part B	School water supply
Module/Part C	School sanitation
Module/Part D	School hand-washing facilities
Module/Part E	School cleaning, operation and maintenance
Module/Part F	Solid waste disposal in schools

Part A of the Questionnaire included general questions about the school facility, number of pupils and teachers, type of school, age of the school building and age of pupils. Interviewed school staff provided contact data for each school.

Part B Questionnaire on water supply consisted of 20 questions relating to the main source of water supply, functionality of the water supply source, alternative sources of water supply, water availability during research, sufficiency of the quantities of available water, use of water at school, applied additional water treatments, as well as monitoring of microbiological and chemical safety of drinking water.

Part C Questionnaire on sanitation in schools consisted of 21 questions relating to access to sanitation, toilet type, separation of toilets according to gender, functionality, availability of toilets to the youngest children and children with disabilities, menstrual hygiene, and toilet ventilation and lighting.

Part D of the Questionnaire on hand-washing facilities consisted of 15 questions related to the type of hand-washing appliances, accessibility, functionality, appliance availability to the youngest children and children with disabilities, as well as questions related to education on hand-washing and maintaining personal hygiene in schools.

Part E of the Questionnaire consisted of 11 questions related to the maintenance of cleanliness of toilets and hand-washing appliances in schools.

Part F of the Questionnaire consisted of 4 questions relating to the manner of disposal of solid waste from the school facility and if it is done on a regular basis.

Additional Questionnaires were as follows:

- Questionnaire for technical and technological assessment of defects and damage in the water supply facilities as regards installations, sanitary installations in schools and hand-washing appliances in schools,
- Questionnaire for pupils dealing with opinions of pupils, their satisfaction with conditions of WASH in their school as well as pupil hygiene habits,
- Questionnaires for sanitary control of different types of water supply facilities (protected source, drilled hole with electric pump (hydrophore), drilled hole with manual pump, dug well with manual pump, uncovered dug well, dug well with well sweep, dug well with pump (hydrophore), small water supply system-distribution network, small water supply system-tank and distribution network), created for the Project “Rapid Assessment of Drinking Water in Serbian Rural Environments“, when the school is not connected to the urban water supply system, but to its own water supply source, or the so called rural water supply system.

The Questionnaires were carried out through the interviewing method or monitoring or inspection method (direct examination) for the questions especially marked with the water droplet sign “ „. Furthermore, Questionnaire testing and piloting was carried out in three schools in the Municipalities of Rača and Topola in May 2016, before field research. All Questionnaires are shown in Exhibit 1 of this Study.

For the purpose of field work, field teams were provided with the instructions for field work, instructions for filling databases, blank database forms and school codebook with a unique school code for every school facility.

3.2. Sampling and laboratory testing of drinking water quality

Sampling and laboratory testing of drinking water quality was performed in school facilities connected to the so called rural water supply system or individual water supply source (well, spring).

Sampling, sanitary control of water supply facilities, as well as complete carrying out of field work according to methodology were performed by expert teams of the Kragujevac Public Health Institute (IZJ Kragujevac, total number of 6 teams). Laboratory testing of drinking water samples was performed in the IZJ Kragujevac accredited laboratory (21).

Microbiological and physical and chemical parameters of laboratory tests of drinking water samples are shown in Table 2.

Table 2 Test parameters for safe drinking water

Microbiological parameters	Physical and chemical parameters	Organoleptic parameters
*Escherichia coli**	Ammonia	Colour
	Nitrates	Odour
	Manganese	Temperature
	pH value	Turbidity
	Residual chlorine#	Conductivity

*** Note:** According to methodology, counting, i.e. determining the exact number in a sample of 100 ml of water shall be performed

Note: If water is chlorinated

3.3. Analysis and processing of results

Test results of the mentioned parameters concerning drinking water quality were compared to the national standard, i.e. the Rulebook on safety of drinking water ("Official Journal of FRY", No 42/98) for water supply distribution systems up to 5,000 population equivalent (22). Maximum permitted values of the mentioned parameters according to the Rulebook are as follows: *Escherichia coli* (0 CFU/100 ml), ammonia (1 mg/l), nitrates (50 mg/l), manganese (0.05 mg/l), residual chlorine (0.5 mg/l), pH value (6.8-8.5), colour (5° Co-Pt scale), turbidity (5 NTU), electrical conductivity (1000 µS/cm), odour (without odour) (22). On the basis of comparison of the test results with values from the Rulebook, compliance with each individual parameter was calculated: microbiological compliance, physical and chemical compliance and overall compliance (all parameters included).

Assessment of sanitary risk for all types of water sources and water supply systems was performed on the basis of the mentioned Questionnaires, of which each individual questionnaire consisted of ten questions, with "yes" or "no" answers. The sum of all positive answers made the total risk score in the range from 0 (no risk) to 10 (the greatest sanitary risk) (18).

Furthermore, microbiological results, i.e. the *Escherichia coli* count in 100 ml of water were combined with the sanitary risk score for each individual type of the water supply source and distribution network, with which the so called "Risk-to-health matrices" were created according to the World Health Organisation methodology (18). Risk-to-health matrices were formed on the basis of counted values of *E. coli* categorised in four categories: <1, 1-10, 11-100, и >100, and scores of sanitary risk (number of positive answers) categorised in the ranges: 0-2, 3-5, 6-8 and 9-10. Thus, four risk levels (low, medium, high and very high) when contamination is in question were provided for the given type of water source, i.e. distribution network. Table 3 shows calculation and interpretation of risk matrices according to the WHO methodology.

Matrices were used for determining the priority level for undertaking corrective measures in order to reduce the risk for drinking water contamination, and subsequently human health risk.

Table 3 Risk-to-health matrices – calculation and interpretation

E. coli count (CFU/100 ml)	Sanitary risk (Number of positive answers for the risk assessment)			
	0-2	3-5	6-8	9-10
<1	Low	Medium	High	Very high
1-10	Medium	Medium	High	Very high
11-100	High	High	High	Very high
>100	Very high	Very high	Very high	Very high

Legend:

Risk level	Low	Medium	High	Very high
Priority for undertaking measures	Does not require measures undertaking	Low priority	Higher priority level	Urgent (Very high) priority level

Source: World Health Organization. Rapid Assessment of Drinking-Water Quality: a handbook for implementation. World Health Organization, Geneva, 2012.

Besides, with the aim of classification and assessment of the existing access to WASH of each individual school, service ladders – achieved levels of standards, were used, defined and created by WHO and UNICEF (Expert Group on Monitoring WASH in Schools within the Sustainable Development Goals, WHO/UNICEF Joint Monitoring Programme for water supply and sanitation), to the end of monitoring progress in reducing inequality in all fields, as well as comparison among countries (23, 24).

Table 4 shows the levels of standards, in particular when WASH is in question. The basic level in Service ladders is the threshold and corresponds to the achieved sustainable development Goal 4.a. (SDG). For countries striving towards higher level of standard of WASH in schools, an Advanced level of services/standards has been introduced. It is envisaged that every country shall define its national criteria for the Advanced level of services/standard; thus, in Table 4, preliminary definitions for the mentioned level of standard according to WHO and UNICEF, are given.

Table 4 Service ladders – levels of standards achieved

Service / standard level	Drinking water	Sanitation	Hygiene
Advanced service	Drinking water is available at all times for all children* and is safe to drink	Toilets are clean, accessible to all children*, adequate quantity of appliances, and have menstrual hygiene facilities†	Hand-washing facilities are accessible to all children* when necessary, menstrual hygiene education provided
Basic service	Drinking water comes from an improved source# and is available at	Toilets are improved‡, sex-separated and usable at the school$	Hand-washing facilities have soap and available water for washing purposes

	the school		
Limited service	There is an improved water source, but water is not available at time of survey	Toilets are improved, but are not sex-separated or are not usable	Hand-washing facilities with available water, but without soap
No service / standard	There is no water supply source or it is un improved	There are no toilets or they are not unimproved	There are no hand-washing facilities or there is no water

Source: UNICEF, WHO. Core questions and indicators for monitoring WASH in Schools in the Sustainable Development Goals. 2016

Legend:

∗ Including children with disabilities, limited physical mobility, blind

Water supply system, borehole, protected source, protected dug well, bottled water

† Presence of bins with lids in toilet cubicles

‡ Toilet with flushing power or lower flushing power into the sewage, septic tank or toilet hole and advanced ventilation, toilet with hole and advanced ventilation and composting toilet

$ Implies availability (the door is unlocked or the key is always available), functionality (the toilet bowl is not broken, water drain is not blocked and water is available for full flushing or lower flushing power) and privacy (the toilet door can be closed or locked and there are no greater openings in the construction)

Bearing in mind that in Serbia national criteria according to the described SDG indicators in this field have not yet been adjusted, to the end of processing data in this Study, criteria defined under Table 4 were used that correspond to definitions given by WHO and UNICEF in the document “Core Questions and Indicators for Monitoring WASH in Schools within the Sustainable Development Goals“. Furthermore, for the purposes of this Study, criteria as regards the Advanced level of services/standards, as the desirable levels for the improvement of the current situation (23), were used.

3.4. Assessment of technical and technological malfunctions in water supply and sanitary & hygiene facilities

Assessment of the necessary resources for the improvement of the status of access to WASH in rural schools of Šumadija and Pomoravlje Districts was performed on the basis of the mentioned Questionnaires for the assessment of technical and technological defects and damage, Questionnaire for sanitary control of the water supply facilities as well as the general Questionnaire with all six modules.

During the assessment, all cost and expenses for the necessary material and performance of necessary works were taken into consideration, for the improvement of the current (established) status. Regarding the construction and technical interventions in every school where it was necessary, the cost of developing, smaller or bigger, individual sanitation and renovation projects, as well as other administrative costs (obtaining necessary construction permits, studies, administrative fees, etc.), which are not direct subject matter of this Study, were not taken into consideration.

The scope of the necessary technical and construction interventions was assessed in order to achieve advanced standards in local conditions in this field.

The envisaged interventions mean the repair of the current installations, appliances and facilities as well as the construction of the new ones, where necessary.

The assessment of investment needs was performed according to the type of perceived deficiencies in the following manner:

❖ **Installations in schools**

➢ The assessment was performed on the basis of data obtained through the Questionnaire for the assessment of the technical and technological condition of the hand-washing facilities and toilets.

❖ **Water supply sources**

➢ When the Questionnaire for examining the sanitary characteristics of the water source, according to the type of protected water source, is in question, only the schools with the following risks at the water source: Risk 1 (groundwater collection facility absent or damaged) and Risk 5 (there is no fence or the fence is damaged), were taken into consideration.

➢ When the Questionnaire for examining the sanitary characteristics of the water source, according to the type of the borehole with electrical pumping, is in question, only the schools with the following risks at the water source: Risk 6 (animals have access to the facility, therefore, there is no fence or the fence is damaged) and Risk 10 (there is no lid on the well or the lid is damaged), were taken into consideration.

➢ When the Questionnaire for examining the sanitary characteristics of the water source, according to the type of dug well with windlass and partial cover, is in question, only the schools with the following risks at the water source: Risk 5 (there is no drainage channel around the facility), Risk 6 (there is no above-ground part of the well or it is damaged), Risk 8 (there are cracks on the concrete floor around the well – thus, it is necessary to reconstruct the floor in order to avoid collecting of water around the well) and Risk 9 (the walls of the well are permeable up to the depth of 3 meters, which means that the value of making a cement or concrete layer on the interior surface of the well wall, up to the depth of 3 meters, should be calculated), were taken into consideration.

➢ When the Questionnaire for examining the sanitary characteristics of the water source, according to the type of the dug well with pump/hydrophore, is in question, only the schools with the following risks at the water source: Risk 5 (there is no drainage channel around the facility), Risk 6 (there is no above-ground part of the well or it is damaged), Risk 7 (the width of the concrete floor around the well is less than 1 meter), and Risk 8 (the walls of the well are permeable up to the depth of 3 meters), were taken into consideration.

➢ Additional calculations were performed for eliminating Risk 1 – there is no fence around the reservoir or the fence is damaged, when the rural water supply system is in question, according to type of distribution network with reservoir.

❖ **Water chlorination**

➢ All types of the school water supply, except connections to the urban water supply system, were treated as water sources with at least small, simple, distribution network. Thus, even the situation when the school water supply is from own school well found in the yard, it is treated as water source and distribution network. It means that when inspections of the water source and inspections of the network are in question, in any case, beside Forms/Questionnaires for water sources (borehole, dug well, spring), the Forms for the distribution network were used as well (depending on whether there is a tank/reservoir or not).

➢ These Forms were used even in cases when the school water supply (IWSF – Individual water supply facility or SSWS – Small-scale water supply system) was characterised as water supply from individual water supply facility (IWSF). Thus, data on

the fact whether the water is chlorinated or not for every school not connected to the city/town water supply system were obtained.

- Therefore, for the investment assessment as regards the issue of necessary water chlorination system, data were obtained only from the Questionnaire for the inspection of the water supply network (with tank or without tank). The number of schools for which it is necessary to assess the investment value for water chlorination totalled 117.

❖ **Sanitation**

- The assessments were performed on the basis of data and answers obtained from the Questionnaire as regards the questions: whether the toilet is found in the school building or not, what type of toilet is found in school, in what manner is the sanitary wastewater disposed of and what type of dry toilet is used (if any). When all answers that the toilet is found outside the school building are in question, financial needs for the construction/building in the toilet inside the school building were calculated.

Furthermore, when all answers that the school uses permeable holes for the disposal of wastewater / faecal water and sewage, i.e. that it does not have adequate disposal system (septic tank or impermeable toilet hole) are in question, financial needs for the construction of an "average" septic tank for the needs of a rural school (see the concrete number of pupils in any such school) were calculated

- Note 1: Where the adaptation of the sanitary blocks is necessary, in order to make them available to children with special needs, it could be considered that the investment cost is increased by 30%.
- Note 2: In cases when the team working in the field did not get answers to certain questions, negative assumptions were taken as a starting point in terms that the risk exists and that there are deficiencies as regards the subject of a certain question.

3.5. Limitations of the Study as regards the investment assessment

As regards the possibility of providing access to safe drinking water for all children, there are several objective obstacles which cannot be handled by this Study.

Namely, in the situation when the water is not available within the school property, this Study cannot provide an estimation of necessary cost for the problem resolution. Such an issue requires an individual approach, i.e. individual study for any such school. Only such a study could determine what method for providing drinking water within the school property is the most justified one (taking into consideration demographic and other data) and what is the potential cost of the following going to be:

- possible connection of such schools to the urban water supply system (if it is feasible, i.e. if the access to the urban water supply system is found at an acceptable distance, with acceptable topographic and other terrain features);
- connection to the rural water supply system (if such a water supply system exists and if drinking water of satisfactory quality is distributed);
- construction of a well (drilled or dug, if the geophysical, hydrogeological and other research, as well as laboratory analyses, show that it is justifiable to choose such a solution);
- catchment of a source or spring (if an adequate water source or spring are found at an acceptable distance);
- other solutions (e.g. construction of a water tower with tank, which would be filled with water brought in by auto-tanks, and in which the water would be disinfected – chlorinated).

This is a case where it is possible that a certain school “appears“ after the Study is completed with an especially high estimated investment as regards providing safe drinking water; although, as already mentioned, such individual studies and estimations cannot be in any manner a part of this Study.

Furthermore, in providing access to safe drinking water for all children, there are certain problems that are, bearing in mind current circumstances in Serbia, almost irresolvable even in urban environments.

The problem of possible microbiological properties that make water unsafe to drink could be considered resolved by introducing water disinfection. The most reliable method is water chlorination, and from such aspect this Study provides a considerably reliable estimation of the necessary cost.

However, in schools where the water sample testing proved that water is unsafe to drink regarding its physical and chemical properties, in particular regarding the content of ammonia, nitrates or manganese, it is neither rational nor economically justifiable to offer technological solutions in terms of construction of a water treatment plant which would eliminate such unsafe qualities of drinking water. Such plant require huge investments and further expert, energy and any other logistics as well as high maintenance cost, which would be impossible for any rural school. The capacities of the water sources used for water supply of rural schools are not enough to implement such a system. In many Serbian cities/towns (e.g. especially in Vojvodina) water from the public water supply systems, to which schools with a large number of pupils are connected, do not meet the prescribed physical and chemical requirements, even when the public water supply networks include water purification plants. This problem is awaiting a satisfactory resolution for many years, although for the reasons mentioned, the construction of new or additional plants for the water purification/treatment systems within schools is not considered anywhere. This is also a case where it is possible that a certain school “appears“ with a particularly high estimation of investment necessary to provide safe drinking water, or, as emphasised, such individual studies and estimations are not the subject of this Study.

The final assessment of investment cost is based on all professional principles and experience in this field, within a reasonable framework enabled by the design of this Study/Project.

4. Results

4.1. Basic school characteristics

The research was conducted on a sample of 238 school facilities in two Districts: 108 in Šumadija District and 130 in Pomoravlje District. At the moment of research, schools in rural environments of Šumadija and Pomoravlje were attended by over 11 thousand pupils and had approximately 2,000 teachers. Half of all examined schools have less than 17 pupils; in 25% of examined school facilities there are less than 10 pupils, while in one quarter of all schools there are more than 57 pupils. Only 15% of the examined schools have more than 100 pupils. The numbers of pupils and teachers in the examined schools are shown in Tables 5-6.

Table 5 Number of pupils in schools

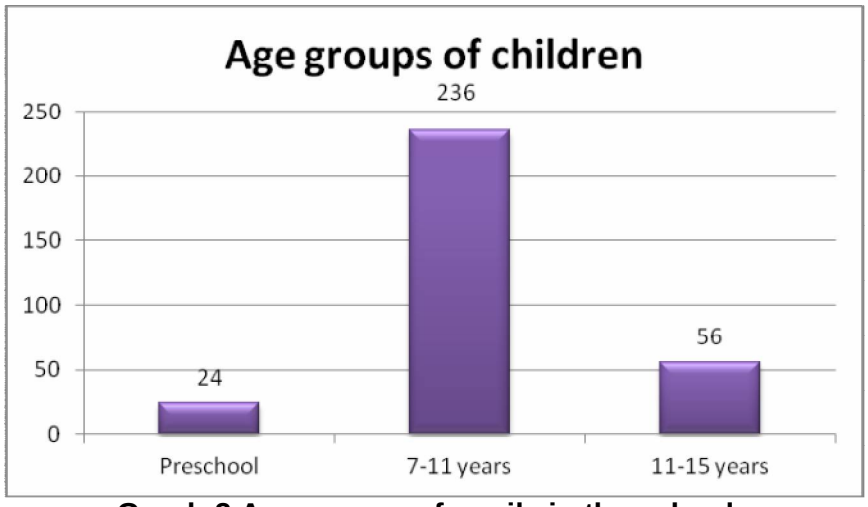
	Boys	Girls	Total
Average number of pupils per school	24	22	46
Range of the number of pupils per school	1 - 224	0 - 252	2 - 476
Total number of pupils in all schools included in the Study	5,654	5,271	11,039

Table 6 Number of teachers in schools

	Men	Women	Total
Average number of teachers per school	3	6	8
Range of the number of teachers per school	0 - 20	0 - 52	1 - 71
Total number of teachers in all schools included in the Study	612	1,391	2,007

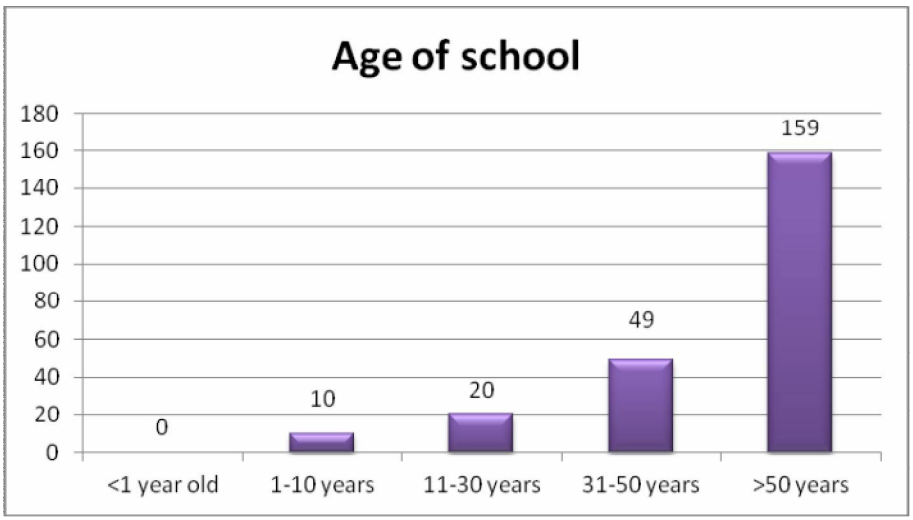
During research, the examined schools included a total number of 19 pupils with disabilities in 15 school facilities (0.17% of the total number of pupils), as follows: 8 boys in 7 schools (0.14% of the total number of boys) and 11 girls in 11 examined schools (0.21% of the total number of girls).

In almost all examined schools are pupils between ages 7 to 11, in 56 schools there are also older pupils (ages from 11 to 15), while the pre-school children attend only 24 schools in rural environments. Pupil age groups are shown in Graph 2.



Graph 2 Age groups of pupils in the schools

All examined schools are general education schools, without boarding facilities. Two thirds of the examined school facilities (66.8%) during research were older than 50 years, while every fifth school facility in rural environment (20.5%) was between 30 and 50 years old. The age of the examined school facilities during research is shown in Graph 3.



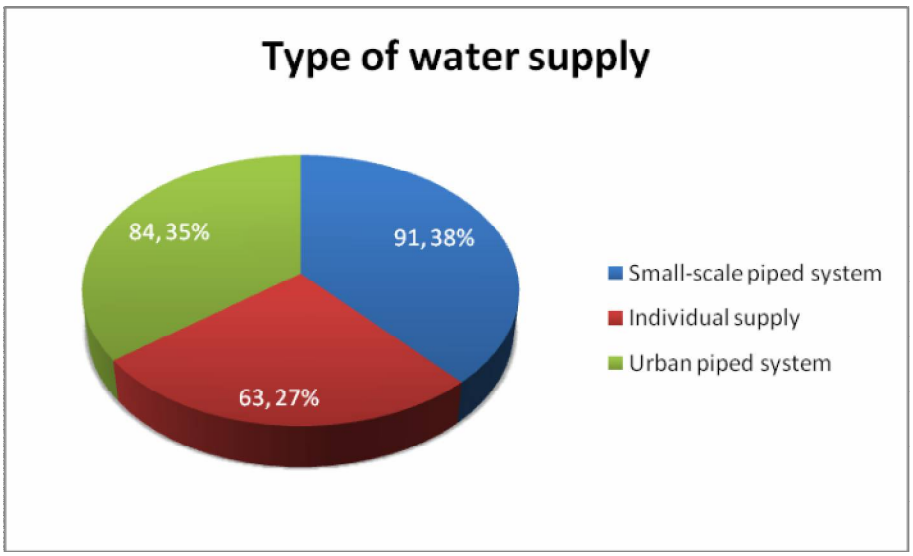
Graph 3 Age of the school building at the time of Study

4.2. Water supply in schools

4.2.1. Drinking water supply in schools

On the basis of the Questionnaire on water supply the following information was established: which is the main source of the school water supply, is water available within the school property or in the school building, is the water source functional, and is the water available every day, is water available to all children, including the youngest children and children with disabilities, is the water treated at school and is the water quality tested on a regular basis.

On the basis of interviews with the school staff, it was established that there are three main sources of school water supply as follows: water from the urban water supply system, which supplies 84 schools (35%), water from the rural water supply system, which supplies 63 schools (27%), and water supply from individual water supply facilities (wells or boreholes), which supply 91 schools (38%). The frequency rates of different water supply sources of schools are shown in Graph 4.

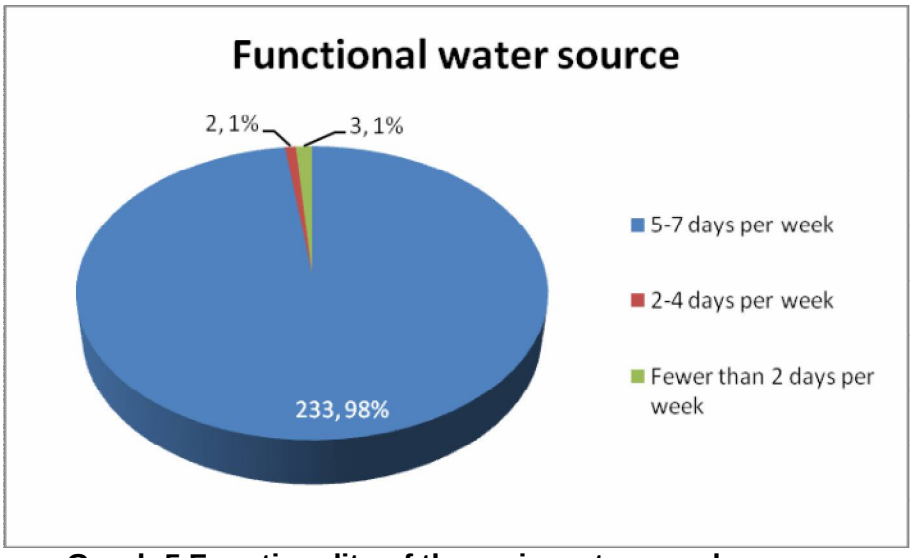


Graph 4 Types of water supply of the schools

It is important to indicate that the differences concerning water supply between the two Districts (water supply in Pomoravlje is mainly from urban water supply systems) also contribute to the existence of other differences in characteristics of water supply of the examined schools included in this research.

To the question, if water from the main source is available in the school building, 235 schools (99%) answered affirmatively; while in one school it was established that water is available within the school yard at a distance of less than 10 meters from the school building; in one school, water is available within the school yard at a distance longer than 10 meters from the school building; while in one school, water was available outside the school yard.

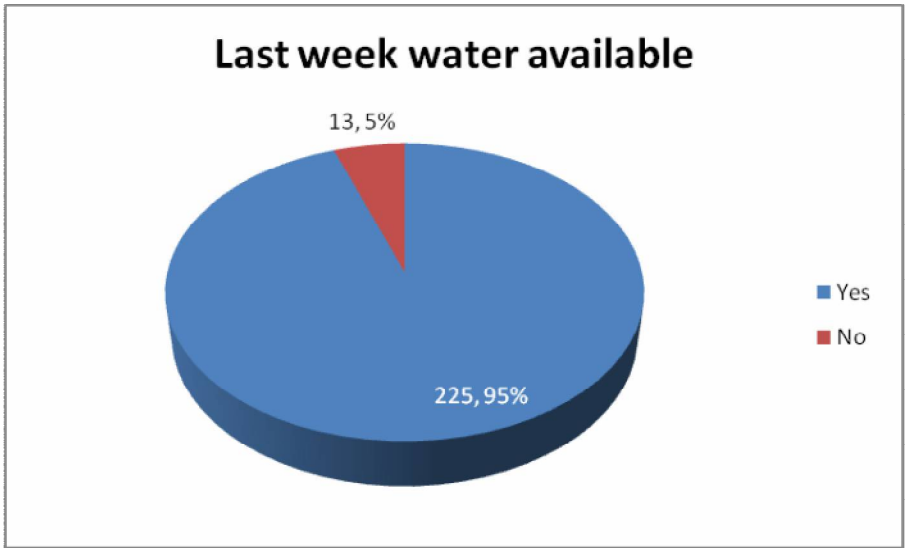
On the basis of the Questionnaire, it was established that the main school water supply source is functional almost every day (5 to 7 days a week) in almost all schools and that in only 5 schools the mentioned water supply source is functional more rarely – 2 to 4 days a week or less than 2 times a week. The frequency of functionality of water supply sources is shown in Graph 5.



Graph 5 Functionality of the main water supply source

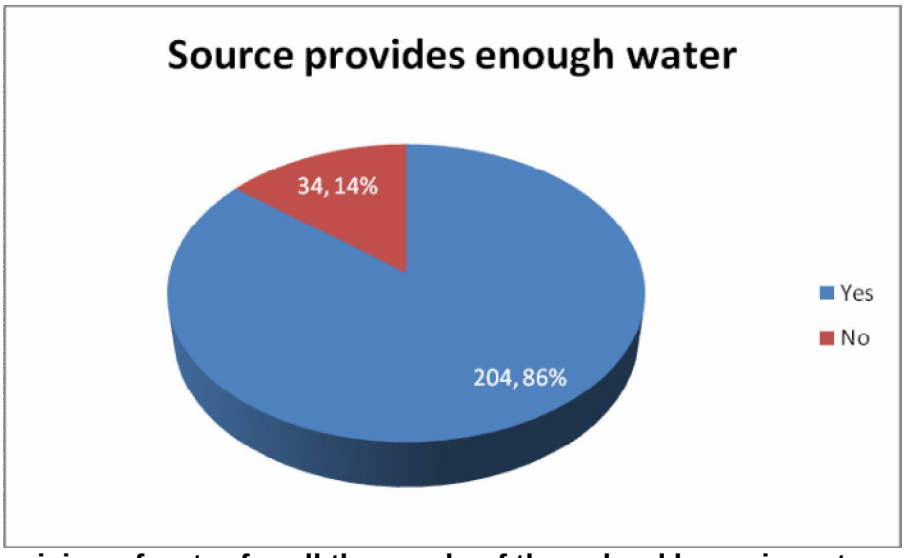
Regardless of the functionality of the main source of water supply, the Questionnaire served to examine whether the water was available in schools the whole day long during the week preceding the research, which is shown in Graph 6. In the majority of examined schools (95%) water was available every day of the preceding week, while in 13 school facilities water was not available.

Likewise, on the basis of the Questionnaire it was established that water from the main water supply source is available in school during the whole year irrespective of the seasonal period in 229 school facilities (96%), and that in 9 school facilities water is not available during the whole year.



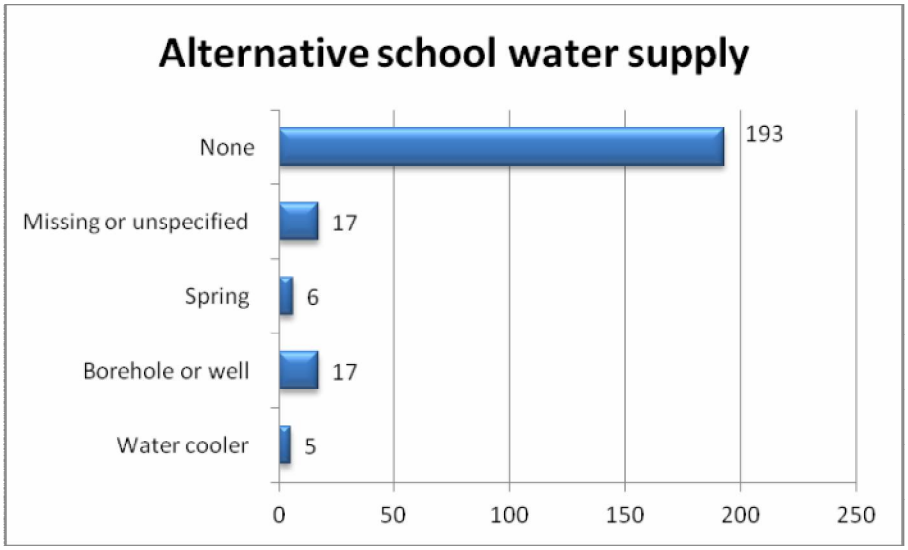
Graph 6 Availability of drinking water at the school in the week preceeding the Study

Furthermore, it was examined if the main source of water supply provides sufficient water quantities for all school needs, including for drinking, hand-washing, food preparing, when the water source is functional, i.e. available for use, which is shown in Graph 7. According to the Questionnaire, the water supply source provides adequate water quantities for all needs in 86% of the examined school facilities.



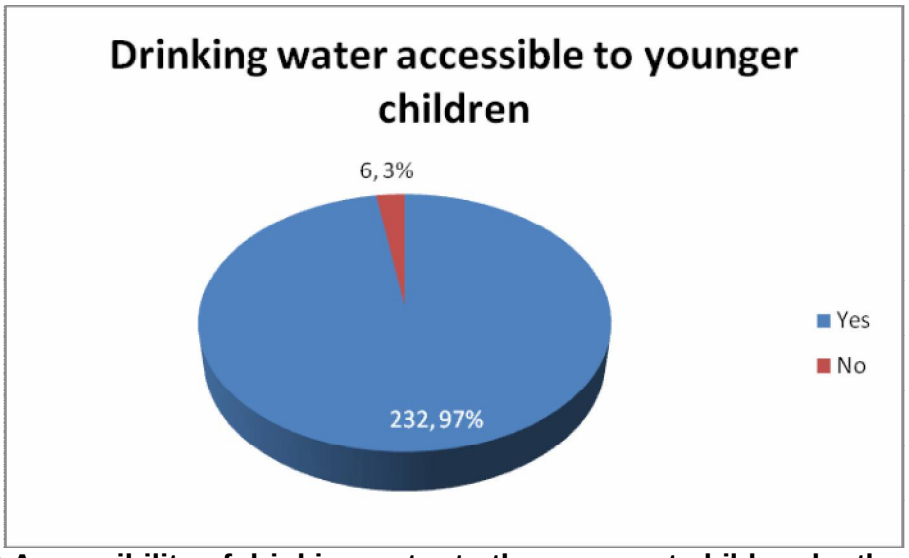
Graph 7 Provision of water for all the needs of the school by main water source

In the case when the main source of water supply is not functional, the question was posed whether there is an available and acceptable alternative source of water supply in the school, which is shown in Graph 8. For four fifths of school facilities (81%) it was established that there is no alternative school water supply source, while in other cases, alternative school water supply sources appeared to be a local well or a borehole (7%), water cooler appliance (2%), or a local spring (2%), whereas 17 schools did not answer the question.



Graph 8 Existence of alternative water supply for schools

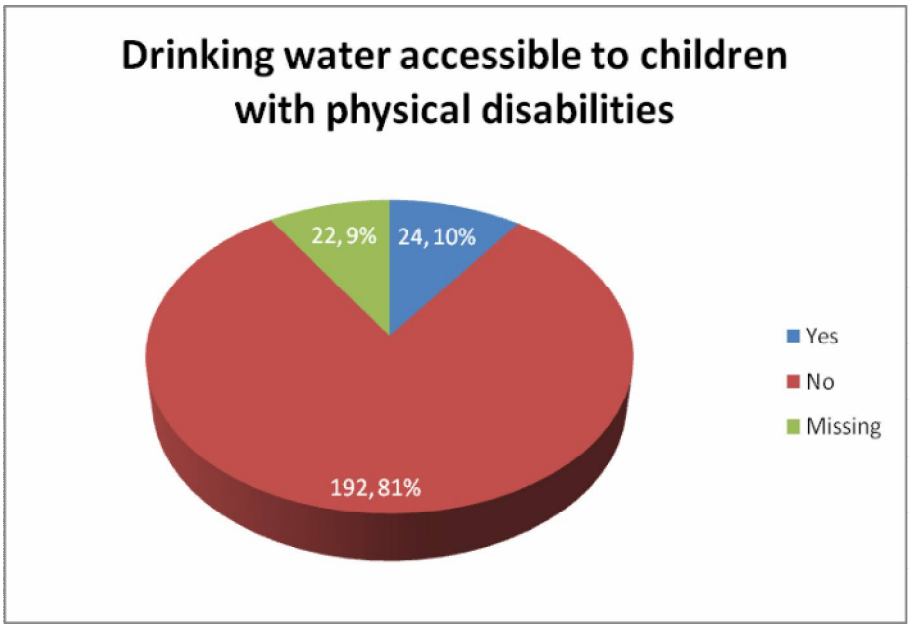
Accessibility of water to the youngest pupils is shown in Graph 9. Monitoring showed that in majority of examined schools (97%), the youngest pupils can easily and independently use water from the water supply source by themselves.



Graph 9 Accessibility of drinking water to the youngest children by themselves

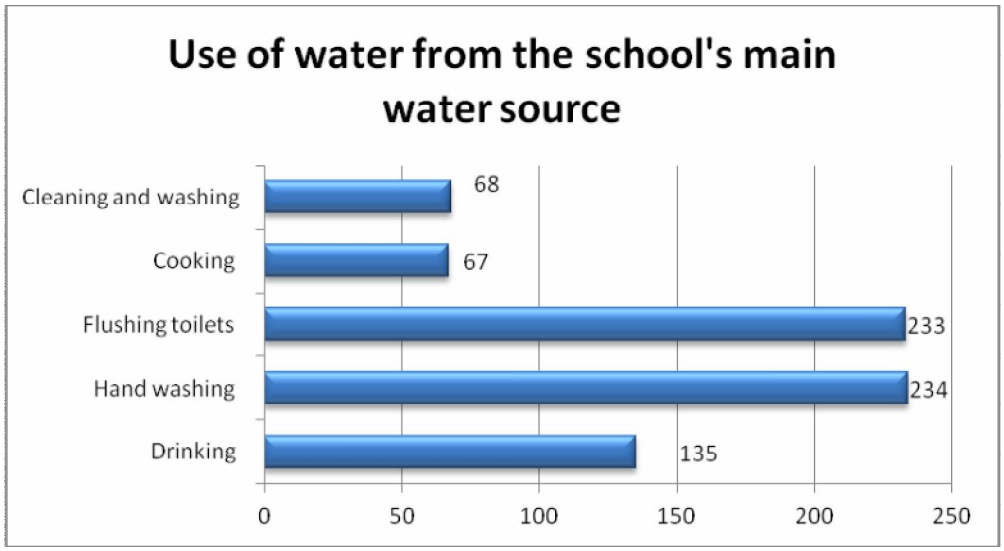
Accessibility of drinking water to children with physical disabilities is shown in Graph 10. According to the methodology, in order to consider water available or accessible to persons with disabilities, on the way to the water supply source there must be no steps or obstacles that could impede access of persons in wheelchairs, and water must be accessible to such persons lowered in a sitting position. Unfortunately, these criteria of accessibility of drinking water are fulfilled only in every tenth examined school (24 school facilities), 22 schools did not answer to this question, while in the majority of cases, drinking water cannot be considered to be available to children with disabilities.

When schools attended by children with disabilities (15 schools) are separately observed, it was established that only six of them meet the criteria concerning the accessibility of water to children with disabilities.



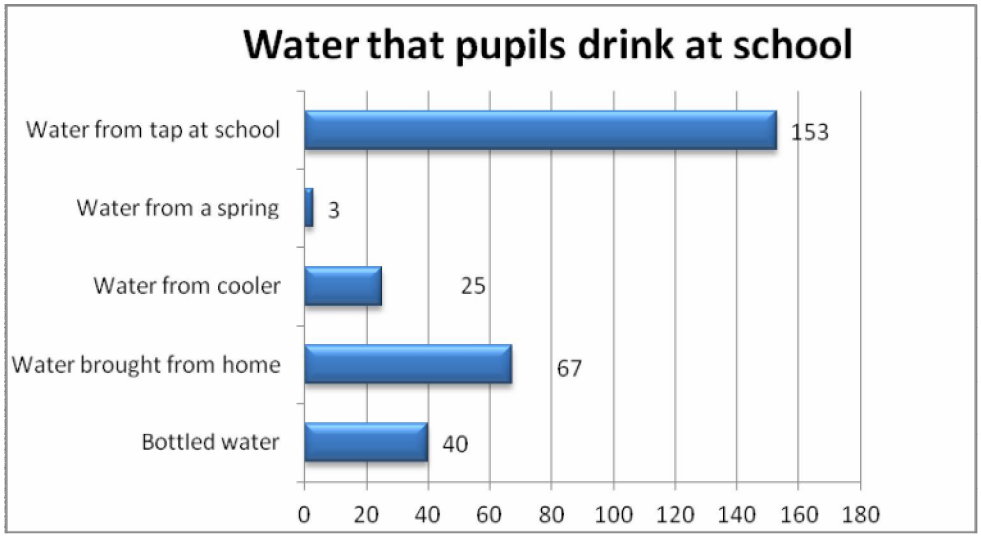
Graph 10 Accessibility of drinking water to the children with disabilities

Furthermore, it was examined on the basis of Questionnaire what is water from the main water supply source used for, which is shown in Graph 11. In the majority of schools (98%) water is used for hand-washing and toilet flushing. Only in 57% of the examined school facilities is water from the water supply source used for drinking. Somewhat more than one fourth (28%) of the examined schools mentioned that they use water for cooking and cleaning and washing of the school premises and the school building.



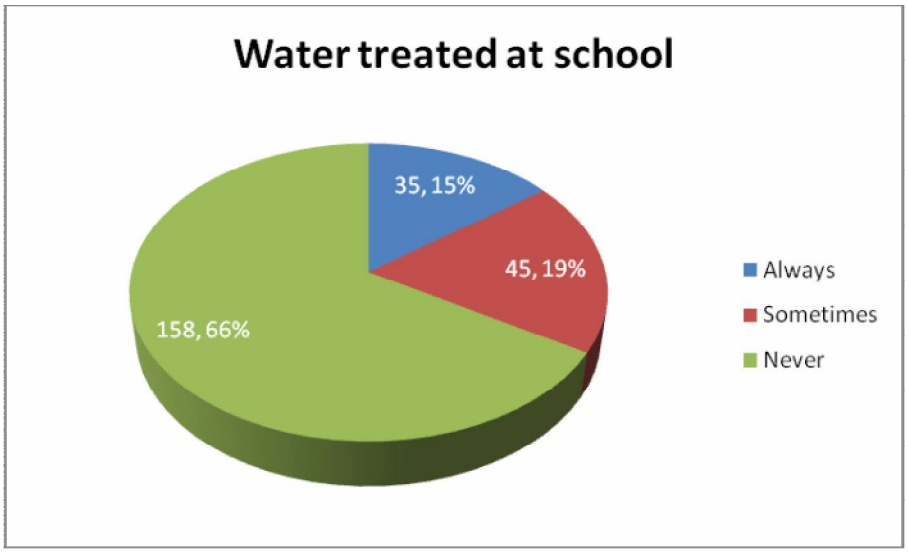
Graph 11 Use of water from the school's main water source

On the other hand, in schools that answered that water from the main source of water supply is not used for drinking, special attention was paid to the fact what kind of water do the pupils and staff drink during their stay in school, which is shown in Graph 12. Answers to this question varied, from the ones that children drink water that they bring from home (28%), through bottled water (19%), water cooler appliance (10.5%), and while in even three school facilities it was established that pupils drink water from the neighbouring source.



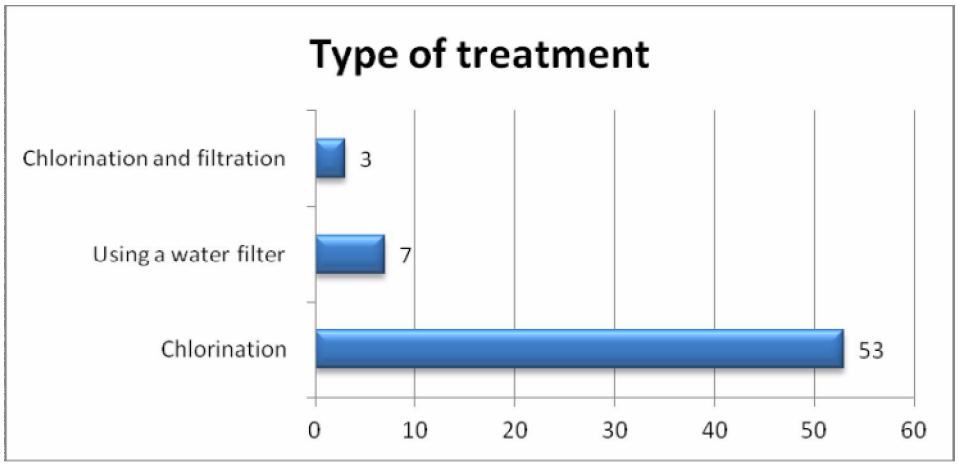
Graph 12 Origin of water that pupils drink while at school

Graph 13 shows frequency of the treatment of water from the main source of the school water supply through a certain process, regardless of the processes conducted in the water supply network. On the basis of Questionnaire it was established that water is never treated in two thirds of school facilities, while in one third of school facilities water is treated in the very school occasionally or all the time, regardless of the fact if the school is connected to a water supply system (rural or city/town) or not.



Graph 13 Water treatment performed by the school itself

Only 63 schools answered to the question what is the usual procedure during water treatment in the school. In these schools dominate the water chlorination and filtration procedures, which are shown in Graph 14.



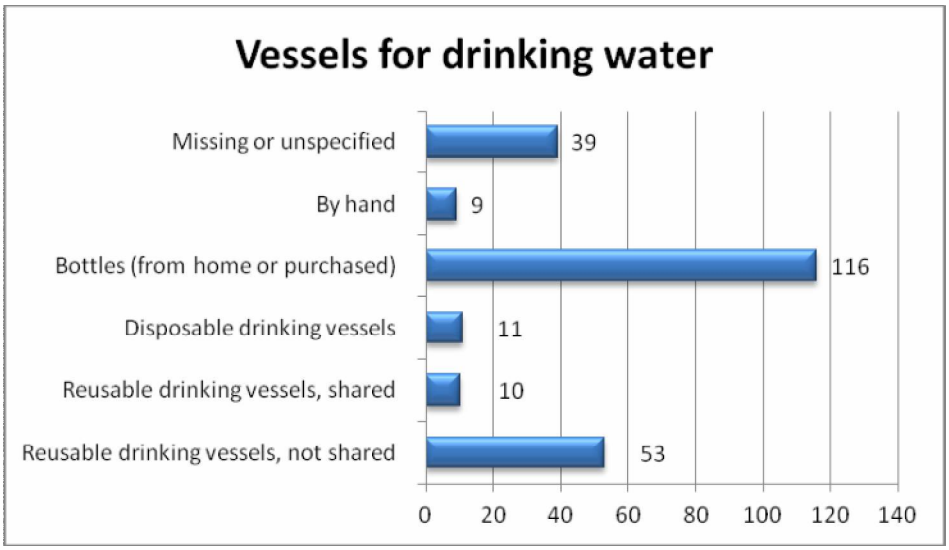
Graph 14 Type of water treatment performed at school

The schools were asked to answer to the question, what is the reason why water from the main source of water supply is not treated in school on a regular basis, which is shown in Table 7. It was established that majority of schools mentioned that they consider the water supply source to be safe or that they do not have enough funds nor devices for water treatment.

Table 7 Reasons for irregular water treatment from the school water supply source

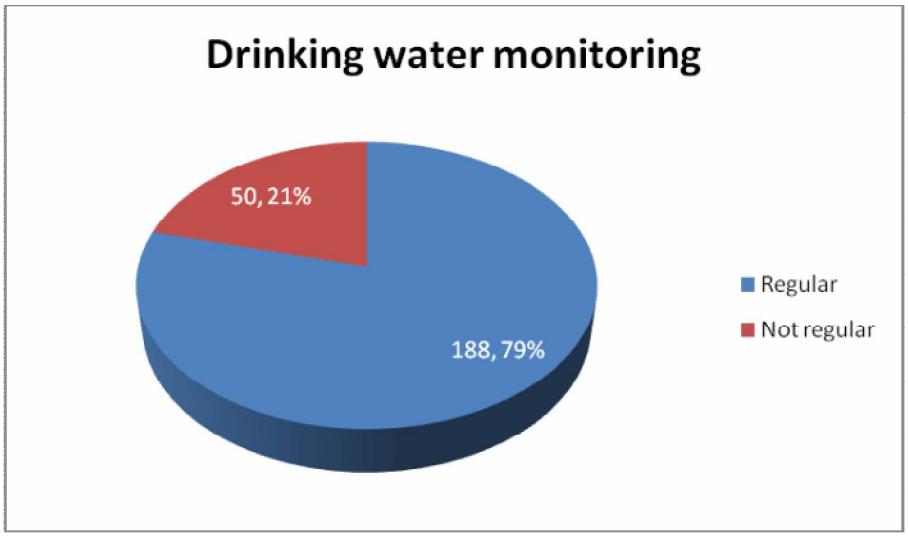
Reasons for not treating the water (several possible answers)	Number of school facilities with positive answer (%)
Water supply source is safe	70 (29.4%)
School has no water treatment devices	29 (12.2%)
School has no funds	48 (20.2%)
School has neither devices nor funds	12 (5.0%)
School has a small number of pupils	1 (0.4%)
Water is used as technical water	2 (0.8%)
Unknown or unspecified reason	6 (2.5%)
No answer to the question	70 (29.4%)

Graph 15 shows what kind of drinking containers do pupils use when they drink water at school. In half of schools (48.7%) pupils drink water from bottles (bought or filled at home), in one quarter of schools (26.9%) pupils use multi-use glasses (glass, plastic, tin), for each pupil separately, or single-use glasses, which could be considered to be hygienically acceptable. Only in 10 schools do the pupils drink water from glasses that they mutually share, while in 9 school facilities they drink water with cupped hand, which cannot be considered to be hygienically acceptable.



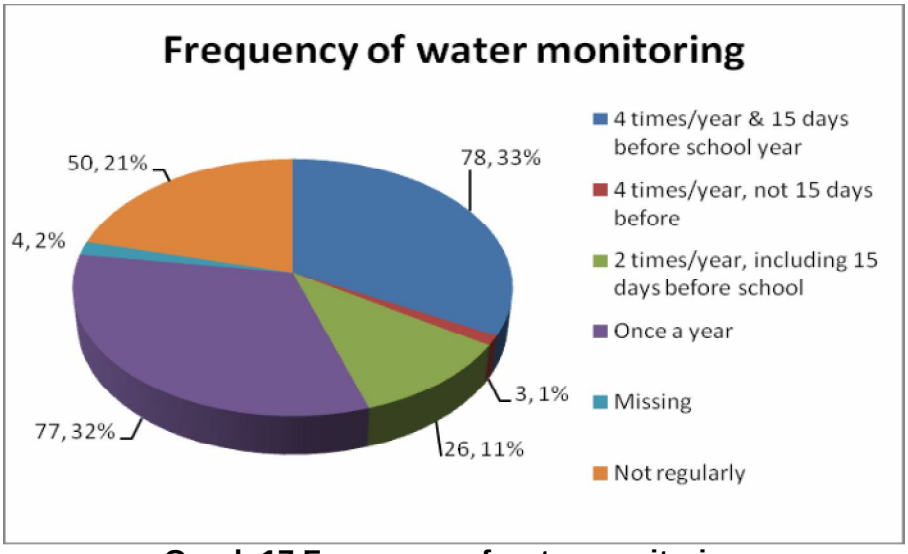
Graph 15 Vessels pupils use to drink water at school

Finally, on the basis of the Questionnaire it was established if microbiological and chemical safety of drinking water from the main source of school water supply is checked on a regular basis, which is shown in Graph 16. According to the definition from the methodology, regular monitoring of safety of drinking water from the main source of school water supply means that water is tested on a regular basis by autorized laboratory ~~or~~ of the regional Institute of Public Health. To this question, four fifths of the examined school facilities answered that the checks of microbiological and chemical safety of water are performed on a regular basis.



Graph 16 Drinking water monitoring

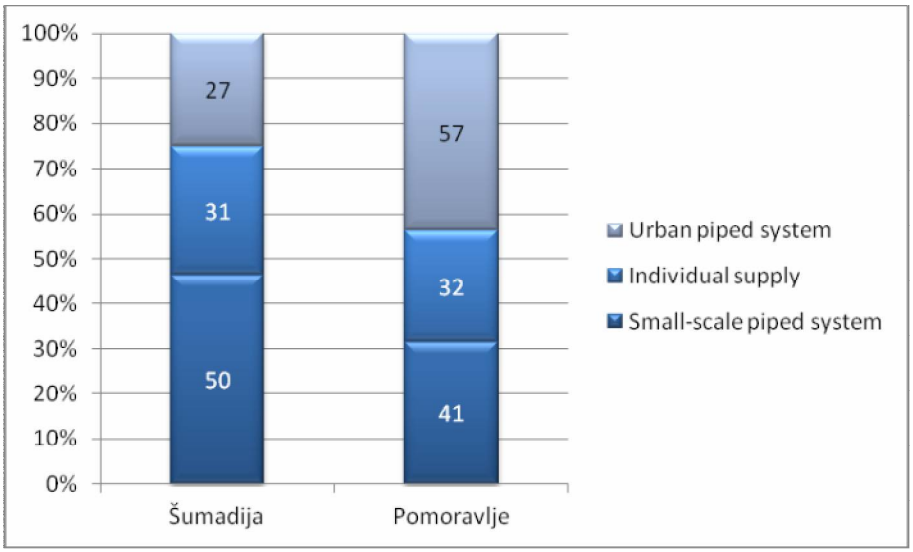
In addition, the frequency of monitoring of microbiological and chemical safety of water from the main source of water supply is shown in Graph 17. In one third of the examined schools, monitoring is performed four times a year and 15 days before classes begin, which is considered to be a standard for primary schools. Every tenth school tests water only 2 times a year (including 15 days before the classes begin), while one third of schools tests water only once a year.



Graph 17 Frequency of water monitoring

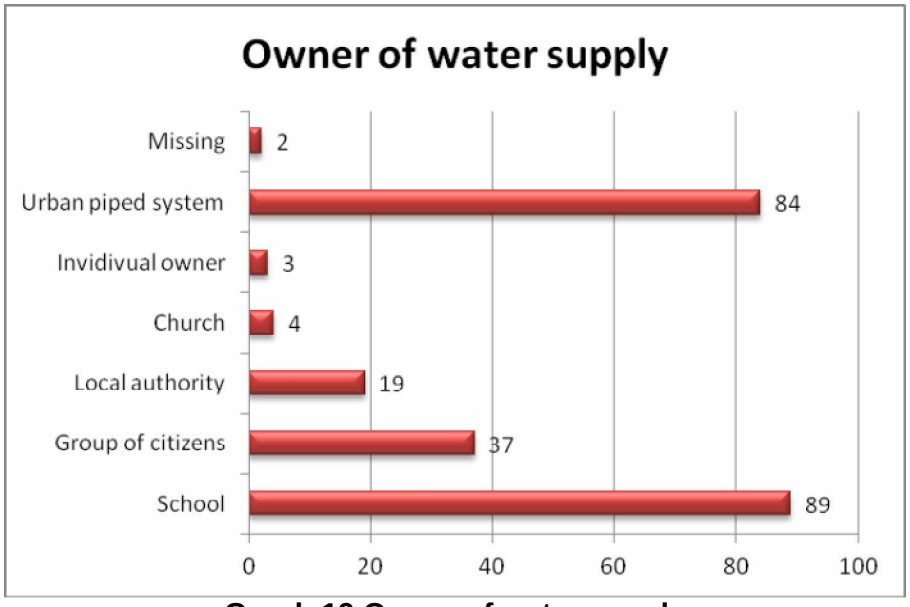
4.2.2. Sanitary inspection of water supply facilities

Graph 18 represents the distribution of the types of water supply facilities by the districts. Considering the fact that 84 schools are supplied with drinking water from an urban water supply system, the sanitary inspection was conducted on other types of water facilities, including the small-scale water supply systems (91 water facilities) and individual supplies (63 facilities). This section will, thus, present the results of the sanitary inspection of these water facilities only.



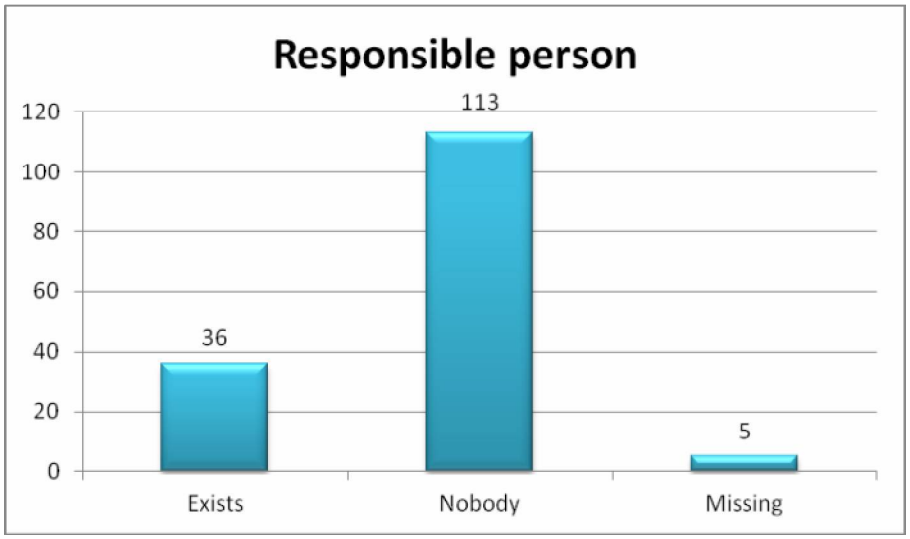
Graph 18 The types of water supply facilities by Districts

First of all, the questionnaire on the sanitary characteristics of water supply facilities was applied to find out the basic characteristics of the facilities. The owners of water supplies are represented on Graph 19. Other than 84 urban water supply systems, owned by public authorities, in most cases the owners of water supply facilities in rural areas of Šumadija and Pomoravlje are schools themselves (37%), groups of citizens (15%), local communities, church, and individual owners. In two cases the owner was unknown or missing.



Graph 19 Owner of water supply

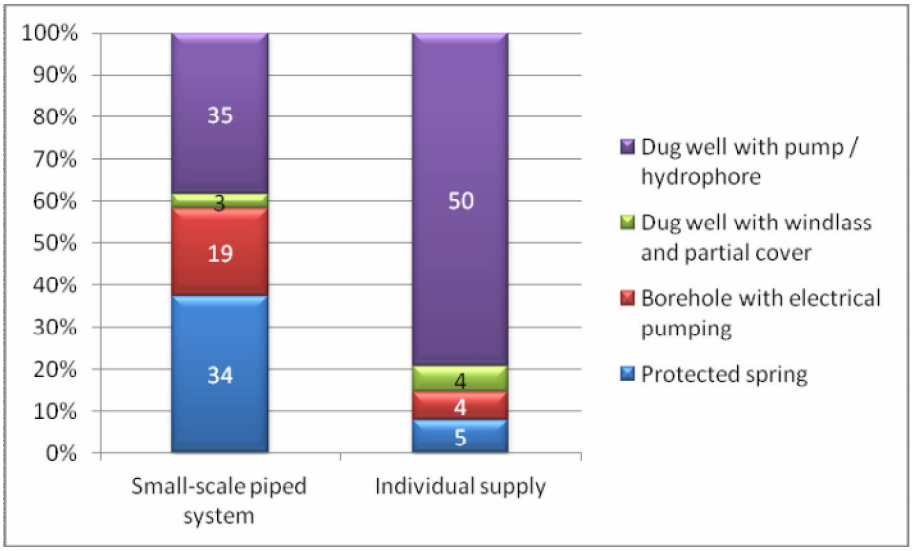
In addition, the questionnaire tried to assess whether there is a person responsible for the maintenance of the water supply objects. As shown in Graph 20, in most water supplies (73% of the inspected 154 water supplies) there is no responsible person in charge of the maintenance of either the source or the network of the water supply facility.



Graph 20 Responsible person for the maintenance of the water supply objects

All water supply facilities contain a source and a distribution network.

The inspected 154 water facilities had different types of sources, as shown in Graph 21. Among small-scale water supply systems, the dominant types of sources are protected springs and dug well with pump (hydrophore) (37% of water facilities each), followed by the boreholes with electrical pumping (21% of all small-scale water supply systems). Among individual supplies, the dominant type of source is the dug well with pump (hydrophore) with 79% of all water supply facilities.



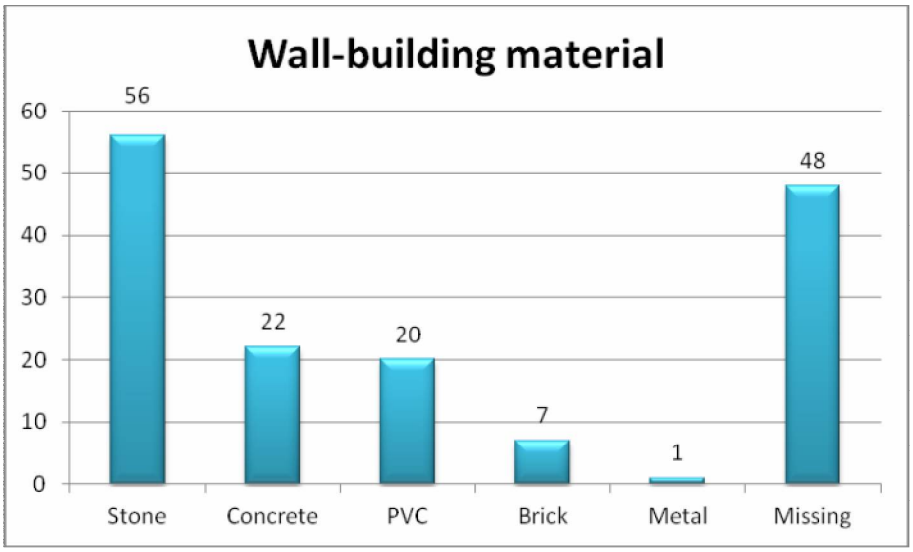
Graph 21 Type of the source of the water supply facilities

Table 8 shows the general characteristics of the sources of water supply objects. In general, they supply from 4 to 2500 consumers in rural areas and are of 43 years of age at the moment of the investigation.

Table 8 Characteristics of the sources of water supply objects

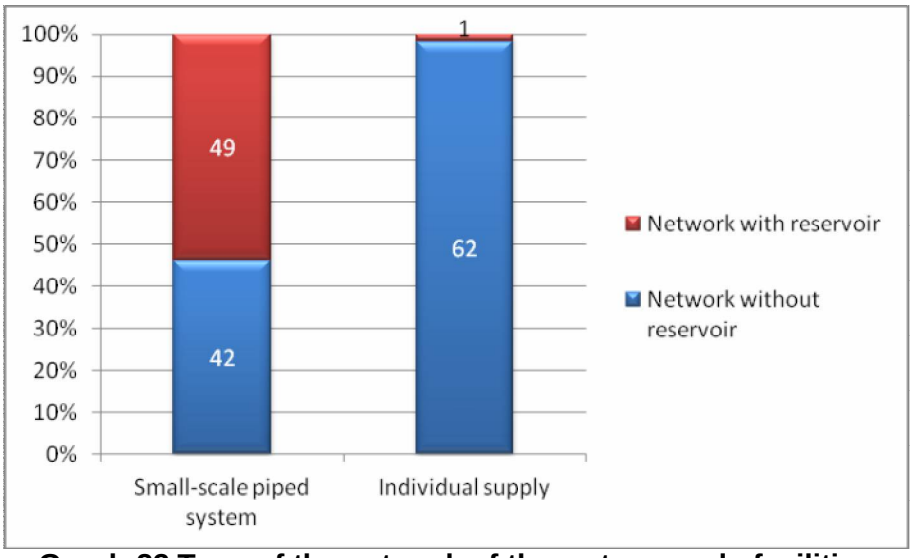
Parameters	Average value	Range (minimum-maximum)
Number of consumers supplied	138	4 - 2500
Well depth (meters)	30	2.5 - 148
Well diameter (meters)	1.3	0.5 - 7.0
Age of the source (years)	43	2 - 89

Graph 22 shows the type of the material used for the construction of the source of water supply objects. In most cases, the sources are built of stone (36%), concrete and PVC (14%), but in 48 cases the building material was not assessed during sanitary inspection.



Graph 22 Type of material used for the construction of the source of water supply objects

The inspected 154 water facilities had different types of networks, as shown in Graph 23. Among small-scale water supply systems, the two types of networks are equally distributed, i.e. distribution network with reservoir (46%) and network without reservoir (54%). Among individual supplies the dominant type of network is distribution network without reservoir.



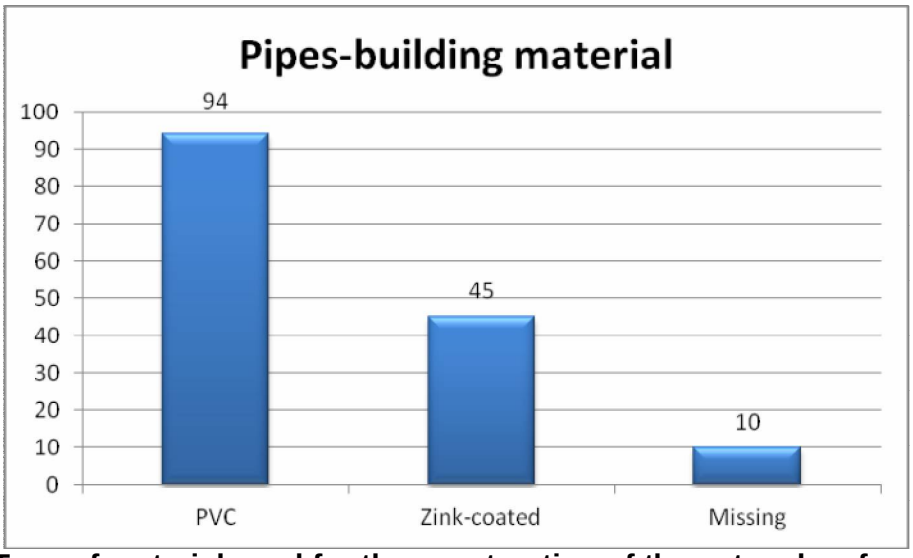
Graph 23 Type of the network of the water supply facilities

Table 9 shows the general characteristics of the networks of water supply objects. In general, the networks in rural areas are very long (up to 24 kilometers), and are of 41 years of age at the moment of the investigation.

Table 9 Characteristics of the networks of water supply objects

Parameters	Average value	Range (minimum-maximum)
Number of sources within facility	1,1	1 - 3
Number of reservoirs within facility	1,2	0 - 2
Network length (meters)	1733.1	10 - 24000
Age of the network (years)	41	2 - 95

Figure 24 shows the type of the material used for the construction of the pipes within the networks of water supply objects. In most cases, the pipes are made of PVC material (61%) or are zinc-coated (29%), but in 15 cases the pipes-building material was not assessed during sanitary inspection.



Graph 24 Type of material used for the construction of the networks of water supply objects

The questionnaire for water supply facilities was also used to assess the sanitary risk at the sources and in the networks of the water supply objects. Tables 10-13 show the results of the risk assessment at the sources, and Tables 14-15 show the risk assessment of the networks of the investigated water supplies.

Table 10 shows the results of the sanitary risk assessment identified during the sanitary inspection of protected springs. In almost a half of all water facilities of this type the prevalent sanitary problems are unfenced areas around the spring, and in 40% of the supplies the problems are absent or non-functional diversion ditches above the spring. In addition, huge problems are the animals that have access to the spring source and the collection of surface water uphill of the spring.

Table 10 Sanitary risk inspection data for protected springs

Sanitary risk inspection data for Protected spring	N (%) of positive responses	
	Small-scale piped systems N=34	Individual supplies N=5
Is the collection or spring box absent or faulty?	3 (8.8)	0
Is the masonry or backfill area protecting the spring faulty or eroded?	5 (14.7)	0
Is the inspection cover and/or air vent insanitary?	6 (17.6)	0
Does spilt water flood the collection area (e.g. from overflow pipe)?	2 (5.9)	0
Is the area around the spring unfenced?	15 (44.1)	3 (60.0)
Can animals have access within 10 m of the spring source?	7 (20.6)	2 (40.0)
Is there a latrine uphill and/or within 30 m of the spring?	0	0
Does surface water collect uphill of the spring within 30 m?	5 (14.7)	1 (20.0)
Is the diversion ditch above the spring absent or non-functional?	13 (38.2)	2 (40.0)
Are there any other sources of pollution uphill of the spring?	0	0

Table 11 shows the results of the sanitary risk assessment identified during the sanitary inspection of boreholes with electrical pumping. Three quarters of the water facilities of this type have drainage channels that are absent or cracked, broken or in need of cleaning. Another important problem presents the other sources of pollution of the boreholes, such as latrines, sewers or uncapped wells within 100 m of the borehole or its pumping mechanism, as well as animal access to the borehole.

Table 11 Sanitary risk inspection data for boreholes with electrical pumping

Sanitary risk inspection data for Borehole with electrical pumping	N (%) of positive responses	
	Small-scale piped systems N=19	Individual supplies N=4
Is there a latrine or sewer within 100 m of the pumping mechanism?	8 (42.1)	3 (75.0)
Is there a latrine within 10 m of the borehole?	3 (15.8)	0
Is there any source of other pollution within 50 m of the borehole (animal breeding, cultivation, roads, industry)?	5 (26.3)	0
Is there an uncapped well within 100 m?	7 (36.8)	1 (25.0)
Is the drainage channel absent or cracked, broken or in need of cleaning?	14 (73.7)	3 (75.0)
Can animals come within 50 m of the borehole?	7 (36.8)	0

Is the base of the pumping mechanism permeable to water or damaged?	1 (5.3)	0
Is there a possibility of penetration of the water directly into the borehole?	3 (15.8)	1 (25.0)
Is there any stagnant water within 2 m of the pumping mechanism or borehole?	1 (5.3)	0
Are there frequent interruptions in electricity supply?	2 (10.5)	1 (25.0)

Table 12 shows the results of the sanitary risk assessment identified during the sanitary inspection of dug wells with windlass and partial cover. For this type of the source of water facilities, the following sanitary problems were identified: other sources of pollution, such as animal excreta, rubbish, or latrines near the well, as well as technical problems related to drainage channel, the structure of the walls and the concrete floor around the well, that may cause the contamination of water in the well.

Table 12 Sanitary risk inspection data for dug well with windlass and partial cover

Sanitary risk inspection data for dug well with windlass and partial cover	**N (%) of positive responses**	
	Small-scale piped systems N=3	Individual supplies N=4
Is there a latrine within 10 m of the well?	1 (33.3)	2 (50.0)
Is the nearest latrine on higher ground than the well?	0	2 (50.0)
Is there any other source of pollution (e.g. animal excreta, rubbish) within 10 m of the well?	1 (33.3)	2 (50.0)
Is the drainage poor, causing stagnant water within 2 m of the well?	0	3 (75.0)
Is there a faulty drainage channel? Is it broken, permitting ponding?	1 (33.3)	4 (100.0)
Is the wall (parapet) around the well inadequate, allowing surface water to enter the well?	1 (33.3)	2 (50.0)
Is the concrete floor less than 1 m wide around the well?	0	3 (75.0)
Are there any cracks in the concrete floor around the well which could permit water to enter the well?	0	3 (75.0)
Are the walls of the well inadequately sealed at any point for 3 m below ground?	1 (33.3)	3 (75.0)
Are the rope and bucket left in such a position that they may become contaminated?	0	1 (25.0)

Table 13 shows the results of the sanitary risk assessment identified during the sanitary inspection of dug wells with pump / hydrophore.

Table 13 Sanitary risk inspection data for dug wells with pump / hydrophore

Sanitary risk inspection data for dug well with pump / hydrophore	N (%) of positive responses	
	Small-scale piped systems N=35	Individual supplies N=50
Is there a latrine within 10 m of the well?	5 (14.7)	12 (24.0)
Is the nearest latrine on higher ground than the well?	8 (23.5)	12 (24.0)
Is there any other source of pollution (e.g. animal excreta, rubbish) within 10 m of the well?	8 (23.5)	12 (24.0)
Is the drainage poor, causing stagnant water within 2 m of the well?	11 (32.4)	14 (28.0)
Is there a faulty drainage channel? Is it broken, permitting ponding?	27 (79.4)	39 (78.0)
Is the wall (parapet) around the well inadequate, allowing surface water to enter the well?	2 (5.9)	15 (30.0)
Is the concrete floor less than 1 m wide around the well?	12 (35.3)	16 (32.0)
Are the walls of the well inadequately sealed at any point for 3 m below ground?	11 (32.4)	24 (48.0)
Is there a possibility of penetration of the water directly into the pump house or can be considered unsanitary in any way?	8 (23.5)	15 (30.0)
Are there frequent interruptions in electricity supply?	4 (11.8)	6 (12.0)

For this type of the source of water facilities, a wide range of sanitary problems was identified: primarily the other sources of pollution, such as animal excreta, rubbish, or latrines near the well, followed by the technical problems related to drainage channel, the structure of the walls and the concrete floor around the well.

Finally, there are problems related to the unsanitary pump houses of the well that allow the penetration of the water directly into the pump or well, as well as frequent interruptions in electricity supply that run the pumps, thus possibly presenting risk for the contamination of water in the well (Table 13).

Table 14 shows the results of the sanitary risk assessment identified during the sanitary inspection of distribution networks of the water supply facilities.

Table 14 Sanitary risk inspection data for distribution network (without reservoir)

Sanitary risk inspection data for distribution network	N (%) of positive responses	
	Small-scale piped systems N=49	Individual supplies N=62
Piped system is managed by unqualified persons?	45 (91.8)	60 (96.8)
Drinking water is not chlorinated?	31 (63.3)	54 (87.1)
Is the area around the tap insanitary?	7 (14.3)	11 (17.7)
There was the interruption of water supply during the past 10 days?	3 (6.1)	4 (6.5)
Changes of water pressure in the network have been noticed during the past 10 days?	4 (8.2)	6 (9.7)

Intersections or insufficient distances from the pipes that are not for drinking water are present in the system?	2 (4.1)	6 (9.7)
Pipes are exposed in some parts of the system and there is a possibility of damage?	3 (6.1)	4 (6.5)
Consumers noticed changes in the sensory characteristics of drinking water?	9 (18.4)	9 (14.5)
The largest part of the network has not been replaced during the last 10 years?	18 (36.7)	10 (16.1)
Some households have dual water supply?	13 (26.5)	3 (4.8)

In almost a half of all water facilities of this type the prevalent sanitary problem is the lack of water chlorination, followed by the management by unqualified persons, interruptions of water supply and changes of water pressure in the network during the previous ten days, as well as changes in the sensory characteristics of drinking water noticeable by the consumers. In addition, the largest part of the network has not been replaced during the last 10 years; there are intersections or insufficient distances from the pipes in the network and water supply of some household, which implies an inadequate management of these water supply facilities (Table 14).

Table 15 shows the results of the sanitary risk assessment identified during the sanitary inspection of distribution networks with reservoir of the water supply facilities. In almost a half of all water facilities of this type the prevalent sanitary problem is the lack of water chlorination, followed by the unsanitary areas around the reservoirs and the insufficient replacement of the network during the last ten years. In addition, there are problems related to the structure of the network and the absence of fences around the reservoirs, which implies an inadequate management of these water supply facilities.

Table 15 Sanitary risk inspection data for distribution network with reservoir

Sanitary risk inspection data for reservoir and distribution network	**N (%) of positive responses**	
	Small-scale piped systems N=42	Individual supplies N=1
There is no fence around the reservoir?	18 (42.9)	0
The area around the reservoir is unsanitary?	13 (31.0)	1 (100.0)
Reservoir chamber is visibly damaged or it leaks?	4 (9.5)	0
The inspection cover of the reservoir is missing or insanitary?	3 (7.1)	0
The air vents of the reservoir are missing or opened?	3 (7.1)	0
Drinking water is not chlorinated?	21 (50.0)	1 (100.0)
Pipes are exposed in some part of the system and there is possibility of damage?	8 (19.0)	1 (100.0)
There was the interruption of water supply during the past 10 days?	3 (7.1)	0
The largest part of the network has not been replaced during the last 10 years?	21 (50.0)	1 (100.0)
Some households have dual water supply?	30 (71.4)	0

4.2.3. Drinking water quality

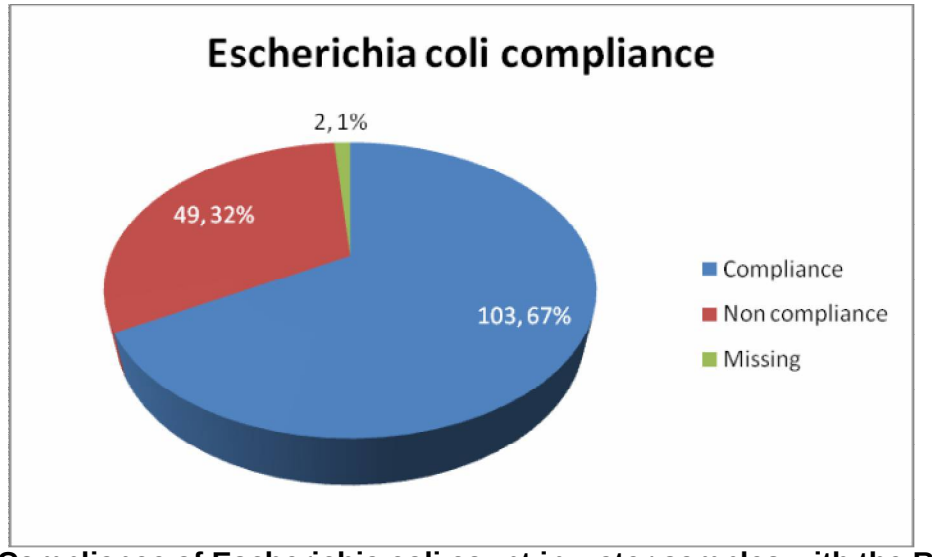
Beside sanitary control of water supply facilities, during the monitoring period one sample was taken from each school facility for physical and chemical and bacteriological analysis. Since 84 schools are providing water from urban water supply systems, water samples were taken and subject to analysis only in 154 school facilities providing water from small water supply systems and individual water supply facilities. Also, during research, there was no water in 2 schools, thus, in this section, results of analysis of only 152 water samples shall be presented.

Table 16 shows average values of examined parameters in drinking water.

Table 16. Average values of examined parameters in water

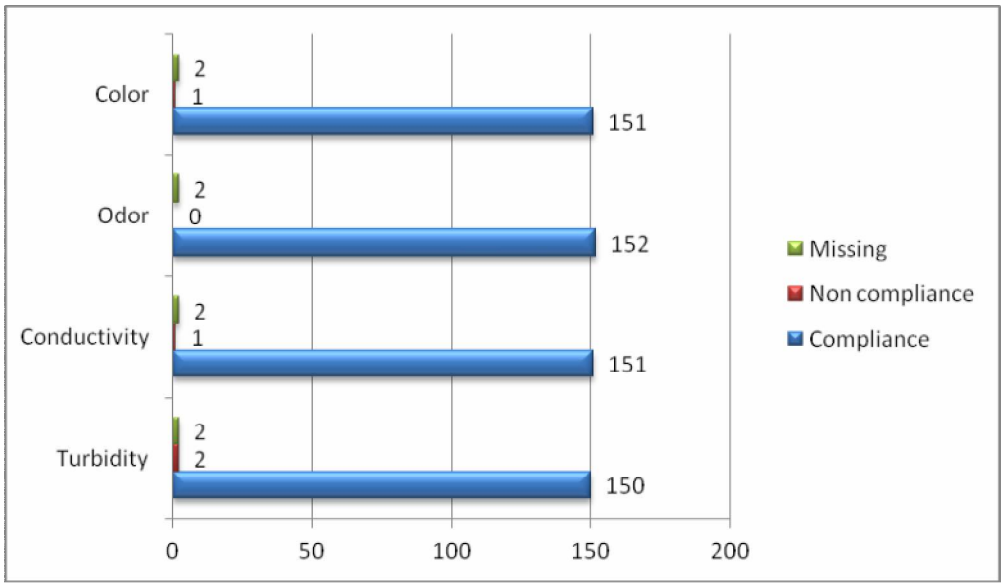
Parameter	Average value	Median value	Range (minimum-maximum)
Escherichia coli (count/100ml)	33	0	0 - 1050
Temperature (°C)	17.03	17.00	11.90 - 23.40
Residual chlorine (mg/l)	0.029	0.025	0.025 - 0.40
Colour (Pt/Co scale)	5.14	5.00	5.00 - 27.00
Odour (description)	N/A	N/A	
Turbidity (NTU)	0.34	0.10	0.01 - 12.78
Conductivity (µS/cm)	1019.55	824.00	127.00 - 23100.00
pH value	7.171	7.15	6.21 - 9.72
Ammonia (mg/l)	0.034	0.015	0.02 - 1.40
Nitrates (mg/l)	43.053	19.885	0.25 - 665.00
Manganese (mg/l)	0.034	0.025	0.03 - 0.45

Graph 25 shows frequency of compliance of the number of bacteria *Escherichia coli* with values specified under the Rulebook. According to methodology, the allowed count of colonies of this bacteria in drinking water is 0 in 100 ml of water. Unfortunately, two thirds of water samples was in compliance with standards regarding the presence of this bacteria in water.



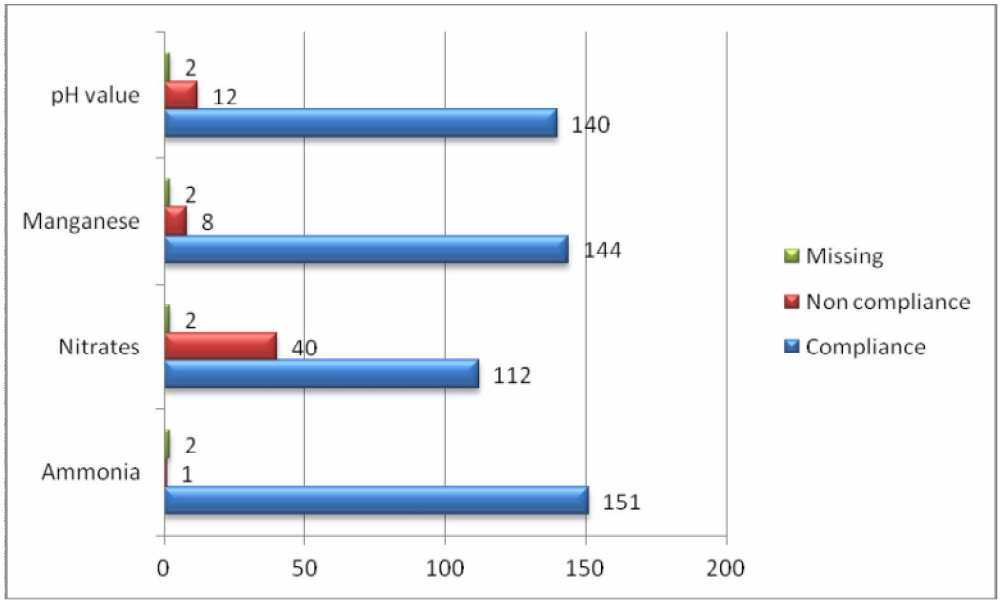
Graph 25 Compliance of Escherichia coli count in water samples with the Rulebook

Graph 26 shows frequency of compliance of organoleptic parameters (colour, odour, turbidity and conductibility of water) with requirements of values under the Rulebook. According to methodology, the allowed values of these parameters are as follows: Colour – 5 degrees of the Platinum-Cobalt scale; odour – without odour, conductivity up to 1000 µS/cm, and turbidity up to 5 NTU (Nephelometric Turbidity Units). Almost all examined water samples meet the criteria prescribed under the Rulebook on safety of drinking water.



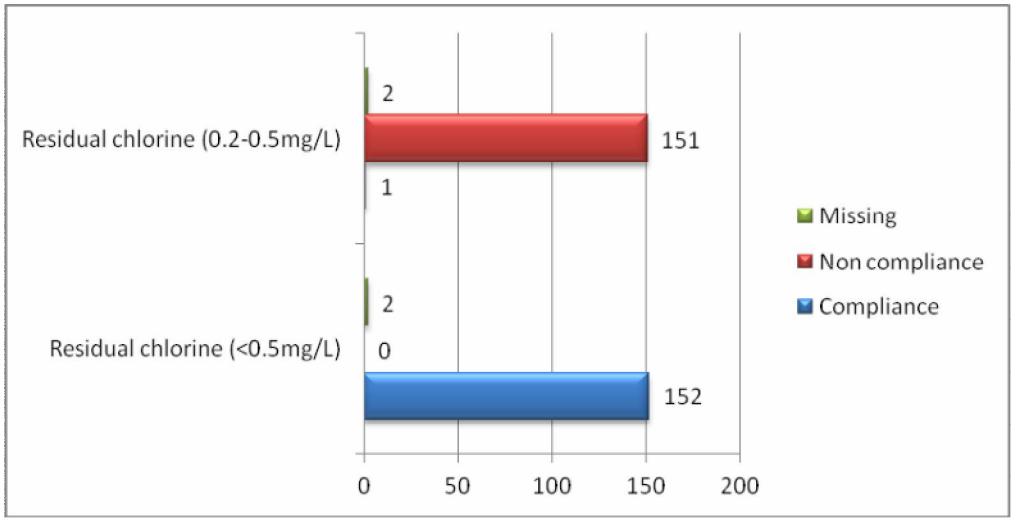
Graph 26 Compliance of organoleptic parameters in water samples with the Rulebook

Graph 27 shows the frequency of compliance of water chemical parameters (pH value, manganese, nitrates and ammonia in water) with requirements of values prescribed under the Rulebook. According to methodology, the allowed values of these parameters are as follows: pH value in the range 6.8-8.5, concentration of manganese 0.05 mg/l, concentration of nitrates 50 mg/l and concentration of ammonia 1 mg/l. Over 90% of examined water samples meet the values prescribed under the Rulebook for pH value, 94% of samples are in compliance with the Rulebook on concentrations of manganese, while 98% of samples are in compliance as regards concentrations of ammonia in water. On the other hand, only 73% water samples are in compliance with standards regarding concentrations of nitrates in water.



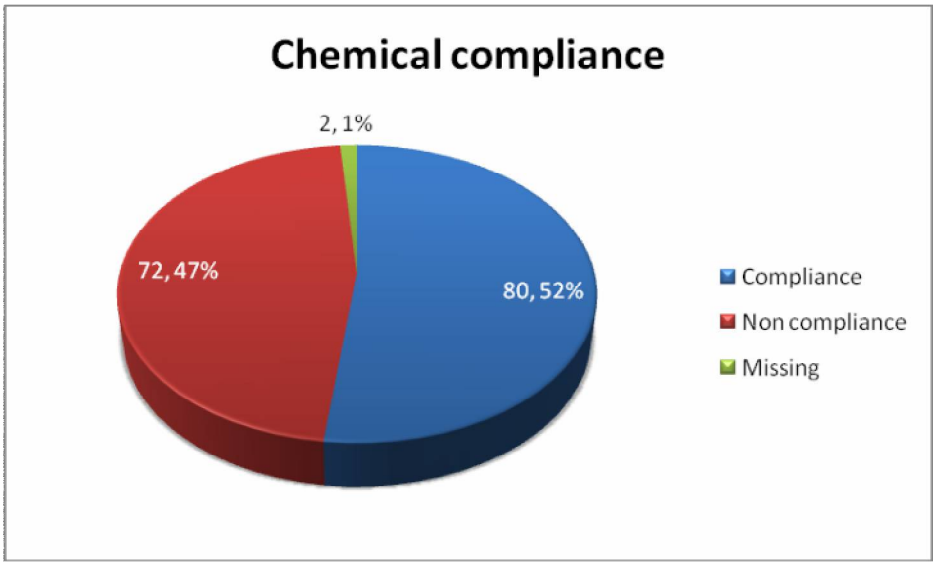
Graph 27 Compliance of chemical parameters in water samples with the Rulebook

Graph 28 shows frequency of compliance of residual chlorine in water with the values under the Rulebook and proposed standards valid in the European Union. According to the Rulebook, the value of residual chlorine should be less than 0.5 mg/l, and according to the proposed standards of the European Union the defined value range is 0.2- 0.5 mg/l. In the first case, all examined samples may be considered to be in compliance with the Rulebook, while in the second case where more strict criteria are applied, it could be considered that residual chlorine in water is not present in adequate concentrations.



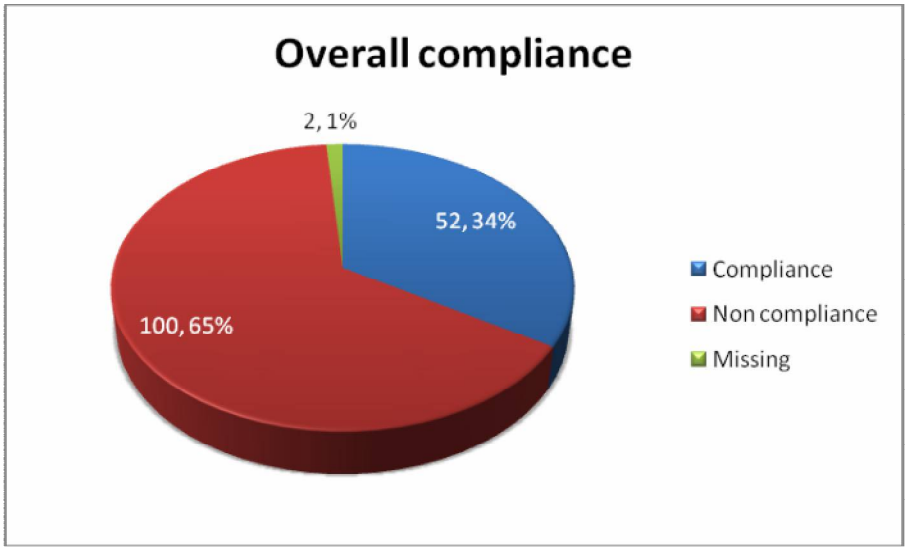
Graph 28 Compliance of residual chlorine in water samples with the Rulebook and EU standards

Graph 29 shows frequency of compliance of physical and chemical parameters with the rules under the Rulebook. When all organoleptic, physical and chemical parameters are taken into consideration, the conclusion is that only half of the examined samples of water in rural schools are in compliance with the Rulebook.



Graph 29 Compliance of chemical parameters in water samples with the Rulebook

Graph 30 shows the frequency of total compliance of parameters in water with values under the Rulebook. When all microbiological, physical and chemical parameters are taken into consideration, the conclusion is that only one third of the examined samples of water in rural schools meet the criteria valid for drinking water prescribed by the Rulebook.



Graph 30 Overall compliance of all investigated parameters in water samples with the Rulebook

Finally, by crisscrossing data obtained by sanitary control of water supply facilities and data on microbiological safety of water samples, risk-to-health matrices for the examined water supply facilities are obtained.

Table 17 shows the risk-to-health matrix for water sources of 152 examined water supply facilities, which are not connected to the urban water supply system. The matrix shows that only 39 water supply facilities (29.8%) have such water sources that belong to the low risk facility category, in which it is not necessary to undertake any activity for remediation and improvement of the water quality. Water sources of 53 water supply facilities in rural environments (40.5%) belong to the medium risk facility category, for which it is necessary to undertake certain low priority remediation measures.

Water sources of 27 water supply facilities (20.6%) belong to the high risk facility category, for which it is necessary to undertake certain higher priority remediation measures, while water sources of even 12 water supply facilities (9.2%) belong to the very high risk facility category, for which it is necessary to undertake urgent activities for the remediation of the water source and water quality protection in order to protect the health of children in schools supplied from these water supply facilities (Table 17).

Table 17. Risk-to-health matrix for water sources of water supply facilities

E. coli (number/100 ml)	Number of positive answers for risk assessment			
	0-2	3-5	6-8	9-10
<1	39 (29.8%)			
1-10		53 (40.5%)		
11-100			27 (20.6%)	
>100				12 (9.2%)

Table 18 shows risk-to-health matrix for networks of 152 examined water supply facilities of schools that are not connected to urban water supply system. The matrix shows that only 49 water supply facilities (34.3%) have such a network that belongs to the low risk facility category, in which it is not necessary to undertake any activity for remediation and improvement of water quality.

Networks of 65 water supply facilities (45.5%) belong to the medium risk facility category, for which it is necessary to undertake certain low priority measures for remediation. Networks of 19 water supply facilities (13.3%) belong to high risk facility category, for which it is necessary to undertake certain higher priority measures for remediation; while networks of 10 water supply facilities (7.0%) belong to the very high priority risk facility category, in which it is necessary to urgently undertake activities for remediation of the distribution network and protection of water quality in order to protect the health of children in schools supplied from these water supply facilities (Table 18).

Table 18. Risk-to-health matrix for networks of water supply facilities

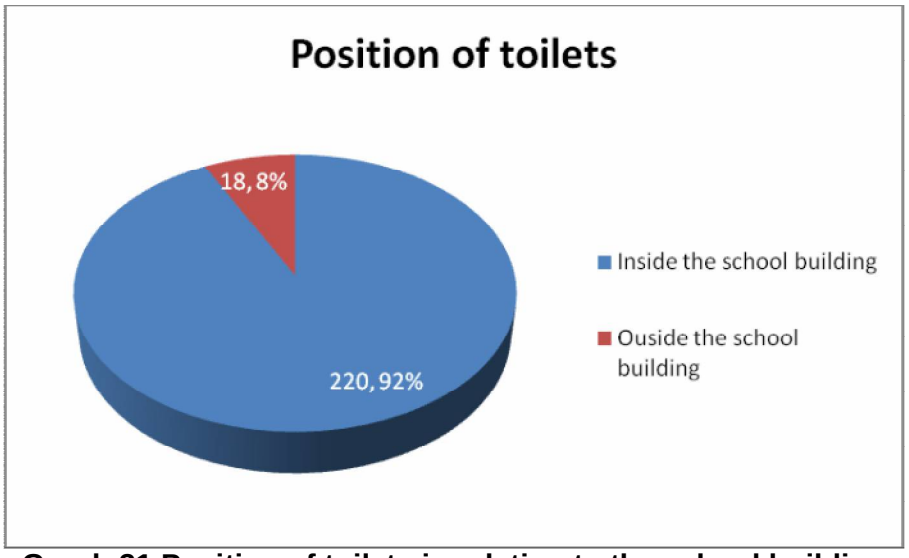
E. coli (number/100 ml)	Number of positive answers for risk assessment			
	0-2	3-5	6-8	9-10
<1	49 (34.3%)			
1-10		65 (45.5%)		
11-100			19 (13.3%)	
>100				10 (7.0%)

4.3. Sanitary and hygienic conditions in schools

4.3.1. School sanitation

On the basis of the Questionnaire on sanitary and hygienic conditions in schools, data on the existence of sanitary premises in schools, their accessibility, in particular to children with disabilities, were obtained.

Primarily, it was established that in all examined schools there are toilets, regardless of the type of school. In majority of schools, toilets are found inside the school building (92%), while toilets outside the building are found in 8% of the examined schools. Toilet location is shown in Graph 31.



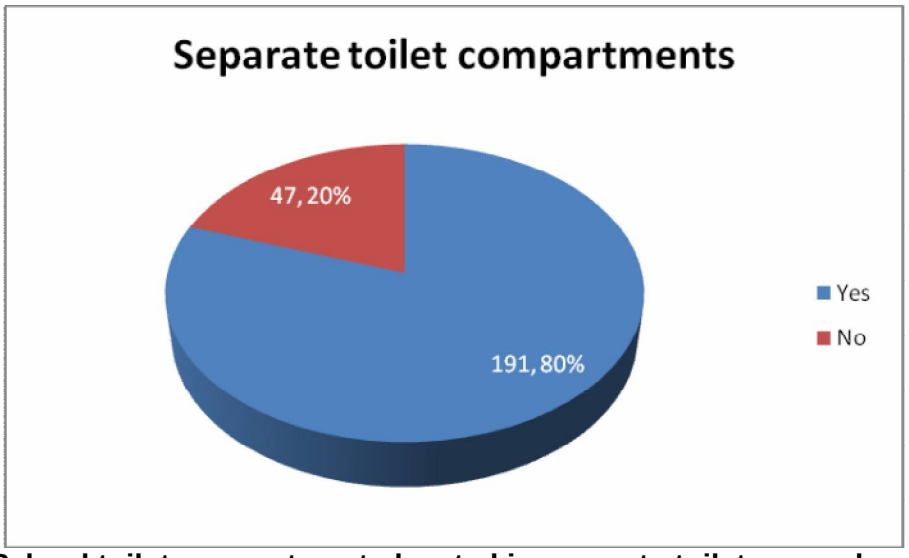
Graph 31 Position of toilets in relation to the school building

In school facilities where toilets are found outside the school building (18 schools), it was particularly checked whether the path leading to the toilet is suitable for all weather conditions and if there is adequate lighting on the path. Out of 18 schools, 16 schools answered the question.

It was established that the path leading to the toilet outside the school building is suitable for all weather conditions in 8 schools, while in 8 school facilities the path is not adequate for all weather conditions. On the other hand, adequate lighting on the way to the toilet exists only in 4 schools, while in 12 schools there is no adequate lighting.

Furthermore, it was established through monitoring, if the toilet compartments for boys and girls are separated in different premises / rooms, which is shown in Graph 32. In four fifths of the examined school facilities, toilet compartments are separated by gender, while in 20% of schools toilet compartments are unisex / communal.

When school facilities with communal toilets (47 schools) are observed, it was established that compartments are marked in a certain manner for boys and girls in only 17 schools, and that in the majority of such cases (28 schools), compartments are not marked by gender in any manner.



Graph 32 School toilet compartments located in separate toilet rooms by gender

In almost all examined school facilities there are doors on all toilet compartments in order to ensure respect of privacy, while only in one school there are no doors on toilet compartments.

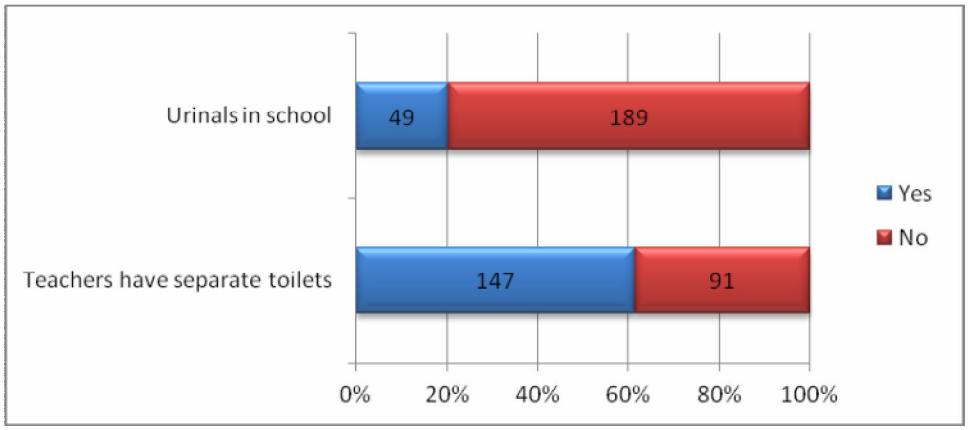
Furthermore, it was established through monitoring how many toilet compartments there are for school children. Cubicles / compartments were observed according to functionality and separation by gender. The term “In use" means all toilets in which all toilet elements are in order and functioning during research, while the term “Not in use“ includes toilets which during research do not have flushing water, with closed/blocked drain, or no closable doors. During the survey it was established that in all school facilities there are both cubicles in use and not in use, but that in all schools the number of cubicles unavailable for use is smaller than the number of toilet cubicles available for use.

Secondly, hand-washing appliances were observed separately in relation to their separation by gender. Term “For Boys/ Girls Only“ relates to toilet compartments found in separated toilet premises, while the term “Communal“ relates to compartments found in one toilet room, regardless of being marked by gender. In majority of school facilities there are both separate and communal toilet cubicles. The number of toilet cubicles for school children is shown in Table 19.

Table 19 Number of toilet compartments for school children

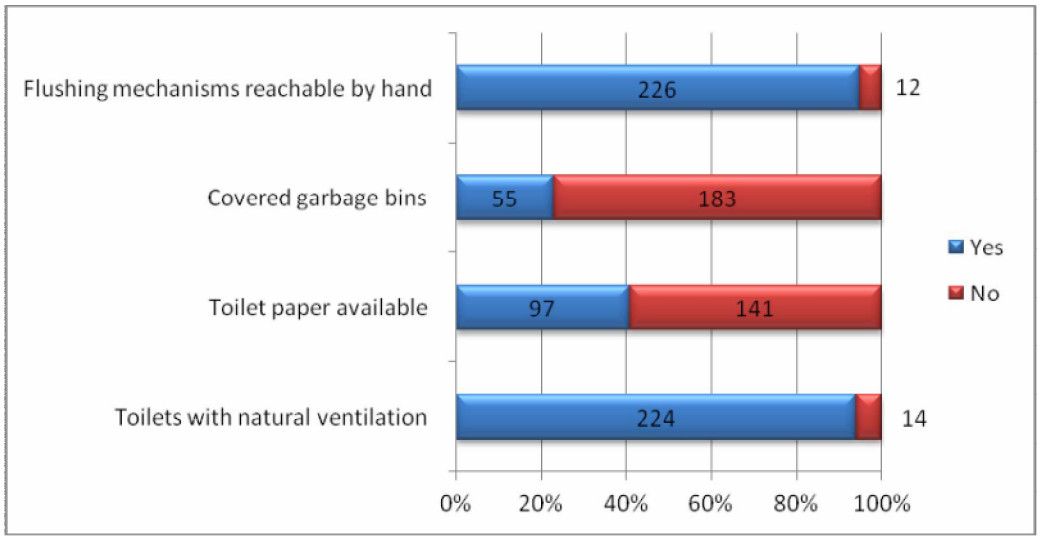
Number of appliances	Toilet compartments in use		Toilet cubicles not in use	
	Average number per school	Range (minimum-maximum)	Average number per school	Range (minimum-maximum)
For Girls Only	1.6	0 - 10	1.1	1 - 2
For Boys Only	1.5	0 - 10	1.1	1 - 2
Communal	1.4	1 - 3	1.0	1 - 1

It was also established through monitoring that there are also separate toilets for teachers and urinals in sanitary blocks, which is shown in Graph 33. Separate toilets for teachers were recorded in 62% of examined school facilities, while there were urinals in toilets in only one fifth of schools (21%).



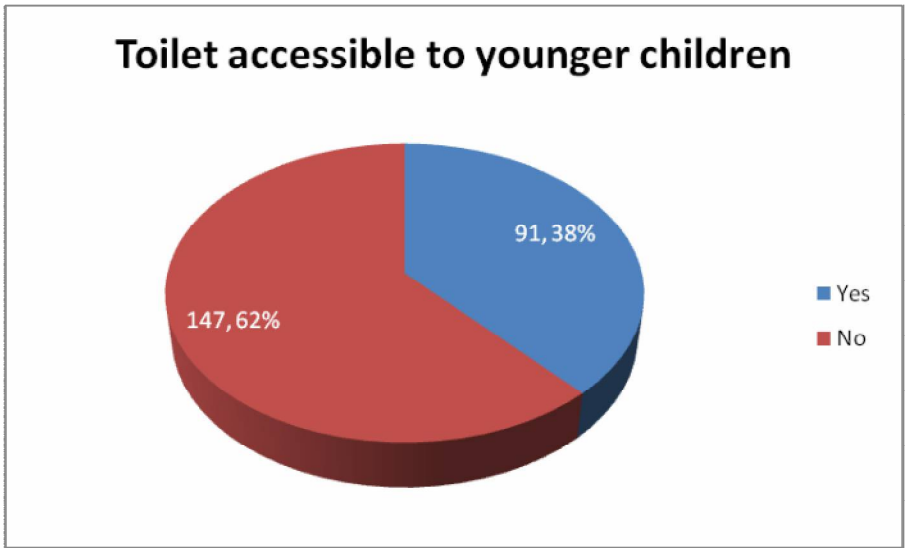
Graph 33 Existence of separate toilets for teachers and urinals in school toilets

Graph 34 shows accessibility of water flushing mechanisms, waste bins, toilet paper and natural ventilation in school toilets. It was established through monitoring that during research, water flushing mechanisms from toilet water tank were available for all children in 95% school facilities, which means that they can be easily reached by a child. Secondly, in 94% of school facilities there is natural ventilation in toilets, including both windows and ventilation openings. However, it was established that toilet paper was available in every toilet compartment in only 41% of examined school facilities, and that waste bins with lid in compartments intended for girls for maintaining menstrual hygiene exist in one fourth (23%) of the examined schools.



Graph 34 Accessibility of water flushing mechanisms, waste bins, toilet paper and natural ventilation in school toilets

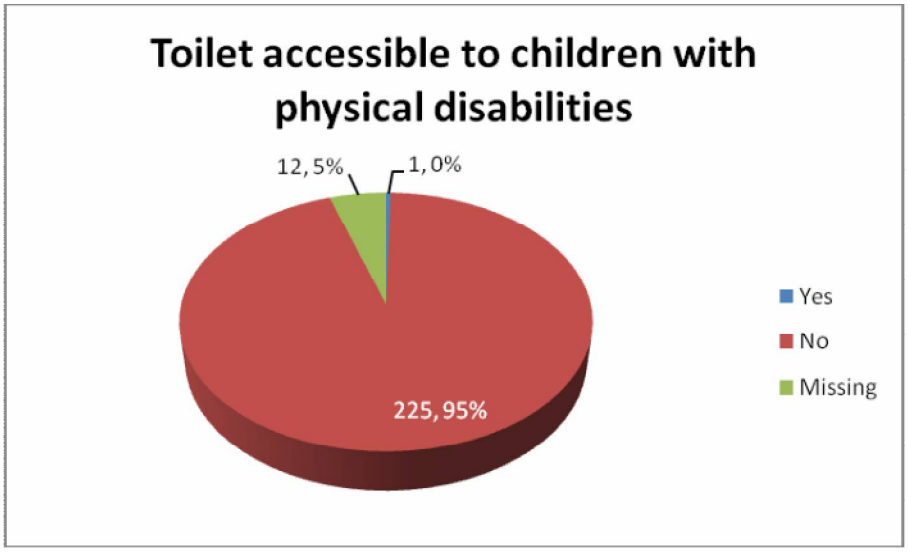
Accessibility of school toilets for the youngest pupils is shown in Graph 35. It was established through monitoring that in a little more than one third of examined schools (38%) there is at least one toilet adapted or available for the youngest pupils, which is defined as the existence of smaller size toilet bowls / seats.



Graph 35 Accessibility of school toilets to younger children

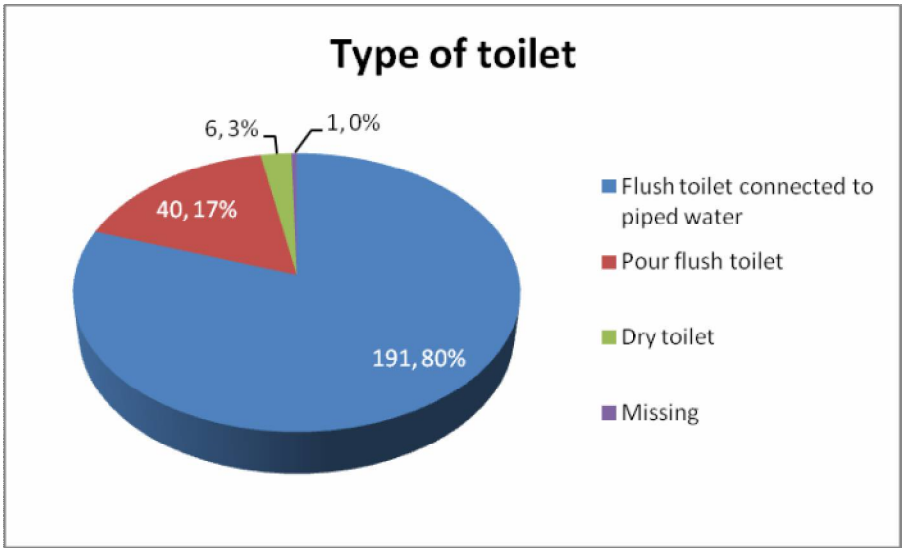
Accessibility of school toilets to children with disabilities is shown in Graph 36. According to methodology, in order to consider toilets available or accessible to persons with disabilities, there must be no stairs or steps on the way to such toilets which would hinder access to persons in a wheelchair; also, there must be enough space in the cubicle for the wheelchair, doors of the cubicle must be at least 80 cm wide, and the door handle, seat and lid of the toilet bowl must be accessible from a sitting position. Unfortunately, these criteria are met by only 1 school, while 12 schools did not give any answer (5%).

When schools attended by children with disabilities (15 schools) were observed separately, it was established that only one of them meets the criteria for the accessibility of toilets to children with disabilities.



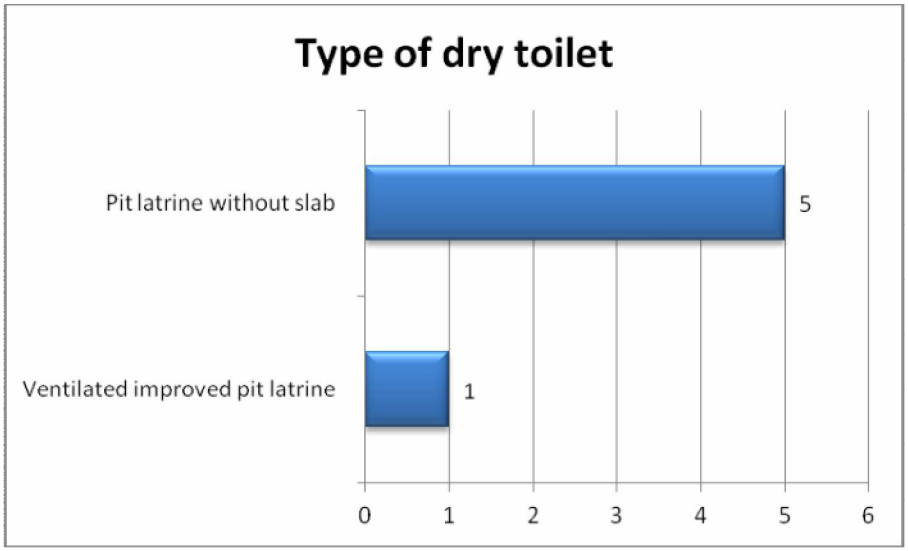
Graph 36 Accessibility of school toilets to children with disabilities

Type of the toilet used by pupils is shown in Graph 37. Dry toilets (without flushing) are registered in 6 schools, pour flushing toilets are present in 40 schools, while toilets flushed from water tanks / connected to piped water were recorded in 191 schools.



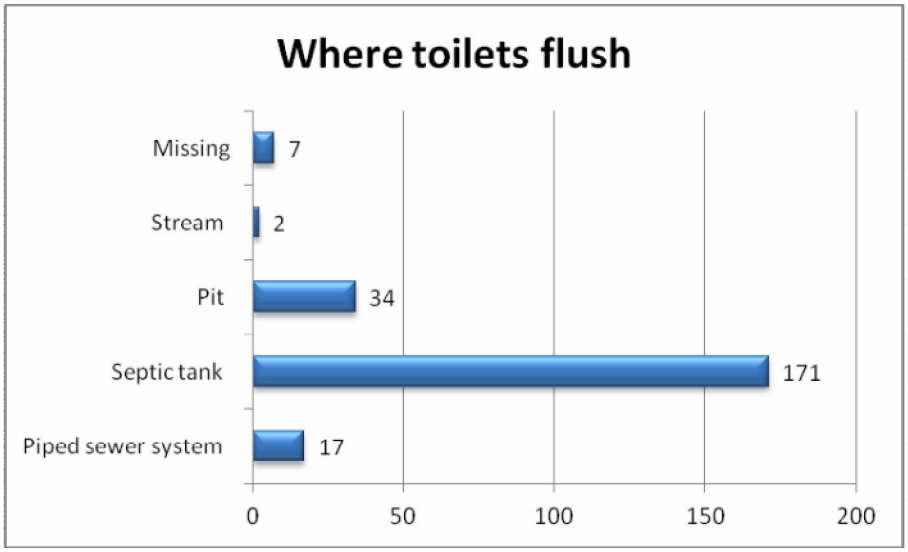
Graph 37 Type of toilet facilities in schools

In cases when the school uses a toilet without flushing (6 schools), it was further examined what type of toilets were in question, which is shown in Graph 38. It was established that these toilets were permeable toilet holes / pit latrine without slab in 5 schools, defined as a hole in the ground for excreta collection which does not have a squatting slab, platform or nor seat (squatting toilet), while in one school, toilet hole with ventilation opening was recorded (ventilated improved pit latrine). Dry toilets such as pit latrine with slab and septic tank or composting toilet, defined as hole in which organic material is added (scraps, straw, leaves, hay), of which compost is made and later safely used in agriculture, were not found in any of the schools.



Graph 38 Type of dry toilet in schools that only have dry toilets

In cases when flushing toilets are used in schools (231 schools), it was examined through monitoring in what way is the sanitary wastewater disposed of, which is shown in Graph 39.



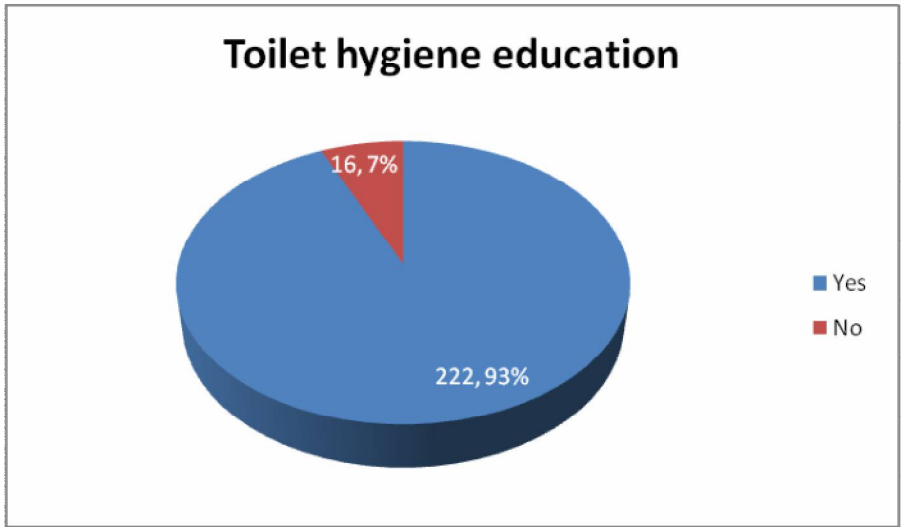
Graph 39 Disposal of flushed waste water in schools that have flush toilets

In majority of examined school facilities (74%) it was established that disposal of sanitary wastewater is performed through septic tanks, which are defined as tanks for collecting excretes, and are made of impermeable material in form of an underground tank, in which layers of excretes are deposited, and is located at prescribed distance from the school building and toilet, secured from the contamination of drinking water sources (groundwater or surface water) by human excreta. and where periodical emptying is possible, as well as leaching from the septic tank into the sewage for later treatment (Graph 39).

34 school facilities (15%) dispose of wastewater through permeable holes/pits, i.e. holes that serve for collecting excretes (protected, covered), but are not isolated with concrete or other layer, thus, they are not meeting the requirements for septic tanks (Graph 39).

Only 17 school facilities (8%) possess complete piped sewer infrastructure, while 2 schools mentioned that they do not have a system for the disposal of wastewater, but that there is outpouring of wastewater into a stream in the school facility vicinity (Graph 39).

Finally, on the basis of Questionnaire, the engagement of teachers in the education of pupils on the use of toilet was checked. First of all, it was established in all schools that pupils are allowed to use the toilet at any time while they are in school. Besides, in almost all schools (93%) it was established that the education on the use of toilet is included in the school programme, which is shown in Graph 40.



Graph 40 Toilet hygiene education at school

4.3.2. Hand-washing facilities in schools

On the basis of the Questionnaire on sanitary and hygienic conditions in schools, data on hand-washing facilities in schools, their functionality, equipment and accessibility to children, were obtained as well.

Primarily, it was established that hand-washing appliances are found in all examined schools. In almost all school facilities, hand-washing appliances are made according to centralized water supply which provides water at the tap (piped water system), while in one school, there is a hand-wash stand – a plastic canister with tap for hand-washing.

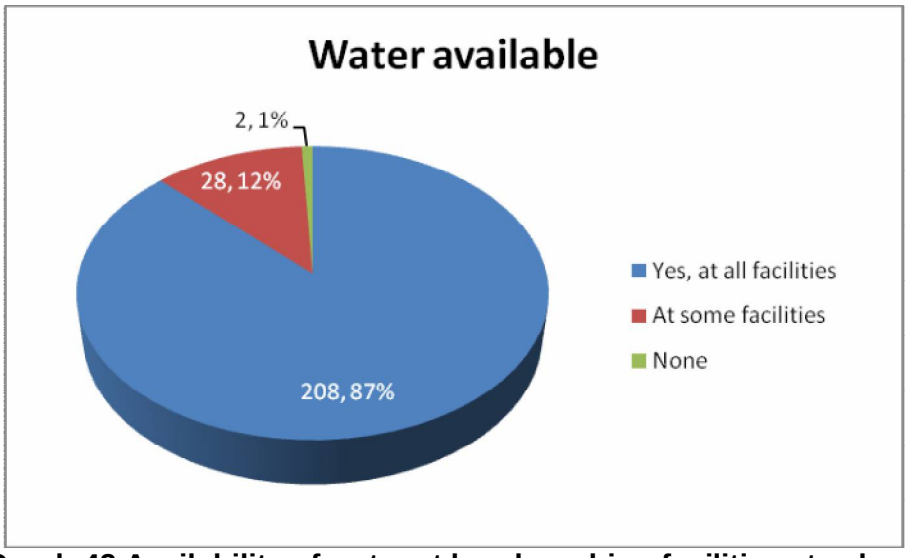
Hand-washing appliances in the majority of school facilities are found adjacent to the toilet (85%), while outside the toilet, as well as in both places (in the toilet and outside the toilet) these appliances are found in 20% of examined schools. Locations of hand-washing appliances are found in Graph 41.

Graph 41 Position of hand washing facilities in relation to school toilets

In school facilities in which hand-washing appliances are found outside the toilet (52 schools), it was particularly checked at what distance from the toilet are hand-washing facilities found and is the path leading to them suitable for all weather conditions. Out of 52 schools, only 45 schools answered to these questions. It was established that hand-washing appliances are found at a distance of 10 meters from the toilet in 38 schools (73% of schools that have hand-washing appliances outside the toilet), while in 7 school facilities, these appliances are found at a distance longer than 10 meters.

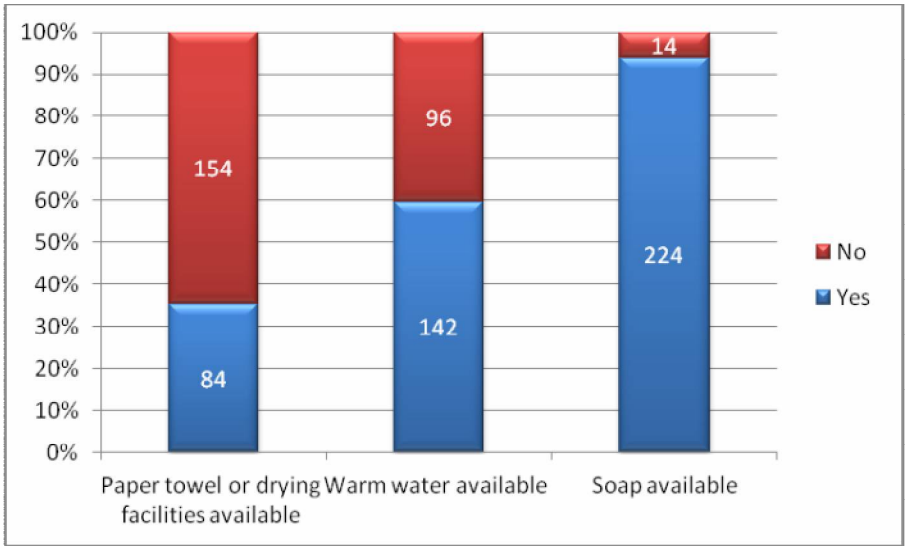
Likewise, the path leading to the hand-washing appliance found outside the toilet is suitable for all weather conditions in 38 schools, while in 7 school facilities the path is not suitable for all weather conditions.

Availability of water in hand-washing facilities at the time of the survey is shown in Graph 42. During examination, water was available in all existing hand-washing appliances in 87% of examined school facilities, while in only 2 school facilities water was not available for hand-washing at all.



Graph 42 Availability of water at hand-washing facilities at school

Graph 43 shows availability of warm water, soap and paper towels in hand-washing facilities. It was established through monitoring that hot water for hand-washing was available in 60% of school facilities, and that soap was available in 94% of school facilities. However, it was established that paper towels or other means for hand drying were available in sufficient quantities at any moment in all facilities in only one third (35%) of examined school facilities.



Graph 43 Availability of warm water, soap and paper towel or drying facilities at hand-washing facilities at school

Furthermore, it was established through monitoring how many appliances/faucets/hand-washing stations are available to children in schools. Hand-washing stations were observed according to functionality and separation by gender. Term "functional" means hand-washing appliances with both available water and soap during examination, while hand-washing appliances were lacking either water or soap were marked as "non-functional".

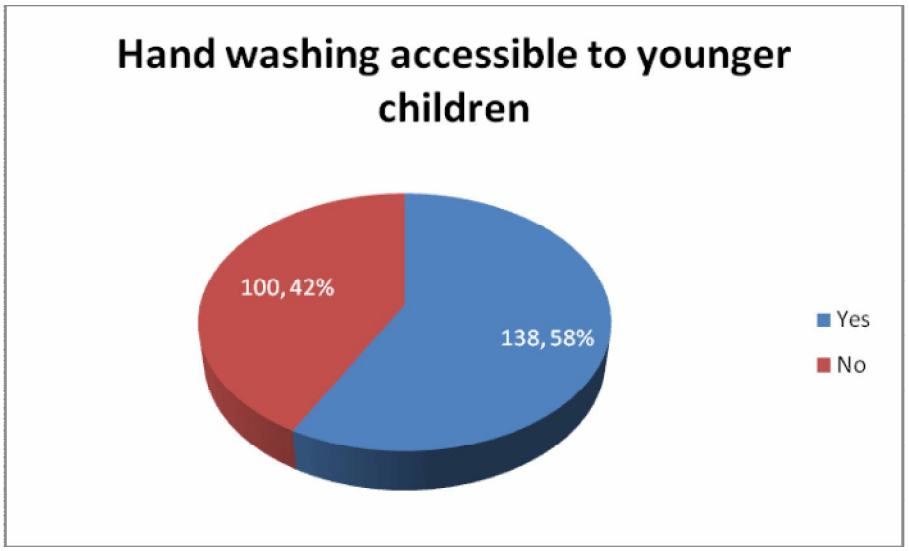
During research, it was established that in all school facilities there are both functional and non-functional hand-washing stations, although in every school the number of non-functional appliances is smaller than the number of functional ones.

Secondly, hand-washing stations were particularly observed as regards separation by gender. Term “For Boys/Girls Only“ relates to appliances found in separated hand-washing facilities, while the term “Communal“ relates to hand-washing stations found in one space /toilet room regardless of being marked by gender. In majority of school facilities there are both separate and communal hand-washing appliances. The number of appliances, i.e. faucets for children in school is shown in Table 20.

Table 20 Number of appliances / faucets / hand-washing stations for children in school

Appliance number	Functional appliances, faucets or stations		Non-functional appliances, faucets or stations	
	Average number per school	Range (minimum-maximum)	Average number per school	Range (minimum-maximum)
For Girls Only	1.9	1 - 7	1.2	1 - 3
For Boys Only	1.8	1 - 7	1.3	1 - 3
Communal	2.4	1 - 15	1.9	1 - 8

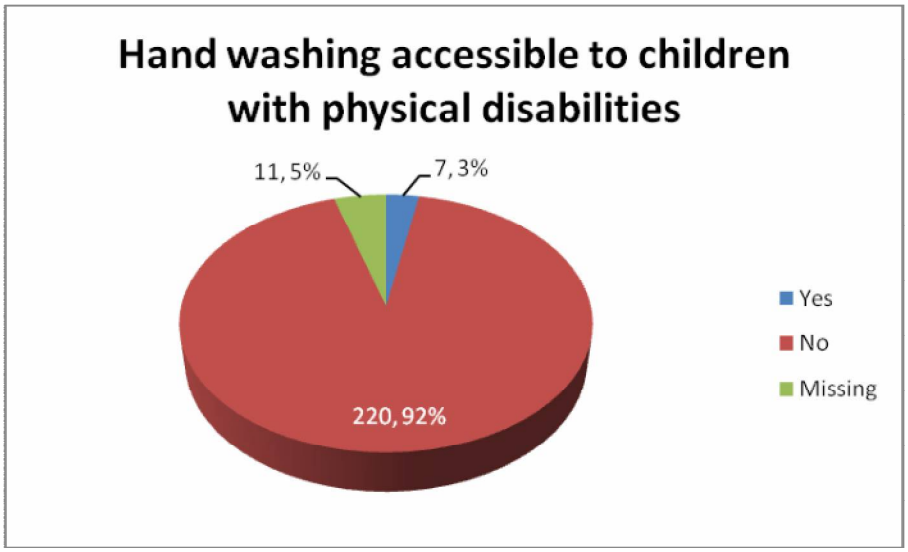
Accessibility of hand-washing appliances to the youngest pupils is shown in Graph 44. It was established through monitoring that in more than half of examined schools there is at least one hand-washing appliance accessible to the youngest pupils.



Graph 44 Accessibility of hand-washing facilities to younger children in school

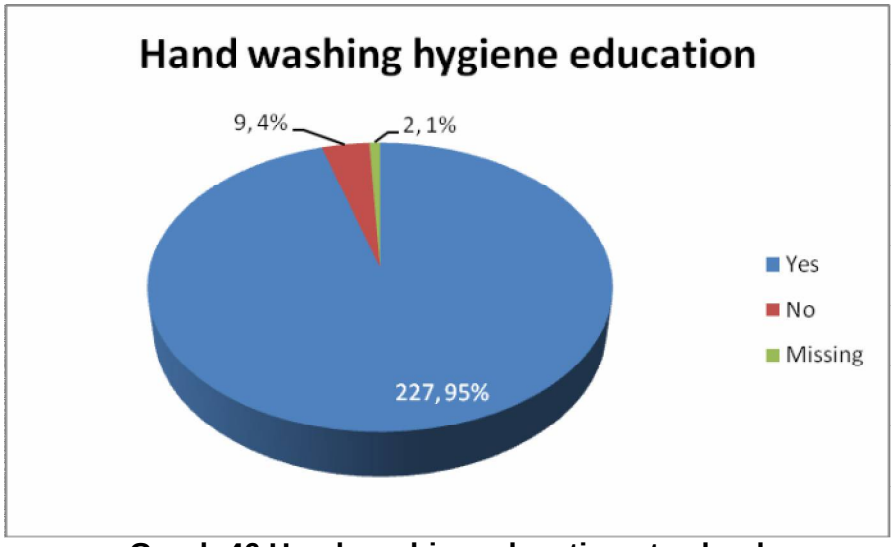
Accessibility of hand-washing facilities to children with disabilities is shown in Graph 45. According to methodology, in order to consider appliances accessible or available to persons with disabilities, there must be no stairs or steps/obstacles on the way leading to the appliance that would hinder access to persons in wheelchair, and the appliances must be accessible from a sitting position. Unfortunately, these criteria for the accessibility of hand-washing appliances are met in only 7 school facilities (3% of the examined schools), while in most cases, hand-washing appliances cannot be considered to be accessible to children with disabilities.

When schools attended by children with disabilities (15 schools) were observed separately, it was established that none of them fulfils the criteria for accessibility of hand-washing appliances to children with disabilities.



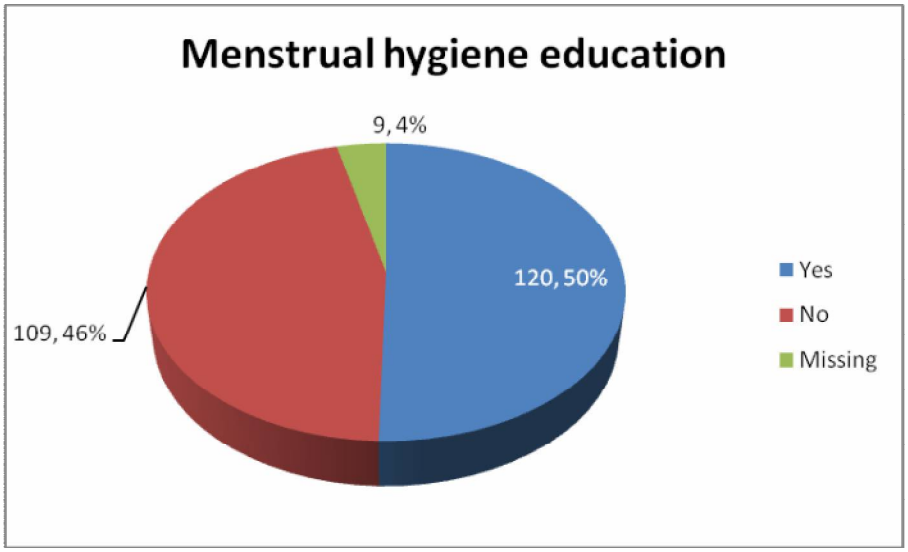
Graph 45 Accessibility of hand-washing facilities to children with disabilities in school

Finally, on the basis of the Questionnaire, teacher engagement in education of pupils on the maintenance of hygiene was examined as well. Primarily, it was established that in almost all schools (236 school facilities) teachers require from children to wash hands during the day, for example before meals. Furthermore, in almost all schools (95%) it was established that hand-washing training and education is included in the school programme, which is shown in Graph 46.



Graph 46 Hand-washing education at school

On the other hand, it was established that education on maintaining menstrual hygiene for older girl pupils is included in the school programme in half of all examined schools, which is shown in Graph 47.



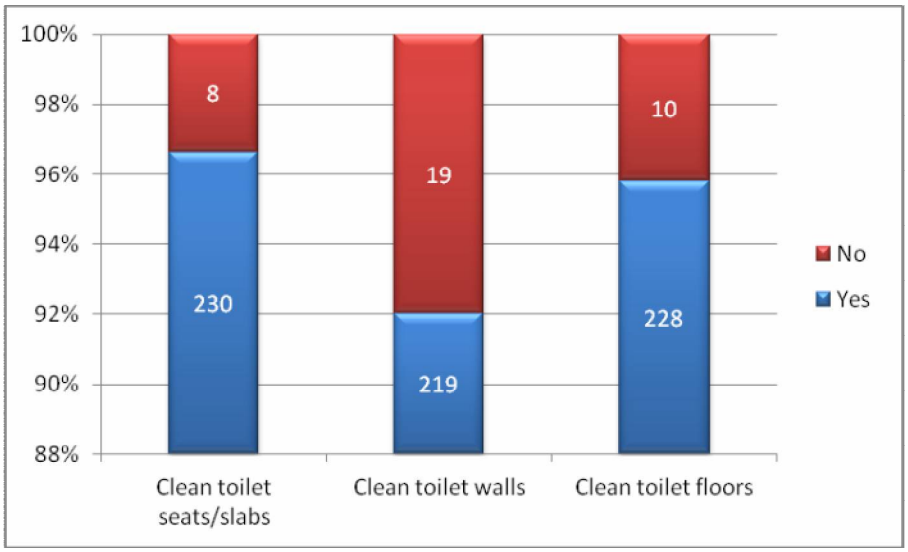
Graph 47 Menstrual hygiene education at school

When only school facilities attended by older pupils (between ages 11 and 15; 56 schools) were observed, it was established that education on menstrual hygiene is included in the school programme of even 47 schools, i.e. 84% of schools attended by older pupils.

4.3.3. School cleaning, operation and maintenance

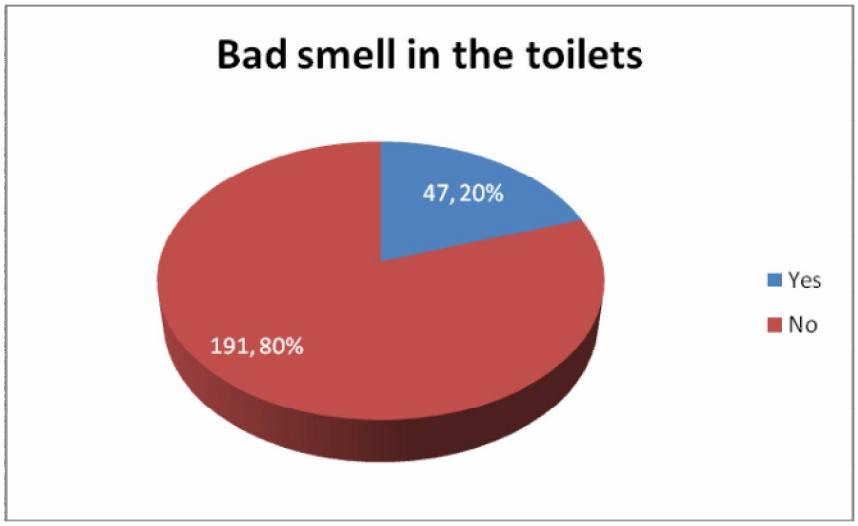
On the basis of Questionnaire on sanitary and hygienic conditions in schools, data on cleaning and maintaining cleanliness of sanitary premises in schools were obtained.

Graph 48 shows the results of the state of cleanliness of toilet cubicles, walls and floors in school facilities. In over 90% of examined school facilities it was established that toilets are clean, both toilet walls and doors as well as toilet bowls and seats.



Graph 48 State of cleanliness of toilet walls, floors and seats at school

Graph 49 shows presence of unpleasant odours in school toilets in examined schools. In 80% of school facilities, there is no bad smell in toilets, while in every fifth school facility unpleasant toilet odour is felt.

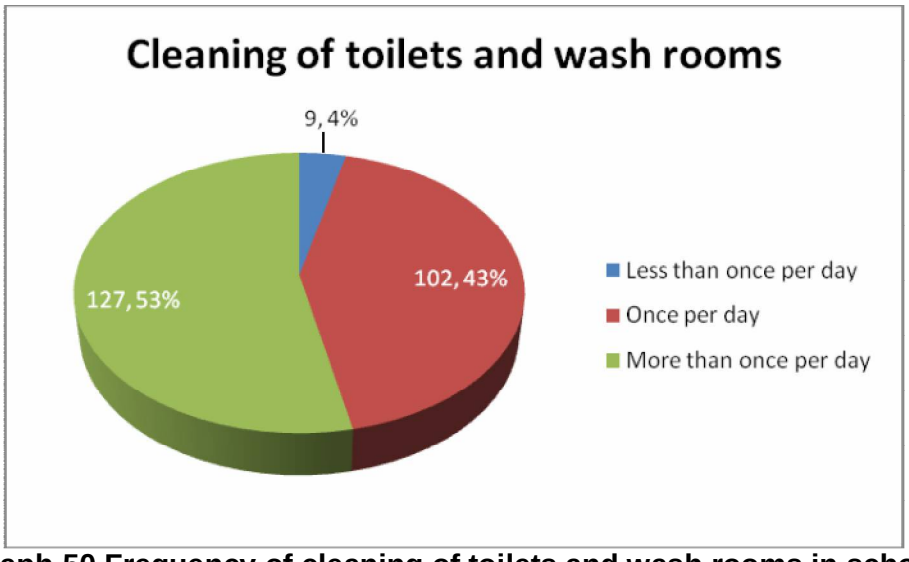


Graph 49 Bad smell in school toilets

On the basis of Questionnaire, it was established through monitoring in schools that in 232 school facilities (97.5% of the examined schools), there is a person responsible for cleaning and maintaining cleanliness in all sanitation facilities, including toilets and hand-washing facilities, while only in 82 schools (24.4% of the examined number of schools) there is a person responsible for maintenance of the school water supply facilities and devices.

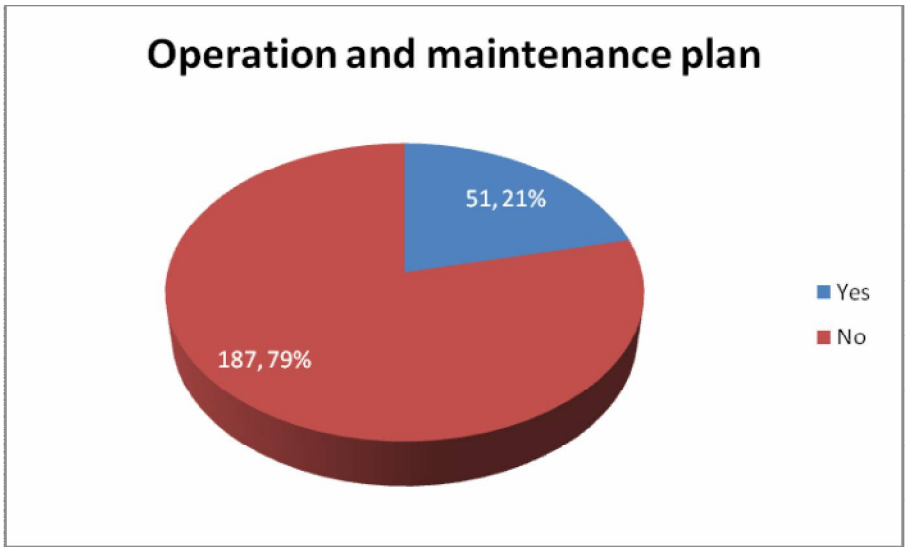
Besides, it was recorded that in 154 school facilities (64.7%), septic tank/toilet hole is properly managed/emptied on a regular basis if the school uses a toilet hole in an outhouse or toilet connected to septic tank.

Graph 50 shows frequency of cleaning toilets and hand-washing facilities in the examined school facilities. In 96% of school facilities, toilets and hand-washing facilities are cleaned at least once a day or several times a day.



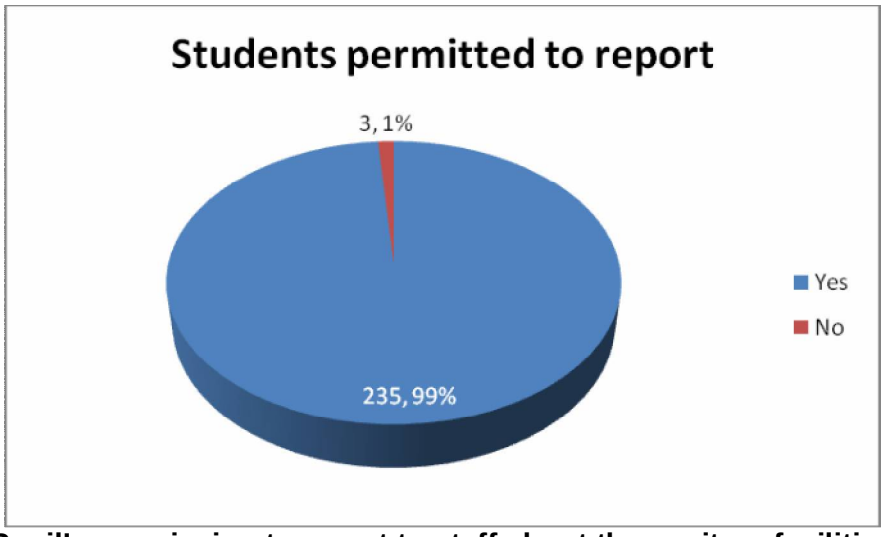
Graph 50 Frequency of cleaning of toilets and wash rooms in school

Graph 51 shows the presence of the cleaning and maintenance schedule of toilets and hand-washing facilities in schools on a regular basis. On the basis of Questionnaire it was established that in four fifths of school facilities (79%) there is no plan/schedule for cleaning and maintaining toilets and hand-washing facilities with defined responsibilities and tasks providing adequate and sustainable space maintenance, while in one fifth of school facilities there is such plan/schedule.



Graph 51 Existence of the operation and maintenance plan in schools

Graph 52 shows the liability of expressing own opinion and remarks of pupils on the state of toilets and hand-washing facilities in examined schools. It was established that in almost all examined school facilities (99%), pupils can express their opinions and are permitted to report to responsible persons any bad situation about sanitary blocks / toilets and hand-washing facilities.



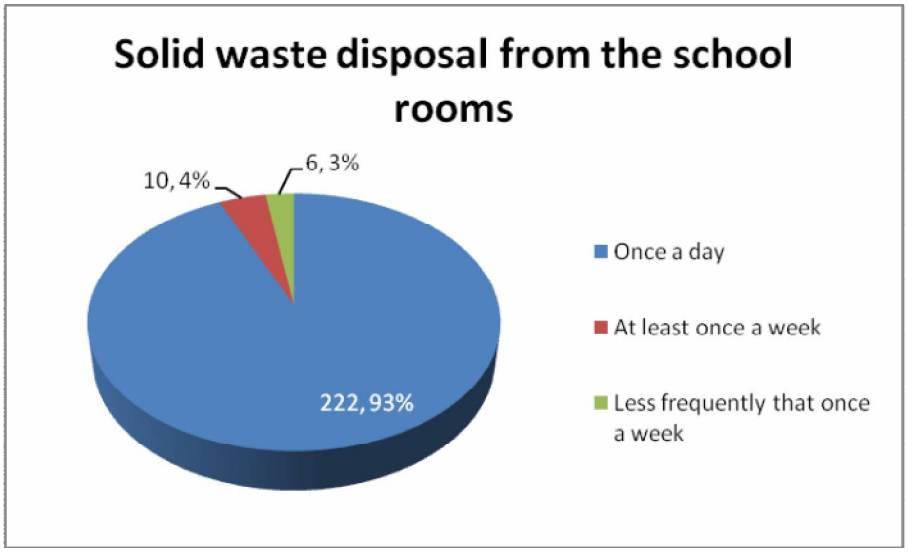
Graph 52 Pupil's permission to report to staff about the sanitary facilities in school

Furthermore, in school facilities where there is such a possibility, a procedure is established in 211 schools (i.e. 89.8% schools gave a positive answer) that enables rapid response of the competent responsible persons, while in the remaining 20 schools such a procedure does not exist.

4.3.4. Solid waste disposal at school

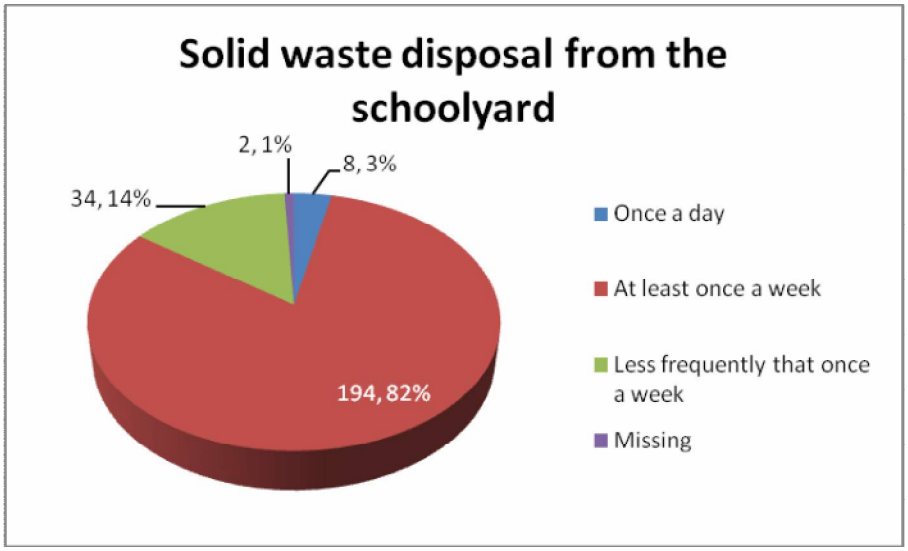
On the basis of Questionnaire on sanitary and hygienic conditions in schools, it was established that in 224 schools (94%) there is an organised collection of solid waste.

Graph 53 shows the frequency of solid waste disposal from school premises/classrooms. In more than 95% of school facilities, waste from classrooms is removed on a daily basis, i.e. at least once a week and more frequently, while in only 6 school facilities (3%) it is done less than once a week.



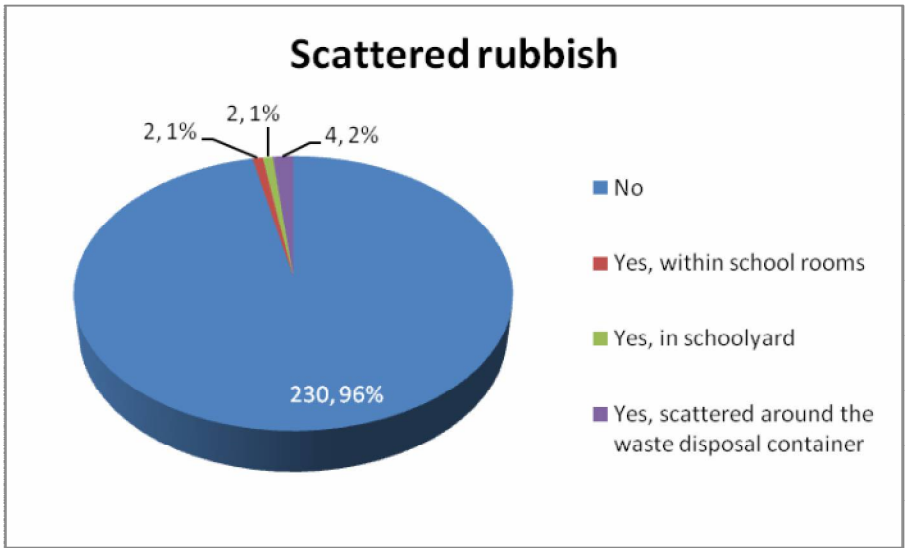
Graph 53 Frequency of solid waste disposal from the school rooms

Graph 54 shows the frequency of taking away of solid waste collected in schools. In 85% of school facilities, waste is taken away from the school yard at least once a week or on a daily basis, and only in 6 schools (3%) less than once a week.



Graph 54 Frequency of solid waste disposal from the schoolyard

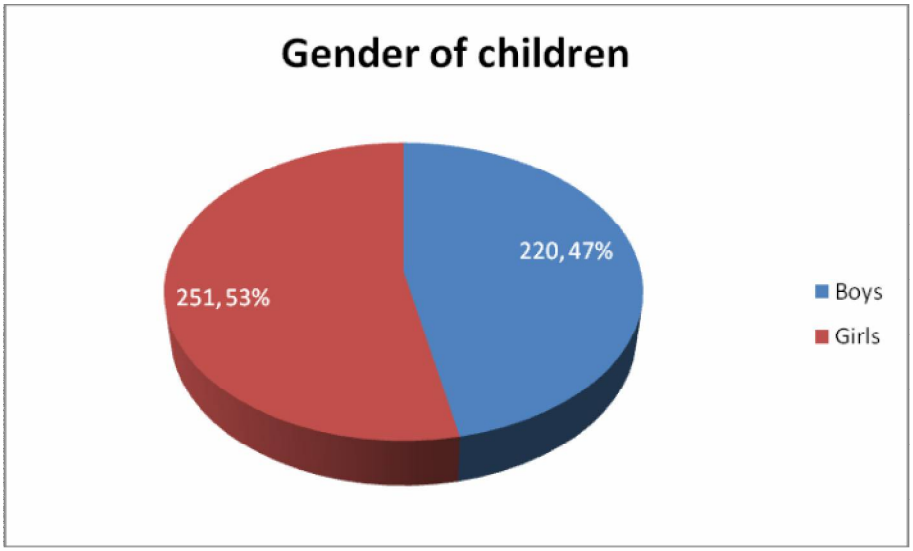
Graph 55 shows the presence of scattered rubbish / garbage in school facilities. In 96% of school facilities there is no scattered garbage anywhere, neither in school premises nor in the school yard or around the garbage container, while only in 8 school facilities (4%) scattered garbage was registered.



Graph 55 Presence of scattered rubbish in school

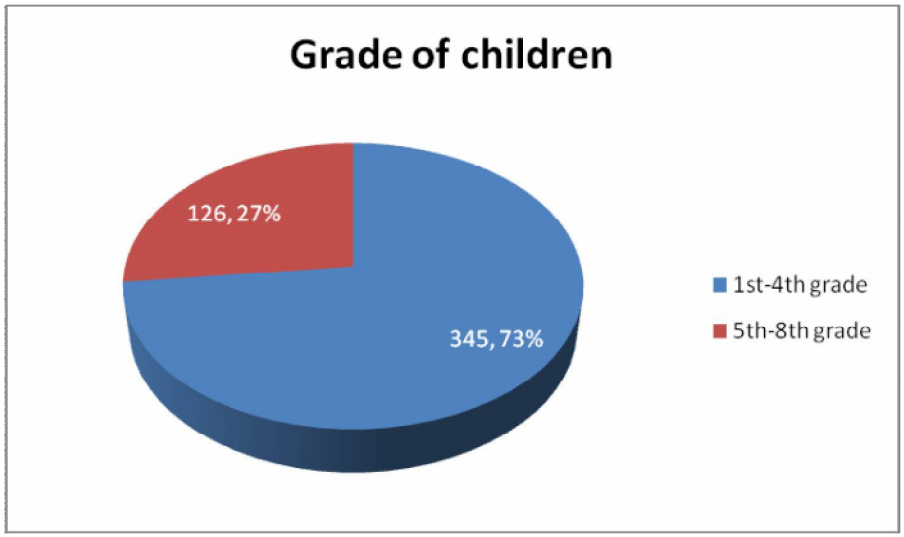
4.4. Pupils' assessment of sanitary and hygienic conditions

Examining of pupils' assessments on sanitary and hygienic conditions in schools in rural environments was performed in all examined school facilities on a sample of 471 pupils, i.e. 211 pupils in Šumadija District and 260 pupils in Pomoravlje District. There were no differences in the distribution of interviewed pupils by gender between the two districts. Graph 56 shows distribution of interviewed pupils by gender.



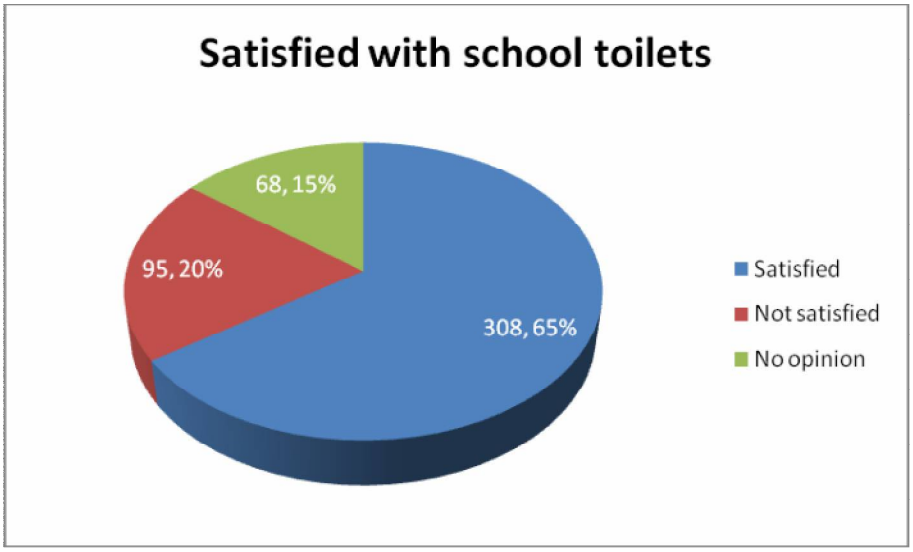
Graph 56 Distribution of the interviewed pupils by gender

Majority of interviewed pupils attended lower grades of primary schools (Grades 1 - 4), while 27% of interviewed pupils attended higher grades of primary school (Grades 5 - 8). No differences were established in the distribution of interviewed pupils by grades between two districts. Distribution of pupils by grades is shown in Graph 57.



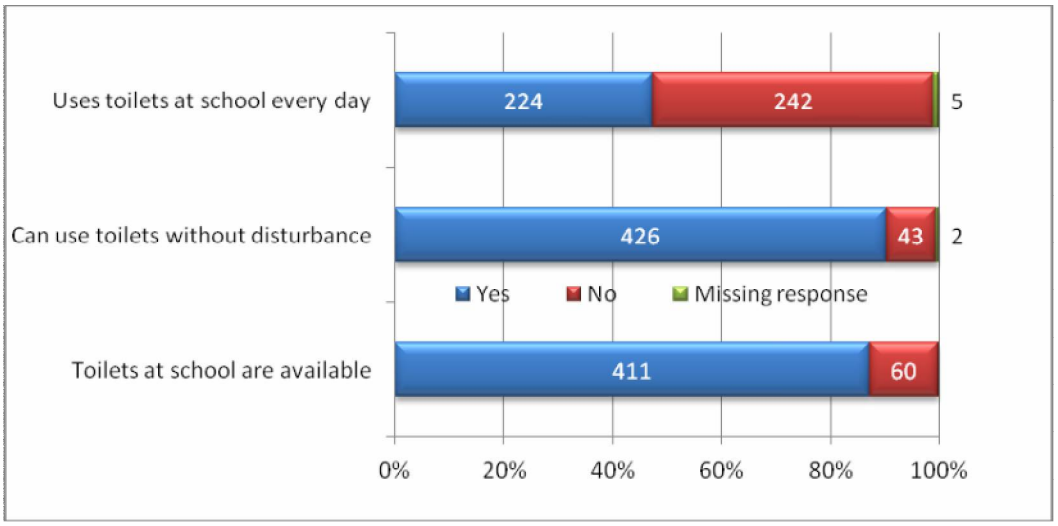
Graph 57 Distribution of the interviewed pupils by grades

On the basis of Questionnaire intended for pupils, their satisfaction concerning the use of toilets in school was established as follows: almost two thirds of pupils are satisfied with the school toilets, although older pupils are considerably less satisfied with school toilets than the younger pupils. Graph 58 shows the distribution of pupils according to indicated satisfaction with school toilets.



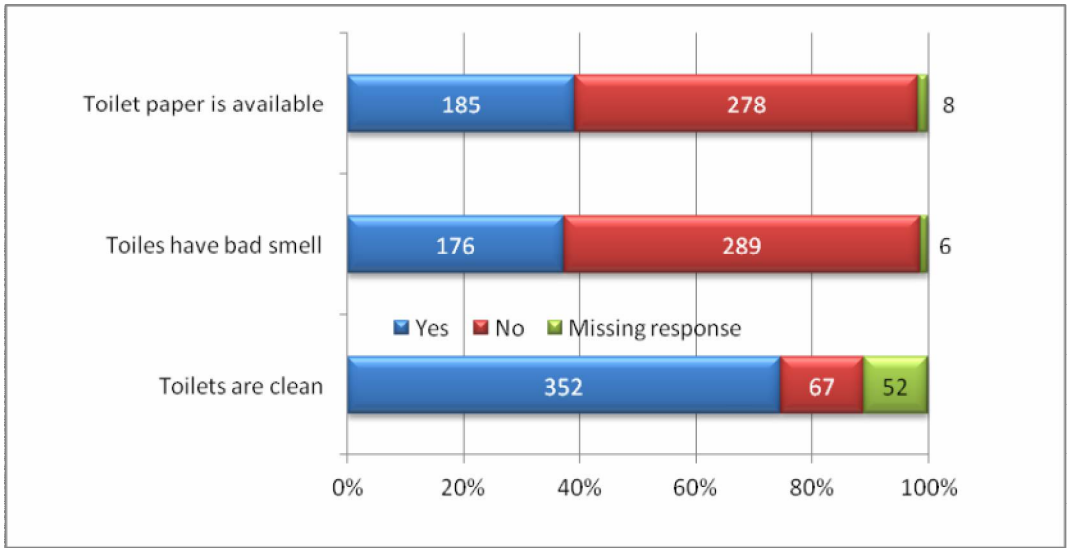
Graph 59 Distribution of the interviewed pupils according to satisfaction with toilets

On the basis of Questionnaire, pupils' habits related to the use of toilets as well as their assessment related to the accessibility of toilets and possibilities regarding their use, were identified, which is shown in Graph 59. Half of the pupils state that they do not use the school toilet on a daily basis, the older pupils somewhat more than the younger ones, and more girls than boys. Almost all pupils (87%) assess that the school toilets are available, which means that they can always use them when necessary, meaning that toilets are always unlocked, that pupils do not have to stand in line in order to use it, that toilets are in the vicinity of the classroom and that there are no physical barriers on the way to the toilet. Furthermore, 90% of pupils assess that they can use toilets without disturbance by others since there are always doors of separate toilet compartments.



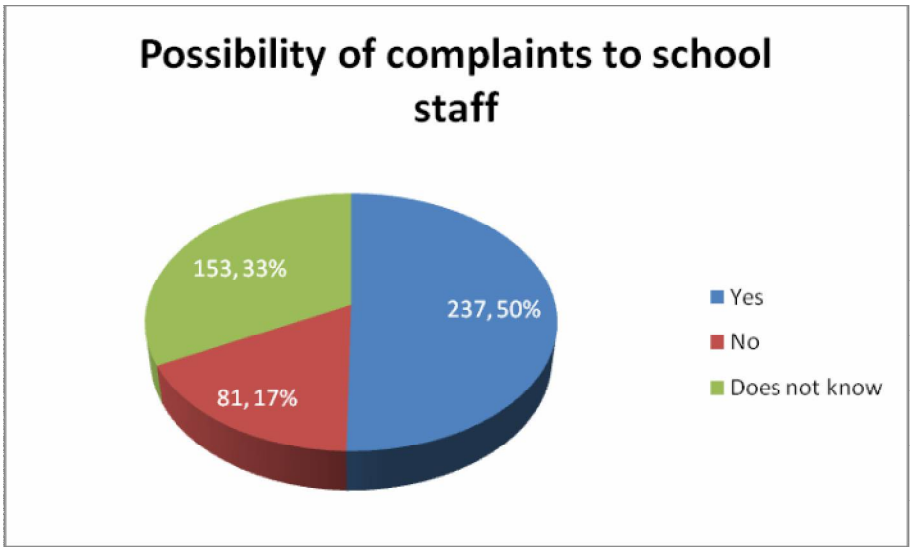
Graph 59 Pupils' habits and assessment related to the use of toilets in school

Also, pupils expressed their own opinion in the Questionnaire on the cleanliness of school toilets, availability of toilet paper and unpleasant odour in school toilets, which is shown in Graph 60. Approximately three fourths of pupils (74%) believe that school toilets are clean, and approximately 40% of pupils state that there is bad smell in toilets, while approximately the same number of pupils state that there is toilet paper in school toilets. At the same time, the older pupils have much worse opinion on the cleanliness of toilets and odours and availability of toilet paper than the younger pupils, regardless of their gender.



Graph 60 Pupil's opinion on cleanliness, smell and presence of toilet paper in school toilets

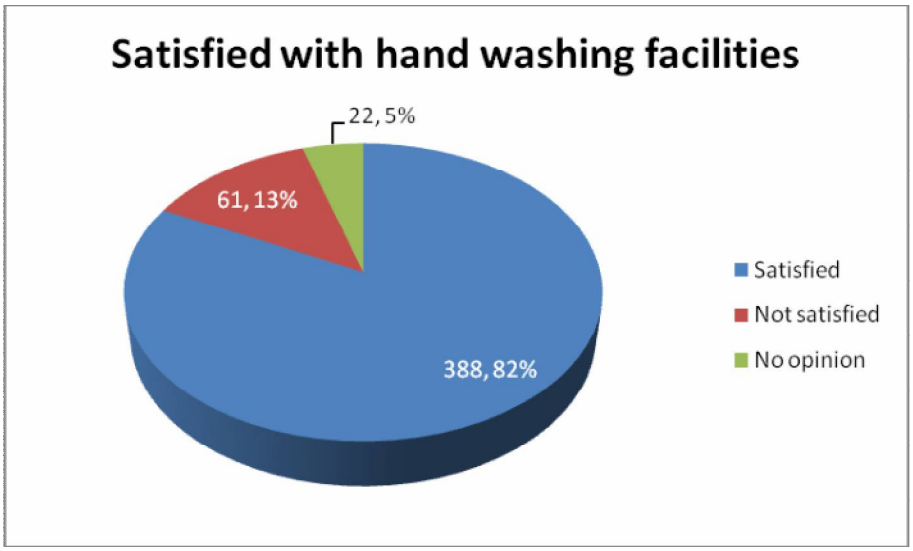
Finally, pupils were asked if they can complain to school staff about the poor state of school toilets, and half of pupils answered affirmatively, 17% answered negatively (younger pupils more), while one third of pupils was not acquainted with such possibility or did not answer (which is considerably more frequent when pupils in higher grades are in question). Distribution of pupils answersregarding the possibility of complaint to the school staff as regards the state of school toilets is shown in Graph 61.



Graph 61 Distribution of the interviewed pupils' answers regarding ~~to~~ the possibility of complaint to school staff regarding the school toilets

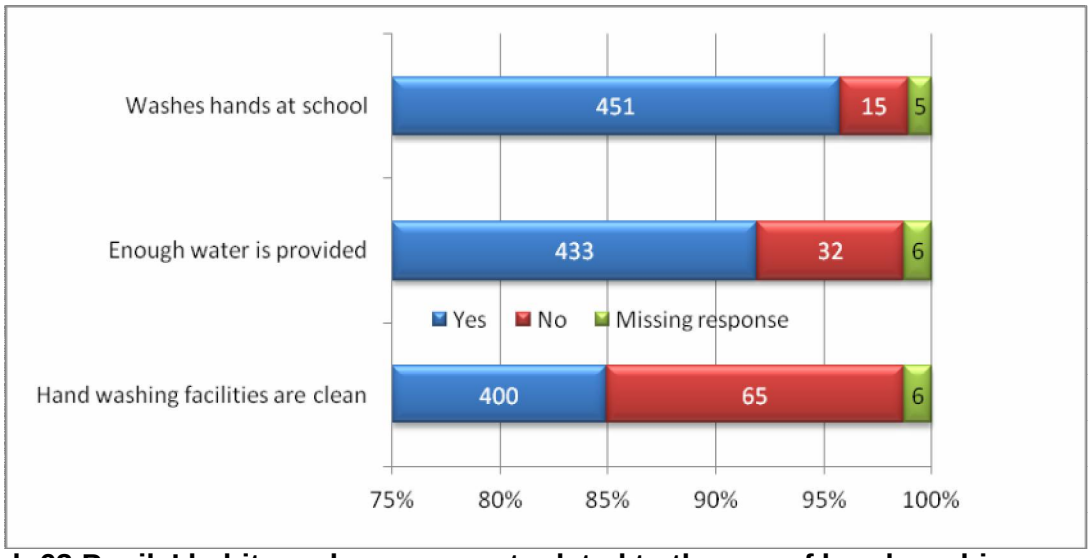
Of all interviewed pupils, only 58 of them (12.5% interviewees) personally complained to a teacher or school staff on poor state of school toilet, older pupils somewhat more frequently. At the same time, half of the pupils who personally complained stated that the school staff did not resolve the problem in a proper manner.

On the basis of Questionnaire, satisfaction of pupils with the hand-washing facilities in school was assessed as well, where four fifths of pupils are satisfied with hand-washing facility, although older pupils are considerably less satisfied than the younger pupils. Graph 62 shows distribution of pupils according to satisfaction of pupils with the hand-washing facilities.



Graph 62 Distribution of the interviewed pupils according to the satisfaction with hand-washing facilities in school

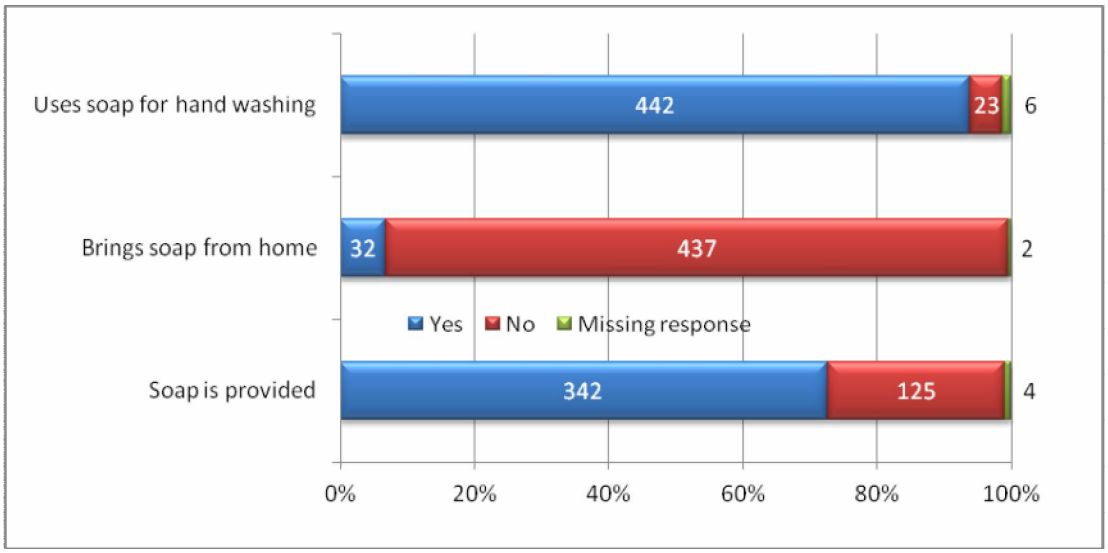
Besides, on the basis of Questionnaire pupils expressed their own opinion on the cleanliness of the hand-washing facility, availability of sufficient quantity of water for washing hands and hand-washing habits during their stay in school, which is shown in Graph 63. Over 80% of interviewed pupils state that the hand-washing facility is clean, and over 90% of pupils believe that there is enough water and that they have a habit of washing hands in school. The pupils of higher grades assess the cleanliness of hand-washing facility with lower grades than the younger pupils.



Graph 63 Pupils' habits and assessment related to the use of hand-washing facilities in school

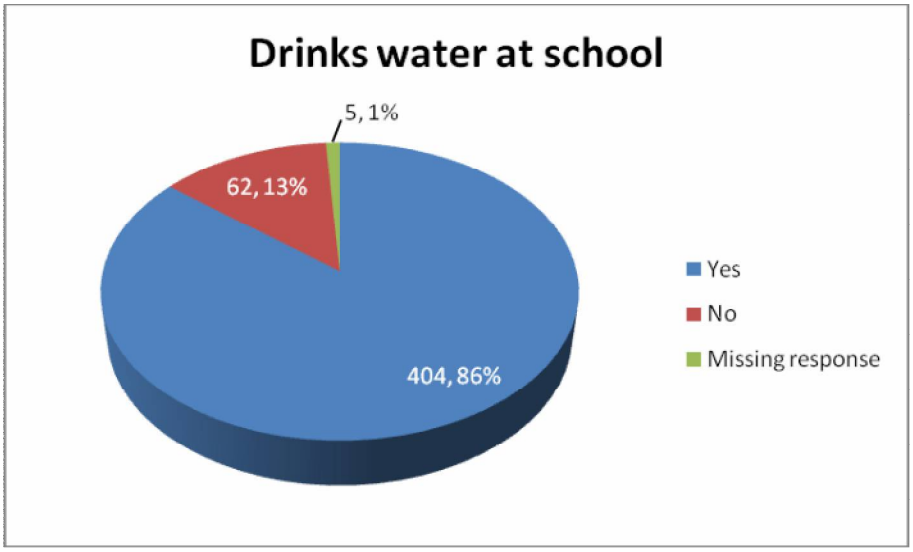
Although majority of pupils answered that they wash their hands while in school, 134 mentioned additional reasons why they do not wash hands. Among the reasons for not washing hands in the school they state as follows: "I don't have time", "I don't consider it necessary", "I have wipes", "I don't feel like doing it", "I forget to wash hands" or "I have no reason at all". Such, the so called personal reasons for not washing hands, stated 48 pupils (35.8% of all answers, i.e. 10.2% of the total number of pupils), and these are more frequently reported among pupils of lower grades. Furthermore, pupils answered that they do not wash hands due to reasons concerning the hand-washing facility, such as: "Hand-washing space makes me sick", "There is no water", "There is no soap" or "I don't have anything to dry hands with". These reasons are reported by even 97 interviewees (72.4% of all answers, i.e. 20.6% of all interviewed pupils), more frequently by the older pupils. Both reasons for not washing hands were reported by as much as 11 pupils (2.3% of interviewees).

Furthermore, on the basis of Questionnaire, the pupils expressed their own opinion on the availability of soap in school, the need to bring soap from home and the habit of using soap during hand-washing, which is shown in Graph 64. Approximately three fourths of pupils (72.6%) assess that there is enough soap in school, although the older pupils have a considerably more negative assessment than younger pupils. Over 90% of all pupils use soap for hand-washing and state that they are not asked to bring soap from home.



Graph 64 Pupil's opinion on the availability and use of soap for hand washing in school

On the basis of Questionnaire, pupils' habits related to drinking water at school were identified as well, whereas it was proven that more than four fifths of pupils drink water during their stay at school. Distribution of pupils according to their water drinking habit is shown in Graph 65.



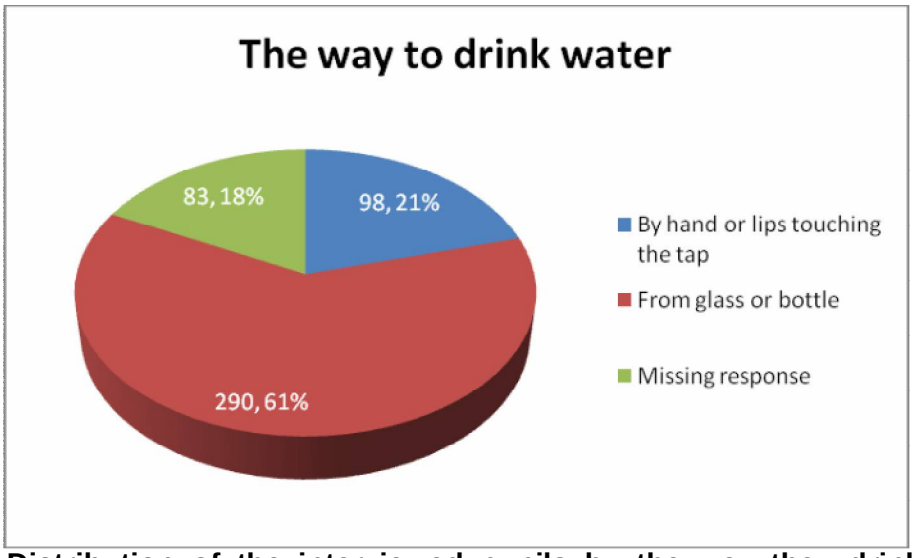
Graph 65 Distribution of the interviewed pupils by habit to drink water at school

The pupils were asked to answer what kind of water they drink at school, which is shown in Table 21. It was established that two thirds of pupils drink water that they bring from home, while only one third drinks school tap water. Only a small number of pupils state that they drink water from the neighbouring households or drinking water appliances. At the same time, it was noticed that the pupils from higher grades considerably more frequently state that they drink school water, while younger pupils state more frequently that they drink water brought from home.

Table 21 Origin of water that the pupils drink while in school

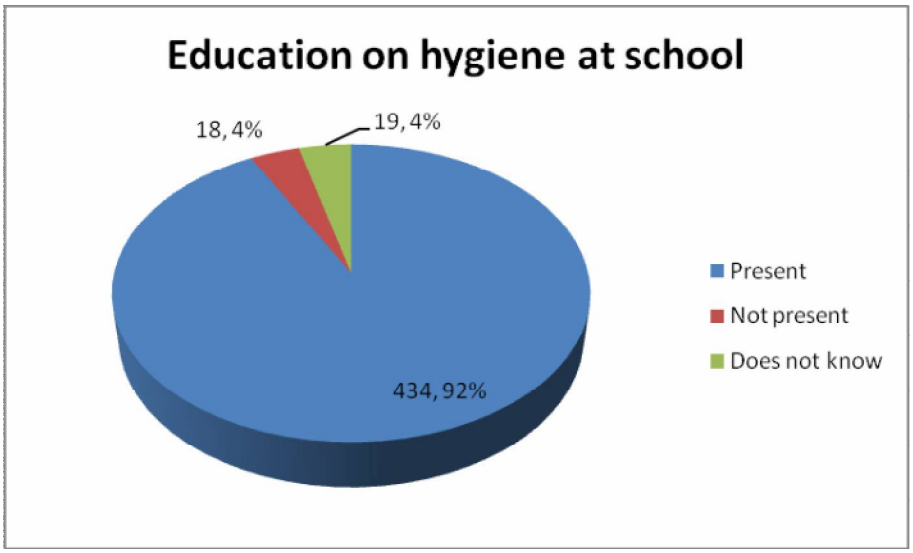
What kind of water pupils drink at school (several answers possible)	Number of pupils who answered with "Yes" (%)
Water brought from home	318 (67.5%)
Tap water in school	159 (33.8%)
Drinking water appliance	17 (3.6%)
Water from neighbouring households	12 (2.5%)
Does not drink water at school	8 (1.7%)
The answer is missing	9 (1.9%)

Pupils who answered that they drink school tap water were asked to be more precise and tell how they drink water, which is shown in Graph 66. It was established that 60% of pupils drink water in a hygienically acceptable manner from a glass or bottle, while approximately 20% of pupils drink water in an unhygienic manner from cupped hands or touching the tap with mouth.



Graph 66 Distribution of the interviewed pupils by the way they drink water at school

Finally, pupils answered to question whether and if they are taught in school about maintaining personal hygiene and good hygiene habits. To this question, almost all pupils answered affirmatively (more than 90%). Among pupils who answered negatively or who did not know the answer to the question, there were considerably more pupils from higher grades than the younger ones. The distribution of pupils according to the existence of education at school on maintaining personal hygiene is shown in Graph 67.

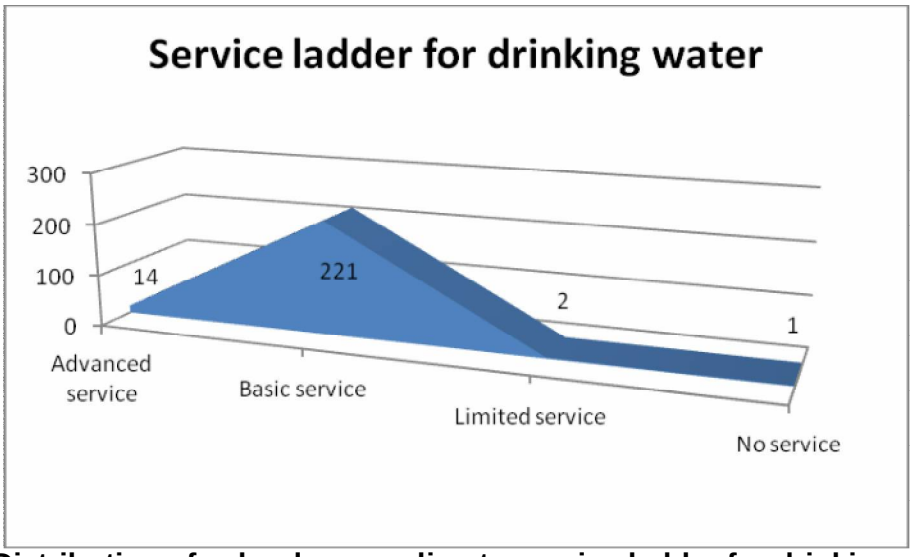


Graph 67 Distribution of the interviewed pupils by the presence of hygiene education at school

4.5. Service ladders – levels of achieved standards in schools

In this research, classification of examined school facilities according to levels of achieved standards was performed, i.e. the so called service ladders for three standards in schools – water supply, sanitation and hygiene (WASH) were created.

Graph 68 shows distribution of schools according to water supply service ladder, while Table 22 explains the reasons for the classification of certain school facilities into the proposed service ladder categories.



Graph 68 Distribution of schools according to service ladder for drinking water

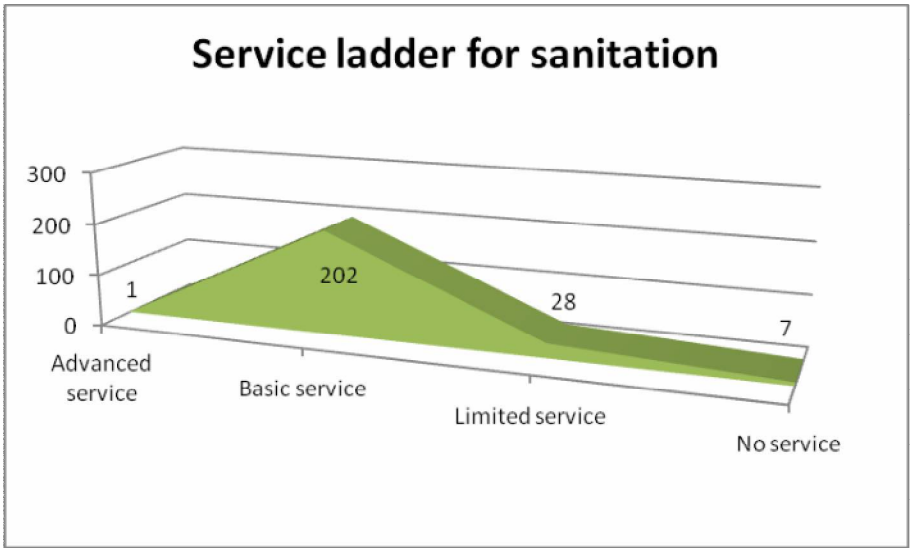
According to the research methodology, the basic level of standard for the water supply service ladder is fulfilled by majority of schools, although, unfortunately, 3 school facilities do not meet the criteria of the basic level, since they have no water or do not provide water from and advanced water supply source.

On the other hand, almost 6% of examined school facilities meet very demanding criteria for the advanced standard level and their number could be bigger when safe drinking water is provided to schools, if the water supply source would provide water at all times and if drinking water would be accessible to children with disabilities.

Table 22 Classification of examined school facilities into categories of drinking water service ladder

Category of Drinking water service ladder	**Number (%) of school facilities**	**Reasons for not meeting the conditions for the Basic service level**	**Reasons for not meeting the conditions for the Advanced service level**	
Advanced level of standard	14 (5.9%)			
Basic level of standard	**221 (92.8%)**		Water is not available in school at all times	13 (5.5%)
			Drinking water is not accessible to children with disabilities	214 (89.9%)
			Water is not safe to drink	102 (42.8%)
Limited level of standard	2 (0.8%)	No water in school during monitoring		
No service	1 (0.4%)	School water supply from unimproved water source		

Graph 69 shows distribution of schools according to sanitation service ladder, while Table 23 explains reasons for the classification of certain school facilities into the proposed ladder categories.



Graph 69 Distribution of schools according to service ladder for sanitation

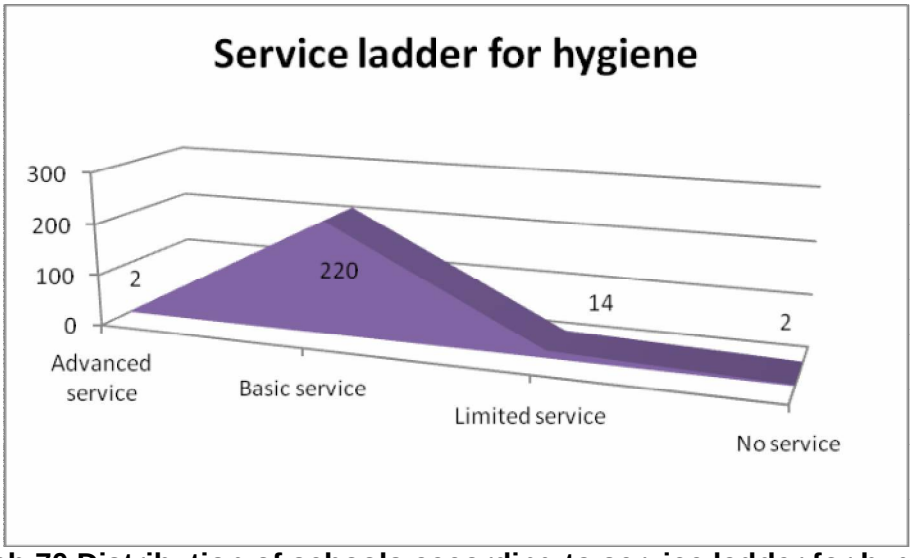
According to the research methodology, the basic level of the sanitation service ladder fulfil almost 90% of examined schools, although, unfortunately, 35 school facilities do not meet the criteria of the basic level, either because they have dry toilets or because toilets are not separated by gender.

On the other hand, only one school meets very demanding criteria for the advanced level of standard. Advanced level of standard could be achieved by investing in cleanliness of toilets, introducing options for disposal of menstrual waste (waste bins with lid), planning the number of toilets according to the number of pupils as well as the construction of toilets according to standards providing access to children with disabilities.

Table 23 Classification of examined school facilities into categories of sanitation service ladder

Category of Sanitation service ladder	Number (%) of school facilities	Reasons for not meeting the conditions for the Basic service level	Reasons for not meeting the conditions for the Advanced service level	
Advanced level of standard	1 (0.4%)			
Basic level of standard	**202 (84.9%)**		Toilets are not clean	8 (3.4%)
			Toilets are not accessible to children with disabilities	237 (99.6%)
			Inadequate number of toilets (>25 boys / girls per toilet)	26 (10.9%)
			No menstrual waste disposal options	183 (76.9%)
Limited level of standard	28 (11.8%)	Toilets are not sex-separated		
No service	7 (2.9%)	Dry toilet (outhouse)		

Graph 70 shows distribution of schools according to hygiene service ladder, while Table 24 explains the reasons for the classification of certain school facilities into the proposed ladder category.



Graph 70 Distribution of schools according to service ladder for hygiene

According to the research methodology, the basic level of the hygiene service ladder fulfil majority of examined schools, although, unfortunately, 16 school facilities do not meet criteria of the basic level, either because they did not have water or soap during monitoring.

On the other hand, only two schools meet very demanding criteria for the advanced level of standard. Advanced level of standard could be achieved by investing in education of girl pupils on menstrual hygiene and construction of hand-washing appliances that provide access to children with disabilities.

Table 24 Classification of examined school facilities into categories of hygiene service ladder

Category of Hygiene service ladder	Number (%) of school facilities	Reasons for not meeting the conditions for the Basic service level	Reasons for not meeting the conditions for the Advanced service level	
Advanced level of standard	2 (0.8%)			
Basic level of standard	**220 (92.4%)**		Hand-washing facilities are not accessible to children with disabilities	231 (97.1%)
			There is no education on menstrual hygiene	118 (49.6%)
Limited level of standard	14 (5.9%)	There is no soap for hand-washing		
No service	2 (0.8%)	There was no water during monitoring		

4.6. Technical and technological deficiencies of water supply and sanitary and hygienic installations and facilities

For a comprehensive assessment of technical and technological deficiencies of water supply and sanitary and hygienic installations and facilities, i.e. for the assessment of necessary interventions for the improvement of the situation, data obtained from the following sources were used:

- Questionnaire for technical and technological assessment of the condition of water supply installations and facilities as well as sanitation in rural schools of Šumadija and Pomoravlje Districts;
- Sections of the General Questionnaire for schools concerning water supply and sanitation;
- Questionnaire for sanitary inspection of the water supply sources (for all schools that are not connected to city/town water supply systems).

Identified, quantified and analysed deficiencies are divided for practical reasons in three groups:

1. Installations and construction and technical characteristics of hand-washing facilities and school toilets
2. School water supply facilities
3. The necessity for the construction of new sanitation facilities

4.6.1. Installations and construction and technical characteristics of hand-washing facilities and school toilets

In accordance with the World Health Organisation (WHO) methodology for collecting data during research in schools, the Questionnaire for technical and technological assessment of the condition of water supply installations and facilities in rural schools of Šumadija and Pomoravlje Districts, developed for the needs of this Study, includes two sections:

A. Hand-washing facilities (with additional questions on wells, if the school is supplied from own water supply facility – well), and
B. Toilets.

On the basis of this Questionnaire, exceptionally detailed data can be provided enabling at the same time insight into all deficiencies in the school water supply and sanitary facilities.

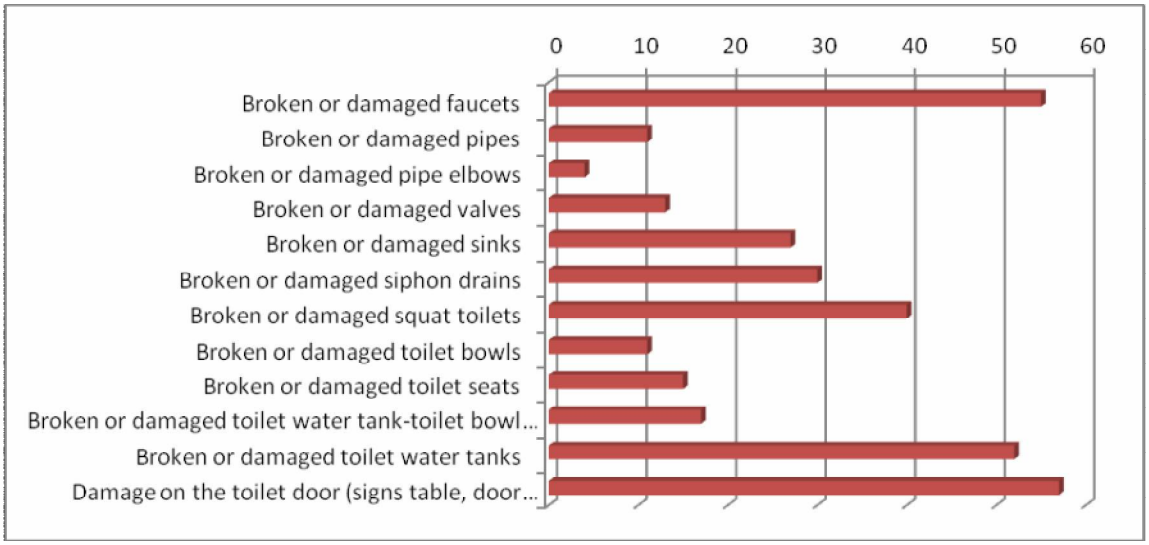
Although the Questionnaire deals in detail with hand-washing facilities and toilets, majority of examined and quantified elements is identical/common for both types of premises (water supply elements, characteristics of walls, ceilings and floors...), thus they are presented here together.

Bearing in mind that 65% (155) of examined rural schools of Šumadija and Pomoravlje Districts are older than 50 years, and that 75 (32%) schools did not report any installation defects nor damage nor construction and technical damage in the hand-washing facilities and toilets, this fact could be considered to be exceptionally positive, which leads to the conclusion that the school property is managed and taken care of in a responsible manner.

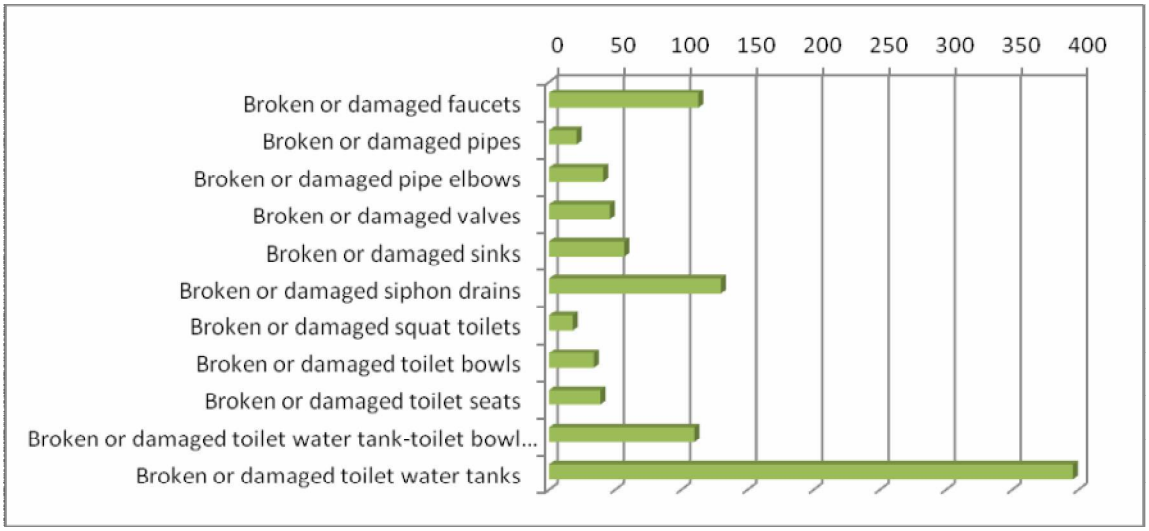
The most common defects and damage as regards installations in the hand-washing facilities and toilets are shown in the table and graphs below.

Table 25 Types of defects and damage of installations in hand-washing facilities and toilets, by number of defects and damage and by number of schools in which the mentioned defects/damage were recorded

Type of defect/damage	Number of defects/damage in all examined schools	Number of schools in which the mentioned defects/damage were recorded
Broken or damaged faucets	113	55
Broken or damaged pipes	-	11
Broken or damaged pipe elbows	21	4
Broken or damaged valves	41	13
Broken or damaged sinks	46	27
Broken or damaged siphon drains	57	30
Broken or damaged squat toilets	130	40
Broken or damaged toilet bowls	18	11
Broken or damaged toilet seats	34	15
Broken or damaged toilet water tank-toilet bowl pipes	39	17
Broken or damaged toilet water tanks	110	52
Damage on the toilet door (table, door frames, handles, hinges)	396	57



Graph 71 Types of defects and damage of installations in hand-washing facilities and toilets, by number of schools in which the mentioned defects/damage were recorded



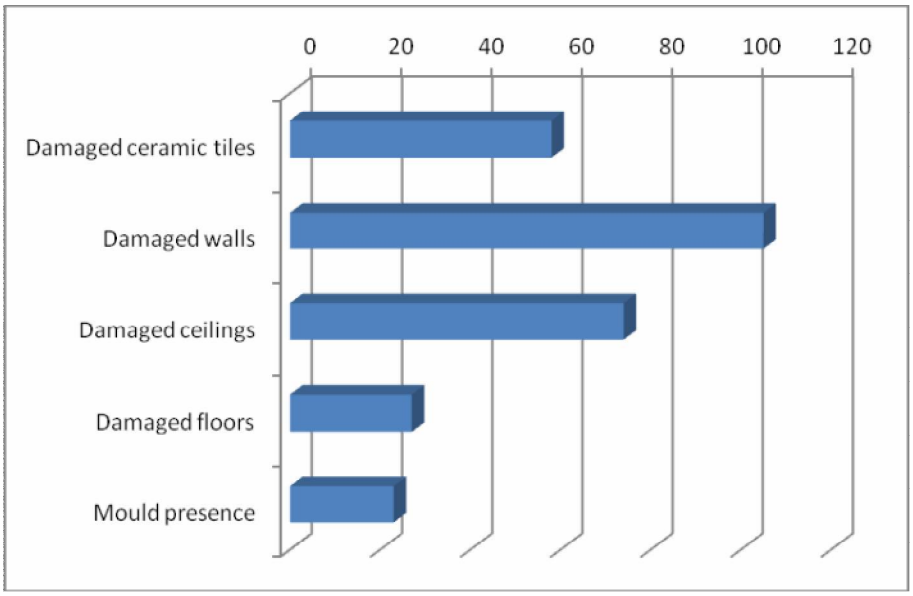
Graph 72 Types of defects and damage of installations in hand-washing facilities and toilets, by number of defects and damage in all examined schools

Both previous graphs show that as most common types of damage and defects (both as regards the number of schools where they appear and the number of the very damage and defects, although in somewhat different ratios in these two graphs) in hand-washing facilities and toilets, 4 elements appear: doors, faucets, toilet water tanks and squat toilets.

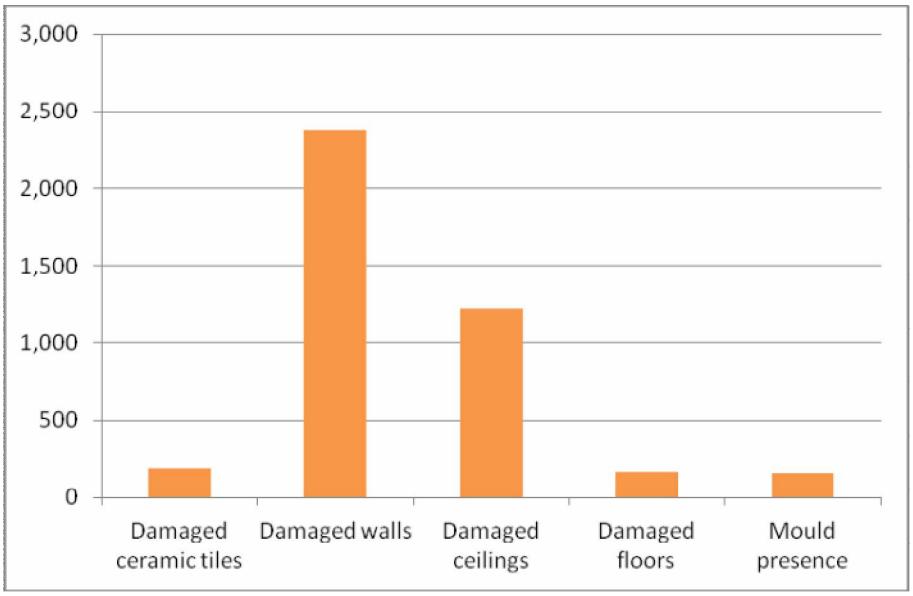
Construction and technical damage in hand-washing facilities and toilets is shown in the table and graphs below.

Table 26 Construction and technical damage in the hand-washing facilities and toilets, as regards damaged surface areas and number of schools in which the mentioned defects/damage were recorded

Type of damage	Total damaged surface area in all schools	Number of schools in which mentioned damage was recorded
Damaged ceramic tiles	189.3 m^2	58
Damaged walls	2381.5 m^2	105
Damaged ceilings	1224 m^2	74
Damaged floors	163.2 m^2	27
Mould presence	159 m^2	23



Graph 73 Construction and technical damage in the hand-washing facilities and toilets, as regards number of schools in which the mentioned defects/damage were recorded



Graph 74 Construction and technical damage in the hand-washing facilities and toilets, as regards damaged surface areas in all examined schools

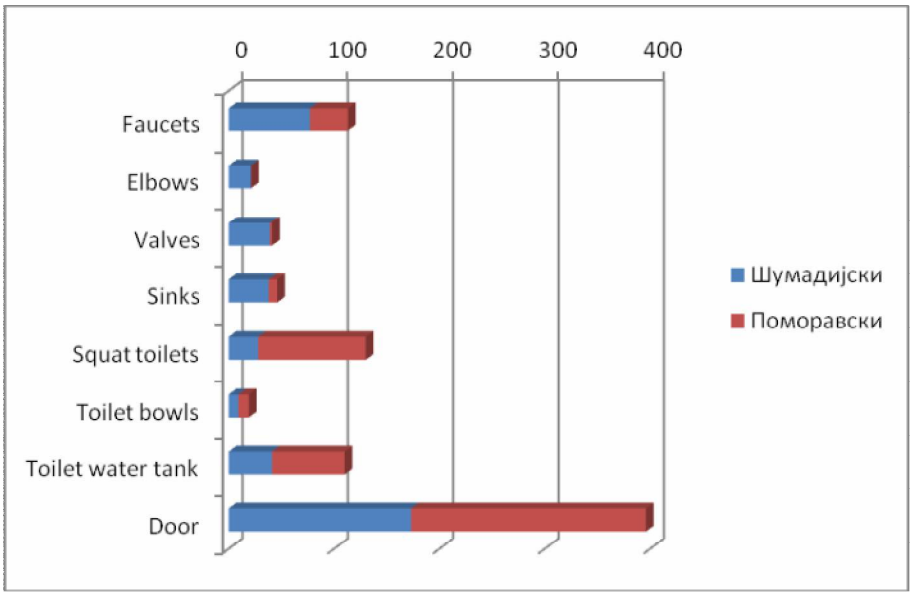
The following two tables and two graphs show types of defects and damage in hand-washing facilities and toilets, according to number of defects and damage and damaged surface areas, by districts.

Table 27 Type of defects and damage of installations in hand-washing facilities and toilets, by number of defects/damage, by districts

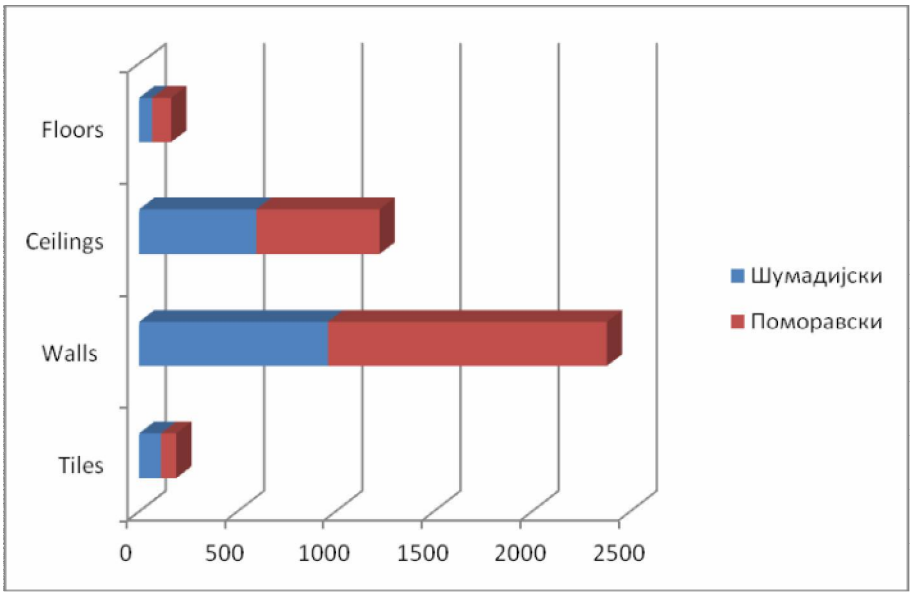
Type of defects and damage	Šumadija	Pomoravlje	TOTAL
Faucets	77	36	113
Elbows	21	0	21
Valves	39	2	41
Sinks	38	8	46
Squat toilets	28	102	130
Toilet bowls	10	8	18
Toilet water tanks	41	69	110
Doors	173	223	396

Table 28 Type of construction and technical damage in hand-washing facilities and toilets, regarding the total surface damaged, by districts

Tape of construction and technical damage	Šumadija	Pomoravlje	TOTAL
Tiles	111.5m^2	77.8 m^2	189.3 m^2
Walls	961.3 m^2	1420.2 m^2	2381.5 m^2
Ceilings	596.5 m^2	627.5 m^2	1224 m^2
Floors	66.3 m^2	96.9 m^2	163.2 m^2



Graph 75 Distribution of types of defects and installation damage in hand-washing facilities and toilets, by districts

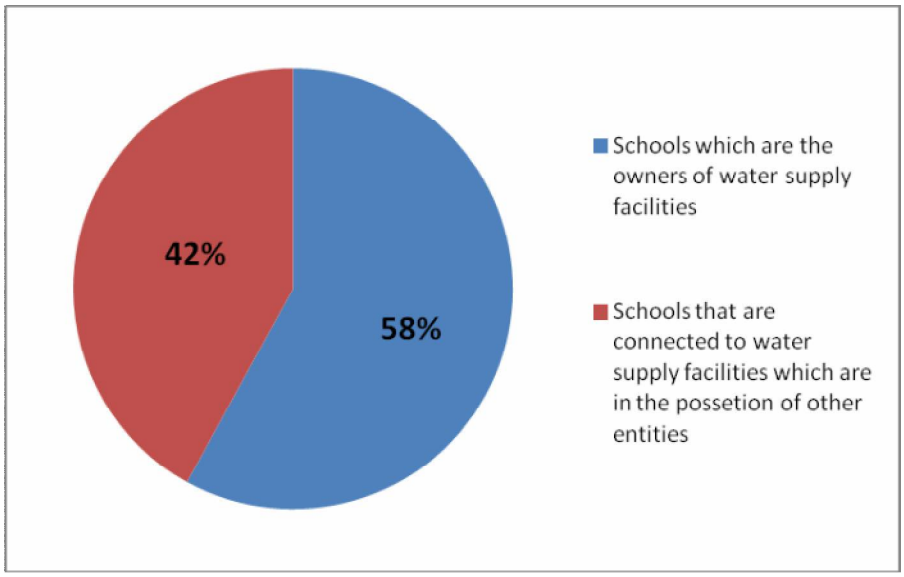


Graph 76 Distribution of types of defects and installation damage in hand-washing facilities and toilets, regarding the total surface ~~areas~~, by the districts

4.6.2. School water supply facilities

As shown in Graph 18, out of 238 examined schools (108 in Šumadija and 130 in Pomoravlje District), 84 (35.3%) are connected to urban water supply systems (27 in Šumadija and 57 in Pomoravlje District). These schools cannot be subject-matter of the assessment of technical and technological deficiencies in water supply. Bearing this in mind, for the purposes of this Study, data of the remaining 154 schools (64.7%), with different types of water supply (81 in Šumadija and 73 in Pomoravlje District) were processed.

Among the schools that are not connected to a urban water supply system, water supply facilities are in the possession of 89 schools (57.8%), irrespective if small water supply systems (SMSS) or individual water supply facilities (IWSF) are in question. The remaining 65 schools (42.2%) are connected to water supply facilities which are the property of other entities (citizen associations, local communities, church or individuals). Ownership structure of water supply facilities to which examined schools are connected is shown in Graph 19 and Graph 77.



Graph 77 The ratio of schools that are not connected to the urban water supply system and which are the owners of water supply facilities – to schools that are connected to water supply facilities which are in the possession of other entities

These data are of utmost importance in the context of proposal of measures, i.e. determining priorities for eliminating technical and technological deficiencies in water supply of the examined schools.

It was assumed that all owners of water supply facilities will be very supportive in terms of providing safe drinking water in rural schools, and cooperative in the possible implementation of the proposed measures. Furthermore, the potential investors/donors that would invest funds for the improvement of the water supply in rural schools in Šumadija and Pomoravlje, should know that they would indirectly help with their investment to raise the standard of living of a wider rural population, and not only the standard of pupils in the respective schools.

Within the consideration of technical and technological deficiencies when water supply facilities in rural schools are in question, two aspects of utmost importance are emphasised, i.e. two fields for which it was assessed that must be prioritised. The resolution of problems in these fields would bring to considerable improvement of water supply in schools, which are subject-matter of this Study.

These fields are as follows:

- Water disinfection with chlorine
- School water supply sources and distribution network elements.

4.6.2.1. Water disinfection with chlorine

Disinfection with chlorine preparations is of utmost importance in providing safety of drinking water. The presence of residual chlorine in water guarantees its bacteriological safety. Bacteriological safety of drinking water in schools is still more important than the physical and chemical one, far more than it is usually the case. Pupils spend in school only several hours a day and the risk of possible drinking of physically and chemically unsafe water is far smaller than the risk of drinking bacteriologically unsafe water, since drinking such water could have acute health effects.

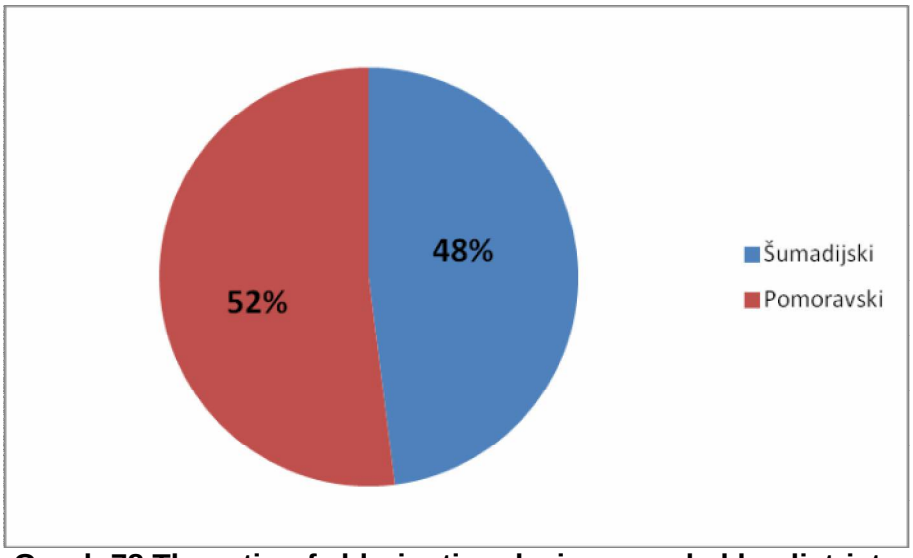
Among different methods of water disinfection, disinfection with chlorine (chlorine preparations) still does not have a right alternative in public water supply, since only chlorine provides residual effect.

As already emphasised several times, out of 238 examined schools in Šumadija and Pomoravlje District, 84 schools are connected to urban water supply systems with strict control and regular chlorination. Bearing in mind such manner or water treatment and preparation in urban water supply systems, on which schools cannot exert any influence, sanitary control was implemented in the water supply facilities of the remaining 154 schools, which are not connected to the urban water supply system, but supply water to school in another manner (rural small-scale water supply systems, individual water supply facilities...).

Out of 154 examined schools, impossibility of water chlorination was established in 117 schools (76%), and providing drinking water chlorination devices for these schools should most certainly be one of the main priorities, in order to provide safe drinking water.

Table 29 Number of water chlorination devices needed by districts

District	Number of water chlorination devices needed
Šumadija	56
Pomoravlje	61
Total	**117**



Graph 78 The ratio of chlorination devices needed by districts

Among the mentioned 117 schools, many of them are not the owners of small water supply systems (SWSSs) or individual water supply facilities (IWSFs), for the school water supply. It is assumed that local communities, citizen associations or other owners of water supply facilities, from which schools are supplied, are vitally interested in providing safe drinking water in schools; thus, the mentioned need to provide the water chlorination devices is not expressed only for the water supply facilities in school property, but also SWSSs and IWSFs from which schools are supplied with water.

One of the obstacles for the successful fulfilment of this goal is also a very poor perspective to employ qualified persons in charge of management and maintenance of the water chlorination devices.

4.6.2.2. School water supply sources and distribution network elements to which schools are connected

Regardless of the fact whether small water supply systems (SWSSs) or individual water supply facilities (IWSFs) are in question, and whether they are the property of schools or other entities (local communities, citizen associations, church, individuals...), sanitary inspection was implemented over all water sources and all distribution systems-networks from which schools are supplied with water. Control (inspection of water supply facilities) was performed with the help of purposeful Questionnaires for different types of water supply sources.

4.6.2.2.1. School water supply sources

The choice of water supply sources is frequently conditioned with factors which could be influenced by various reasons (hydrogeological, geological and geochemical characteristics of the region), but also financial parameters.

Graph 21 shows representation of certain types of water supply sources: SWSSs and IWSFs. It could be seen in the graph that the most common water supply source, both when SWSSs and IWSFs are in question, are dug wells with pump/hydrophore. When SWSSs are in question, from which schools are supplied with water, SWSSs were recorded in 34 cases, while IWSFs were reported in 51 cases. It means that 85 schools (55.2%) are supplied with water from such type of well. At the time when majority of the respective water supply facilities were built (average age of well is 44 years, while the oldest one was dug in 1923), such type of well was considered to be a pretty good solution. The levels of pollution and general degradation of the layer of soil on the surface (i.e. the first aqueous layer/aquifer, from which water is most frequently drawn through dug wells) were far lower in the past.

The age of these wells represents a risk for drinking water safety on its own, since the interior of dug well wall surfaces, that are several decades old, cannot be considered reliable, in terms of their permeability for possible contaminants.

On the other hand, the construction of deep, drilled wells (boreholes), which draw water from deeper aquifers, required then, and today, ever bigger investments, which has never been an easy thing to do in a rural environment. This explains the fact that boreholes with electric pump, as the safest type of water supply sources, are found only in the third place (14.9%) and appear in 23 cases – 19 in SWSSs and 4 in IWSFs, from which water is supplied for schools. The possibility of construction of an ever greater number of boreholes, as replacement for other types of water supply sources of rural schools in Šumadija and Pomoravlje, is not subject-matter of this study and requires an individual approach to each concrete case. This means that it is necessary, for this purpose, to conduct numerous other research studies (geophysical, hydrogeological, demographic...), as well as to consider the possibility and perform financial analysis of the possible connection to some urban water supply system, if there is such a water supply system at an acceptable distance.

Other type of water source as regards representation among the examined SWSSs and IWSFs, from which schools are supplied with water, is protected spring (25.4%). This type of water supply is present in 39 cases (34 in SWSSs and 5 in IWSFs). This type of water source also bears certain sanitary risks, since in a great number of cases, water which does not come from the protected, deep aquifers is in question; most frequently, karst and crack aquifers are in question, on which atmospheric precipitation has a great influence (occasional turbidity followed by increasing bacterial contamination).

The fourth type of water source among the examined SWSSs and IWSFs are dug wells with well sweep/windlass and partial cover, and they are found in only 7 cases/schools (4.5%) – 3 in SWSSs and 4 in IWSFs. They bear identical risks as dug wells with pump/hydrophore.

When we speak about the material which water supply facilities are constructed of (water sources/wells), dominate as follows; stone, concrete, then PVC and very seldom bricks or metal, which is seen in Graph 22. This is in accordance with the representation of certain types of water sources: dug wells with hydrophore or windlass, as dominant type of water source, were most frequently constructed/built of stone, protected source tanks were almost always concrete, while PVC is a dominant material when casing and tubing strings of drilled wells/boreholes are in question, which are found in a third place among water sources. Bricks are material from which certain wells are built, and, finally, older drilled well casings were as a rule made of metal.

Such ratio of construction materials is not bad at all; bearing in mind that stone is the least permeable/porous material for building dug wells, while PVC is the best and most manageable material for casing and tubing strings of boreholes.

It should be noted that a certain technical and technological risk is lack of qualified persons/staff for managing and maintaining water supply sources of SWSSs and IWSFs, from which rural schools are supplied (Graph 20). This problem is really difficult to solve, since it is almost impossible for schools, citizen associations and local communities to employ qualified persons for such a job. Qualified staff is particularly important for the management and maintenance of water chlorination devices.

On the basis of sanitary inspection implemented over all types of water sources of small water supply systems and individual water supply facilities, shown in Tables 10 to 13, the main technical and technological deficiencies of/risks, in terms of (non)fulfilment of sanitary and technical and hygienic requirements on water sources of small water supply systems and individual water supply facilities, from which rural schools in Šumadija and Pomoravlje are supplied with water, were identified, such as:

- non-existing or damaged fence around the well/water source;
- damaged concrete floor-ring with sloping around the well;
- damaged or non-existing drainage channel from the well concrete floor and around the well and catchment of a spring, for atmospheric water and spilled water;
- damaged catchment facilities (collection or spring box) on protected springs and damaged tanks/reservoires;
- repair or placing protector caps/lids on boreholes;
- building/reconstruction of the interior walls of dug wells (making a cement-concrete layer) where walls of the well are permeable up to the depth of 3 meters.

4.6.2.2.2. Distribution networks (distribution network elements) to which schools are connected

Some of the characteristics of distribution networks of water supply facilities to which rural schools of Šumadija and Pomoravlje District are connected, are shown in Table 9 and Graphs 23 and 24.

When SWSSs are in question, the ratio of distribution networks with or without tanks is equable, with little advantage of networks without tank (54% : 46%), while when IWSFs are in question, only one distribution network with tank (out of 63) was recorded, which is logical and something expected, bearing in mind the individual water supply criterion, which means maximum 20 inhabitants/consumers or 5 households, which means that the tank when IWSFs are in question is most frequently unnecessary.

When material of which distribution networks, to which rural schools of Šumadija and Pomoravlje are connected, are in question, the most common material dominating over galvanised pipes, is PVC – it is used twice as much (94 : 45). This is a good example, because it testifies to the fact that in spite of average network age of approximately 42 years, they still belong to modern type of distribution networks, or the pipes have been successively replaced to a notably large extent over time.

When the distribution networks of SWSSs and IWSFs, to which rural schools are connected, are in question, similarly as with water supply sources, there is a certain technical and technological risk due to lack of qualified persons/staff for their maintenance (Graph 20). This problem is extremely difficult to solve, since it is almost impossible for schools, citizen associations and local communities to employ qualified persons for such jobs. Qualified staff is of utmost importance when management and maintenance of water chlorination devices is in question.

Although sanitary inspection was implemented over all distribution networks, bearing in mind the complexity of ownership relationships as regards SWSSs and IWSFs, from which schools are supplied with water (Tables 14 and 15), as well as feasibility and rationality of performance of the possible hydro-construction interventions (e.g. replacement of the distribution system – pipes or increasing the depth when laying all network pipes in order to increase safety of the pipes when breaking is in question), an expert position has been taken that priority measures for eliminating deficiencies with the aim of preserving drinking water safety would be as follows:

- placing a fence around the tank/reservoire where there is no fence or it is damaged, and
- repair of the damaged reservoires or reservoires with water leaks/runoff.

The identified risks by certain types of water supply sources and distribution networks of SWSSs and IWSFs, from which rural schools in Šumadija and Pomoravlje are supplied with water, are shown in Table 30. Table 31 are risks identified by types of risk with a total number of risks.

Table 30a Recorded risks / deficiencies according to type of school water supply sources

Water source type	Dominant risks/deficiencies, by types of water sources	No.
Protected (catchment) source		
	1. Is the collection or spring box absent or damaged?	3
	5. Does the fence exist or is it damaged?	18
Drilled well with electric pump		
	6. Are the animals allowed access in the circle of 50 meters from the borehole?	7
	10. Is the lid/cap of the well damaged or is ther eany other possibility of penetration of the water directly into the borehole?	3
Dug well with windlass		
	5. Is drainage channel missing, faulty/damaged,/broken, unclean, permitting ponding?	5
	6. Is the above-ground part missing or is it damaged?	3
	8. Is there a crack on the concrete floor, penetration of water into the well, or the concrete floor is less than 1 m wide around the well?	3
	9. Is the wall of the well permeable (inadequately sealed) at any pointup to the depth of 3 meters?	4

Table 30b Recorded risks / deficiencies according to type of school water supply sources – continued from Table 30a

Water source type	Dominant risks/deficiencies, by types of water sources	No.
Dug well with pump/hydrophore		
	5. Is drainage channel missing, faulty/damaged,/broken, unclean, permitting ponding?	66
	6. Is the above-ground part missing or is it damaged?	17
	7. Is there a crack on the concrete floorwhich could permit water to enter the well, or the concrete floor is less than 1 m wide around the well?	28
	8. Is the wall of the well permeable (inadequately sealed) at any point up to the depth of 3 meters?	35
Tank and distribution network		
	1. There is no sanitary protection zone around the tank (there is no fence around the reservoir and the area around the reservoir is unsanitary)?	17
	3. The reservoir chamber is visibly damaged or it leaks	4
TOTAL		209

Table 31 Recorded risks/deficiencies on water sources of school water supply by types of risks

Type of risk	Risk	No.
The collection or spring box is absent or damaged	1	3
There is no fence or it is damaged	5-1	18
There are no drainage channels, they are damaged or unclean	5-6 5-7	71
Animals are allowed access within 50 meters	6-2	7
Above-ground part of the well is missing or is damaged, penetration of water into the well	6-6 6-7	20
Concrete floor around the well is narrower than 1 meter	7	28
Cracks on the concrete floor, penetration of water into the well	8-6	3
Walls of the well are water-permeable up to the depth of 3 meters	8-7 9-6	39
Damaged lid/protector cap of the well	10	3
There is no sanitary protection zone around the tank	1	17
TOTAL		

In this case, just as in the case of procuring the water chlorination device, it is assumed that the owners of SWSSs and IWSFs, from which schools are supplied with water, understand the common interest for investments in providing water sources and their protection against possible endangering of safety of drinking water that is available to children in schools, and that they would not, in any way “obstruct“ the activities for the improvement of the existing situation.

4.6.3. The needs for the construction of new sanitation facilities

Beside identified deficiencies (defects and damage) in installations of the existing sanitary blocks in schools as well as their construction and technical deficiencies/damage, in a certain number of schools there is a necessity for the construction of entirely new sanitation facilities. This relates to the construction of new toilets and septic tanks as the only proper and safe manner of drainage/removing sewage.

4.6.3.1. Construction of new toilets

When sanitary blocks are in question, out of 238 examined schools, in 18 schools (7.6%) there are no toilets in the school building (16 in Šumadija and 2 in Pomoravlje District). However, there are three schools, where, beside toilets in the building, a toilet outside the building was reported as well (1 in Šumadija and 2 in Pomoravlje District). According to an expert assessment, it is necessary to build for these three schools additional, advanced sanitary capacities in order to fulfil the needs regarding a sufficient number of toilets, according to the advanced standard. Such approach implies construction of additional toilets in 21 school facilities, and not only 18 schools.

Taking into consideration the age and size of school buildings (out of 21 mentioned schools, 19 are older than 50 years, while two are between the age of 31 and 50 years), as well as the limited possibility of redistribution of the available space, i.e. the possibility of expanding the present toilets at the expense of classrooms or some other space, the assessment is that it is most rational and justifiable to construct container type toilet modules.

The module includes sex-separated cabins, with antechamber equiped with hand-washing appliances and necessary installations, including heating. The planned modules would be located on the school property, if available, next to the school building, with applied all advanced sanitation principles (easy maintenance and effective cleaning and disinfection, and lighting and ventilation according to standards, etc.).

As regards the accompanying capacities of the current toilets found outside the school buildings (reported number of compartments for boys or girls only and common cabins, which are available for use or are currently not available for use), the calculation is that it is necessary to construct 31 such container toilet modules.

4.6.3.2. Construction of new septic tanks

Out of examined 238 school facilities, 190 (79.8%) dispose of sewage water in a hygienic manner – 18 is connected to sewerage (7.5%) and 172 have septic tanks (72.3%).

The number of schools that have no connection to the sewerage network, nor do they have septic tanks as the method of disposal of sewage water, totals 41 (17.2%) – 38 in Šumadija and 3 in Pomoravlje District. For 7 schools, during interviewing, it was not possible to determine the method of removing sewage water.

From the sanitary and hygienic and environment aspect, in these cases, only the construction of septic tanks is justifiable.

Septic tanks must be constructed in accordance with applicable sanitary and technical standards and principles:

- they must be of impermeable material (concrete, lined on the inside with cement layer or coated with epoxy resin, or a ready-made, prefab, portable polymer septic tank, including at least two sludge holding chambers);
- they must have cleaning eyes as well as cleaning and emptying openings;
- it is desirable that they have more than one chamber in order to make the sewage content decomposing process as complete and reliable as possible;
- it is necessary to ensure that they are emptied on a regular basis.

4.7. Investment estimation with cost-effectiveness analysis

On the basis of data obtained though the Questionnaire for technical and technological assessment of the condition of installations and water supply and sanitation facilities in schools, exact estimation of financial and material investments necessary for the repair, construction of advancement of sanitary premises, hand-washing facilities and water supply facilities in rural schools, for each facility separately, was made. The investment estimation was additionally performed also by schools and districts.

The Questionnaire for technical and technological assessment of the condition of installations and water supply and sanitation facilities in rural schools in Šumadija and Pomoravlje District was filled in by **238** schools.

The following three aspects were considered:

1. Installations and construction and technical characteristics of hand-washing facilities and school toilets
2. School water supply facilities
3. The necessity for the construction of new sanitation facilities.

4.7.1. Installations

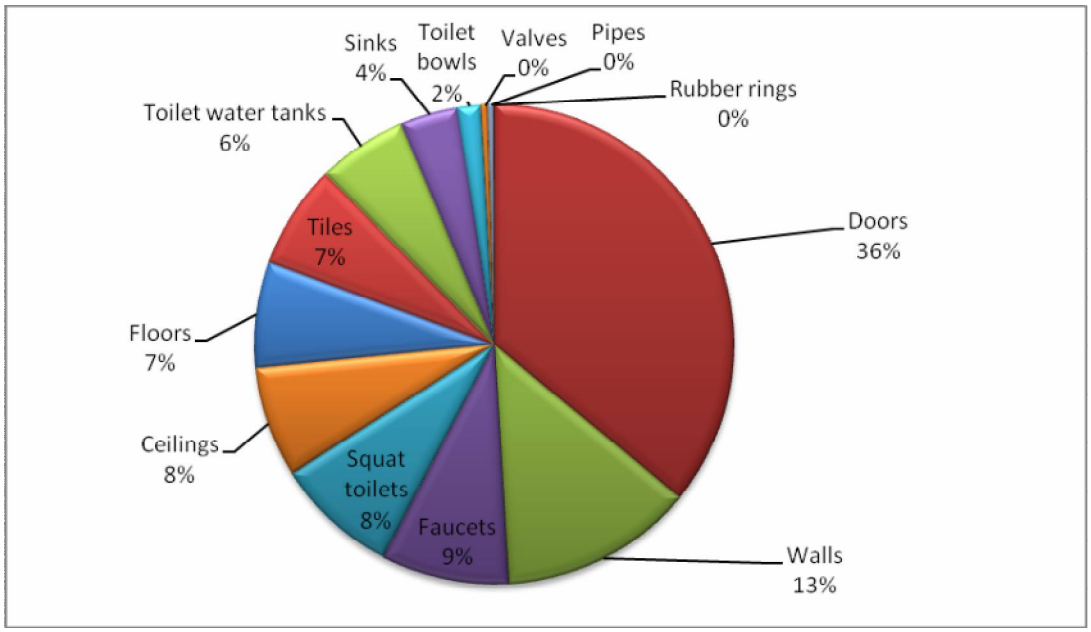
The Questionnaire for technical and technological assessment of the condition of hand-washing facilities and toilets was applied.

Funds necessary for proper functioning of installations through repair or replacement, are estimated in the amount of **RSD 6.8 million.**

For the analysis of damage and defects, elements were classified in 14 groups. Table 32 shows the allocation of costs of their replacement or repair by districts, while Graph 79 shows the share of certain groups of elements in total costs.

Table 32 Cost of repair or replacement of installations and necessary construction and technical interventions in hand-washing facilities and toilets

	Šumadija	Pomoravlje	*TOTAL RSD*
Faucets	396,550.00	185,400.00	581,950.00
Rubber rings	3,360.00	0.00	3,360.00
Pipes	26,655.00	0.00	26,655.00
Elbows	1,761.00	0.00	1,764.00
Valves	28,655.00	1,430.00	30,085.00
Sinks	167,720.00	96,220.00	263,940.00
Tiles	278,745.00	194,375.00	473,125.00
Walls	357,571.50	527,608.50	884,705.50
Ceilings	247,487.50	260,892.50	508,846.50
Floors	197,430.00	288,750.00	486,180.00
Squat toilets	120,960.00	440,640.00	561,600.00
Toilet bowls	47,445.00	58,995.00	106,440.00
Water toilet tanks	152,930.00	257,370.00	410,300.00
Doors	1,062,480.00	1,377,050.00	2,439,530.00
TOTAL	**3,089,750.00**	**3,688,731.00**	***6,778,481.00***

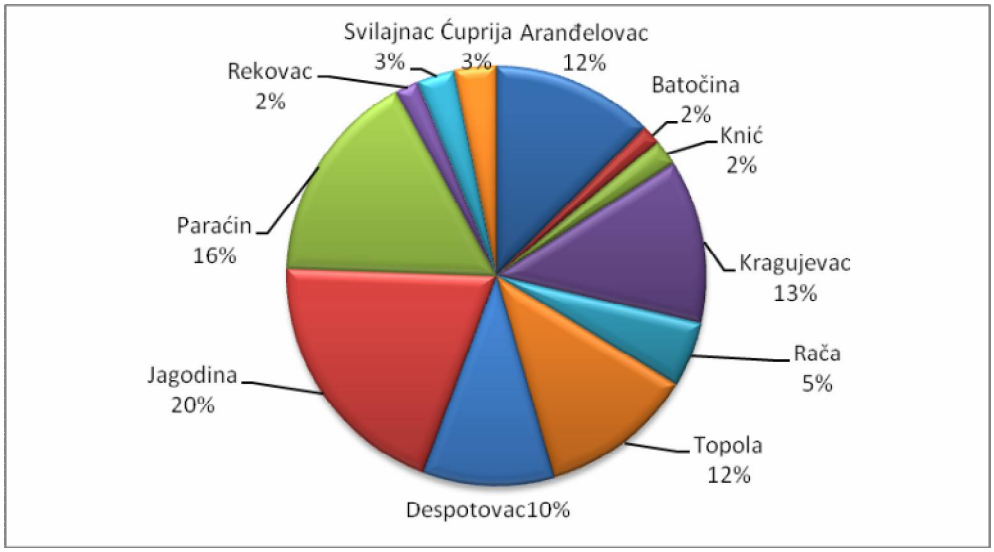


Graph 79 Distribution of costs for reparation or replacement of particular elements of technical and technological assessment

Table 33 shows the allocation of necessary funds by municipalities included in the analysis, while Graph 80 shows percentage in total assessed costs.

Table 33 Allocation of necessary funds by municipalities

Municipality	RSD
Arandjelovac	846,308.50
Batočina	102,224.00
Knić	136,364.50
Kragujevac	856,771.00
Rača	340,527.00
Topola	807,555.00
Despotovac	686,407.00
Jagodina	1,344,759.50
Paraćin	1,117,635.00
Rekovac	123,175.50
Svilajnac	195,525.00
Ćuprija	221,229.00
Total	**6,778,481.00**



Graph 80 Distribution of estimated costs, by municipalities

4.7.2. School water supply facilities

For the analysis, documents *Base_Schools* and *Base_Water Supply Facilities*, as well as the Questionnaire, on the basis of which these Bases were made, were used.

4.7.2.1. Chlorination

The question on water chlorination is included in the Questionnaires for the water supply network inspection (with or without tank/reservoire – M1 and RM1).

By implementing the selection procedure, number of schools in which water chlorination devices should be procured, totalling **117**, was obtained**.**

Therefore, there are **117** schools that are not connected to city/town water supply systems, but are connected to different other water supply sources (both of the SWSS and IWSF type), and in which water disinfection procedure with chlorine is not implemented.

Out of this number, 64 schools are in Šumadija and 59 schools in Pomoravlje District.

Total for chlorinators 117 x 145,000.00 **= RSD 16,965,000.00,** which is shown in Table 34.

Table 34 Allocation of costs for the procurement and installing of chlorinators, by districts

District	RSD
Šumadija	8,120,000.00
Pomoravlje	8,845,000.00
Total	**16,965,000.00**

4.7.2.2. School water supply sources and distribution network elements

Total for water sources: **RSD 15,313,540**

Table 35 Allocation of the cost of water source remediation

District	RSD
Šumadija	8,946,540
Pomoravlje	6,367,000
Total	**15,313,540**

Table 36 Assessed remediation costs (risks) on water supply source facilities

Risks	Questionnaire	Risk	Number	Price RSD	Total RSD
~~There c~~Collection or spring box is absent or damaged	I 1	1	3	30,000	90,000
There is no fence or it is damaged	I 1	5	18	215,000	3,870,000
There are no drainage channels, they are damaged or unclean	I 1 I 2 I 6 I 6 I 7	9 5 4 5 5	102	30,000	3,060,000
Animals are allowed access within 50 meters	I 2	6	7	215,000	1,505,000
Above-ground part of the well is missing or is damaged, penetration of water into the well	I 6 I 7	6 6	20	46,350	927,000
Concrete floor around the well is narrower than 1 meter	I 7	7	27	10,000	270,000
Cracks on the concrete floor, penetration of water into the well	I 6	8	3	13,000	39,000
Walls of the well are permeable up to the depth of 3 meters	I 7	8	34	46,350	1,575,900
Damaged lid/cap of the well	I 2	10	3	15,000	45,000
Sanitary protection zone around the tank does not exist	RM1	1	17	215,000	3,655,000
Tank chamber is damaged or leaks	RM1	3	4	50,000	200,000
Water is not available in the school building			2	38,320	76,640
TOTAL					***15,313,540***

4.7.3. The needs for the construction of new sanitation facilities

For the analysis *Base_Schools* and Questionnaire, on the basis of which the Base was filled in, were used.

4.7.3.1. Construction of new toilets

Schools with toilets outside the school building were sorted out; there are 21 such schools. It is necessary to provide toilets with 31 toilet cabins for girls and 31 toilet cabins for boys.

Container type toilet module with two cabins (for men and women) and pre-space with sink, and necessary installations and heating, is envisaged. The price is RSD 225,000.00.

If it is necessary to provide access to pupils using wheelchair and a specially adjusted cabin, the price shall be increased by approx. 30% and would be RSD 300,000.00.

31 x 225.000,00 = **RSD 6,975,000.00**

Table 37 Allocation of costs for the construction of a toilet with flushing in schools where there is no toilet in the school building, by districts

District	Number of modules	RSD
Šumadija	13	2,925,000
Pomoravlje	18	4,050,000
Total	**31**	**6,975,000**

4.7.3.2. Construction of new septic tanks

Schools that use permeable holes for the disposal of waste/sewage, i.e. they do not have adequate disposal (septic tank or impermeable toilet hole) were selected. There are 41 such schools.

The prices for the construction of a septic tank for rural school needs are determined according to the assessed volume.

It is necessary to construct **41 septic tanks** (capacity for 3-175 users).

Total for septic tanks **RSD 5,308,061**

Table 38 Allocation of costs for the construction of septic tanks in schools that do not have an adequate solution for the disposal of wastewaters, by districts

District	Number of units	RSD
Šumadija	38	5,040,161
Pomoravlje	3	267,900
Total	**41**	**5,308,061**

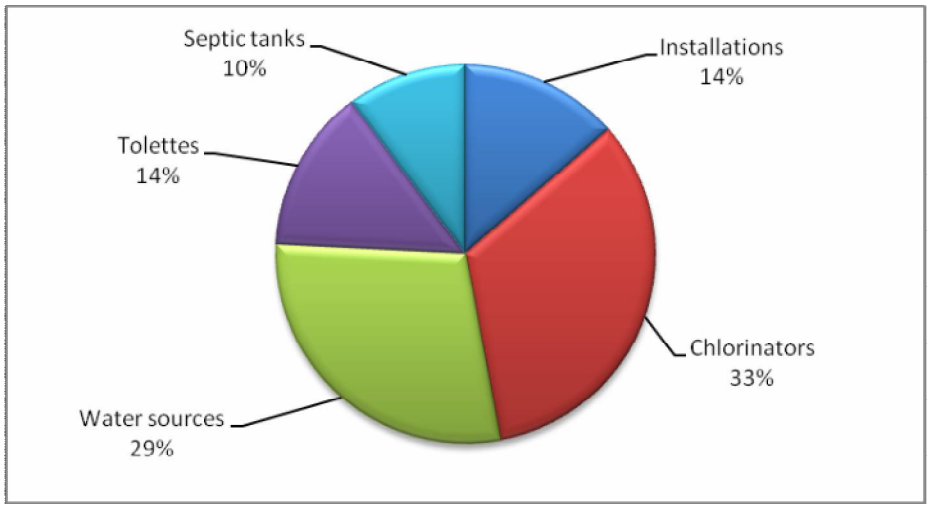
4.7.4. Recapitulation summary

On the basis of the described procedure in the analysis of data from the Questionnaire for technical and technological assessment of the condition of water supply and sanitation installations and facilities in schools, an estimation was made of investment funds necessary for the repair, construction or advancement of sanitary premises, hand-washing facilities and water supply facilities in rural schools, as well as the method of waste disposal.

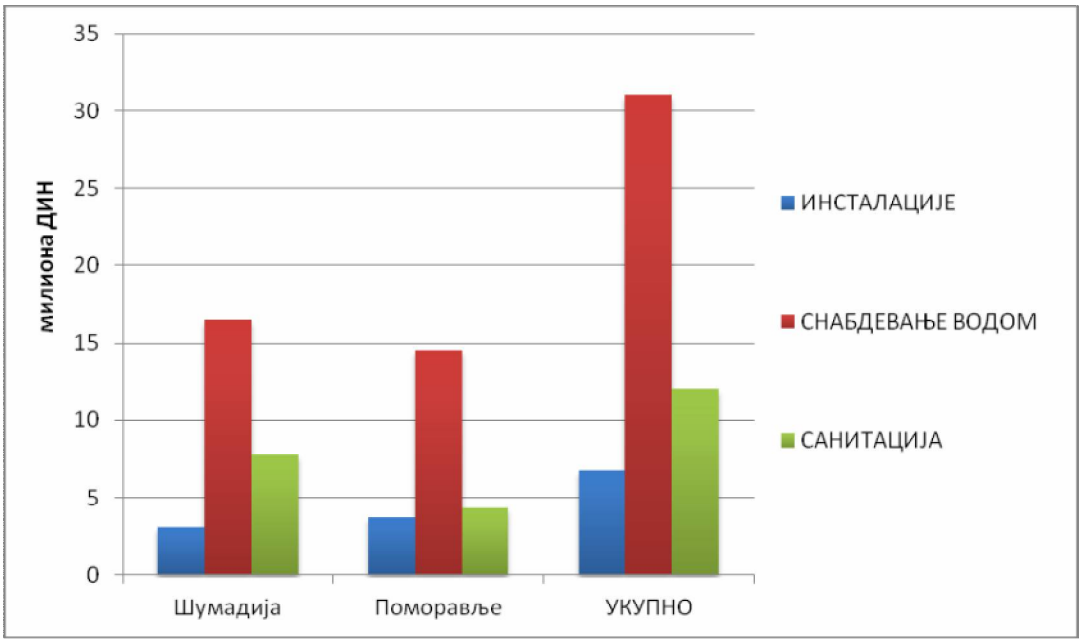
Total amount of necessary investment is expressed in Table 39, while Graphs 81 and 82 show percentage of costs by certain elements, i.e. groups of elements of technical and technological assessment.

Table 39 Total investments needs, by districts, and total

District: / Deficiencies:	Šumadija RSD	Pomoravlje RSD	TOTAL RSD
INSTALLATIONS	**3,089,750**	**3,688,731**	***6,778,481***
Chlorinators	8,120,000	8,555,000	*16,675,000*
Water sources	8,348,950	5,999,700	*14,348,650*
WATER SUPPLY	**16,468,950**	**14,554,700**	***31,023,650***
Toilets	2,925,000	4,050,000	*6,975,000*
Septic tanks	4,829,250	267,900	*5,097,150*
SANITATION	**7,754,250**	**4,317,900**	***12,072,150***
TOTAL	***27,312,950***	***22,561,331***	***49,874,281***



Graph 81 Distribution of costs, by elements of technical and technological assessment



Graph 82 Distribution of costs, by groups of elements of technical and technological assessment

Note: Integral part of this Study is Exhibit with tables containing results of analyses, in which all detailed data on the envisaged activities for the repair, construction and advancement of water supply and sanitation facilities by types of works, and schools, municipalities, districts, are seen.

4.7.5. Cost-effectiveness analysis

The assessed funds necessary for the repair, construction or advancement of sanitary premises, hand-washing facilities and water supply facilities in rural schools, are considerable. The complexity and prices of works range from the most simple ones (and most cost-effective), such as the replacement of rubber rings and faucets, to very complex and expensive construction works, such as the construction of septic tanks, toilets or wells.

Proposal of measures for eliminating deficiencies and improving the As-Is situation in schools will enable considerable enhancement of access to safe drinking water and sanitation for the children attending primary schools in rural regions of Šumadija and Pomoravlje, thus improving health and wellbeing of pupils and preventing health disorders in children and adolescents, which could be caused by inadequate access to drinking water and poor sanitation in schools.

Cost-effectiveness of the fulfilment of the set goals cannot be assessed by classic techno-economic methods.

Nevertheless, for necessary interventions within this Project, the Law on Planning and Construction of the Republic of Serbia shall be applied, since it defines the procedures for the development of the feasibility study and the previous feasibility study (25-31).

5. Comparison with the situation in other countries

Similar researches in examining the WASH situation in schools, as well as habits, knowledge and opinion on personal hygiene and satisfaction with school toilets, were conducted in schools in Romania, Lithuania, Moldova, Croatia, however, it is not entirely possible to compare the results of this research with the mentioned researches due to the following differences:

- Schools covered with research – Research implemented in Serbia included only rural schools in 2 regions, while researches in other countries included mainly urban schools, and some research studies covered the territory of the whole country. Furthermore, studies differ as regards the coverage of pupil age groups, which can most certainly imply huge differences in opinions, knowledge and habits as regards hygiene.
- The scope of research when consideration and assessment of WASH are in question – This Study deals with the assessment of sanitary risks of water supply sources in cases when schools are connected to a small water supply system (rural water supply system or individual water supply source); also, a combined analysis was implemented using risk matrices on the water source and distribution network as well as assessment according to service ladders.

Research in Croatia showed that majority of schools is connected to urban water supply systems (79.4%), while in our Study there are only 38% of schools that are supplied with water from city/town water supply systems. The schools that are not connected to city/town water supply systems are supplied with drinking water from local/rural water supply systems and school wells in both countries. This could be explained by differences regarding the coverage of schools in both researches. Research in Serbia includes only rural schools, while the Croatian research includes to a great extent urban schools.

In majority of schools, according to both researches, regular control of drinking water safety is performed, although 20% of examined school are still not under regular control in Šumadija and Pomoravlje, i.e. 12% according to data of the Study conducted in Croatia. However, there are great differences identified when safety of drinking water in these two researches is in question. Namely, in 96.4% water samples, there have been no irregularities over the past 12 months in the Croatian Study, while in this Study, total number of poor quality of analysed water samples was 34%. In our Study, the analysis of the safety of drinking water was implemented on the basis of one-time sampling and testing, while in the Croatian Study the assessment was performed on the basis of data from previous 12 months. Furthermore, differences regarding the school coverage should be taken into consideration, which was mentioned before. The most common cause of poor quality in the Croatian Study were chemical parameters, while in our Study, microbiological contamination and presence of bacteria *E.coli* was a dominant problem (32). It is mainly the consequence of absence or irregular chlorination of drinking water in rural schools in Šumadija and Pomoravlje and poor sanitary condition, as well.

In Serbian Study, pupils are more satisfied with school toilets, their cleanliness, availability of soap and toilet paper than in the studies conducted in Croatia, Lithuania, Moldova and Romania (32, 33). The identified differences can be explained by the school size and coverage, i.e. in rural schools where our research was conducted, schools are attended by a very small number of pupils (approx. 46 per school). In such conditions it is usually easier to provide sufficient quantities of consumables in toilets and hand-washing facilities and control the behaviour of pupils than in schools with greater number of pupils. Furthermore, our research mostly included schools for pupils from grades 1-4 in primary schools (between ages 7 and 11). Generally, more positive answers were given by pupils

who attend rural schools, as opposed to the ones in urban schools which are usually attended by more pupils (32)

6. Possibility of repeating the Study throughout Serbia

The Study methodology is comprehensive as regards WASH and as such applicable to all schools in all rural environments. Adequacy and easy applicability of all created Questionnaires for monitoring water supply and sanitation facilities in schools were confirmed during the project field stage. Therefore, we believe that the Project could be repeated on the basis of the created methodology in other rural and urban schools throughout the Republic of Serbia.

7. Project added value

The Project added value will be as follows:

- Results of this Study will be presented and disseminated at national and international gatherings/conferences promoting good cooperation between the sectors of education, environmental protection and health.
- Within the Project, a Manual for school staff under the title "WASH in Schools: Importance and Proposals for Improvement", was made with the goal to improve the knowledge of the employees in educational institutions, pupils and parents on the importance of water quality for life and health, as well as skills of managing access to safe drinking water and adequate sanitary and hygienic conditions at school. The Manual was presented in four workshops: "Access to Safe Drinking Water and Sanitary and Hygienic Conditions at School" (two in each district) with the participation of about hundred school staff from primary schools in Šumadija and Pomoravlje. The Manual points to the importance of access to safe drinking water and adequate sanitary and hygienic conditions, solution of wastewater disposal and preservation of environment. It also provides a series of practical examples and proposals for active inclusion of all relevant stakeholders in the local communities – employees in educational institutions, pupils, parents and local self-government units in resolving the identified difficulties and establishing an adequate system, through the current legislative framework and curricula.
- Close and good cross-sector cooperation between all relevant institutions at the local and national levels has been achieved.
- The methodology of monitoring WASH in schools, developed by this Project, has served for the improvement of the methodology and expert-methodological guidelines for regular monitoring implemented by the network of Public Health Institutes and aligning with SDG indicators for WASH in schools.
- Developed methodology could be repeated and applied for the assessment of the WASH situation in other parts of Serbia as well.
- Schools in Serbia have been classified for the first time according to the SDG indicators and service ladders, which point to the level of standard of WASH that schools have to provide to their pupils.

8. Conclusions

This Study represents a unique project in the territory of the Republic of Serbia, systematically approaching the water supply and sanitation issues in rural schools, with the aim of improving health and wellbeing of pupils as well as preventing health disorders in children and adolescents that could occur in relation to inadequate access to drinking water and unhygienic sanitation in schools.

On the basis of insight into the As-Is situation and performed expert assessment of WASH and technical and technological deficiencies in water supply and sanitary and hygienic installations and facilities in rural schools in Šumadija and Pomoravlje District, the following conclusions can be made:

8.1. Conclusions regarding the assessed WASH situation

- One third (35%) of examined schools are supplied with water from urban water supply systems, while 65% of schools are supplied with water from rural water supply systems and individual water supply facilities.
- In almost all schools (99%), drinking water was available during research.
- In almost all schools, drinking water, toilets and hand-washing facilities were accessible to the youngest pupils as well, although they were in a high percentage inaccessible to children with disabilities.
- All schools have toilets and hand-washing facilities.
- Toilets are separated by gender in the majority of schools (80%), while separate toilets for teachers are found in 62% of school facilities.
- Through monitoring sanitary blocks it was established that hand-washing facilities and toilet compartments are clean, but that there is not enough hygiene consumables (toilet paper, soap, toilet towels), nor appliances for menstrual hygiene management (bins with lid).
- Education on maintaining personal hygiene and hand-washing is included in school programme in almost all schools (95%), although programmes on menstrual hygiene education are implemented in only 50% of schools.
- One third of analysed samples from rural water supply systems and individual water supply facilities for school water supply showed microbiological faecal contamination with bacteria *Escherichia coli*.
- Half of analysed samples from rural water supply systems and individual water supply facilities for school water supply showed physical and chemical non-compliance with the Rulebook with higher concentration of nitrates as the most common cause.

- Overall non-compliance of drinking water from rural water supply systems and individual water supply facilities for school water supply amounted to 66% of tested water samples.
- Combined analysis of water quality and identified sanitary risks showed as follows: 29.8% of all types of water sources of rural water supply systems and individual water supply facilities for school water supply, and 21.5% of all types of distribution networks, require high and very high priority improvement measures.
- According to service ladders that show the level of WASH standard that schools must provide to their pupils, 235 (99%) of schools met the criteria of the basic level of drinking water service, 203 (85%) of schools met the criteria of the basic sanitation level, whereas 222 (93%) of schools met the criteria of the basic hygiene level.

8.2. Conclusions regarding the assessment of technical and technological deficiencies and investment needs

- Installations and construction elements in hand-washing facilities and toilets of rural schools included in the Study are maintained relatively well and managed in a responsible manner. Additional financial investments would enable an advanced standard in this field.
- Complex situation as regards the ownership structure and variety of water supply facilities to which the respective rural schools are connected make difficult the full application of adequate measures with the aim of providing continuous safety of drinking water. In given circumstances, it is necessary to carefully and properly set investment priorities, in order to achieve the desirable results in an increasingly rational manner.
- Water chlorination available in schools is one of the key issues whose resolution would considerably improve the safety of water and overall situation related to water supply of the respective rural schools.
- Main technical and technological deficiencies/risks at water sources of water supply facilities and distribution networks, to which schools are connected, in terms of (non) fulfilment of sanitary and technical and hygienic requirements, are as follows:

- there is no fence around well/water source or the fence is damaged;
- damaged concrete floor-ring with sloping around the well;
- damaged or absence of drainage channels from the well concrete floor and around the well and catchment of a spring, for atmospheric water and spilled water;
- damaged collection or spring boxes on protected/ springs and damaged tanks;
-damaged or inadequate protector caps/lids on drilled wells used as water sources of water supply;
- permeable walls of dug wells up to the depth of 3 meters.
- The most critical points in the school sanitation field and certain priorities for the construction of new facilities of this type have been identified.

8.3. Conclusions regarding opinions and habits of school pupils

- Majority of school pupils are satisfied with school toilets and hand-washing facilities at school.
- Pupils assess that school toilets are always available and that they can use them without any disturbance from the others; that the toilets are clean, although half of pupils report that there are unpleasant odours and not enough toilet paper.
- Majority of pupils state that they wash hands while at school and that they use soap for hand-washing.
- Only one third of pupils mention that they drink tap water at school, while the others state that they bring water from home, buy water or drink water from the appliance.
- More than half of pupils drink water in a hygienically acceptable manner from glass or bottle, while every fifth pupil drinks water in a hygienically unacceptable manner from cupped hand or touching the tap with mouth.
- Pupils of higher grades (Grade 5 - 8) generally have a more negative opinion on the hygiene of toilets, hand-washing facilities at school, they have worse habits related to drinking water, washing hands and maintaining personal hygiene, and state more rarely that they are educated in school on maintaining personal hygiene and good hygiene habits, compared to pupils of lower grades (Grade 1 - 4).

9. Recommendations and measures for improvement

Recommendations for the improvement of WASH situation for decision makers at national and local levels have been defined on the basis of research results and relate to the following:

- Legislative framework,
- Technical advancements for the improvement of the current water supply and sanitary installations and appliances, and
- Educational programmes and training for all participants at the local community level (pupils, teachers, parents, representatives of local self-government units and all other relevant stakeholders) on the specific and certain topics related to WASH in schools.

9.1. Legislative framework

- Adopting a Law on Water Intended for Human Consumption with provisions that would regulate the water supply field in school facilities.
- Adopting a Rulebook on safety of drinking water harmonised with the EU Directive (98/83/EC).
- Strengthening monitoring over the application of positive legal regulations in the utility services and sanitation fields.
- Stricter monitoring of sanitary and hygienic conditions in school facilities in rural environments.
- Defining legislative framework for the introduction of Water Safety Plan in managing water supply facilities, with particular reference to water supply facilities from which schools are supplied with drinking water. Promoting their application through trainings and using the current materials for the introduction of the Water Safety Plan into the small water supply systems, individual water supply facilities and other water supply facilities from which schools are supplied with drinking water.
- Developing action plans in local self-government units for the improvement of the situation regarding water supply and sanitation in rural schools, by applying the results of this Study.

9.2. Technical solutions for the improved access of children to WASH

On the basis of research results related to access of children to water supply and sanitation, one of the major reasons for concern and issues is accessibility for children with disabilities. Even if their representation is only 0.17% in the examined children population, access to drinking water and sanitary appliances should be guaranteed and provided. This is the reason why it is necessary to develop designs for the adaptation of sanitary appliances taking into consideration the needs of children with disabilities.

When developing designs, it is necessary to take into consideration the following categories of persons/children with disabilities:

- Low vision children need special bathroom hand grips, steering systems and proper lighting,
- Children using wheelchair or crutches need facilities that would contain ramps, wider doors, additional space in toilets for wheelchair and other aids as well as special hand grips or dismantling mechanisms,
- Children without limbs or children with paralysis need the lids, switches and faucets to be light and easily activated with one arm or leg. When planning adaptation and reconstruction, it is necessary to use certain standards, such as, e.g. United Nations Development Program – Water, briefly described as follows:

- Drinking water fountains: if fountains are used as appliances for access to drinking water, on the way to them there should be no slippery surfaces and there should be equipment that prevents water stagnation. The most suitable is an L-shaped faucet that enables two different heights for intake of drinking water and minimum free space of 40/45 cm in order to provide access to children in wheelchair. The way to the faucet/fountain should be easily accessible and without physical barriers.
- Toilets: it is necessary to provide enough manoeuvring space for wheelchairs during the use of toilet.

On the basis of conclusions deriving from the performed expert assessment of technical and technological deficiencies in water supply and sanitary and hygienic installations and facilities in rural schools of Šumadija and Pomoravlje District, the following recommendations and measures for the improvement of the situation could be adopted:

- It is necessary to provide certain funds for repair and replacement of destroyed, damaged and overage installations as well repair of construction and technical elements in hand-washing facilities and toilets in rural schools included in the Study, in order to achieve the advanced level of standard in this field.
- It is necessary to provide continuous disinfection through chlorination of water available in schools. Thus, status of drinking water quality and safety, as well as overall situation and safety of water supply in schools, would be considerably improved.
- It is necessary to undertake measures and activities for the elimination of identified technical and technological deficiencies/risks on water sources of water supply facilities and distribution measures, to which schools are connected, in order to raise the sanitary protection of water sources and other water supply facilities of rural schools in Šumadija and Pomoravlje to the necessary level. These measures and activities are as follows:

- erecting protection fences and repairing them if damaged or if parts of fence are missing;
- repair, expanding the size or construction of concrete floors-rings with sloping around wells, where damaged, insufficiently wide or missing;
- repair or construction of drainage channels from the concrete floor around the well and catchment of a spring, for atmospheric water or spilled water, where damaged or are missing;
- repair of collection or pring boxes on protected springs, as well as repair of damaged tanks/reservoires of the distribution network;
- repair or placing protector caps/lids on drilled wells where damaged or are missing;
- building or reconstruction of the interior walls of dug wells (making a cement-concrete layer) where walls of the well are permeable up to the depth of 3 meters.

- The advanced level of standard could be achieved by providing quality drinking water, investing into cleanliness of toilets, work on education of children on hygiene, and especially menstrual hygiene, as well as constructing drinking water facilities, toilets and hand-washing facilities according to standards which enable their accessibility to children with disabilities.

9.3. Educational programmes and trainings for all participants at the local level

Educational programmes and campaigns for raising awareness on the importance of safe drinking water and adequate sanitary and hygienic conditions in educational institutions on the basis of WASH Manual: "WASH in Schools: Importance and Proposals for Improvement", created within this Project, shall be implemented.

The content of the Manual has been thought out in such a manner so as to contribute to the fulfilment of the set goals. The Manual is intended primarily for the staff employed in educational institutions, principals, expert associates and teachers.

It is necessary to include in the process of monitoring and control of access to safe drinking water and adequate and possible water channelling also other employees in the institutions in accordance with their competences and tasks and taking into consideration their work obligations.

Furthermore, bearing in mind the fact that access to drinking water is within the competence of the local self-government units, it is expected of schools to influence sensibility of parents and local self-government units and their engagement for the resolution of difficulties or eliminating irregularities in the water supply and channelling processes.

- Within the regular educational process and the existing curricula, there is a possibility to include in lot of subjects at school topics relevant in the fields of health care, environmental protection, sustainable development as well as issues concerning access to drinking water, need for quality drinking water and channelling.
- It is recommended to include these topics into certain subjects at school (e.g. the world around us, science & social studies, biology, chemistry, physics, civics) in primary school – examples for classroom activities.
- Furthermore, it is recommended that school curricula include contents on menstrual cycle and good hygiene habits during the cycle and personal hygiene, which would improve the knowledge of girl pupils on the subject, protect their reproductive health and improve hygiene habits.
- Safe drinking water means more than just good results of water analysis and availability of tap water through water supply systems. This is the reason why it is necessary to apply a comprehensive approach to providing safe drinking water, shifting the focus from risk detection to risk prevention and control process (making Water Safety Plan in managing water supply facilities from which schools are supplied with drinking water),
- From the aspect of providing safe drinking water in rural schools with own water supply, it is of utmost importance to properly maintain the water source from which the water is supplied. This means the implementation of a series of measures with the aim of prevention of pollution of water from the water source to tap.

10. Literature

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11. Annex

1. General School Questionnaire (interview with school staff) and monitoring
2. Questionnaire for technical and technological assessment of the condition of water supply and sanitation installations and facilities in rural schools of Šumadija and Pomoravlje District
3. Pupil Questionnaire
4. Sanitary inspection form