Enabling Water and Sanitation Safety Planning in Rural Communities

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Abstract
Many households and schools in the rural communities in Eastern Europe and the Caucasus often have no access to safe drinking water and hygienic sanitary facilities. Public health, safe water supply and safe sanitation are very much interrelated and their relevance underestimated, particularly in rural communities. Better protection and management of drinking water sources and sanitation facilities are possible, if weaknesses and strengths are identified. For the identification of possible sources of hazards and risks, the knowledge about an adequate quality of water and sanitation, the pathways of contamination and the associated risks, as well as the prevention of risks are essential. A water and sanitation safety plan's methodology (WSSP) has been developed (based on the WHO WSP and SSP approaches) with a focus on rural settings of Eastern Europe and the Caucasus to obtain and maintain safe drinking water and sanitation systems and to minimise related diseases.
As the management of a safe drinking water supply system concerns many stakeholders, the presented compendium aims to enable communities to develop a WSSP for small-scale water supplies and sanitation facilities.
The aim is to raise awareness among the users of small-scale water and sanitation systems on the status of the local facilities, to increase the capacity of the responsible authorities and/or operators as well as the civil society to act within their responsibilities in the field water and sanitation safety. First results show that rural communities are enabled to develop to a large extent autonomously a WSSP for small-scale water supplies, e.g. dug wells, boreholes, springs and piped centralised water supply systems, as well as for sanitary facilities. Schools are mobilised and motivated to include environmental education related to water, sanitation and health in their curriculum.

Keywords
Small-scale systems; water; sanitation; safety planning; rural communities

INTRODUCTION

In Eastern Europe 63% and in the Central Asia 51% of the population has piped water on their premises (UNICEF/WHO 2015). In areas without piped water, pit latrines are common sanitary facilities and in general the pit content is infiltrated uncontrolled in soil and groundwater causing environmental pollution and raising health risks. Sanitary protection zones of the water sources, drinking water quality monitoring, sanitary inspection and maintenance of the systems are frequently inadequate or not in place (WHO 2011a). In many communities a common awareness about the relation between public health, safe water supply and appropriate sanitation is low, and their relevance underestimated. Hence due to anthropogenic factors drinking water is in rural settings often unsafe and this situation can again be improved by local human handling.

Findings of a survey on the status of small-scale water supplies in the WHO European Region, carried out in 2012-2013 within the program for small-scale water supplies and

sanitation under the Protocol on Water and Health, showed that many countries lack information on the water quality served by small-scale water supplies, including supplies serving up to 50 people, non-piped, decentralized and local supplies, public and individual wells and rural utilities. For these groups of small-scale supplies, only 20% (8 out of the 43 countries which returned the questionnaires) provided information about the level of compliance with microbiological and chemical parameter (UNECE/WHO in press). These findings underline the need to support and enable rural communities to monitor their drinking water quality.

The WHO recommends Water Safety Planning as the most effective means of consistently ensuring the safety of drinking water supply and published WSP manuals and guidelines for water supply practitioners, and indicated the approach of WSP can be transferred to sanitation safety planning (SSP) (WHO 2001, 2005, 2011b, WHO/IWA 2010, WHO 2015). On community level, the concerned stakeholders, local authorities, water operators, schools, citizens can play together an important role in improving the management of the local drinking water supplies and sanitation facilities.

WECF and partners recognised the benefits of implementing Water Safety Plans (WSP) in rural communities but also the lack of local knowledge needed for developing a WSP by concerned stakeholders. Even for very small-scale systems a certain basic knowledge of the involved stakeholders is needed for understanding the mechanisms of the water supply, the sanitation system, identification of the existing and potential hazards and related diseases.
In 2009, WECF developed therefore a method, which can be applied in rural areas using the practical manual “Developing Water Safety Plans involving Schools” (WECF 2009). It targets schools and teachers to assess and improve in cooperation with the local authorities and community, the condition of the local dug-wells, boreholes or springs serving as their drinking water sources. The aim was to develop a WSP for their drinking water sources through mobilising the local schools, based on their local conditions. This manual was used successfully in 35 schools in 8 countries in the pan-European Region.
However, based on these experiences, the need of upgrading the methodology was observed: firstly teachers and communities expressed their wish to receive more background information about water related issues. Secondly WECF observed that in several communities the cooperation between schools and operators and/or responsible authorities for public water supplies should be improved. Thirdly the focus was very much on water, neglecting the impact of sanitation. The awareness about the interrelation between health, water quality and sanitation and actions to improve the sanitary conditions in particular in schools was poor.

In 2014, these aspects were addressed in upgrading the method and the Water and Sanitation Safety Planning (WSSP) compendium for rural communities (WECF 2014). The compendium was developed to enable communities to accomplish in a multi stakeholder process step-by-step a WSSP for small-scale water supplies (SSWS), such as dug wells, boreholes, springs and piped centralised water supply systems and for sanitation facilities such as school toilets. Besides targeting water and health issues related to small-scale water supplies (SSWS), special attention was paid to wastewater and sanitation management.
This paper describes the WSSP methodology and highlights some results and outcomes from projects in selected countries: Moldova, Georgia and Macedonia.

MATERIALS AND METHODS

Target group

Rural communities: schools, local water and health authorities, mayor and local deputies.

The communities are selected by the local partner organisation of WECF or a national or regional authority appoints the target communities. In general, the selection criteria are based on observed inadequate environmental conditions of the community and interested stakeholders willing to improve the local conditions. The population of most target communities are not connected to a centralised piped water system or sewerage. Many people are subsistence farmers/gardeners and often not aware of the interconnection of water quality and their handling, neither on possible sources of drinking water pollution.

Water and Sanitation Safety Planning (WSSP) Compendium

The developed WSSP compendium is based on the WHO guidelines on drinking water quality (WHO 2001) and on experiences obtained from the WECF manual "Developing Water Safety Plans, involving schools" (WECF 2009). The WSSP Compendium consists of three parts A, B and C containing 6 or 8 informative working modules each (WECF 2014). It is available in English, Romania, Macedonian and Russian. Most of the modules finish with a list of suggestions for practical WSSP related activities, the expected results or outputs, and a list with references and further readings. The content of the compendium can be flexibly adjusted and developed according to the local situation and possibilities for implementation. The following three parts were developed:

Part A "How to accomplish a water and sanitation safety plan?" explains the approach of developing WSSP and provides basic and practical guidance for developing a WSSP for small-scale systems. This part introduces the practical activities in 10 steps to be carried out by a WSSP team and leading to a local WSSP. Several forms for practical activities, doing risk assessments of the water supply or toilets and interviews of different stakeholders are supplied. Practicing simple water quality tests and processing the collected information are explained and examples are provided (WECF 2014).

Part B "Background information for developing a WSSP" provides technical and regulatory background information, for example on different types of drinking water sources, on water abstraction and protection, water treatment, storage and distribution, water quality and related health or technical risks, water related regulations, on sanitation and wastewater treatment or on management of storm water. The main target groups of part B are persons who appreciate more background information on water and sanitation related issues. These can be local authorities and water operators, but also teachers, NGOs and interested citizens (WECF 2014).

Part C "How to involve schools?" is an additional part, especially for youth and schools. It includes theoretical lessons on general water issues such as the water cycle, and also specific information on school sanitation, water and hygiene. The development of a WSSP is explained especially in terms of involving pupils and citizens. Exercises and suggestions for practical and interactive actions are detailed, and target mainly teachers, NGOs, but also local authorities (WECF 2014).

Steps for developing a WSSP

The WSSP compendium Part A describes a.o. the 10 steps in detail how to run the local activities for teachers, local mayor, water operators, water and health authorities. A summary of the 10 steps is presented:

1. Set up a WSSP working team and identify its responsibilities and tasks
2. Description of the local drinking water system(s) and sanitation facilities. The type of water supply system(s) used; the type and abstraction of the raw water sources; their eventual treatment and storage; the location of the network; and reservoirs, pumps or wells and standpipes; number of connected and unconnected households/inhabitants, regulations and its implementation, etc.

3. Identification of relevant stakeholders for water supply and sanitation systems: who is responsible for what and what is the level of implementation?
4. Obtain or draw a village map, showing the locations of the water catchment, water sources, the direction of the water flow, water networks, water reservoirs, connections with households or public buildings, location of wells, etc.
5. Conducting a risk assessment of the water supply and sanitation system.
   The assessment should ascertain the sources of pollution, the condition of the water supply and the quality of the water provided.
6. Sharing and discussing the gathered and lacking information and mobilising communities - for example by organising exhibitions, meetings, seminars or working groups, and working with the media.
7. Development of an action plan to minimise the risks related to the water supply by consulting and involving the community and relevant stakeholders.
8. Report and share the action planned to improve the water quality with citizens and other stakeholders.
9. Implementation of the action plan. Document in detail the plan's implementation, progress made, failures suffered and any barriers to the planned activities and actions. Keep track of the budget, timetable and people involved
10. Monitoring, improving or adjusting the WSSP activities should be a continuous process.

Implementing a WSSP in rural communities

The implementation of a WSSP aims to follow the above mentioned 10 steps. However its realisation will depend on the available time and the motivation of the key stakeholders. Essential elements of the WSSP are:

Involving different target groups and stakeholders

A team with key persons have to be set up for coordinating, facilitating and implementing the process of a WSSP. By interviewing different target groups perceptions and experiences on the local SSWS and sanitary facilities are collected. For this task, different questionnaires were developed for and are available in the WSSP compendium.

Sanitary inspections

Risks and quality assessments of SSWS and sanitary facilities are conducted, using assessment forms adapted from the WHO (2001) and WHO (2009). The forms for sanitation were developed for this compendium following the same approach of assessing the risk through risk scores.

Drinking water analysis

Monitoring the drinking water quality is one of the essential parts of the WSSP. However, the accessibility of an adequate laboratory is in many rural and remote communities very limited.
Depending on the hydro and geological conditions of the water sources, nitrate, nitrite and micro-biological parameter are often useful and key indicators of the drinking water quality. Whereas nitrate and nitrite have mostly anthropogenic sources and bacteria may appear due to inadequate operation and maintenance of the system and unsafe handling of excreta.
To obtain an impression of the water quality in the target communities, simple chemical water tests such as nitrate / nitrite quick tests (Merckoquant) were introduced, allowing semi quantitative analysis results of the water samples. In addition a longitudinal nitrate monitoring of selected water sources is conducted. Furthermore pupils are asked to observe the turbidity, colour of the water samples. Trained pupils of the target schools are able to carry out under the supervision of a teacher these activities and basic results of the quality of drinking water sources and possible seasonal fluctuations of the quality are obtained.

For identifying one of the most important indicator for infectious and water related diseases, bacteria, a specific training or education and specific conditions for sampling and analysis are required. In remote areas may be adequate bacterial analyses are not feasible while the laboratory is too far located from the target village, or water sources of the community are not included in the administration or competence of the most nearby laboratory. Therefore, in 2015 WECF introduced and used a portable laboratory in some target communities (Republic of Macedonia and Georgia) as an alternative for conducting bacterial analyses.
The portable laboratory (Potatest^{+} from Wagtech) is equipped with tools and consumables for standardised quantitative analyses of thermo-tolerant coliform bacteria and total coliform. In addition in the portable laboratory are enclosed basic physico-chemical analyses such as free and bound chlorine, Ammonia, pH and conductivity.
In those cases where the portable laboratory was handed over to the partner organisation, persons with a degree in chemistry or biology obtained a 4-days training on working with the laboratory and taking drinking water samples according to Bartram and Ballance (1996).

Hygiene trainings
For the schools, the compendium contains in Part A a section on hygiene training. As hand washing is a key for preventing water and sanitation related diseases, practical and interactive activities related to hand washing are proposed in part C of the compendium.

Processing and sharing the gathered information
Collecting information, conducting analyses is one part of the WSSP activities. The following step is reporting and making gathered information and data visible and accessible to other stakeholders and to the public. For these tasks the Compendium provides examples of reporting forms, of visualisation of results and suggest activities for sharing results.

Local WSSP activities
The first step for initiate the WSSP activities is organising a two or three days training for the local project partner and other key stakeholders on accomplishing a WSSP for their local water and sanitation systems. Within the training, activities for developing a WSSP in 10-steps are drafted, water tests and reporting the results are exercised.
The key activities include: identifying and mapping the local water sources; carrying out risks assessment of the facilities, analysing nitrate / nitrite concentrations and turbidity of the local water sources and a 2 or 3 weekly monitoring of nitrate / nitrite of some selected sources and the local weather conditions.
Strongly recommended are microbiological analyses, either by relying on already available analyses results, or contacting an adequate laboratory or a portable laboratory can be taken into consideration.

Furthermore cooperation with local water and health authorities, sharing and discussing the gathered information and findings with all stakeholders is required. Meetings in small groups, public meetings, exhibitions of the project results, working with media or organising regional or national conferences proved to be good instruments for raising awareness on different levels.

RESULTS

Use and acceptance of the WSSP compendium

The target groups welcomed the compendium positively for further usage in communities by water responsible authorities and for educational purposes.

The schools, teachers and pupils appreciate the practical approach of the WSSP, the activities are putting theoretical know how into practice and make the pupils take their own initiative. The national health authorities in the Republic of Macedonia and the school authorities in Timisoara county, Romania, promote the WSSP compendium to be part of the official school curriculum. Other countries such as Georgia or Kyrgyzstan translated selected modules in the local language and were used in small communities.

Involving schools in the WSSP

The big advantage of involving the pupils, is that they are multipliers, can mobilise the communities and initiate change and sustainable development. This works well if secondary pupils are involved. They can become local water experts for the villagers through this programme as they are conducting the interviews with the local population and doing simple water tests with the water samples which the villagers bring to them.

Due to the more practical activities, such as visiting the water sources and taking samples, the pupils are much more motivated than compared to the traditional teaching in classes and this empowers those pupils who learn better through active engagement.

One drawback is that some stakeholders do not take the WSSP serious as soon as they learn that pupils are involved, their perception is then of a purely educational tool.

Drinking water analysis

Use of the nitrate test strips enables schools and communities to get an impression of the anthropogenic contamination of their water sources. By mapping the water sources and the related nitrate contamination the community learns where the “good” water sources are and which sources are contaminated or not suitable for i.e. preparing baby food.

The longitudinal nitrate monitoring gives information about possible seasonal fluctuations of the nitrate concentration in water sources, and which may be related to human activities, precipitation events and the hydro-geological conditions of the target area. After an instruction on do´s and don’ts, nitrate tests strips are also for pupils easy to handle, low cost and the results are very appreciated by the community.

Mapping the nitrate concentration motivate pupils and community to discus and identify the possible causes of found results.

Risk assessments

Using the checklists from the compendium proved to be very useful to assess visually the risks of drinking water sources and quality of the sanitation at schools (and households). The checklists guide the user to identify positive and negative aspects of the facilities and to realise which aspects could be issued for improvements.

Examples of country results and outcomes

Moldova

In 2015 the Republic of Moldova had a population of 3.4 million and 28% of the rural people have piped water on their premises (UNICEF/WHO 2015).

In the frame of a WSSP project in a village that was not connected to a piped water system, pupils found an overall water contamination of the local wells: More than half of the 160 sampled local wells showed nitrate concentrations between 250 and 500 mg/l. The school identified the mismanagement of human excreta and the bad sanitary conditions as a threat for public health. Actions to be undertaken were based on technical solutions, on raising awareness of the local population on the link between health, water quality and wastewater management and advocating for onsite ecological sanitation.

The actions resulted in the construction of a new school toilet (urine diverting dry toilet) and the introduction of greywater treatment systems for the school and households. Also a campaign was started to promote the human rights to safe water and sanitation.
Due to these integrated and beneficial activities the UN-Water "Water for Life" best practice award was dedicated to the Moldavian project partner.[1]

Georgia
Georgia has a population of 4.3 million and 62% of the rural people have piped water on their premises (UNICEF/WHO 2015).
The target municipality where the approach of WSP was introduced, is partly served by centralised piped water from a mountain spring and partly households use individual dug wells. In case of interruptions of the centralised system, neighbouring households use jointly private wells. The village has a low density of inhabitants and no intensive agricultural activities are performed. Project partner and the involved school identified low levels of up to 10 mg/l nitrate in the tested water samples. The condition of the wells was assessed by using the checklist from the WSP manual and by interviewing the owner. Major identified risks of contamination of the well waters were: uncovered wells, cracked walls, missing or cracked apron and inadequate cleaning of the wells.
With the portable laboratory, microbiological tests of samples from 5 individual wells and the centralised system were performed. All the samples exceeded the norm for total coliform bacteria with more than 1000 U/100 ml in the centralised supply. While the tested supplies were not included in the national monitoring program, these results were new and unexpected for the centralised supply operator and users. In cooperation with the operator, a lack of maintenance of the water reservoir was identified as a possible source of the contamination.
These actions resulted in adequate cleaning of the reservoirs of the piped water supply; awareness raising campaign for the local people: how to maintain their wells, how to minimise health risks caused by unsafe water.

Republic of Macedonia
In 2015 the Republic of Macedonia had 2.1 million inhabitants and 83% of the rural population are served by improved piped water on their premises (UNICEF/WHO 2015).
In the project 5 villages from two regions were included. Inhabitants of one village were partly supplied by a centralised water system. Other inhabitants and the other target villages were supplied by individual drilled or dug-wells or by public street taps. The number of the available wells varied in the five villages from 9 up to 420 individual wells; the number of street taps from 3 up to 11.
Under the supervision of the trained teachers pupils monitored during 3 months some selected wells on nitrate, as well as the local weather conditions. Households and water operators were interviewed; wells and the surroundings were observed and assessed. A laboratory expert carried out with the portable laboratory microbiological, analyses of some selected water sources.
During the 15 months lasting project time, the following findings were gathered:

- During three months of nitrate monitoring the nitrate concentrations of dug wells fluctuated in range of 50 o 300 mg/l. See the examples in figure 1.
- Increasednitrate concentrations were observed in particular after heavy rainfalls.
- Wells with a high groundwater table (shallow wells) were more contaminated than wells with a lower groundwater table.
- Nitrate concentrations in well waters fluctuated the most in sandy areas with a high groundwater table and where water protection measures were absent.

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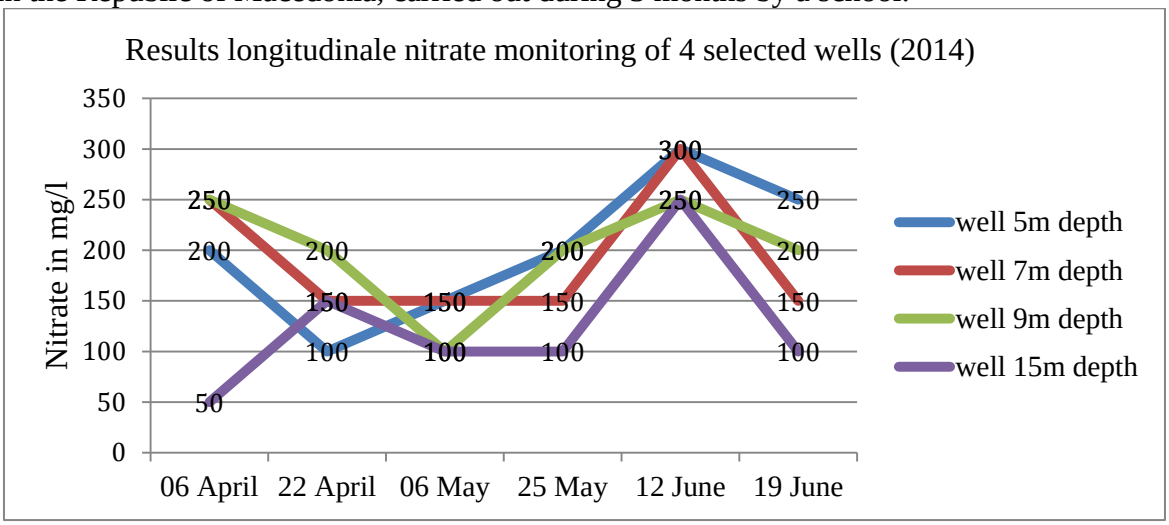
- All 6 tested samples(3 samples of individual wells, one sample of centralised network, 2 samples of public springs) showed too high levels of total coliform bacteria. (10 -35 counted units /100 ml, in comparison with the limit value of 0/100ml); In one sample of a individual well, the units were far over 200/100ml and not countable. In the sample of the centralised water supply nor free neither bound chlorine was detected.
- The condition of the water supply and sanitary facilities is poor in many schools; i.e. the cleanliness is poor, toilet paper and adequate hand-wash facilities are not in place, water supply is interrupted or the water does not fulfil the norms for drinking water quality.

Figure 1. Results of a longitudinal nitrate monitoring of 4 selected wells in one target village in the Republic of Macedonia, carried out during 3 months by a school.



As sources of the observed contamination of the local drinking water were identified:
Lack of adequate management of human and animal excreta: pit latrines, manure heaps and wastewater disposal are often too close to the drinking water sources.
The findings and potential actions for improvements were discussed with the local communities and regional authorities. In order to improve the poor hygienic situation in schools, parents were stimulated to be active in their children´s schools committees.
Advocacy for improvements of the water and sanitation services for schools and an adequate disinfection of the centralised water supply were started.

CONCLUSION

The WSSP compendium is a very useful tool to carry out WSSP in rural settings in Central and Eastern Europe and the Caucasus. It is crucial to combine water and sanitation in one approach for rural settings as they are interrelated and need to be addressed at the same time.
The approach of WSSP is useful to mobilise communities with small-scale facilities, however providing educational and informative materials and trainings to the stakeholders are essential for raising awareness and for increasing knowledge on water and sanitation related issues.
Within the process of developing WSSP schools can play a crucial role for raising awareness and mobilising communities. At the same time, it is essential that local authorities and WO are kept on board and a trustful cooperation between all stakeholders is established.
For rural settings with inadequate management of human and animal excreta and/or with intensive gardening/ agriculture practices the availability of nitrate quick tests can serve as an indicator for anthropogenic pollution and raising awareness of the local people on the effects

of their handling. Testing water sources on nitrate is an excellent instrument for environmental education of pupils and for improving their self-confidence, pupils can become "water experts".
The absence of nitrate gives no guarantee that the drinking water is safe. In remote settings and in cases were an adequate laboratory is absent, a portable laboratory is a good alternative for monitoring drinking water on total coliform and/or thermo-tolerant coliform bacteria.

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