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Developing Water Safety Plans involving schools

Introducing "Water Safety Plans" for small-scale water supply systems
Manual for teachers and pupils

Safe Water and Sanitation

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Photo by Margarita Torres

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Photo by EuroTelecman

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1. Introduction

In many rural areas citizens depend for their drinking water on unprotected water sources and hence depend on unsafe drinking water. The World Health Organisation (WHO) initiated the Water Safety Plans (WSP), which is to be considered as a part of the WHO or other guidelines or directives on drinking water quality. The WSP asks for an identification of risks, which could affect water safety and human health in every stage of the water supply. It is also necessary, however, to identify measures, which minimise and manage the risks have to be identified.

A WSP should be discussed, developed and implemented with involvement of all stakeholders.

The WSP focuses on the safety of all the different aspects of a water supply, which can vary from a large-scale supply providing water to several million consumers to a small-scale system, e.g. a bucket-well. The WSP is a concept to develop a process-orientated observation of the water supply and its goal is to identify and eliminate all the possible risks in the entire water supply system: from the potential risks of water pollution in the catchment area all the way along the line to the consumers. Therefore an understanding of the mechanisms of the system is needed.

As well as the possible risks pertaining to the individual processes involved in the water supply and standard of water quality, the reasons for the potential and real risks have to be identified.

Moreover, all stakeholders of the system and the„is and the should-be" situation has to be defined. In addition, the means and tools on how to monitor the different stations, how to report and share the information and activities for improvement of the supply have to be developed.

In this guideline for development of WSP proposed for schools, we will focus only on small-scale water supplies, such as bore holes, dug-wells and springs. In general at household level the microbiological safety of the domestic water sources is assessed as being critical. For example, water stored in buckets is touched by hands or stored in unclean vessels. This poses a risk to consumer's health. Therefore an inventory and strategy of elimination of risks should also be included in the WSP.

The main goal of this programme is:

- Minimising the health risks caused by unsafe drinking water
- Motivating citizens to take local action for improving their environment and their access to information and to safe drinking water
- Involving pupils and their teachers in monitoring of drinking water in their villages
- Identifying and cooperating with all stakeholders related to the water supply system
- Raising awareness about water quality, the sources of pollution and water protection

2. Why involvement of schools?

Experiences show that children and young people are open to accepting new knowledge and participating in new activities. Children will involve their parents and transfer their knowledge. But for the development of the WSP, the support of the parents, teachers and authorities is also a condition. Cooperation with all stakeholders and sharing information will be learned and will give the children a wider view on their environment and community. A major advantage of the WSP is that children and the other stakeholders are discovering and gathering together information about the environmental situation in their community. This 'learning by doing' has proven a very effective way to internalise knowledge.

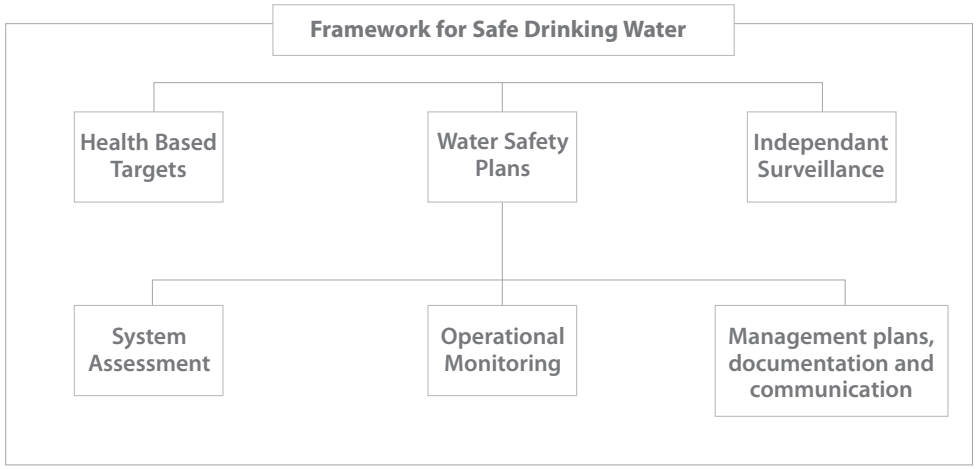
Depending on the age of the children, the available time, the level of involvement of teachers and other stakeholders, the final outcome of the WSP will be more or less detailed, whilst fulfilling certain criteria. Parts of the proposed programme can be selected and even changed and adopted to the local circumstances and implemented by the pupils.

This action plan proposes a programme for children's involvement in the monitoring of the quality of drinking water and the environment in their village. This programme will have several outcomes, such as:

- Understanding of the water supply system, the risks and danger of pollution
- Awareness raising about possible water borne diseases
- Regular monitoring of drinking water quality
- Registration of the seasonal fluctuations of nitrate concentrations in the water
- Assessment and mapping the risks of drinking water pollution
- Environmental awareness raising among children and citizens through active participation
- Cooperation and capacity building of all stakeholders
- Strengthening the demand for active water protection measures on local, regional and national level
- The results of the program can be used for lobbying for the right to information and access to safe drinking water
- The programme will contribute to a better gender balance; besides men, women will be involved in planning and decision making processes

Experiences show that children and young people are open to accepting new knowledge and participating in new activities.

Framework for safe drinking-water (WHO 2004)



3. Development of Water Safety Plans

Identification of the weaknesses and strengths of the water supply and the possible sources and risk of drinking water contamination can be the base for a better groundwater and well protection and improvement of water quality (see annex 1 „Scheme for development of WSP").

The steps for the development of WSP can be:

- Set up a team, discus and decide about the methodology to develop a WSP
- Description of the water supply system: Making a detailed description of the whole system from the water catchment area to the extraction, the transport until water storage at home and consumption by the consumer
- Identifying stakeholders
- Drawing and mapping are good tools to support this activity
- Scheme development
- Discussion and taking decisions on e.g. what and when will be done, who will do it, and how hazards will be monitored and reported
- Hazard assessment: Identification of the main hazards that can affect the safety of the water quality: e.g. water pollution by pit latrines, cracked wells or by dirty hands or buckets
- Practice analyses and interviews
- Identification of local and regional water born disease
- Reporting and sharing information on the findings
- Mass media, exhibitions, meetings/discussions with citizens and authorities
- Development of actions for improvement and maintenance of the system
- Plan for operation, monitoring and maintenance, improvements and follow-ups of the WSP
- Reporting and sharing information on the developed WSP on local, regional and national level
- Reviewing the WSP, the hazards, risks and control mechanisms regularly

4. Organising the programme

For covering the different aspects of the water supply system a team of persons with different backround and expertise will benefit the development of WSP.

A basis of knowledge about the water system from the point where the water is extracted until it is used in the households should be gained by discussions, interviews, observations, and eventually via input from experts. Some existing data about the water supply and quality can be gathered from local and regional authorities. Water analyses can be done partly in the frame of the WSP programme.

Nitrate concentration in water can serve as an indicator of anthropogenic water pollution by mismanagement of wastewater, animal manure or fertiliser. Children can carry out the nitrate analyses of water sources in the village and monitor the seasonal fluctuation of nitrate concentration in water. It gives an impression of the filter capacity of the soil layer and the possible relation to human activities. Further assessment of the occurrence of water born diseases, of the environment and the risks of water pollution will give insight into the level of water safety and the measures to be taken for improving water quality and minimising water related diseases.

Without involving the people Water Safety Plans will not work. Participation is a key to the success of Water Safety Plans

Who is doing what?

1. **Overall coordination and support for development of WSP: Local NGO**
   - *Organising public meetings, contacting schools, experts and authorities:*
   - *Announcement of development of WSP*
   - *Contact and report to experts, stakeholders, media, citizens*

2. **Supporting and coordination of the activities for children, identifying of and cooperation with all stakeholders: School staff and local NGO**
   - *Identification of water supply system*
   - *Risk assessment of the water supply system: Monitoring the state of water supply and environment*
   - *Monitoring Nitrate*
   - *Interviewing the citizens/stakeholders*
   - *Reporting*

3. **Planning of activities for improvements and future monitoring and adjustments of the WSP: Authorities, NGO, school, citizens**

4. **Taking action: All stakeholders**

5. System and Stakeholder analyses

The procedure for carrying out the programme should be discussed in school with children and teachers and it is desirable that parents and local authorities are informed about and involved in the project.

5.1. Responsibilities and management

Investigation of the current situation concerning the responsibilities and management of the water supply system is useful for identification of who is doing what. The involved NGO plays a crucial role in this process by facilitating the gathering of information from the different stakeholders.

Questions like, who have officially the task of monitoring, cleaning and maintaining the water system should be posed. Is there any system or institution analysing the water quality and, if yes, with whom are the results shared?

Is there any budget available for operation and maintenance; is there any contribution from the local citizens for water consumption? Who takes the decision about the budget etc.? Particular attention has to be paid to the role of women, as they are often responsible for the household budget as well as for health and sanitation issues. Local and national joint action can be developed by creating an atmosphere of understanding and cooperation, by knowing the different tasks and responsibilities, and bringing the consumers, water suppliers and all other stakeholders closer together.

Structures of the responsibilities of the whole system can be summarised in an overview of responsibilities or in e.g. a 'network diagram' (see annex 2). Other graphics of listing, ranking and connecting institutions, groups or individuals and communication systems and information sources that influence the community's decision making on water supply can be used.

5.2. Mapping of the village and the water supply

With the help of a map of the village an overview of a specified issue can be given. It helps to make the situation more visible and understandable.

As far as possible pupils, teachers and citizens can make an inventory of the local water supply. What kind of supply is there? Are there dug wells, boreholes or public taps? Which water source is used and how deep is the tapped water layer? Where are the water points? Which distance do they have to the houses of the consumers? Which households have access to the water point or supply? Where are sources of contamination? What is the distance of the pollution (e.g. manure or latrine) from the water point? Many of this information can be transferred to a map. Using an existing map for identification and mapping is very useful. If no map is available an overview of the village and the water points or supply should be drawn up (see annex 3 and 7a).

5.3. Experiences/Problems/perception analyses of supply owner and consumer

The users of the water system often focus on problems or have different perceptions about e.g. water quality or about access to water compared to the water supplier. By using questionnaires or by participatory approaches like ranking, an insight about the problems and experiences of the supplier and user could be obtained. The interviewer should keep in mind that closed questions could easily get unreliable answers. For example the question: 'Do you get ill from the water' might give another answer than 'How do you perceive the drinking water quality? And why? And what are the consequences of drinking this water? What is the daily /monthly water consumption and for which purposes is the water used?' Information can also be gathered by interviews from citizens, doctors or other key-informants (see some examples in annex 4a, b and c).

Note that if you gather information from people, they often want to know the results and the subsequent concrete actions. You can therefore organise a village meeting and inform the people about your findings.

5.4. Inventory of quality

Water can basically be contaminated either chemically (e.g. by heavy metals or pesticides), or biologically by micro organisms/ pathogens (bacteria or viruses which cause diseases).

Unfortunately, it is not easy to measure this kind of pollution. A certified and preferably independent laboratory could be contacted to carry out analyses of bacteria. Also pesticides could be a significant source of water pollution and should be measured in a laboratory. There are many kinds of pesticides and it should be known in advance which pesticides could be found in the drinking water because each pesticide requires a different analysis. However these analyses are quite costly.

For some analyses such as acidity or nitrate in water easy to do quick tests are available (see below)

5.4.1. Observations and secondary data

Nevertheless, it is quite possible to gather some indication about the quality of drinking water without laboratory analyses.

- First of all doctors, teachers and other key-informants in the village can be asked about the occurrence of water-related diseases and a survey can be done among villagers about their perceptions of drinking water quality. The authorities should be asked for the data of water analyses and how the public water supply systems are maintained (see annex 4b, 4c).
- Secondly, the facilitating NGO can search for secondary data such as which research on water quality has been done in the past. Experts can be contacted and interviewed. Probably there is some information available about the geo-hydrological situation (groundwater depth, soil, and direction of the flow). This could be very useful for the planning phase.
- Thirdly, observations can be made concerning the colour, taste, smell, turbidity, sediments etc. Observations can also include potential pollution risks (see below). It always has to be kept in mind that these methods give only an indication. Even if all the results are within the norm, the water can still be highly polluted.

5.4.2. Quick tests

Quick tests can be a good and accurate way of obtaining a better indication of the water quality. They are cheap and easy to carry out. However they are not available for all the different kinds of pollution. Until now WECF has had good experiences with nitrate strips. Nitrate can be dangerous for newborn babies, but for older children and adults nitrate is not the most dangerous substance in drinking water. According to the EU directive for drinking water the limit for nitrate in drinking water is 50 mg/l. The EU considers ground water with nitrate values more than 25 mg/l as influenced by human activities. It therefore indicates if there is some contamination by human sources. Water protection measures should be initiated.

Water samples are quick to analyse on nitrate pollution by using nitrate test stripes (see annex 5). It is preferable to test the water samples in the same season, e.g. during spring or summer time. Pupils can take the sample to school or the tests can be carried out directly on the spot. The depth of the water source should be noted.

Other observations on water quality, like colour, turbidity or others should be reported. Physical parameters such as soluble sediments (turbidity) indicate possible microbiological pollution.

Another easy to analyse parameter is the acidity or pH of water. (see annex 5). The pH is a so-called indicator parameter, which means a too high or too low pH as such will not be harmful for health. Indicator parameters are often fixed for technical or esthetical reasons. The advised pH value in drinking water is 6.5 to 9.5.

However water with a low pH can have corrosive properties for metal tools such as copper or lead water pipes. Too high concentrations of copper or lead in drinking water cause health risks.

5.4.3. Nitrate monitoring of water sources

Monitoring of the water sources can be done in two different ways.

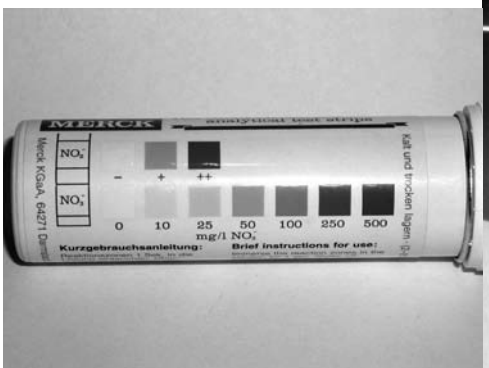
First, a good overview of the existing nitrate concentration of the well water should be obtained. The water sources should be chosen in such a way that they are representative for all water sources. That means sources in different parts of the village, which are potential sources of drinking water for the public must be analysed. It is preferable to test the water samples in the same season, e.g. during spring or summer time. Pupils can take the sample to school or the tests can be carried out directly on the spot. The depth of the water source should be noted. Other observations on water quality, like colour, turbidity or others should be reported. Physical parameters such as soluble sediments (turbidity) indicate possible microbiological pollution.

The locations of the investigated wells and the test results must be noted, and can be transferred to the map (for reporting and mapping see annex 6, 7a and 7b).

Secondly, it can be very informative to monitor nitrate levels in some wells throughout the year. For example a high, low and medium nitrate-polluted well is chosen for the seasonal monitoring. The tests results of a whole year give an overview of the seasonal fluctuation, which might be useful for the WSP. Depending on the soil layers e.g. the leakage of nutrients in the groundwater by precipitation, fertilisation by manure or nitrogen can be assessed clearly using such a monitoring programme. Therefore it is good to measure the precipitation and temperature as well, since these parameters could be related to the nitrate concentration. It must be ensured that everything is registered well to avoid any potential mistakes.

When this is done on a 14-day basis throughout the whole year, you get an interesting and significant picture of the fluctuations of nitrate, temperature and precipitation (see annex 8a and 8b). In order to raise awareness among the villagers, a very good approach, which gets everyone really involved, is to carry out these analyses with the involvement of the children under the teacher's supervision.

Nitrate test strips are cheap and water samples are quick to analyse



The results of the analyses of the drinking water should be carefully documented

5.4.4. Other water quality parameter

As most water borne diseases are caused by microorganisms, this is the most important parameter to identify the safety of drinking water. Water of unprotected and badly maintained sources is easily affected with microorganisms due to the contamination with human and/or animal excreta. One gram of faecal material contains millions of bacteria and viruses!

Water of public wells or central water supplies should be analysed on a regular basis and the results should be made accessible for the public. The frequency of analyses depends on the amount of water supplied to the community. The appearance of microorganisms, such as Escherichia coli (E-coli) or Enterococci should be known; otherwise an authorised laboratory should be requested for analysing the drinking water on microorganisms. Both are indicator bacteria for microbiological pollution: No E-coli or Enterococci at all should be found in 100 ml drinking water.

6. Risk and hazard assessment

For the risk assessment of the danger of well/ground water pollution by e.g. animal manure or wastewater questionnaires and checklists can be used. Also the state of the well or the tap and its surroundings should be investigated. E.g. is there a cover? Is there rain or wastewater flow? Is there an apron around the pump or well etc? After instructions and awareness raising by the teacher, children can make their own observations, such as estimating the distances from manure heaps or pit latrines to the well, population density, or the location of the source of pollution e.g. uphill or downhill, in the north or in the south of the water source. Citizens living near the wells should be interviewed about their practices of fertilising their fields.

Other sources of microbiological pollution such as tools used for extracting the water or for the storage of water in the houses have to be observed and identified. A checklist adapted to the area and circumstances has to be prepared (see examples in annex 9a, 9b and 9c).

Citizens, medical and water administration, doctors are important sources for information and should be interviewed on drinking water quality and related health diseases (see examples in annex 4a, 4b and 4c).

7. What to do with the results?

A part of the WSP is the documentation of the collected information and making the results and plans visible to all stakeholders. All the collected information should be objective and available in reports, and depending on the issue the results can be made visible in graphics or in maps. The facilitating NGO could be responsible for this.

7.1. Systems and structures

Water supply systems can be made visible using drawings with the input of all stakeholders. What types of sources are used, e.g. wind wheels or pumps, dug wells or bore holes. Are there different water layers or sources in use? If yes, where and what are the given properties, such as depth? Location of the public wells or taps, location of sources and pipes etc. Which citizens are dependent on which source? All the collected data and information should be summarised in a report and made accessible to the citizens.

7.2. Reporting, mapping wells and risks

Nitrate analyses

The results of the analyses of the drinking water and seasonal fluctuations should be carefully documented in the register-book. This can include:

- The depth of the well

- The state of the well (is it well maintained, does it have a cover and what kind of cover, does it have a concrete enforcement around it or not)
- The location and presence of possible sources of pollution in 50 m proximity around the well. Is the source of pollution e.g. in the north or in the south of the water source, uphill or downhill
- Nitrate concentrations of the water sources should be mapped (see example in annex 7b)

If maps of the village exist, then those should be used. Wells or taps and the density of citizens can be indicated on the map, using different colours for the wells according to their nitrate pollution. In the absence of maps, simple maps can be drawn.
The sources and dangers of pollution can be plotted manually on tracing paper, and overlaid on top of the map of the village.

It is further recommended to prepare a poster and to hang it in a classroom or a school corridor, where the results of the analyses are open to the pupils and visitors of the school.

8. Development of plans for improvement of the water system

Finally the main goal of the WSP is the identification of weaknesses and strengths of the system; reaching an improvement and minimising risks and hazards, which can deteriorate the water quality. After a shared identification of risks and hazards and possible improvements of the water system, joint actions on a local level could perform a better risk management, e.g. cleaning and restoring the source or pipes, installation of closed pump systems, safe human and animal excreta management, or even lobbying for the installation of a central water supply system (see an example of a table of action in annex 10).
A community based WSP developed with the involvement of all stakeholders will forward:

- An improvement of water protection
- A minimising the health risks of water related diseases
- An adequate management of the water system
- Improvement of access to information and to safe and affordable water
- An improved ownership of the water supply system

9. Remarks

The given examples and annexes are not fixed and should be adjusted and developed according the local situation and possibilities of implementation. For example, the age and the engagement of the pupils, the possibilities of the teachers, the input and cooperation of the citizens, the local and/or regional authorities and other stakeholders will all influence the results of the WSP.

Children learning to appreciate water as a valuable resource
Photo by Margarita Torres

Photo by Earth Forever

2 | Background Information for Teachers

1. Introduction

Water is essential to sustain life and every human being should have access to safe drinking water. International standards on the quality of drinking water are for example laid down in the drinking water directive of the European Union or in the guidelines of the World Health Organisation (WHO). Those standards focus mainly on the end product "drinking water = water intended for human consumption (drinking, cooking and personal hygiene). With the approach of the WSP a better protection and management of a water supply is possible, if the weaknesses and strengths are identified. Knowing about possible sources and risks of drinking water contamination forms the basis for a more effective groundwater and well protection and thus improve the water quality. Health risks are diminished.

To enable teachers and NGOs to work with the involvement of pupils, citizens and other stakeholder on a WSP for small water supply systems like dug wells or boreholes, a toolbox with some basics is developed. It will be convenient to have for each class or group a nice box gathering the tools needed and related to the WSP.

2. The toolbox

The toolbox consists out of several modules, which can be combined according to your needs and circumstances. There are core modules (assessment of water quality, identifying risks to the water quality, identifying responsibilities and developing a Water Safety Plan) that should be used and complementary ones, which are optional. The modules can be adapted by the teachers to the local circumstances, the age and abilities of the pupils, and above all their level of education.

2.1.The content of the toolbox can be

- Manual: "Developing water safety plans involving schools": This manual provides some background information to give an overview over the topics and cater for the immediate needs of teachers

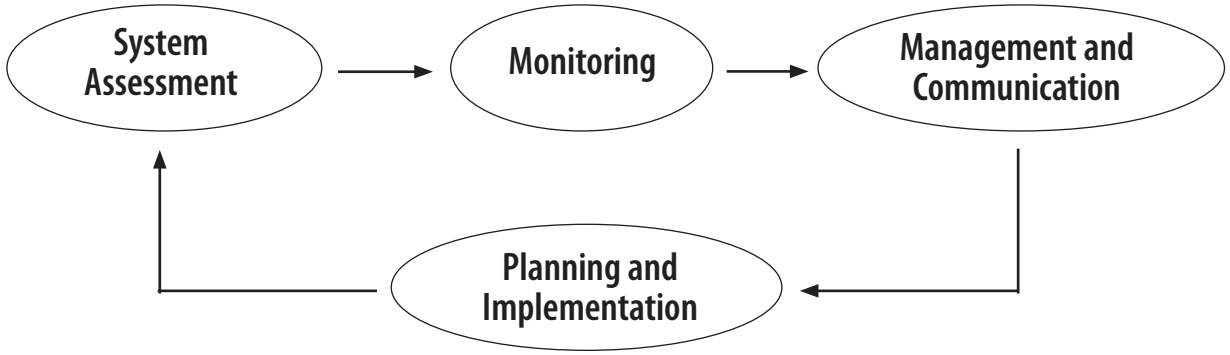
The manual provides additional material, such as:

- Questionnaires, checklists and forms for reporting of results, example of mapping of water quality – water pollution sources
- Clear drinking glass of 2 dl or 3 dl
- Nitrate test strips
- pH – measurement strips
- Colour strip for measuring colour as an indicator for contamnation with micro organisms/ bacteria and/or other organic contamination
- Puzzle poster of "bad" and "good wells", other pictures or drawings (Annex 11)

2.2. What can be learned using this toolbox

The modules can be used in various school subjects such as biology, health and hygiene, chemistry, geography (e.g. water cycle, soil, and environmental science), mathematics (particularly

The components of a Water Safety Plan (WHO)



simple statistics, diagrams). In addition important skills are trained, such as: analysing skills, presentation skills and taking action.

3. Water Safety Plans

A water safety plan can be one way to obtain and maintain a good drinking water quality and to minimise water related diseases. It is based on a comprehensive risk assessment and risk management approach for all the steps in a water supply chain from catchment to consumer. According to the WHO (World Health Organisation), WSP consist of three interlinked components: System Assessment, Monitoring and Management and Communication. This leads to planning and implementing new measures and is followed by a new round of assessing the system.

A better protection of a water supply is possible, if weaknesses and strengths are identified. For this and the identification of possible risks for the water supply, the knowledge about water pollutants, their sources and the ways of contamination is essential. This forms the base for a more effective groundwater and well protection and thus improves the water quality. Health risks are diminished.

On the consumer side, aspects of water transport and storage and questions of general hygiene are covered. The awareness about environmental questions and health problems and their interconnectivity is raised. Responsibilities and stakeholders are identified and actions envisaged. Pupils are of particular concern as they act as multipliers within their families and their community.

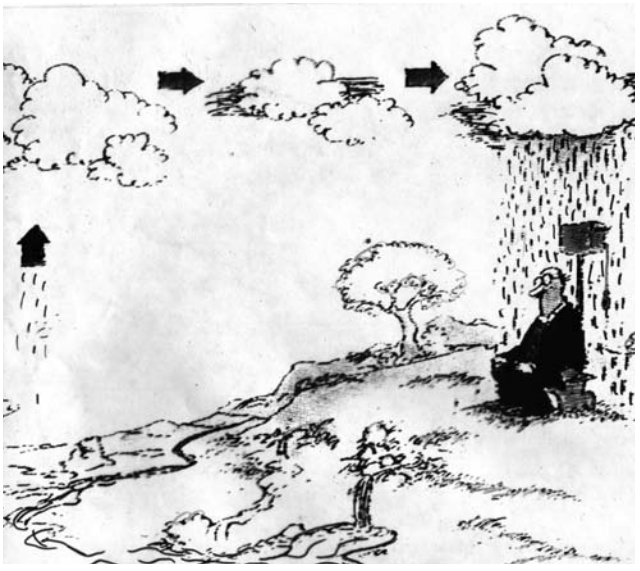
Here is some background information, corresponding to the elements of the toolbox. We tried to include possibilities to prevent pollution or to tackle the contamination before water is consumed.

4. Hydro-geological background

4.1. The water cycle

Water falls from the atmosphere as precipitation, usually as rain or snow. It varies in amount and intensity, depending on seasonal and geographic factors. It either infiltrates the surface or becomes part of the surface water in lakes and streams.

By draining into the ground, water is provided for plants to grow. They take some of it up by their roots and transpire it over their leaves back into the atmosphere. Another part infiltrates the soil and replenishes the ground water. The soil takes up water like a sponge until it can take no more. This capacity varies according to the structure of the soil. The surplus water flows as runoff into streams and lakes.



The water cycle (Illustration by Sabine Brückmann)

Depending on the temperature and humidity the atmosphere takes up water from plants, soil and the surface water. This vapour rises in the atmosphere and cools down until it reaches the dew point. The vapour condensates, clouds form, precipitation falls and the water cycle begins again.

In the ground different layers of soil can be found, which depend on the geology and land use of the specific location.
They can vary in grain size from rocks to sand. On its way through the different soil layers water is filtered and cleaned. The extent to which water is cleaned depends largely on the character of the soil as the water finds its way through cracks and holes. On this way through the soil, the water is leaching rocks and soil layers and is thus enriched with minerals.

Water permeability is another important characteristic of the different soil layers and is closely connected to its filtering capacity. In some areas water can easily seep through the soil until it reaches an impermeable soil layer such as silt or clay. Under this layer the water table of an aquifer can be found, and, depending on many parameters, the water of the aquifer is renewed within one or many more years. There are sometimes aquifers deep down in the ground, which can be centuries or even some million years old.

Like rivers groundwater layers are streaming and move pollutants or clean water from one location to the other.

4.2. Contamination

Pollutant concentrations become diluted when they enter water sources and, depending on the substance, are further reduced by biological degradation, filtration, and absorption to soil.

Some chemicals, such as the man-made chlorinated hydrocarbons, are very stable in the environment. Some of these compounds accumulate in living organisms and are not readily metabolised and excreted. They stay within the organisms and the food chain.

The impacts of contamination events to lakes and reservoirs are more severe and persistent than to streams and rivers because the natural flushing process is less than because of the lower flow than in streams or rivers. Contamination is even more persistent in groundwater due to lack of biological degradation. The most biologically active bacteria live within the soil above groundwater supplies.

Water tables can be contaminated by inflow from polluted surface water or leaking of other contamination sources. This can be the case, when the filtering capacity of the soil is not capable to hold off the pollution. This happens either when the covering soil layers are overloaded with pollutants, are quite thin or have low filtering qualities. If the soil itself is contaminated, these toxic substances can be rinsed into the water table as well.

The sources of contamination are very diverse and depend largely on the type of land use in the specific region. In industrial regions sewage from factories is a big problem whereas in rural regions the leaking of synthetic fertilisers, pesticides and manure stacks cause water pollution.

Looking closer at rural regions without a centralised sewage system or a centralised water supply we find many different sources of contamination.

The bottom of pit latrines often leads near the water table, the latrines then leak into the groundwater. Thereby nitrates and faecal bacteria can leach into the drinking water.

The rearing of pigs or cows close by the well may lead to similar pollution of the water table as rain washes the manure into the water. A dung pile with a concrete slab can prevent this. Often fertilisers and pesticides are washed from fields into the water table, as well. If artificial fertilisers, herbicides or pesticides were used, these can also contaminate the groundwater.

The cheapest and most effective way to tackle this problem is to prevent the contamination of the water layer as cleaning the water is much more expensive. One way is to consider the distances between possible sources of contamination and the wells. For pit latrines the WHO (World Health Organisation) recommends at least a 10 m distance to the well, for manure storage with concrete bottom at least 30 m. Although depending on the circumstances, often there must be much longer distances or e.g. in regions with shallow ground water table, pit latrines are not suitable at all. The well itself can be a source of contamination too, as it provides not only direct access to the water table itself to extract water but can act as a pathway for pollution as well.

If manure is washed into the soil and groundwater, contamination is the consequence.

5. Different types of water supplies

There are many different types of water used for drinking water supplies. The principle sources of private supplies are springs, wells and boreholes. Streams and rivers are also used, but those waters are very susceptible to pollution. The different types of water are available in different areas and have different characteristics with pros and cons.

5.1. Rivers

Where a river or stream is close by it is often used as water supply. But rivers are polluted, as they are not protected against contamination with microorganisms. They can be accessed upstream where many different sources of contamination can be situated, varying from big cities with often industrial and communal sewage to inflow of laundry sites in rural areas. The water from rivers therefore normally requires treatment. This is expensive and technical and maintenance skills are needed.

The water from rivers normally requires treatment

5.2. Dams

Sometimes dams are built to supply water to bigger settlements. They often serve as protection against floods or as storage reservoirs for droughts. But as they are not easily protected against water pollution, treatment is often required as well. They require high construction and maintenance costs.

5.3. Rainwater Harvesting

In areas without industry rainwater can be collected. It is sometimes even used for consumption, if it meets drinking water standards. In many areas rainwater has even a higher quality than the local available groundwater. Precipitation varies and storage facilities are needed. This source is open to contamination, e.g. on top of the roof or in the storage facilities. Therefore a treatment, like disinfection of the rainwater is needed, as well.

5.4. Source / spring

A natural flow of water issuing from the earth's surface under its own pressure is a spring. It can flow throughout the year or be intermittent for some time. As this is often groundwater this water is quite clean in remote areas. Sometimes it comes from glaciers or marshland, sometimes from groundwater. The place where the water of a river originates is called a source.

5.5. Wells

If no clean water is easily obtained at the earth's surface, holes are dug into the soil to reach the groundwater. The surface of the water in the well fluctuates with the height of the water table. This depends on precipitation and seasonal changes, e.g. frozen ground or the intensity of the water abstraction.
If a hole is dug and water comes up to the surface under its own pressure, it is called an artesian well.

There are different types of artificial wells. The suitability depends on various factors, such as the accessibility of the water, the available technology and financial resources.

5.6. Dug wells

They are usually dug into the ground. Their depths depend on the stability of the soil layers and of course on the depths of the water table. There are different structures to bring the water to the surface.

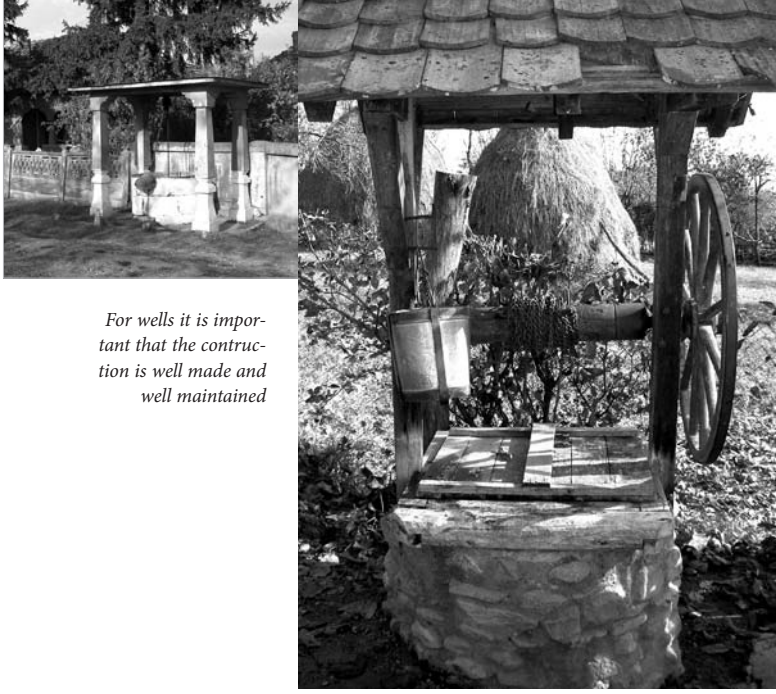
For dug wells it is important that the construction is well made and well maintained. Otherwise the well itself can be a way of contamination as it provides direct access to the groundwater table, as mentioned above. To give a few possible ways of contamination of well water:

- The well is not accessed through a borehole, but water is scooped with buckets. As these are placed on the ground they get dirty. When they are lowered into the well again, they take the dirt with them and thus contaminate the clean groundwater
- The well is not covered tightly. Pollutants fall into the well or get flushed into it by the next rain
- The concrete apron is cracked. Polluted surface water can easily trickle along the outside walls into the water table close to the well
- Human or animal waste are disposed too close to the well: micro organisms and other substances can infiltrate in the groundwater
- No drainage around the well: wastewater or surface water flow down the wall of the well
- The well is not vermin-proof: animals, insects can contaminate the water
- The well is not surrounded by a stock-proof fence: livestock can defecate close to the well
- If the well is not used anymore, and not covered tightly. Sometimes old wells are even used as rubbish dumps. This makes it very easy for pollutants to enter the groundwater

5.7. Boreholes

The water table can be accessed through drilling a borehole as well. By this method the risk of contamination is reduced and deeper water tables can be accessed. But the cost to establish such a well is higher compared to dig wells, as more technical equipment is needed. Water is then pumped to the surface by human, animal or electric power, depending as well on the depths. Water is can be pumped to the surface by human, animal or electric power.

Water abstracted from deep wells or boreholes may have originated from catchments many kilometres away. If the water catchment is well protected against pollutants, the water can be of an



For wells it is important that the contruction is well made and well maintained

excellent quality. Although groundwater abstracted in settlements from shallow wells and boreholes are often contaminated by local pollution, caused by human activities.

6. Water quality and properties

Drinking water should be whole-some and clean, should have no adverse effects on health during long-life consumption.

Water resources can easily be polluted as described above, which can have adverse effects on human and animal health. The most common sources of contamination in rural areas are agriculture, livestock and settlement runoff from sewage systems, pit latrines and septic tanks. Factors that determine the grade and type of groundwater pollution are e.g. depth of groundwater, characteristics of the overlying soil (vulnerable are e.g. sandy soils or fissured and cracked soils) and type of the drift deposits (e.g. manure, synthetic fertiliser or pesticides from agriculture). We take a closer look at the different pollutants.

6.1. Contamination by microbiological organisms

These include bacteria, viruses, fungi and parasites. Microbes can be found everywhere – in human bodies or domestic animals, on the surface of (or in) raw food, in water and everywhere in and around our homes. They are invisible to the naked eye.

Most of them do us no harm and we come into contact with them all the time. They are even used to make cheese or yoghurt. But some types of microbes can make us ill if they enter our body and overcome our body defences.

The contamination of water by microbiological organisms is quite common in densely populated regions without wastewater treatment systems, small water supplies or in water supply systems with leaking pipes or frequently interrupted water delivery.

The source of contamination can often be found in bad management of wastewater within a close distance of the water source. Faecal bacteria mostly come from badly maintained septic tanks, sewage systems, leaking pit latrines or manure. Sometimes even badly maintained wells are the source of contamination, as described above.

Microbiological organisms are not visible to the naked eye

The only way to verify bacterial contamination is by laboratory tests (see above). Usually the laboratory tests are required for public water supplies and carried out by the institutions responsible for drinking water. When laboratory tests are available, E- coli is used as an indicator for other faecal bacteria, even if they are not always causing illness as they grow only in human and animal bowels. But the test for other faecal bacteria is often more complicated and expensive.

If tests are not available, faecal bacteria cannot definitely be detected but there are several characteristics, which can accompany contamination by bacteria.

Please be aware that also clear, colour- and odour-free water can easily be contaminated with microbiological organisms.

6.2. Turbidity

Turbidity is used as an indicator that the water could be contaminated and is a possible health risk. It can be caused by a contamination with microbiological organisms. Increased rinsing of the soil due to heavy rainfall or churning of mud at the bottom of the well by the scoop can cause turbidity.

The turbidity of water is nowadays measured in NTU nephelometric turbidity units, comparing water to the standardized suspension of formazin. The nephelometer measures the intensity of light scattering in one particular direction. As the nephelometer is not available everywhere, we propose to approach this indicator with easy available methods using a clear glass and estimating the turbidity just by visual assessment.

In water supply systems turbidity is removed for aesthetic and hygienic reasons and because turbidity decrease the ef ciency of disinfection. A severe contamination with microbes is often accompanied by suspension and an increased turbidity

Waterborne diseases
Microorganisms: Diarrhoea and Vomiting

The most common disease caused by drinking water contaminated by microbiological bacteria is diarrhoea. Repeated diarrhoea can lead to malnutrition and thus to feebleness. Malnourished people are more likely to catch other additional diseases, as their immune system is impaired. This keeps people from working efficiently and costs additional money for medicine and the doctor.

Studies have found that children younger than 15 years have a 50% lower risk of getting diarrhoea and to catch colds and pneumonia as well, if they wash their hands regularly, and have a 40% lower risk of getting diarrhoea if they have access to safe sanitation.

A crucial point to tackle this problem is to build a toilet that does not allow faeces and urine to leak or spread into the environment and to wash hands after using a toilet and before preparing food or eating.

6.3. Taste and Odour

If water has a distinct smell, this can be an indicator for contamination by microbiological organisms or other substances. The odour can vary from very weak to quite strong. The type of odour can be attributed to different categories: no odour, decomposition, soil, faecal, chlorine or petrol.

6.4. Colour

In general clean water is clear and without any colour.

Natural substances such as salts can cause a yellow or brown colour from iron or manganese. Humic substances from peat or other decaying vegetation can colour the water as well and can variable with the seasons. If there is a severe contamination with microbes the water can be coloured with an accompanying suspension.

Coloured water reduces the ef ciency of disinfection. The colour can easily be determined holding a clear glass filled with water in front of white paper.

6.5. Nitrate

Nitrate is a natural substance and occurs natural in soils and plants. Plants need nitrate (nitrogen) for growing, which is natural present in soil, but for growing faster and better nitrate is often added as fertiliser by farmers in form of synthetic fertiliser (nitrogen or ammonia or urea) or manure. Animal and human faeces and urine are nitrate-rich sources.

A frequent contamination in rural areas is that of nitrate. The nitrate concentration in water can serve as an indicator of anthropogenic (man-made) water pollution by mismanagement of wastewater, latrines or septic tanks, animal manure or fertiliser. Nitrate is readily soluble in water and therefore it can be washed out easily into the groundwater.

- Nitrate reaches the ground water, if the covering soil has bad filtering qualities or is already overloaded with nitrate (fertiliser, manure).
- Higher levels of nitrate can be measured in the ground water after incidents of rainfall as the trickle down through the soil is higher and pollutants are washed into the groundwater.
- If the bottom of pit latrines is too close to the water table, liquids can trickle into the groundwater. The same can happen, if the ground water table rises according to higher precipitation.
- Where a lot of nitrate seeps in the ground, the soil becomes saturated with it. It steadily trickles into the ground water and is flushed in by any precipitation. This is the case when manure is stored without any prevention measures such as concrete bottoms.

Nitrate can be tested easily with the nitrate quick test. Children can carry out the monitoring of seasonal fluctuation of nitrate concentration in water. It gives an impression of the filter capacity of the soil layer and the possible relation to human activities. According to WHO guidelines, the limit of nitrate level in drinking water is 50 mg/l.

Nitrate has not only positive effects for plants, but also negative ones for humans and some animals. Ruminants such as cows are very sensitive to high nitrate levels in their drinking water.

6.6. Pesticides

'Pesticide' is a general term for substances, which are used to poison pests (weeds, insects, moulds, rodents, etc.) in agriculture and the garden. Insecticides, fungicides and herbicides are the most common subgroups. Pesticides are all associated with serious

Waterborne diseases

Nitrate: Blue Baby Disease (Methaemoglobinaemia)

Nitrates in the drinking water can aggravate "Blue Baby Disease" as they are converted to nitrites in the body. These react then with haemoglobin in the red blood cells to form methaemoglobin, affecting the blood's ability to carry enough oxygen to the cells of the body.
Infants less than three months of age are particularly at risk. The haemoglobin of infants is more susceptible and the condition is made worse by gastrointestinal infection. The intake of tea or other baby food prepared with nitrate-rich water can effect that the baby does not get enough oxygen anymore and turns blue.
This disease can be lethal or damage brain or nerves of the child. Older people may also be at risk because of decreased gastric acid secretion.

Thyroid problems

In areas where the natural iodine intake by the inhabitants is little, high nitrate concentrations in drinking water can increase the frequency of thyroid problems.

Toxic substances such as pesticides are often used in agriculture. Residues can often be found in drinking water

health effects including cancer. They enter surface and ground water primarily as runoff from crops or storage facilities and are most prevalent in agricultural areas. They can be detected only through laboratory tests.

There are about 300 substances. The most common pesticides are herbicides such as alachlor, atrazine, cyanazine, metolachlor, and simazine.

The potential contamination of water is influenced by several factors, such as the ability of the pesticide to dissolve in water, the amount and application methods and other practices associated with the pesticide use. Environmental factors like soil conditions, weather and the distance to water sources play a role, as well.

The contamination of groundwater is higher when there is no or young plant cover. The limits for pesticides in drinking water are 0,1 µg/l for one substance and 0,5 µg/l for the total of all pesticides found. Little allowance was made for the various degradation products.

Sometimes the degradation products are even more toxic than the original pesticide. Some of them are under suspicion as carcinogens. Often the degradation products are more stable, that means more difficult to degrade, and more soluble than the former substance.

7. What can be done?

7.1. Microorganism and nitrate

The best way to fight microbiological or nitrate contamination is to find the source of the contamination and resolve the problem there. In general, prevention of contamination is the most effective and cheapest way to provide safe water.

Microbiological contaminated wells or other water supply systems have to be cleaned disinfected and eventually be repaired. Before drinking, boiling the drinking water for 1 minute is advisable to kill the contaminating microbes. But boiling during a long time can have a negative effect in terms of nitrates. If a little water is boiled without a lid, it reduces by evaporation the amount of water, but leaves the nitrates untouched. The share of nitrate can even be increased. Mechanical filters or chemical disinfection don't remove nitrate from water either.

Nitrate can be removed using reverse osmosis, distillation or other treatment processes. In centralised water supplies adding water with low nitrate levels can diminish high nitrate levels.

Women are advised to breast feed their babies as the mother filters nitrate to some extent. But babies were even affected indirectly in cases with high nitrate levels in drinking water.

7.2. Hygiene

Water can be contaminated after it has been brought to the surface, as well. This can happen during transport, storage or handling the drinking water. Therefore hygiene is very essential for safe drinking water.

7.2.1.Transport and storage of drinking water

If water is stored in the kitchen for consumption, it is important to protect it from pollution. Here are some guidelines:

- During collection and storage, do not allow anyone to put their hands into the water or drink directly from the storage vessel or tank. Use scoops instead
- It is best, when the scoops can be stored in a storage jar, which is then covered
- Well closing lids are an essential part of this and have to be used during transportation as well
- Water stored at home can easily be re-contaminated due to hand contact or dirty vessels
- Therefore the reservoirs have to be cleaned and disinfected regularly
- To enable this, the storage should not be topped up continually
- The storage vessel or reservoir should have a narrow neck, a lid and a tap at the bottom so that no hand contact is possible
- Animals have to be kept away from stored water

Water stored at home can easily be re-contaminated

Washing hands is easy and very important. Cases of pneumonia and diarrhoea can be reduced with 50%

7.2.2. Personal Hygiene

Personal hygiene is an important measure to prevent becoming sick. Our hands are one of the most important means of spreading microbes and dirt, transporting it from faeces to food or water. Therefore an easy hygienic barrier is washing hands after using the toilet and again before preparing food or eating. children should be taught to do this from a young age To enable this clean water, plain soap and towels have to be available close to the toilet and in the kitchen. Washing hands is easy and very important. Cases of pneumonia and diarrhoea were cut by 50 percent in families given soap as compared to the control group. There was a 34 percent drop in impetigo (2009 Asia Pulse Data Source)

8. Responsibilities in water quality monitoring

The monitoring of quality of communal water supplies is a very important responsibility in a community. In general health authorities are responsible for this, as they have to prevent the outbreaks of diseases.

Water samples can be tested in independent laboratories as well. If the responsible authority does not monitor the water quality regularly, the simple indicators mentioned above should be used to indicate a laboratory test. Citizens and/ or local NGOs can send a request to the authorities or the laboratory for testing the water quality. Finally the authorities should fulfil their duties and inform the citizens about the quality of the public water sources.

Further assessment of the environment and the risks of water pollution and will give insight into the level of water safety and the measures to be taken for improving water quality and minimising water related diseases. This can be a task for the whole community.

9. Suggestions, solutions and ways to tackle the problem

In order to minimise the health risks, plans can be developed and implemented for a safe water supply. Schools and NGOs can identify many problems and risks of the water system. Although planning and implementation of the improvements have to take place with the involvement and cooperation of all stakeholders: authorities, experts, citizens, consumers and the responsible institutions for the drinking water.

9.1. Protection of the water source

- Water sources and water supply systems should be protected against any infiltration of pollutants. Pollutants can come from agricultural activities and from mismanagement of wastewater
- A sustainable wastewater management system should be installed to prevent leaking of excreta or manure into the groundwater layer. This can be either through sewage systems, on a central or a household level, or through urine diverting dry toilets or other well-adapted solutions, where the toilet products are collected, sanitised or recycled
- The manure of pigs and cattle should be collected in concrete cesspits. The solid waste should be collected and composted
- Pesticides, too much fertiliser or manure application can cause water pollution and should be avoided

9.2. Protection of the water supply system

- Attention should be paid to leaking or missing aprons around the well, missing lids or badly maintained wells
- A pump should be installed, so that the risk of contamination through the well itself is diminished. Cheap hand pumps are available
- Attention should be paid to safe transport and storage facilities
- Hygiene is important in preventing diseases: water and soap have to be at hand
- A system of monitoring and reporting of the appearance of water related diseases and cases of deterioration of water quality of quantity should be developed
- Access to Information: the consumers should be informed on a regular base about water quality
- The consumers and other stakeholders should be kept informed about the development and implementation of the WSP
- A schedule should make clear which actions can be achieved with the existing resources and which will require additional resources

9.3. Additional suggestions and activities for working with the topic "water"

In order to raise awareness among the youth and to mobilise them, children can carry out and can be involved in many activities.

For example:

- Build a precipitation measurement station

- Identify the relation between water quality, seasons and precipitation
- Water Filter System (sewage treatment plant) based on PET Bottles and sand/clay layers
- Collecting local sayings and proverbs around water
- Painting competition or drawings during the classes on different themes (e.g. how clean/dirty is their village, water pollution sources, field observations, paint the cleanest well, a well maintained well)
- Develop plans how to improve the water protection – how to prevent water pollution at school and in the village
- Planning the future water supply
- Identify water-borne diseases in the national state and in the village
- Planning what can be done at school and at home to prevent contamination of water and improve hygiene
- Theatre, role Play for older pupils or at the end of a year
- Suggestions for the presentation of the survey results, such as inviting the citizens, authorities, stakeholders and press, drawing posters, showing experiments, maybe organising a panel discussion
- Taking advantage of public attention by integrating presentations into the Danube Day or World Water Day or other local, • Exchange with other schools in person or via Internet
- School contest on the best WSP
- Try different experiments with water: introduce different substances (e.g. soil, colours) in order to give it different colours, smells, etc
- Give homework to the children to write down observations about their own water well and pollution sources they find in their backyard
- Pupils can bring water samples from their own water well and test it in class
- Group work can be done with the pupils: ask them to debate on different themes or create discussions with them on the different topics (e.g. water sources from their village, what they have learned, solutions for pollution prevention, imagining they have applied the water pollution prevention measures they have learned about to their own household).
- Invite during the classes the village doctor / the mayor / or somebody from the city hall to explain the situation with the water system in their village
- Field visits (e.g. visit water wells, observe how clean is the school & the yard of the school, monitor the cleanness of the school toilet, visit dumping sites)
- Prepare an activity for waste collection with the class

Teachers have to make their classes interactive, practical, involve children in discussions and think permanently of attractive water related activities.

9.4. Developing visions

In many rural villages hardly any of the existing wells of other small drinking water systems can supply safe drinking water. Chemical pollution often requires the water to be treated in a specific way. If only a microbiological pollution is identified water can be made safer by disinfection, e.g. by boiling or chlorination or UV treatment. But improvement of water quality in the short term is often not practical and alternatives have to be found. It is better to prevent the pollution happening in the first place by safeguarding clean water sources.

A community based centralised water supply system could be developed and designed. Steps to be taken:

- Establish an active local water committee
- Identify the most important stakeholders needed for a central water supply
- Use the results of the WSP (results of nitrate monitoring, interviews, identified health risks) to lobby for financial support on local, regional and national level; Involve the media
- In order to know where the safest water sources in sufficient amounts are available, a geo-hydrological study should be carried out. In general the water sources for a central water system should be located outside and upstream of the community. It must be possible to establish adequate water protection zones
- Develop with experts and other stakeholders a visibility study for a safe water supply system. Recommendations from other experts and similar projects can be useful
- Ensure the involvement of men and women at all stages and in all decision making processes
- Ensure the operation and maintenance by well skilled and trained persons
- Ensure a cost covering operation and maintenance of the system
- Ensure a pro-poor water financing system
- Ensure an adequate water protection policy and WSP for the system
- Find donors for the implementation of the water supply project
- Share all the gathered information with the citizens
- Don't forget the treatment of the used drinking water and sharing all the gathered information with the citizens

Literature for more information

- For detailed information about the WSP: http://www.who.int/wsportal/en/
- The ground water primer offers a good overview to ground water topics, although it is focused on a rural region in the US: http://www.purdue.edu/envirosoft/groundwater/src/ground.htm
- Information to contamination through pesticides: http://extoxnet.orst.edu/faqs/safedrink/pest.htm
- Publication to health effects of washing hands: http://www.aku.edu/CHS/pdf/SoapHealth_ARI_Lancet_Man.pdf
- EU-Council Directive on the quality of water intended for human consumption: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=DD:15:04:31998L0083:RO:PDF

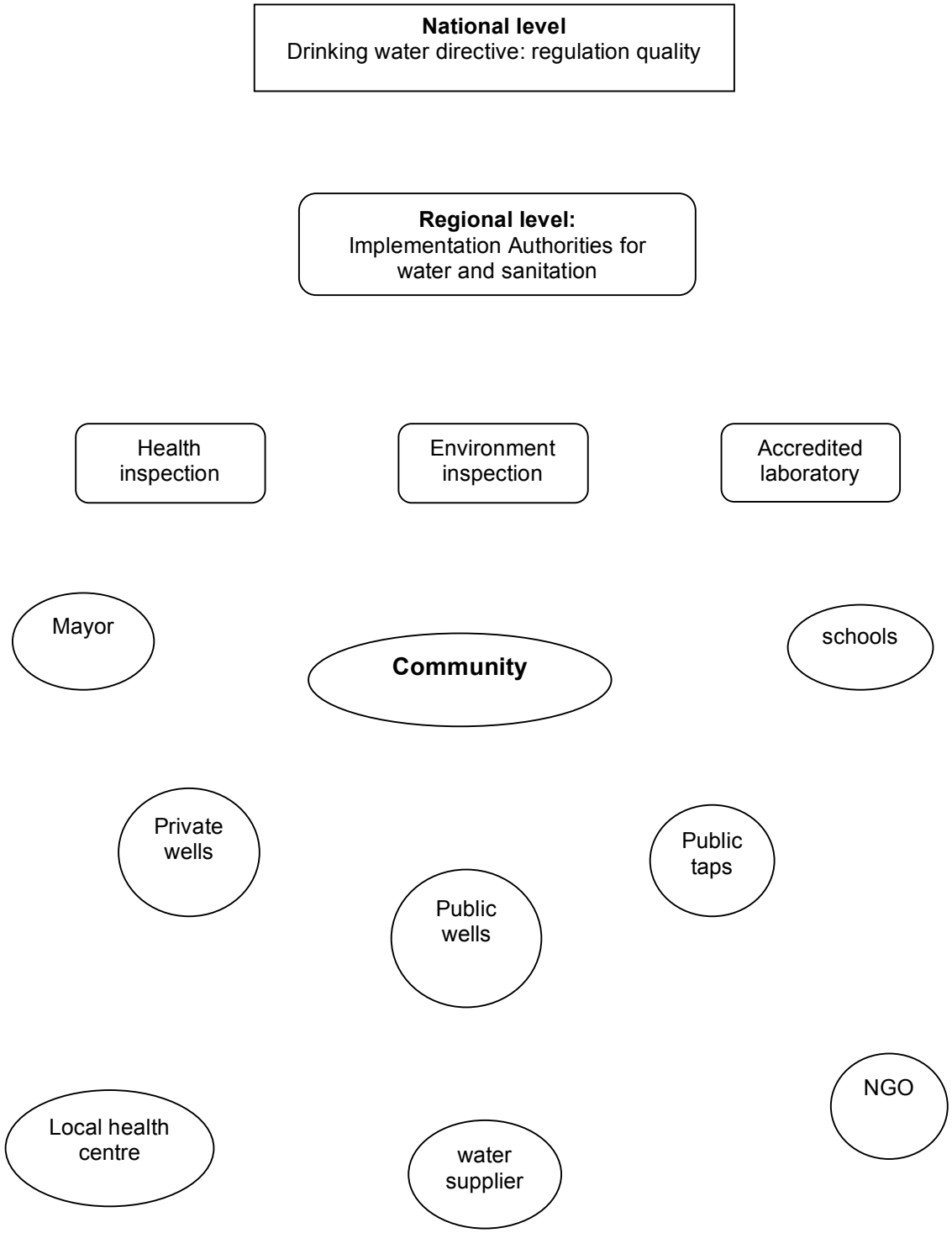
You can make a precipitation measurement station with simple means

Annex 1. Scheme for development of WSP for small-scale water supply systems

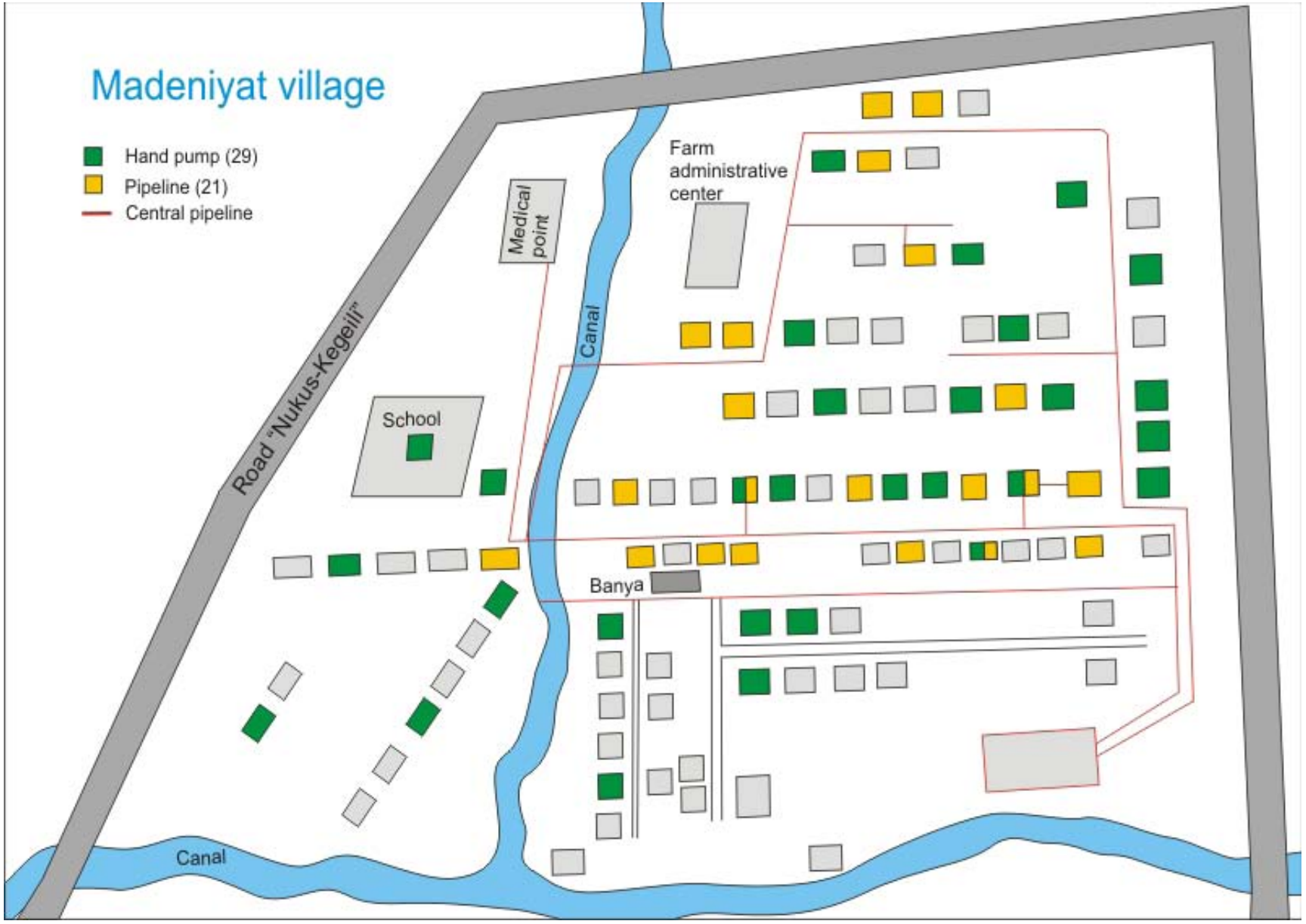
Step	Activity	Input-Tools	Output
1	Setting up a WSP, working team and identification of tasks	Sharing information and discussion with local authorities and school staff	Work plan of team
2.	Describe water supply system	Secondary data from governmental bodies, Surveys, etc.	Description of water supply system, sources of water, and its state, maintenance and operation (report).
3.	Identify stakeholders	Secondary data from governmental bodies, structured interviews with stakeholders	Stakeholder analysis (Annex 2, report).
4.	Draw the situation of the area with water points or water network and results of water quality monitoring (e.g. nitrate)	Local maps. Secondary data from governmental bodies, local and regional water authorities, structured interviews with stakeholders. Field visits and water analyses.	Map of village with water points and Nitrate results. Knowledge on water quality (nitrate), other analyses-results. (Annex 3, 7b, 8b, report)
5.	Conduct hazard assessment	Local map, input from experts, Field visits, checklists and questionnaires. Secondary data from governmental bodies, structured interviews with stakeholders (authorities, experts)	Map of village with risks points, Identification of water related health risks and causes (report).
6.	Report and share information on findings on local and regional level	Meetings- exhibition- media	Awareness of the situation. Maps, poster, leaflets, articles
7.	Discussions with stakeholders and action planning,	Action planning: community mobilization: involving stakeholders	Description of action and actors. Timetable and financial plan (Annex 10, report)
8.	Report and share information on conclusions and planning on local and regional level	Meetings- exhibition- media	Awareness of the situation and plans. Maps, poster, leaflets, articles
9.	Implementation of action plan	Input of all stakeholders, authorities, community, pupils	Start of improvement of the system
10	Develop an operation and maintenance system of the water supply	Input from local and regional (water) authorities, involvement of community and pupils	Description of action and actors. Timetable and financial plan (report).
11.	Report and share information on findings on local and regional level	Meetings- exhibition- media	Awareness of the situation. Maps, poster, leaflets, articles
12.	Make plan for operation monitoring and maintenance	Input from local and regional (water) authorities, involvement of community and pupils	Description of action and actors. Timetable and financial plan (report).
13.	Review of the WSP	Input of all stakeholders, authorities, community, pupils	Description of action and actors, timetable.
14.	Bring findings to local, regional and national level- lobbying	Conferences, meetings	Awareness of the situation. Maps, poster, leaflets, articles

Annex 2. Water network diagram

Identifying stakeholders: Here some important stakeholders involved in a water supply system are collected. Of course other relevant stakeholders can be added. Please, set them into the right relation and visualise their relationships and interactions.



Annex 3. Example of mapping of a village



Annex 4a. Questionnaire for citizens: Experiences / problems / perception analyses of consumer

Interviewer:

Date:

Family:					Nr. of persons in the household
Address					
	Public tap	Public well	Private well	Central wss	Remarks
Which source of water do you use?					
How much water do you need per day?					
Which and how many animals drink from the water?					
What is the distance from home to the water source? Please try to estimate it in meters.					
Is there always enough water available?					
How often per day do you catch water					
Do you think the drinking water (dw) quality is good?					
If quality is not good, what is the cause?					
Do you use bottled water?					
Do you treat/boil the dw?					
How do you store the dw? In vessels, bucket, bottles, canister or other					
Is the water reservoir at home covered?					
How do you take water from the reservoir?					
Where is the place of storage? Outside, in the kitchen or others					
Do you think you get ill of the dw?					
Wishes concerning drinking water					

Annex 4b. Questionnaire for doctors or other health professionals: Water quality and water related diseases

Interviewer:
Date:

Resource person
Name of Village
Number of inhabitants

		yes or no	Remarks
1	What do you think about the water quality in the village?		
2	What, in your opinion, is the main problem concerning drinking water in the village?		
3	What is the main illness related to drinking water quality in the village?		
4	How many cases of blue baby diseases did occur during the last 3 years in the village?		
5	How many cases of typhus did occur during the last 3 years in the village?		
6	How many cases of tuberculosis did occur during the last 3 years in the village?		
7	Do you think there is any relation between cases of diarrhoea and water quality in the village?		
8	Are there many cases of thyroid diseases in the village?		
9	If yes, what is the cause of the frequently thyroid diseases in the village?		
10	Did you ever receive the results of the water analyses of the water supply/sources on the village?		
11	Do you advice the citizens to boil the water for consumption?		
12	Do you advice the citizens to treat the drinking water for disinfection?		

Remarks:

Annex 4c. Questionnaire for water supplier or responsible institution of the public well / tap / piped water

Interviewer:
Date:

Resource person
Name of Village
Number of inhabitants

	Question	Yes/No or Nr.	Answer and/or comments
1	Do you have a budget for the operation and maintenance (O&M) of the system?		
2	If there is a budget, is the money enough for O&M of the system?		
3	Does the consumer pay for drinking water? If yes how much?		
4	If there is an additional budget, where does it come from?		
5	How often is the water quality monitored?		
6	Do you have results of analyses of water quality?		
7	Who has access to the analysis results?		
8	Do citizens have access to the analyses results?		
9	How old is the oldest and newest well?		
10	How often is the state of the wells inspected?		
11	How often are the wells cleaned?		
12	If there is piped water, how old are the pipes?		
13	Of which materials are the pipes?		
14	Are there plans to improve the system?		
15	If yes, what and when will the improvement carried out		
16	Who will pay for it?		
17	Are there problems of the water supply system?		
18	Please, name the biggest problem. If there are more, state them in the order of their priority.		

Remarks:

Annex 5. Nitrate test strips and simple analysis methods

1. How to use the Merck Nitrate test strips

1. Read the instructions of the package carefully.
2. For testing the nitrate concentration in water, keep the strip just one second in the water sample and shake very gently excess water from the strip.
3. Wait one minute and compare the developed colour with the colour/concentration scale on the tube.
4. Do not test nitrate in an area with a temperature below 15 degrees Celsius. During times with cold temperatures, please take the sample to a warm location for testing.
5. In case of unexpected results, it is necessary to repeat the analysis. For this reason take again a new sample into a clean glass and repeat the procedure as described above.
6. Please be aware, the test strips are not suitable for chlorinated drinking water.
7. If no tests are carried out, please keep the test strips in the well-closed tube in a cool place/fridge.

It is possible to cut the test strip lengthways and make from one strip two strips. Please work very clean and hygienically, and use very clean scissors. Never touch the nitrate indicator with your fingers and don't lay the strips down somewhere on a table.

2. Simple physico-chemical and organoleptic analyses methods

For these test the clean drinking glass with 0,3 l volume, which is included in this tool kit, can be used. It is important that it is clean and clear, without any scratches. Otherwise the results are biased.

3. Odour

The odour of the drinking water samples can be determined by the olfactory sense of the sampler in the field. For that purpose, a glass 0,3 l is filled with water and the odour is determined by smelling. The intensity of the smell can be categorised as weak, medium or strong. The type of odour can be attributed to no odour, faecal, soil, chlorine and others.

4. Turbidity

The turbidity of drinking water can be assessed visually in the field. A glass with 0,3 l volume is filled with water. It is hold against the light. Turbidity is assigned to the categories: clear, weak turbid, medium turbid or strong turbid.
Note if the suspended solids settle on the ground of the glass after some time.

5. Colour

Qualitative visual assessment of the water colour can be carried out in the field. A drinking glass with 0,3 L volume is filled and held in front of white paper and the colour is determined.

6. pH test strips

pH is the unit of the acidity or alkalinity of a solution. Pure water has at 25ºC a pH level of 7 and is called neutral then (the measurement scale ranges from 0-14). Acids are defined as those solutions that have a pH less than 7, while bases are defined as those solutions that have a pH greater than 7. For drinking water the pH level lies between 6,5 and 9,5.

How to use the test strips:

- The water temperature should have about 20ºC when it is measures, as the pH level depends on the temperature, as well.
- Dip strip for 1- 3 seconds for reaction to take place and compare strip to colour chart

7. Reporting

Record date and location (street, nr, village) of sampling, results, the source of water and some information about the environment of the water source.

Annex 6. Example form for monitoring Nitrate concentration of wells or sources in the village

It is advisable to map the results of the water tests. It is best to start with the nitrate levels as the other four parameter are due to personal perception.

Date of analyses	Location of well/source	Depth of well	NO3 mg/l	turbidity	odour	colour	pH	Last rainfall before the test; temperature at time of test	Other remarks

Annex 7a. Mapping the water supply and analyses results
Use an existing map of the village if possible. If no map is available, you can easily draw one yourself. Draw a draft first to find out what has to be included, how big the scale will be and what size the map will be (how many papers A4 you will need).

Each child will then draw a more detailed map of the surroundings of his home. This works like a zoom into the bigger map. Use the water supply (the well, where the drinking water is taken from) as the centre of the map and include the near surroundings. The radius around the water supply should be about 30 m.

Place the maps together to get the bigger picture of the village.
If there are still unmapped parts of the settlement, the basic elements should be added.
Drafts are sufficient here.
If the individual maps overlap, compare the results. The more accurate version will be placed on top.

The following basic elements should be found:

- Distinctive landmarks and institutions such as schools, churches, town hall, dispensary
- Heights (hills, valleys etc.)
- Rivers, waterways etc.
- Streets
- Houses
- North
- Scale

Then include the following elements:

- water supply: wells, public tabs, water points, springs etc.
- land use, such as grazing land, land fill (dump), industry or small businesses (garages, fuel stations, workshops etc.)
- (pit / school) latrines
- pig / cow stables

After testing the quality of the water, think about colours to mark the quality of each water supply. Different symbols can be used to distinguish the various types of water supplies.

Possible Questions to be asked:

- Compare the environments of polluted and clean water supply?
- Have you identified any risks to the water supply?
- Identify possible sources of pollution.
- Are there any patterns in the dispersion of the water quality visible?
- What can be done to protect the water from contamination? Collect all ideas. Often the unconventional suggestions lead to innovative solutions.

It is further recommended to prepare a poster and to hang it in a classroom or a scholl corridor, where the results of of the analyses are open to the pupils and visitors of the school.

Annex 7b. Example of mapping the Nitrate Test Results of wells in the Smilovichy Village, Belarus

Carried out by Secondary School N2 students and the Ecoproject Partnership Organisation, with the support of WECF, using the MERCK indicator strips.

Index of nitrate concentration in drinking water*

0 mg/l
10 mg/l
25 mg/l
50 mg/l
100 mg/l
150 mg/l
200 mg/l
500 mg/l

*The set value for nitrate in drinking water is in Belarus 45mg/l and should not exceed. The tests give an impression of the level of nitrate pollution, but do not demonstrate the exact concentration.

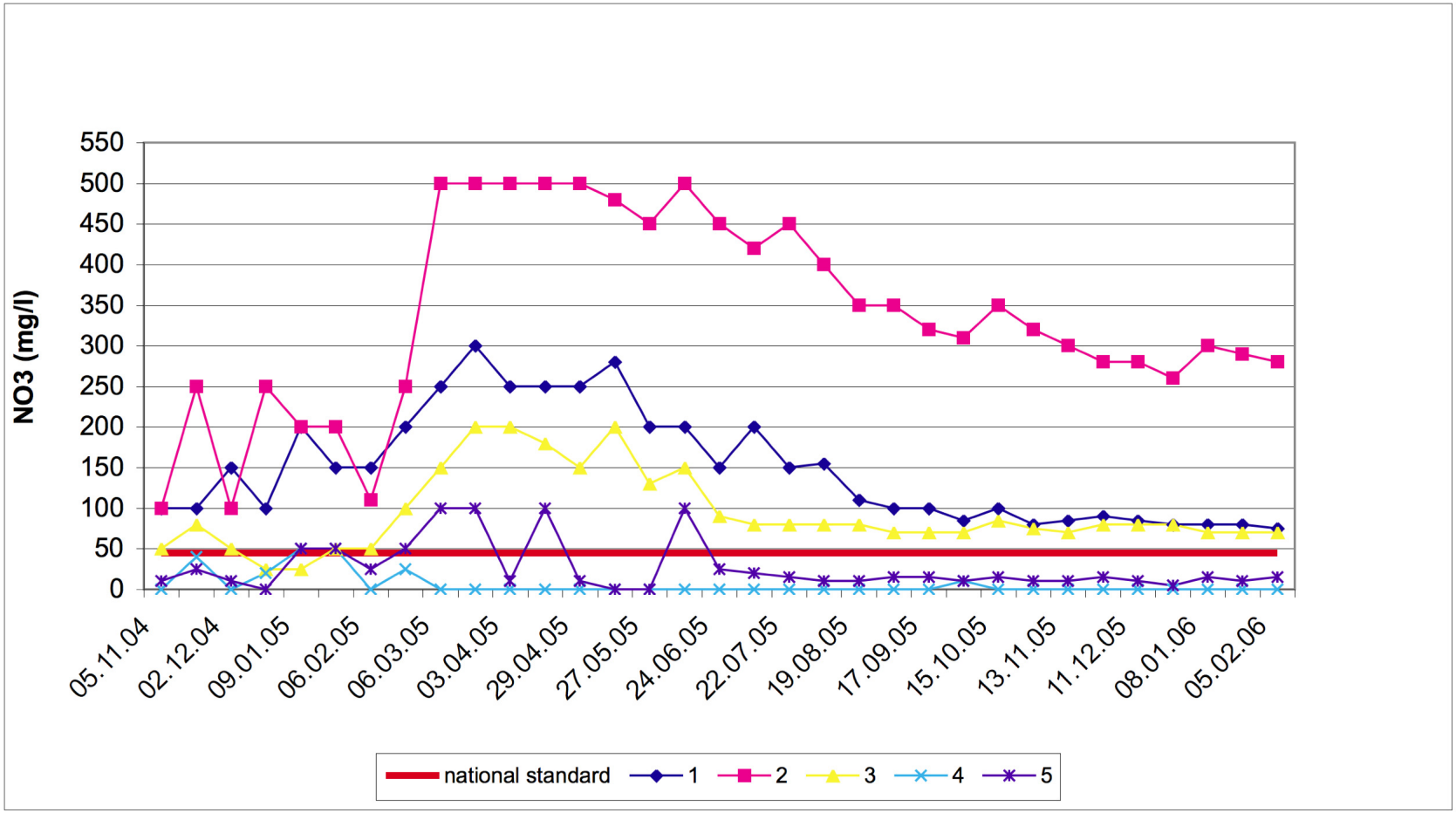
Nitrate levels exceeding the set value endanger in particular the health of a newborn baby. Besides nitrates, the drinking water may contain other pollutants. That is why a low nitrate level does not guarantee a good quality of water.

Annex 8a. Example reporting form for seasonal monitoring of water sources
Nitrate concentration related to precipitation and season should be transferred in a graphic

	1	2	3	4	5
Name/address of well /source					
State of well /remarks					
Date of monitoring					
Nitrate mg/l					
pH					
Suspended solids?					
Water temperature ^{0}C					
Out-door temperature ^{0}C					
Precipitation during 14 days					

	1	2	3	4	5
Name/address of well /source					
State of well /remarks					
Date of monitoring					
Nitrate mg/l					
pH					
Suspended solids?					
Water temperature ^{0}C					
Out-door temperature ^{0}C					
ml Precipitation during 14 days					

Annex 8b. Example: monitoring fluctuations of Nitrate concentrations in water from 5 wells in Bobryk, Ukraine 2004-2006



Annex 9a. Risk assessment for dug well or borehole

Location:

Date of visit
Nitrate (rapid test) **mg/litre**

	Specific Diagnostic Information for Assessment Risk	Yes	No	Remarks
1	Is there a latrine within 10m of the well?			
2	Is there animal breeding pigs, cows, goats or others within 10m of well or borehole?			
3	Is there any cultivation (use of manure or fertilizer) within 10m of well or borehole?			
4	Is the drainage faulty allowing ponding within 2m of the well or borehole?			
5	Is the drainage channel cracked, broken or need cleaning?			
6	Is the fence missing or faulty?			
7	Is the apron less than 1m in radius?			
8	Does spilt water collect in the apron area?			
9	Is the apron cracked or damaged?			
10	Is the hand pump loose at the point of attachment?			
11	Is the well-cover insanity?			

(Source WHO, modified by WECF)

Total Score of Risks: 10 for dug well, 11 for borehole
Risk score: 9-11 = Very high; 6-8 = High; 3-5 = Medium; 0-3 = Low

Results and Recommendations:

The following important points of risk were noted (list nos. 1-11):
Inspection was carried out by:

Comments:

Annex 9b. Risk assessment for Piped water

Location:

Date of visit
Nitrate (rapid test) mg/litre

	Specific Diagnostic Information for Assessment Risk	Yes	No	Remarks
1	Do any tapstands leak?			
2	Does surface water collect around any tapstand?			
3	Is the area uphill of any tapstand eroded?			
4	Are pipes exposed close to any tapstand?			
5	Is human excreta on the ground within 10m of any tapstand?			
6	Is animal manure on the ground within 10m of any tapstand?			
7	Is there any fertilizing with manure or chemicals within 10m of any tapstand?			
8	Is there a sewer within 10m of any tapstand?			
9	Has there been discontinuity in the last 10 days at any tapstand?			
10	Are there signs of leaks in the mains pipes in the Parish?			
11	Do the community report any pipe breaks in the last week?			
12	Is the main pipe exposed anywhere in the Parish?			

(Source WHO, modified by WECF)

Total Score of Risks 12
Risk score: 10-12 = Very high; 10-7 = High; 4-7 = Medium; 0-4 = Low

Results and Recommendations:

The following important points of risk were noted (list nos. 1-12):
Inspection was carried out by:

Comments:

Annex 9c. Risk assessment for piped water with service reservoir

Location:

Date of visit
Nitrate (rapid test) **mg/litre**

	Specific Diagnostic Information for Assessment Risk	Yes	No	Sample nr.	Remarks
1	Do any standpipes leak at sample sites?				
2	Do water collect around any sample site?				
3	Is the area uphill of any tapstand eroded?				
4	Are pipes exposed close to any sample site?				
5	Is human excreta on the ground within 10m of any tapstand?				
6	Is sewer or latrine within 30m of sample site?				
7	Is animal manure on the ground within 10m of any tapstand?				
8	Is there any fertilizing with manure or chemicals within 10m of any sample site?				
9	Has there been discontinuity in the last 10 days at any sample site?				
10	Are there signs of leaks in sampling area?				
11	Do the community report any pipe breaks in the last week?				
12	Is the supply main exposed in sampling area?				
13	Is the service reservoir cracked or leaking?				
14	Are the air vents or inspection cover insanitary?				

(Source WHO; modified by WECF)

Total Score of Risks 14
Risk score: 14-12 = Very high; 11-8 = High; 5-7 = Medium; 2-4 = Low; 0-1 Very low

Results and Recommendations:

The following important points of risk were noted (list nos. 1-12):

Inspection was carried out by
Comments:

Annex 10. Example table of action

Public well-windlass	Is - situation	Should be	Date and action of improvement	Monitoring	Responsible person
General state of well	Cracks in the wall	No cracks, no damages	2008-05-21 Repairing wall; new layer of concrete	By visit monthly	
Cleanliness of well	Moss and excrements of birds	No visible dirt's	2008-06-01 Scrubbing the intern of the well; pumping away the water; disinfection of the well	By visit monthly	
Fence	No fence	No entrance for animal	2008-05-22 Installation of fence	By visit monthly	
Apron	Apron cracked allowing leakages	No leakages	2008-05-23 Repairing the apron	By visit monthly	
Drainage	No drainage, ponding is visible	Flow off of waste – rain water	2008-05-25 Making a drainage around the well	By visit after rainfall	
Rope	Rope is in a good condition.	In a good condition, clean, no handling by hand	No action needed	By visit monthly	
Bucket	Is leaking, but clean	Not leaking, regularly cleaning	2008-06-01 Repairing the bucket, if not possible buying a new bucket	By visit monthly	
Windlass	Is for old people too heavy to handle	Easy and comfortable handling	Spring/summer 2008 Lobbying for an electric driven pump Identifying the causes and if possible improve the situation	By visit monthly	
Cover	Very good lid, but is the lid is not used by the citizens	Avoiding entrance of dust, insects or others (birds) in the well	Spring/summer 2008 Awareness raising campaign among the citizens. Making sign on the well	By visit monthly	
Environment	Pit latrine and livestock chickens nearby the well;	Protection of well and groundwater for contamination	Spring/summer 2008 Awareness raising campaign among the citizens. Together with the owner looking for solution s to keep away the chicken, find alternative for pit latrine	By visit monthly	
Water quality	Nitrate exceeds the limit of 50 mg/l	Meet the standards for drinking water	Spring/summer 2008 Awareness raising campaign among the citizens Making sign on the well Identification of well with lower nitrate. Analyses of Micro organism Eventual lobbying for other sources of water Making safe water available for vulnerable groups (e.g. pregnant women, babies, children)	Sampling every 6 month	

Women in Europe for a Common Future asks

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Wat vervuilt jullie drinkwater? Vind de 8 verschillen!

Was verschmutzt Euer Trinkwasser? Findet die 8 Unterschiede!

Qu´est-ce qui contamine votre eau potable? Trouvez les 8 différences !

Что загрязняет вашу питьевую воду? Найди 8 отличий!

Що забруджує вашу питну воду? Знайди 8 відмінностей!

Ce polueaza apa voastra? Gasiti cele 8 diferente!

Какво замърсява вашата питейна вода? Открийте 8-те разлики!

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