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University of Bonn - IHPH Institute for Hygiene and Public Health

WATER & RISK

Editorial

Dear Colleagues,

We are happy to present you the next volume of our WHOCC Newsletter and would like to give our special thanks to the authors who made highly interesting contributions to this Newsletter.

In the current issue, we invited Venera Djudemisheva of the Rural Water Supply and Sanitation Project to present an actual overview on aspects of Water and Health in Kyrgyzstan. Despite huge amounts of water resources in terms of ground water reservoirs, rivers and glaciers, the quality of water actually used for drinking and irrigation is still unsatisfactory in the country.

Margriet Samwel and Sascha Gabizon from Women in Europe for a Common Future present experiences with the use and perception of new sanitation concepts in schools of Romania and the Ukraine.

Again in Romania, many children are exposed to Methemoglobinaemia and show the so-called “blue baby syndrome”. Anca Tudor and Mihaela Vasilescu from the Institute of Public Health in Bucharest have investigated the impact of nitrates and microbiological substances in well water with respect to the “blue baby syndrome”.

Tan Qinwen from the Environmental Monitoring Centre of Chengdu City, China reports about sanitation and drinking water aspects in rural areas around Chengdu City. Besides an extension of centralised water supply pipe networks to rural plains and hilly regions, the investigation points out that technical improvements – amongst others – are urgently needed for all small scale water supply projects in rural areas.

This issue will be completed by a short report from Dr Alexander Vereschagin, Chief Physician of the Federal Centre of Hygiene & Epidemiology of Rospotrebnadzor, Moscow, about the Workshop on Water Safety Plans, which took place from 4 - 5 December 2007 in Moscow, Russian Federation. The Workshop was held within the framework of the Biennial Collaborative Agreement (BCA) between the World Health Organization (WHO) and the Ministry of Health and Social Development of Russian Federation.

We thank our contributors and our readership for their interest and encourage you to contribute to one of the future issues of ‘Water & Risk’.

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Water and Health in Kyrgyzstan

Kyrgyzstan is a rugged country, with the Tien Shan mountain range covering approximately 95% of the whole territory. The average altitude in Kyrgyzstan is 2,750m above sea level. The highest point is Peak Pobeda at 7,439m and the lowest is 350m above sea level in the south-west of the republic. Kyrgyzstan is the second smallest of the Central Asian republics in both area and population and is located between two giants: Kazakhstan to the north and China to the south and east (Figure 1). About 60% of the population live in rural areas.

Water resources in Kyrgyzstan

Kyrgyzstan has sufficient water resources. Total water resources are equal to 2,458km^3, of which 50km^3 are rivers, 13km^3 are potential ground water resources, 1,745km^3 are lakes and 650km^3 are contained within glaciers (Figure 2). Altogether there are 8,208 glaciers of different sizes in Kyrgyzstan with a total ice area of 8,169km^2.

The tendency towards climatic warming has led to a continuous process of glacial retreat. The forecast for 2025 is that glaciers will reduce by 30-40% and result in a reduction in river waters of 25-35% [1].

In Kyrgyzstan there are 1,923 lakes with a total water surface area of 6,836km^2. The biggest lakes in Kyrgyzstan are the Issyk-Kul with 6,236km^2, the Son-Kul with 275km^2 and the Chatyr-Kul with 175km^2.

More than 3,500 rivers in the republic supply water to the neighbouring countries of Kazakhstan, Uzbekistan and Tajikistan (Figure 3). The longest rivers are the Naryn at 535km, the Chatkar at 205km and the Chu River at 221km. The country uses only 12-17% of all the available water resources, of which 90% are used for irrigation [2].

Figure 1. Overview of Kyrgyzstan
Source: http://geography.about.com/library/cia/nckyrgyzstan.htm?once=true

Figure 3: Water reservoir of the Talas River (Kyrgyzstan), which supplies water for the needs of neighbouring Kazakhstan
Source: V. Djudemisheva

Figure 2: Glaciers in Kyrgyzstan
Source: V. Djudemisheva

Human access to water and sanitation

The Comprehensive Development Framework (CDF), which was developed by the government of Kyrgyzstan together with non-governmental and business organisations, states that access to drinking water is a significant problem in Kyrgyzstan, especially for those people who are poor and living in rural areas. Lack of clean potable water affects their health and quality of life, reducing general standards of living and people's ability to engage in economic activities. Furthermore, pollution is an increasing problem especially in rural areas due to unprotected streams and wells. According to national statistics, 90.2% of the urban population are supplied with clean drinking water, but only 19% of the rural population have adequate access to clean water for drinking [3]. The goal of the CDF was to facilitate the political, economic and social development of the republic, leading to the halving of poverty among the population by 2010 and a reduction in Kyrgyzstan's foreign debt.

According to the WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation [4], 98% of the urban population are supplied with clean drinking water. However, in rural areas only 66% of people have access to an improved water supply. Only 27% of households are connected to a water and sanitation network and 51% of people have access to improved sanitation (Table 1). The most adverse situation exists in the southern regions of the country, where 550,000 people use water from open sources or irrigation systems (Figure 4).

The biggest difficulties in relation to the provision of improved water supply and sanitation services are related to the weakness of the institutional capacity to manage and regulate the process. The lack of funds for the reconstruction and improvement of schemes as well as the low capacity of the population to pay tariffs has resulted in infrastructure in both urban and rural areas falling into a bad state of repair. To date, the physical deterioration of the facilities is estimated at 70% for municipal and 40% for rural water supply schemes. More than 30% of the existing facilities do not have sanitary zones, water treatment or disinfection systems. 85% of water supply schemes use groundwater sources. Nevertheless, due to the high cost of pumping groundwater, the number of water supplies that take water from less secure open sources is increasing.

A lack of adequate wastewater collection or acceptable systems for human waste disposal are common in the rural areas of the country. There is no formal infrastructure for sanitation; basic pit latrines with no sanitary refinements are used throughout the rural areas. Some urban areas have operational sewage systems but these are also falling into a bad state of repair due to their age and the lack of new investment.

Figure 4: Open water source used by the population in Kyrgyzstan
Source: V. Djudemisheva

According to national statistics, the provision of sewerage systems for the whole country is 21%. For the capital Bishkek it is 78% and in the regions it averages about 10% (Figure 5) [5].

Pollution and quality of water

The main cause of water pollution is wastewater discharge from industry and agriculture, irrigation wastewater saturated with mineral fertilizers and chemicals and domestic wastewater.

Year	Population			Improved Drinking Water Coverage						Improved Sanitation		
				Total		Urban		Rural		Total (%)	Urban	Rural
	Total (thousand)	Urban (%)	Rural (%)	Total (%)	Household connection	Total (%)	Household connection	Total (%)	Household connection	Total (%)	Urban (%0	Rural (%)
1990	4,395	38	62	78	47	98	79	66	27	60	75	51
2004	5,204	34	66	77	45	98	79	66	27	59	75	51

Table 1: Access to improved water supply and sanitation coverage in the Kyrgyz Republic
Source: WHO & Unicef, 2006

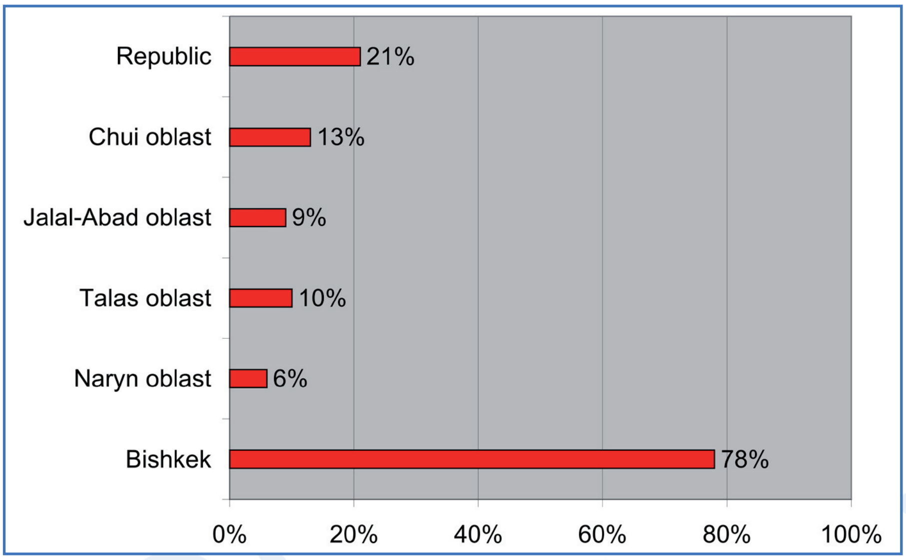

Figure 5. Provision of sewerage systems in the Kyrgyz Republic
Source: State Sanitary and Epidemiological Service, Kyrgyzstan

For the last 5 years the volume of polluted waste water has increased by a factor of 1.6. Every year 900-1,150 million m³ of waste water is being discharged into surface waters, out of which 301-635 million m³ goes through biological, physical, chemical or mechanical treatment. According to the National Statistical Committee of the Kyrgyz Republic (KR), in 2006 about 700 million m³ of water was discharged, out of which 12.6 million m³ was polluted or insufficiently cleaned. The concentration of harmful substances in the water exceeds the established standards by a factor of ten [2].

As a result, many surface rivers (Chu, Alamedin, Chon-Kemin, Issyk-Ata, Kechi, Kemin, Naryn, Akbura, Kara-Darya, Tar, Yassy, Kurshab) have an increased level of ammonium nitrate and nitrites, compounds of copper, zinc, oil and oil products, organic and other harmful substances and also residual quantities of toxic chemicals.

The situation regarding nitrate pollution of the ground water in Ala-Archa and Orto-Alysh water inflows, which provide water for the capital of the republic, has become serious. Excessive nitrate concentrations have been identified at 150m depth. Such pollution is related to the location of animal-breeding facilities in the sanitary zone, the development of irrigation agriculture, the poor sanitary condition of populated areas, together with the lack of water supply and sewerage systems [1].

The lack of financing for environmental protection activities in the republic causes serious problems in the operation of treatment plants and sewerage systems. Operating facilities are obsolete and in poor condition. More than half of the small towns do not have centralized sewerage systems or a treatment structure.

With regard to sanitary and chemical indices, the worst quality of water indicated as per cent of samples going beyond the threshold is found in the surface waters of the Issyk-Kul region (40%), the Chui region (90,9%) and Osh City (50%). Microbiological indices show the worst quality of water to be in surface water sources in the regions of Issyk-kul (42%), Jalalabad (35.8%) and Batken (28.4%) and show a 18.7% average of samples going beyond the limit in the republic [5].

In the KR, 29.4% of surface and 3.7% of ground drinking water sources do not comply with regulations and standards. An average of 13% of all samples of piped water tested by the sanitary epidemiological centres failed to meet hygiene standards in terms of microbiological parameters. The worst quality drinking water for microbiological parameters is identified in the regions of Osh (20%), Issyk-Kul (16.9%), Chui (25.7%) and Jalalabad (14.7%) (Figure 6).

For chemical indicators, the deviation from the hygiene standards is 3%. Some of the samples from the Batken region do not comply with the standards for chemical contents (9%) [6].

Water related infections in Kyrgyzstan

The lack of effective and adequate sanitary conditions as well as poor-quality water have become the main factor for the high morbidity of the population who suffer from intestinal diseases, typhoid, dysentery, viral hepatitis and parasitic diseases, especially in the southern part of the country.

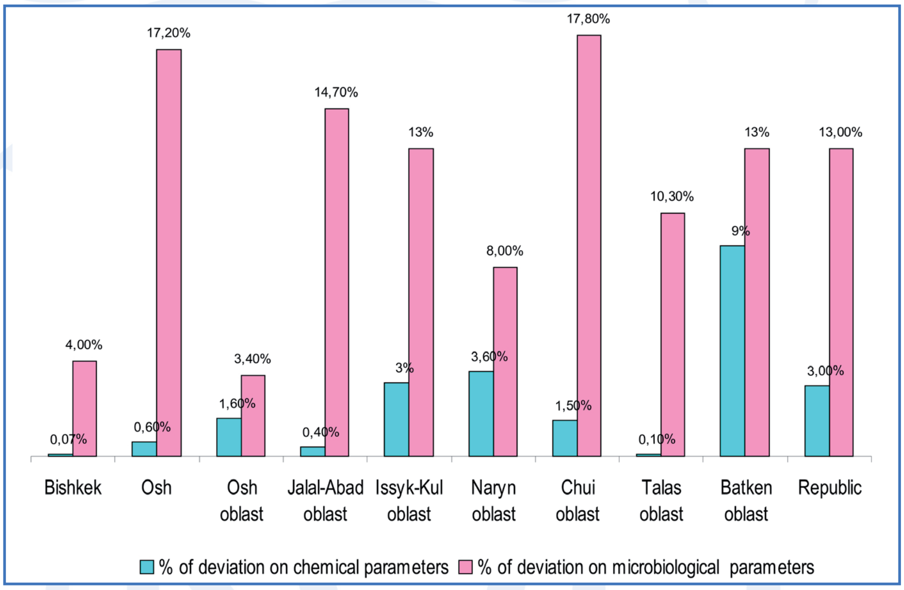

Figure 6. Assessment of the quality of water from the distribution system regarding microbiological and chemical parameters in the KR
Source: State Sanitary and Epidemiological Service, Kyrgyzstan

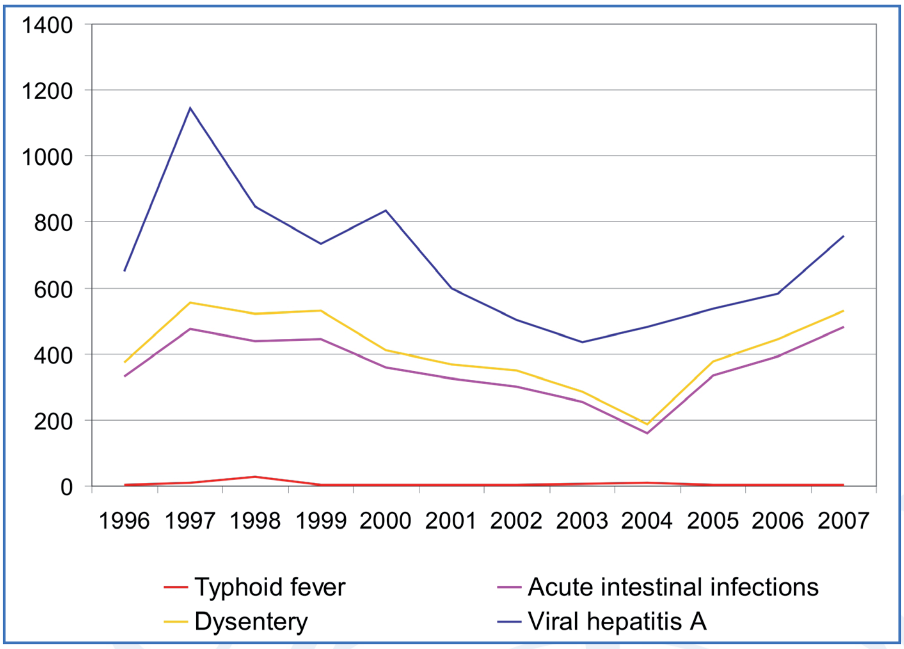

Figure 7. Incidence of intestinal infectious diseases in the KR (new cases per 10,000 people)
Source: State Sanitary and Epidemiological Service, Kyrgyzstan

For the last three years, a growing rate of acute enteric infections has been recorded (Figure 7). Children's mortality from acute enteric infections remains high. In the last five years 2,200 children have died because of diarrhoea.

The typhoid morbidity rate is still a serious issue. Typhoid is often registered in the form of waterborne disease outbreaks. Thus, in 2007, the morbidity rate for enteric typhoid and paratyphoid increased by a factor of 1.4 and resulted in 186 cases of typhoid and 90 of paratyphoid. During the last 3 years (2005-2007), Jalalabad oblast has been the region in the republic most affected by enteric typhoid, registering 70% of total cases. In 2007, 159 cases were registered in the form of local outbreaks, mainly in populated areas located along the Mailusuu river [7]. The main reason for the increase in disease rates remains the insufficient provision of good quality drinking water.

Helminthiasis holds a significant position in the infectious pathology of the population of the republic. In total, 40-45% of infectious diseases are cases of helminthiasis. High rates of infection in the population have been been caused by poor hygiene habits in parts of the population and behavioural aspects as well as poor water quality. Every year, 35,000 to 45,000 people infected with helminths are officially registered in the country. However, the true picture exceeds the official statistics several times. The most widely-spread helminthiases are enterobiasis (63%), ascariasis (22.4%), hymenolepiasis (5.8%) and echinococcosis (2.3%). As for protozoan infestations, giardia makes up 14.4% [5].

Within the framework of the Department for International Development (DFID), funded project examinations of children for parasitic diseases were undertaken in 2003-2005. It was discovered that 61% to 79% children in selected villages were infected with the four main parasites: enterobius, ascaris, giardia and hymenolepis. Similarly, 6,500 children have been tested for giardiasis and the rate of infected children was more than 38% [8].

Conclusion

Although Kyrgyzstan has plenty of water resources, it actually uses the poorest quality part for both drinking and irrigation purposes. As a result, a significant proportion of the rural population has problems with access to safe drinking water and existing water supply facilities which are deteriorating. Therefore, the provision of the population with safe drinking water remains one of the highest priority issues for the government of the KR.

Over the last few years, the government and the people of the KR have been faced with fundamental changes in attitude and approaches to governance and community responsibility for services such as water supply and health. The government has changed the paradigm from state responsibility for water supply to independent community based supply including the transfer of competence and facilities to the communities. Under this system the role of higher level government is becoming one of facilitation and assistance for community conceived and executed projects. This role is very differ-

Figure 8. New water supply system in a village of Issyk-Kul oblast
Source: V. Djudemisheva

ent from the past when rural water was managed by the state with little community involvement.

Currently, various international and local aid organizations have been implementing numerous projects related to the rehabilitation and construction of new rural and municipal water supply facilities. In two major investment projects, financed by the World Bank (WB), the Asian Development Bank (ADB) and with Technical Assistance by DFID, more than 500 villages were covered. This means that about 31% of the rural population now has access to safe drinking water (Figure 8) [3].

Despite the significant support received from international donors, there remains a serious concern with regard to the ability of many of the communities to manage their water supply schemes in the long term, and the capacity of the government to support the communities in this. Moreover, since the water resources of the republic are not only used internally, but are also delivered to neighbouring countries, the problem of the safeguarding of water sources from pollution and contamination is a serious one.

Obviously, there is a need to consider the current situation to develop a common vision of the way ahead for sustainable water supply services in the future.

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Sustainable School Sanitation for Better Child Health in the EECCA and in the new EU Member States

In the European region, the lack of safe water and adequate sanitation has been recognized as a major cause of child mortality and morbidity, especially in the countries of Eastern Europe. In the World Health Organisation (WHO) European Region, 120 million people do not have access to safe drinking water, and even more lack access to hygienic sanitary facilities, resulting in waterborne diseases such as hepatitis A, diarrhoeal diseases and typhoid fever. Microbial contamination has been recognised as a prime concern throughout the European region. Better management of water and sanitation would prevent over 30 million cases of water-related disease per year in the region [1].

Big disparities in water and sanitation exist in the countries grouped into the WHO EUR-B sub-region. However data collected to date are mainly based on the situation of the total population living in households. There is little data collection or knowledge about the access to adequate water supply and safe sanitation for public institutions such as schools.

Lack of safe sanitation and safe drinking water in the new EU member states

In the new EU member states of Romania and Bulgaria, pit latrines and unmanaged sewage are an important source of water pollution by nutrients and pathogens, in addition to the widespread agricultural pollution from mineral fertilisers and pesticides. Romania has over 10 million inhabitants not connected to a centralized sewage system and without access to safe sanitation. 8 million mostly rural inhabitants rely on unprotected wells for their drinking water. The World Bank estimates that in Romania at least 25% of groundwater nitrate pollution comes from pit latrines and badly functioning septic tanks. There are 1,310 municipal and industrial wastewater treatment plants and storage installations. In 2005, only 492 plants were functioning adequately.

Major problems in Bulgaria's water sector include an insufficient number of wastewater treatment plants. Of the existing sewage network, 17% needs to be replaced either due to age or outdated technology, and 98% of villages have no sewage systems. Urban wastewater treat-

Figure 1: A latrine for 160 pupils, unpleasant smelling and therefore far away from the school
Source: WECF

ment plants are planned for 430 cities with populations over 2,000 by 2015 [2].

Lack of safe sanitation and safe drinking water in EECCA countries

Since the independence of former Soviet states such as the Ukraine, Moldova, Armenia and many others, existing centralized water and sewage systems have often collapsed or are badly maintained due to the lack of ownership, expertise and an adequate financing system for operation and maintenance. Nowadays, the water situation in rural areas in the Ukraine is one of the worst in Europe and the Newly Independent States (NIS). According to the Ukraine National Report on Drinking Water (2004) only 26% of the rural population is connected to a centralized water supply system and only about 6% has a direct in-house connection. The remaining rural population obtains their drinking water from private or public wells. Meanwhile, only 4.4% of the rural population (i.e. 690,800 people) is connected to the central sewage systems, while all the rest use either pit latrines or septic tanks, which are seldom emptied.

The same situation is observed in countries such as Armenia, Kyrgyzstan, Uzbekistan and others. Officially households have access to an improved water supply, but in most cases the water supply is frequently interrupted, with leaking pipes allowing infiltration of pollutants and micro-organisms into the environment. Rural citizens depend on pit latrines in their backyards or on septic tanks, the contents of which are not properly sanitised. Most people using pit latrines (private or shared) are very unhappy with them because they are unhygienic, dirty and smelly. Since the pit latrines are located outside, in wintertime they are cold and inconvenient, especially when someone is ill.

However, access to a central piped water supply system and access to flush toilets is not at all a guarantee of adequate sanitation. Regular interruptions, even interruptions for some weeks are rather common and hinder the users' access to safe sanitation.

Observed state of sanitation

Women in Europe for a Common Future (WECF) together with local partners has carried out and also has ongoing projects in the rural areas of the new acceded EU countries of Romania and Bulgaria and in 10 EECCA countries (Ukraine, Belarus, Moldova, Armenia, Georgia, Afghanistan, Kyrgyzstan, Kazakhstan, Tajikistan, and Uzbekistan), and has gained experience concerning issues of water and sanitation. The projects were and are mainly financed by the Dutch Ministry of Foreign Affairs and by the French Fondation Ensemble. In many rural communities in the project countries, lack of access to safe drinking water is an important issue. However WECF gained the impression that the problem of the lack of safe sanitation is sometimes even worse among schools in rural areas.

Unhygienic sanitation facilities contain high faecal-oral pathogen loads posing a high risk of infection to their users. Moreover, desludging, predominantly carried out by family labour, is a risk for infection for those involved in this work [3]. The incidence of diarrhoea in children living in neighbourhoods with drainage and sewage is about 60% lower than in those without [4]. Furthermore, associations between the condition of latrines and death through diarrhoeal diseases were observed [5]. In Khorezm, Uzbekistan, the number of households found to have dirty to very dirty sanitation facilities was surprisingly high (35%). The even worse hygiene conditions of school toilets lead to the creation of a participatory health hygiene education programme for schools and communities in Khorezm, aiming at habitual changes as a basis for the optimization of long-term health benefits from water supply and sanitation interventions [6]. It is therefore not only the householders who often have to deal with bad smelling and unhygienic pit latrines, but in particular in schools the sanitary conditions are generally in an unacceptable state [3].

Figure 2: Exterior and interior of a latrine for 360 pupils: no privacy, unhygienic, cold and slippery during wintertime
Source: WECF

Conditions of school sanitation

WECF observed worse conditions for school sanitation in rural areas of all its working countries, for example in Romania, Moldova, Armenia, Ukraine or Uzbekistan; not because the citizens or school staff do not care about the sanitary facilities, but because the systems themselves cause many problems. In pit latrines, faecal matter is disposed of together with urine in a pit and hence the material exhibits high moisture levels, causing very bad odours and attracting flies.

Missing comfort

Due to the system, pit latrines are extremely bad smelling, and in summer visited by large numbers of flies, which pose a health risk. Because a latrine can have an extremely unpleasant odour, the facilities are located far away from the schools (Figure 1). There is not a problem regarding this in countries with a moderate climate, but in areas with very cold winters, where temperatures are far below zero visiting the school toilet is a threat to children's health. For example, in Armenia, Belarus, Moldova, Romania or the Ukraine, temperatures of -15°C are not unusual during wintertime. The latrine users, in particular girls and women, are affected by the cold and bladder infections were mentioned by school staff as a problem during winter for themselves and the pupils.

Another danger during freezing temperatures are slippery floors in the latrine. Usually, the floors of school latrines are wet with displaced urine and will freeze at temperatures below zero. Pupils of an Armenian school complained of being afraid of slipping on the frozen floor of the latrine facility and falling down in the dirt. In almost all school sanitation facilities visited by WECF in rural areas of Romania, Bulgaria and EECCA region, no privacy is

guarantied for the users. Doors cannot be locked or there are no doors at all. Sometimes the pits are assembled or are in a line in one communal space (Figure 2). Often there is no separated latrine for girls and boys. Mostly children and school staff try to avoid visiting the facility as much as possible by reducing their intake of liquids such as tea or water. The general rules for a healthy lifestyle are compromised, promoting the risks of bladder infections and kidney stones. During menstruation, girls prefer to stay at home and are allowed by the school staff to take some days off school. School exclusions have a gender aspect; girls who are unable to access clean, safe and separate toilets and hand washing facilities, may disproportionately drop out of school at puberty, or even earlier [7].

Missing Hygiene

As already mentioned, moist faecal materials are attractive to flies and hence pose a risk for the transfer of pathogens from the faecal material to food and to open reservoirs of stored drinking water.

On the whole, in sanitation facilities there is no anal cleaning material available for the facility users. In some schools the users (mostly school staff) bring toilet paper from home, in summertime children use leaves for anal cleaning (observed in Romania) or children do not clean at all. In many schools visited no hand washing facilities or in some cases even any water was available for washing or drinking purposes. Many studies and literature provide information regarding the health risks related to the lack of hand washing, e.g. intervention studies showed that hygiene education including hand washing using soap have the capacity to decrease the risk of diarrhoea by 43-59% [8]. Using and managing a pit latrine is related to soil infiltration and the handling of unsafe human excreta. The pits are mostly constructed in such a way that the bottom is permeable allowing infiltration of liquid urine contaminated with pathogens into the soil. Depending on the local geo-hydrological conditions, ground water can be contaminated with faecal bacteria and nitrates. Very high concentrations of nitrates and bacteria were found in WECF project villages with a high density of population and pit latrines, e.g. in Romania or in the Ukraine [9]. Once the pit is filled with faecal material, it has to be emptied and often due to a lack of awareness or other possibilities, further safe treatment or reuse of the faecal material is not implemented.

Although all these countries have institutions which perform hygiene inspections or produce regulations on the sanitary conditions of schools, children and teachers often lack basic sanitary facilities. A hygienic and dignified stay at school is not guaranteed. The authorities responsible for school sanitation and policies are not aware of the situation or just ignore it and are not interested in dealing with the issue. The Water Supply and Sanitation Collaborative Council express this behaviour as the following: "Lack of efficient and accountable local governments and municipal authorities has been the most common barrier to progress" [10].

Introduction to sustainable and safe school sanitation – dry urine diverting (UD) toilets

One of the aims of the WECF projects in cooperation with local partners was to improve the sanitary conditions of schools and to manage human excreta in an affordable and sustainable way. However, the projects should also serve as examples to prove that even without access to piped water or to a sewage system, the sanitary conditions can be improved easily and quickly. In 2003, WECF and a local partner introduced the first dry UD school toilet facility in Romania in the village of Garla Mare for approx. 180 children and 8 staff members.

A UD toilet has two outlets and two collection systems; one for urine and one for faeces in order to keep these excreta types separate. Other than that, the system has mainly conventional technical devices, even if they are used in a completely or partly new way [11]. The system does not need water for flushing and implements a safe storage and sanitising process for the separated urine and faeces, followed by the reuse of the sanitised excreta as an agricultural fertiliser, according to the guidelines of the World Health Organisation (WHO) on the safe reuse of human excreta [12].

The UD toilet contributes not only to an improvement of the sanitary conditions, but also to food production and to the elimination of poverty. The principal forces driving the increase in use of excreta and grey water in agriculture are:

- Increasing water scarcity and stress, and degradation of freshwater resources resulting from the improper disposal of wastewater, excreta and grey water;
- Population increase and the related increased demand for food and fibre;
- A growing recognition of the resource value of excreta and the nutrients it contains;
- The MDGs, especially the goals for ensuring environmental sustainability and eliminating poverty and hunger [12];

Figure 3: Exterior and interior of the double vault dry UD toilet facility, built in conjunction with the school for 160 pupils: hygienic, safe and easily accessible without leaving the school.
Source: TUHH, WECF

The first double vault dry urine diverting toilet in Romania

There is no central water supply system in the village of Garla Mare and all the villagers have pit latrines in their backyards. The primary school has its own well, however it was not functioning at the time the project was undertaken. Therefore no means for children to wash their hands after using the toilets were provided. Investigation of groundwater quality showed that the groundwater was extremely polluted with nitrates and faecal bacteria [13]. The pit latrines in the schools were badly built with the floor sloping towards the entrance door. The children therefore had to first wade through wastewater before getting to the latrine.

A toilet facility with 4 double vault dry UD toilets and 3 waterless urinals was installed in August and September of 2003 at a primary school with approx. 180 pupils (aged 6–10 years) and 8 teachers. The Hamburg University of Technology (TUHH) and WECF supported the practical implementation and installation of the UD toilet facility. The sanitation facility should serve as an example of how to improve sanitation and protect ground water in an affordable way, even if there is no connection to a sewage system or water system for flushing [14]. For hygienic reasons, UD squatting slabs were chosen. For the boys additional urinals were installed. The local stakeholders could not imagine that the dry UD toilets could function odour and fly-free, even without water for flushing, therefore the wish was followed to construct an outdoor school toilet facility. The urine and faecal material were separated and stored in reservoirs or chambers allowing a sanitising procedure and reuse in agriculture according to the WHO guidelines [12]. The school well was restored, serving 3 washbasins for washing hands. A survey on the acceptance and the sanitation in the village was carried out among the users and the citizens after one year using the facility. The results showed that almost all of the children (94%) find the ecosan toilets easy and pleasant to use. Only 6% of the children said that the toilets are complicated or unpleasant. The children also like the design of the toilets. Most citizens chose the ecosan toilet as the best choice for toilets at the school (66%), followed by the water flush toilets (26%), and finally pit latrines (2%). The others had no preference (8%). The owners of the pit latrines all agree that the bad odour is the biggest disadvantage of a latrine. Other problems that are generally mentioned are the nuisance of the flies (68%) and the emptying of the pit (47%). Among the pupils interviewed, very few complained about bad smells or flies in the new toilet facilities [15].

The first double vault dry urine diverting toilet in the Ukraine

The kindergarten, primary and middle schools of Gozhuly, Poltava oblast, are situated under one roof and offer education to 160 pupils. The village has a central water supply system (cwss) and a wastewater system, which was not functioning any more and in a dilapidated condition. The cwss delivered water too high in fluorine and sodium concentrations which caused dental and bone fluorosis among the users. However, approximately half of the villagers were not connected to the cwws and depended on nitrate polluted groundwater. The school is connected to the cwss and has two water flush toilets for the smaller children. The older pupils still had to go outside a distance away from the school, to the very unhygienic, smelly and in wintertime, very cold latrines. For these children, the first ecological sanitation toilet facility in the Ukraine was built, with 3 double vault dry UD toilets (squatting models) (Figure 3) and 3 waterless urinals. Due to the very cold Ukrainian winters, the school staff and parents greatly appreciated having a toilet facility which is accessible from the school so that the pupils do not have to go outside in the cold or in the rain for a toilet visit. With the experiences gained in the Romanian school, the fear of bad odours in the UD toilet facility was low.

With the support of the TUHH, a design was developed and the facility was constructed in conjunction with the school. In addition, a simple hand-wash facility for the toilet users was installed. Although some technical problems with the ventilation system had to be overcome, this dry UD facility had a high level of acceptance among the school staff and the users [16]. With the newly gained experience of large-scale indoor school sanitation facilities, other sustainable indoor school sanitation pilot projects in the Ukraine [16] and Armenia [17] were successfully implemented by WECF in cooperation with local partners and TUHH. In the coming 3 years at least 50 UD school toilet facilities in Bulgaria, Romania and in the EECCA region are planned.

Experiences and observations regarding the implementation of urine diverting school toilets

It was shown, that even without a connection to a centralised water or sewage system, the dry UD toilet is a very fast and easy to realise tool to improve the sanitary conditions of schools in an affordable and sustainable way and to protect groundwater against the infiltration of human excreta. The UD toilets do not need water for flushing, do not need connection to a sewage system and bad odour and flies are absent. To have access to an indoor toilet facility without having to walk through the cold or rain was a real improvement for the users.

In general, the level of awareness of environmental and sanitation issues in the project areas was low. At the local level there is very limited access to information on the environment or water quality and a low level of awareness of these issues. The local development and implementation of a sustainable sanitation approach requires authorities to create a good action plan with the involvement of all stakeholders and experts. However, local governments are often lacking in experience, expertise and financial resources.

The challenge of up-scaling sustainable school sanitation

In most EECCA countries there is no effective rural state programme, which focuses on school sanitation; moreover the governments often neglect the desperate situation in rural areas. Pilot projects of indoor dry UD toilets for schools attracted the attention of the regional school authorities and in some countries, such as the Ukraine, school sanitation became an issue for the decision makers. Even UD toilets were well accepted as a great improvement for school sanitation.

Lack of knowledge about alternatives to pit latrines, about the safe management of human excreta and sustainable sanitation systems makes the decision makers re-

luctant to act. The lack of national and international (e.g. EU) recognized regulations on safe sanitation systems, including UD, and on the safe reuse of human excreta, is a reason for decision makers not to promote the approach of the UD systems. Finally, the lack of interest in school sanitation and hence the lack of financial resources are for many communities the main barrier to any improvement of the sanitary conditions in schools.

Conclusion

In their projects in the rural areas of the newly acceded EU countries of Bulgaria and Romania and in the EECCA region, WECF and its partners observed a severe lack of safe school sanitation, where outdoor pit latrines far away from the school without hand washing facilities are commonly found. It was shown that even without a connection to the centralized water or sewage system, the dry UD toilet is a very fast and easy to realise tool to protect groundwater. The new approach of ecological (sustainable) sanitation improved the sanitary conditions of the school in an affordable and sustainable way, and thus improved health conditions. It was also shown that indoor waterless UD toilets for schools with, for example, 360 children (Ukraine and Armenia) contribute greatly to the comfort and safety of the children and thus an improved learning capacity.

School sanitation is an issue that needs the attention of regional, national and international policy makers, although good examples of sustainable school sanitation attract the attention of the decision makers. Better regulation on the adoption of UD systems and the reuse of human excreta in agriculture is a prerequisite for the scaling-up of UD facilities.

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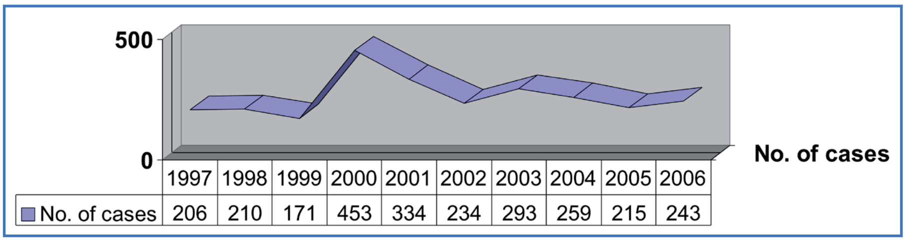
The Evaluation of Acute Infantile Methemoglobinaemia Cases Generated by Well Water in Romania

Methemoglobinaemia (MHb) or "blue baby syndrome" was discovered in Japan few hundred years ago, and was known as "Kuchikuro", the disease of the black mouth. In its current form, the disease was first described in 1945 by the American, Hunter Comly, who discovered the link between the consumption of well water, its high level of nitrates and the occurrence of methemoglobinaemia [1]. Comly also suggested that the conversion of nitrates to nitrites in the human body is favoured by a gastro-intestinal bacterial infection [1],[2].

In Romania, MHb has been considered a public health problem in rural areas since 1955. Since 1984, the Institute of Public Health in Bucharest (IPHB) has established the first recording and reporting system for infantile MHb according to WHO criteria, and since then the local Public Health Authorities (PHA) have recorded the cases caused by the consumption of well water contaminated with nitrates. The national report on "The evaluation of acute infantile MHb cases generated by well water" [3] is elaborated on by IPHB, Water Laboratory, in cooperation



	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
No. of cases	206	210	171	453	334	234	293	259	215	243

Figure 1: The number of cases of acute poisoning with nitrates due to the consumption of well water during the last decade. Source: Institute of Public Health, Bucharest

with local PHAs, within the framework of the National Health Programme, coordinated by the Ministry of Public Health.

In 2002, Romania transposed the Drinking Water Directive (DWD) 98/83/EC into national legislation, Law no. 458/2002 regarding drinking water quality [4]. Two years later, this law was amended (Law no. 311/2004) to include the water provided by wells located in rural areas. The safe limit for nitrates is 50 mg/l and for nitrites 0.50 mg/l.

The Statistical Yearbook of Romania, 2002 shows that out of the total number of 15,700 rural localities, 2,686 have a public drinking water supply (17%). The rest of the rural localities (83%) rely on well water that might be contaminated with nitrates.

Methodology

The toxicity of nitrates to humans is mainly attributable to its reduction to nitrites. These are harmful due to the oxidation of haemoglobin to methaemoglobin, which then does not transport oxygen to the tissues. Because of their sensitivity to oxidizing agents, infants are particularly vulnerable to nitrites. Drinking water is the major source of nitrates for children, and MHb often occurs when infants consume water with a high nitrate content which was used in the preparation of their food (infant formula milk). In 1984, an initiative by IPHB established the first recording and reporting system for infantile MHb, however, a standardized questionnaire was only developed in 2001 to collect information based on the experience acquired.

Part A of the questionnaire, "data about MHb case" provides information about the infant's name, date and place of birth, sex, age, feeding habits, severity of disease, recording place (GP/hospital) association with diarrhoea and/or respiratory diseases, the presence/absence of cyanosis at different locations (extremities, face or generalized), laboratory confirmation and the type of treatment administered.

Part B of the questionnaire, "data about well water" refers to the ownership of the water source (public or private well), construction characteristics of the well (depth of the well), hygiene status (sanitary protection of the well and the distance to the pit latrine, fertilizer and manure disposal, agricultural practices), water quality (chemical – nitrate and nitrite concentrations, and microbiological – faecal coliforms and faecal streptococci contamination).

Results

The number of cases of acute poisoning with nitrates due to the consumption of well water, during the last decade is shown in Figure 1.

When a case of poisoning is recorded, it is followed by an assessment of the well that generated the case. This type of data shows that the illness occurred at concentrations of nitrates exceeding 500mg/l in the counties of Bacau, Botosani, Buzau, Dolj, Iasi, Olt, Vaslui, all of which seem to be hot spot areas. In most of the counties, 24 out of 42, a concentration of nitrates in well water generating the illness was seen within the range of 100-500 mg/l, and 3 districts were in the range of 50-100 mg/l

In order to describe in depth the correlations between various aspects, the situation in 2006 is used as an example, when 243 cases of infantile MHb were registered. The distribution of cases by sex of the children is shown in Figure 2.

According to age group, the distribution of cases is the following: 71 newborns (29%), 110 cases in children aged 1-3 months (45%), 52 cases aged 3 – 6 months (21%) and 10 cases older than 6 months (4%) (Figure 3). The highest frequency of disease occurrence is for the age group 1-3 months.

According to the type of feeding, 155 cases of acute poisoning were related to feeding with formula milk, 70 cases to mixed feeding, breast and formula milk, and the other 18 cases were breastfed babies.

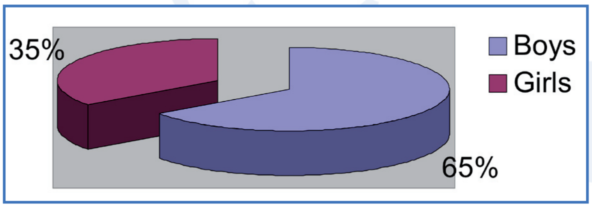


Figure 2: The distribution of cases by sex of the child, 2006
Source: Institute of Public Health, Bucharest

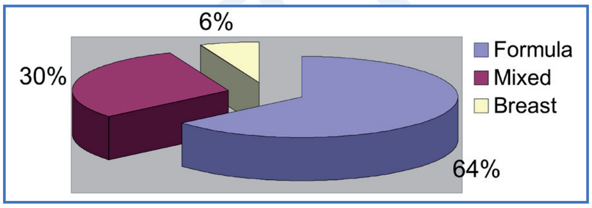


Figure 4: The distribution of cases by type of feeding , 2006
Source: Institute of Public Health, Bucharest

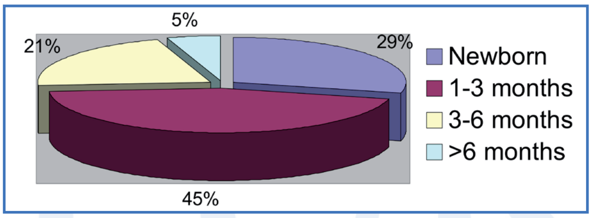


Figure 3: The distribution of cases by age group, 2006
Source: Institute of Public Health, Bucharest

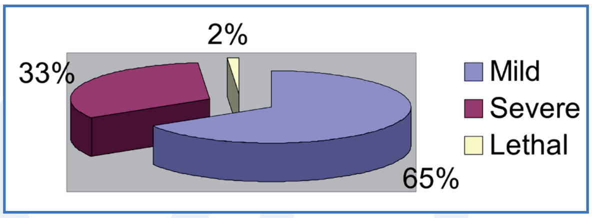


Figure 5: The distribution of cases by severity of the disease, 2006
Source: Institute of Public Health, Bucharest

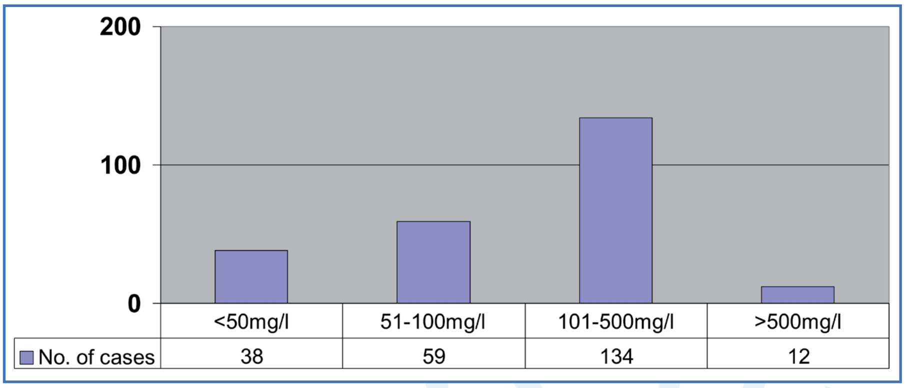


Figure 6: The distribution of cases in relation to the nitrate concentration, 2006
Source: Institute of Public Health, Bucharest

All recorded cases were hospitalized. The blue baby syndrome exhibited as a mild form for 160 patients and a severe form for 79. There were 4 fatal cases recorded, out of which 3 babies were fed with formula milk and 1 with mixed feeding. The concentration of nitrates in well water associated with fatal cases was in the range of 100 – 500 mg/l.

Acute diarrhoea was associated with 48% of the blue baby syndrome cases, and acute respiratory infections with 42% of cases. The treatment consisted of the administration of methylene blue, Vitamin C, perfusions with hydroelectrolites, and antibiotics for the cases with acute diarrhoea and/or respiratory diseases.

The results of the questionnaire, "data about well water" related to the cases of illness showed that 55% of the cases were associated with private wells and 45% with public wells. Only 23% of the cases were associated with a well with a sanitary protection zone. For 84% of the cases, the distance between the well and the pit latrine was more than 10m. The shallow wells with a depth below 10m generated the biggest number of cases (56%). A depth in the range of 10-20m was associated with 31% and wells deeper than 20m generated only 13% of the cases.

The distribution of the cases according to the nitrite content of the well water shows that 72.5% are associated with a nitrite content within the range of 0 - 0.5mg/l and 27.5% with a nitrite content higher than 0.5mg/l.

As regards the microbiological quality of the well water that generated the illness, the following was observed:

- Faecal coliforms in well water: <2 FC/100ml is associated with 30% of cases; >2 FC/100ml is associated with 22% of cases; >10 FC/100ml is associated with 48% of cases;
- Faecal Streptococcus in well water: <2 FS/100ml is associated with 24% of cases; >2 FS/100ml is associated with 28% of cases; >10 FS/100ml is associated with 49% of cases.

Conclusions

Summarizing the data, the following aspects are highlighted:

- The vulnerable groups are newborns and infants between 1 – 3 months.
- Most of the cases are associated with feeding with formula milk.
- Most of the cases showed a mild form of the syndrome.
- In approximately half of the cases the syndrome was associated either with acute diarrhoea or with acute respiratory diseases.
- Most of the cases were generated by the water from shallow wells with a depth less than 10m, without sanitary protection, with a distance to the pit latrine of less than 10m, with a concentration of nitrates within the range of 101–500mg/l, a nitrite content smaller than 0.5mg/l, and poor microbiological quality of the water with more than 10 FC and FS/100ml.
- The counties of Bacau, Botosani, Buzau, Dolj, Iasi, Olt, and Vaslui seem to be the hot spots for nitrate concentrations in well water as well as the risk areas for the occurrence of blue baby syndrome.

The trend for well water contamination with nitrates in specific areas of the country can be established on the basis of the risk charts corroborated with the nitrate vulnerable zones that are recorded by the local environmental authorities, within the implementation programme for the Nitrate Directive 91/676/CEE.

In order to improve the present situation and to protect the babies' health, collective efforts should be undertaken to increase public awareness and to educate the population about the importance of the use of "safe water". The target group for information regarding health related risks of the consumption of drinking water contaminated with nitrates should be pregnant women and those who have small children. The advocacy of breast feeding is also of crucial importance.

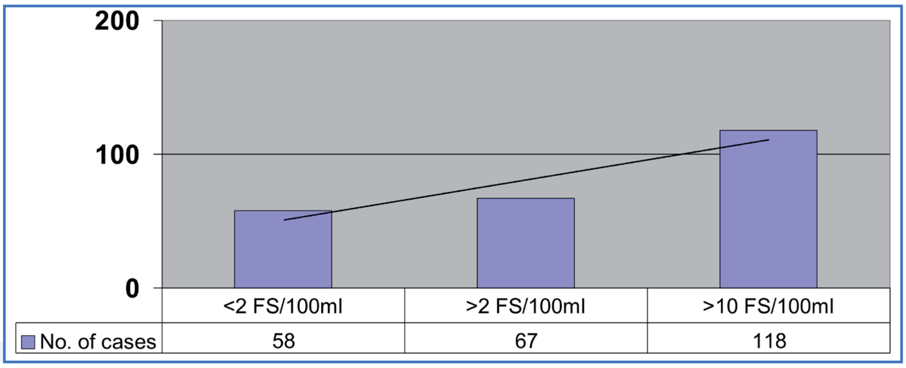


Figure 7: The distribution of cases in relation to the microbiological quality of well water, 2006
Source: Institute of Public Health, Bucharest

The link between children's health and environmental health is an issue of a regional and global concern. Many initiatives like the Convention on the Rights of the Child, the Protocol on Water and Health, CEHAPE, relate children's health to access to safe water and proper sanitation and are seeking solutions to improve the present situation.

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The Investigation of Sanitation and Drinking Water in Rural Areas around Chengdu City, Sichuan Province, China

Chengdu, the capital of Sichuan Province, China, lies in the hinterland of the Chengdu Plain in central Sichuan, traditionally called "the country of heaven". Covering a total land area of 12,400km², Chengdu has jurisdiction over 9 districts, 4 cities and 7 counties. By the end of 2006, the population of Chengdu had reached 10.4 million, of which 3.3 million were urban residents. Water supply for urban residents is provided by water departments. Water provided by water departments all reaches the state sanitation standard; the source water for drinking is safe and clean.

Chengdu is a big city with abundant water resources. It has 12 rivers such as the Ming and the Tuo, together with numerous tributaries. In addition to the reputed Dujiangyan irrigation system, reservoirs, pools and weirs criss-cross in the city, which has an effective irrigated area of 366,000ha.

Water safety estimation system for state drinking water

In 2003, the Chinese State Council published drinking water safety projects for rural areas in the "11th Five Year Plan" [1]. The drinking water safety estimation system for rural areas includes the following indicators [2]:

1. Water quality

Safe water quality is stated as existing when the "living and drinking water sanitation standards" are achieved.

Quasi-safe water quality is stated as existing when the "rural area living and drinking water sanitation standards" are achieved.

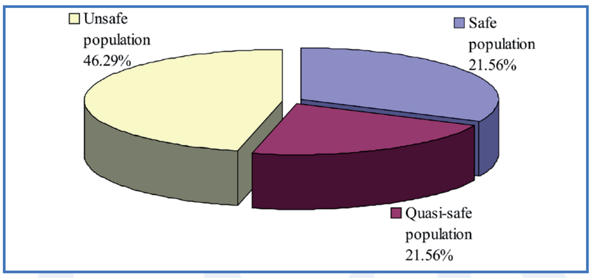

Figure 1 Drinking water safety distribution conditions in rural areas
Source: Du Huilan, 2006

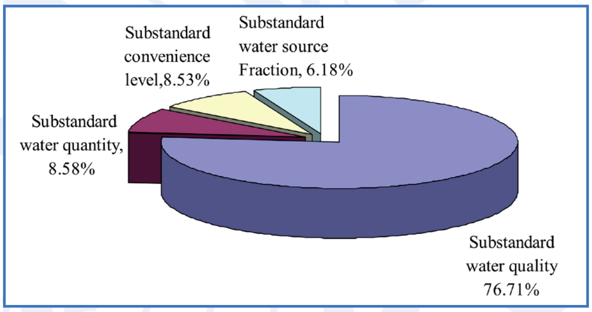

Figure 2 Substandard drinking water distribution conditions in rural areas
Source: Du Huilan, 2006

2. Water quantity

Safely acquired water quantity for one person is more than 40-60 liters/day.

Quasi-safely acquired water quantity for one person is more than 20-40 liters/day.

3. Convenience level

The safe time frame for obtaining water manually is within 10 minutes.

The quasi-safe time frame for obtaining water manually is within 20 minutes.

4. Water source fraction

The safe water source fraction is no less than 95% of total consumed.

The quasi-safe water source fraction is no less than 90% of total consumed.

The rural area water supply mode could be classified into centralized water supply (including municipal water supply, town water supply, village water supply) and non-centralized water supply.

Investigation and estimates

A survey across the city has been conducted. 413 water samples were chemically analysed. Every village was investigated as a basic unit with regards to the water supply mode. Peasants were randomly sampled to complete the questionnaires.

Figure 3: Two small scale drinking water projects in rural areas
Source: www.aoazhou.gov.cn

The statistical analysis indicated that of 6,859,000 rural inhabitants around Chengdu City, a safe water supply is provided for 233,000, a quasi-safe water supply for 1,500,000 and an unsafe water supply is provided for 3,221,000 inhabitants (Figure 1) [3].

The ratio of reasons for substandard water quality, the water source fraction, the water quantity and the convenience level were measured for the population exposed to an unsafe drinking water supply and resulted in 76.71%, 6.18%, 8.58% and 8.53%, respectively (Figure 2).

In 2004, the water supply mode investigation indicated that the population in rural areas connected to a centralized water supply is 1,330,000; the population that uses surface water is 858,000 and the population that use groundwater is 472,000.

Figure 4: Well in rural area
Source: Chinese language of 4th grade in elementary school

The proportion of people with access to tap water is 19.12%. The population that uses a distributed water supply is 5,629,000 or 80.88%. The population that uses water supplied by equipment such as wells or fountains, is 5,359,000, the population that uses water without equipment is 270,000.

The main water quality problems are chrome, turbidity, contamination by iron or manganese, water hardness and bacterial quantity. The amount more or less exceeds the 3rd class value of "rural area living and drinking water sanitation standard". On the whole mountainous and hilly areas are more heavily polluted than the plains and lower reaches are more heavily polluted than upper reaches. The reasons for drinking water being substandard and their relevant proportions are shown in Table 1 [4].

Conclusion

The survey revealed that the situation relating to drinking water safety in rural areas of Chengdu is not satisfactory. 46.3% of 6.96 million rural inhabitants do not have access to a safe drinking water supply. About 76.7%, or 2.47 million of the rural population can not obtain water with a satisfactory standard of water quality. The monitoring data indicated that the main problem regarding drinking water in rural areas of Chengdu was that water quality indicators did not even reach the 3rd standard of "the implemented guideline of standards for drinking water quality in rural areas". Although groundwater and surface water are plentiful in the plain area of Chengdu, the Fe^{2+} and Mn^{2+} in underground water exceed the standard as a result of the geological structure. This has a significant effect on the safety of drinking water. In the surface water source area, organic and bacteriological pollution due to the uncontrolled emission of domestic and industrial sewage endangers the drinking water safety.

Waterworks are small and about 74.6% of waterworks in Chengdu use old, simple and crude equipment, which is often in a state of disrepair, and rusty water pipe networks. More than 45% of small waterworks are without any water purification equipment for drinking water supplies in rural areas. The standard quality of rural drinking water is low, and it is likely to cause waterborne diseases. It is urgent, therefore to implement drinking water safety programmes to expedite the urban-rural integration progress.

Suggestions

1. Technical improvements are urgently needed for all small scale water supply projects in rural areas. To adopt advanced and appropriate process flows to produce drinking water, delivery quality must reach sanitary standards. If surface water is used as source water, some simple and stable water treatment measures such as rough filtration and slow filtration techniques should be applied at rural water treatment plants. Small waterworks can provide safe drinking water for centralized peasants. It is

Water Quality Substandard Species	Population (thousand)	Rate
Brackish water	10,00	0,40
Untreated Ⅳ class surface water	6,18	2,50
Bacterial substandard and untreated surface water	30,17	12,21
Iron ion or manganese ion substandard	54,03	21,87
Others water quality problems	109,00	63,02
Total	155,73	100,00

Table 1: Substandard water quality by type
Source: Government of Chengdu City, 2005

also important to choose appropriate pipeline material and routes. Water contamination by the pipeline and by dead water should be prevented during the transportation process.

2. The development plan should be designed according to local conditions. The centralized water supply pipe networks need to be extended to the plains and hilly regions.
- To replace old, small and simple waterworks with new waterworks and to extend the water pipe networks from town to central village, to outlying villages and then to residential points;
- To enhance the environmental protection around wells in regions not reached by water pipe networks.

3. Improve the protection of drinking water sources in rural areas. A good water source is the precondition for drinking water safety assurance.
4. Pay attention to the purification and disinfection of drinking water, which is a very important aspect in rural drinking water supply programmes. The capability to sanitize and monitor water quality should be enhanced to ensure that the treated water achieves the quality goal. In regions with limited water supply, action must be taken to disinfect drinking water at least in summer and autumn.
5. Depending on the monitoring and detection capability of existing centres for disease control and prevention, a rural drinking water monitoring network is to be built to ensure drinking water safety. The monitoring networks can also assess water quality based on new drinking water supply projects.

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Workshop on Water Safety Plans (WSPs)
4 -5 December, 2007, Moscow, Russian Federation

Within the framework of the Biennial Collaborative Agreement (BCA) between the World Health Organization (WHO) and the Ministry of Health and Social Development of the Russian Federation, a workshop on Water Safety Plans took place in Moscow on 4-5 December 2007. On behalf of the WHO, Dr. Thomas Kistemann and Dr. Susanne Herbst, held a seminar on the quality and safety of drinking water in the context of updated recommendations by the WHO and experience in the European region.

The workshop was attended by 29 senior experts from institutions and organisations of the Federal Service on Surveillance of Consumers' Rights, Protection & Human Well-Being (Rospotrebnadzor) of the Russian Federation, institutes for scientific research with a hygiene background and responsible professionals from Rospotrebnadzor. The WHO/ EURO experts presented the goals and objectives of the seminar – the introduction of Water Safety Plans (WSP) and all the steps of water safety planning.

Access to safe drinking water remains a problem in the Russian Federation. Recent data from the Joint Monitoring Programme of the WHO and UNICEF (2004) have shown that water is supplied to homes for 93% of the urban population and 52% of the rural population. Water quality is a frequent problem, and thus an increase in the efficiency of water quality management would be a significant contribution to public health.

Figure 1: Workshop on Water Safety Plans
Source: T. Kistemann

Figure 2: Workshop on Water Safety Plans
Source: T. Kistemann

The Water Safety Plan approach is presented in the 3rd edition of the WHO Guidelines for Drinking Water Quality. This approach includes a comprehensive risk assessment in all steps of water supply from catchment to consumer, as well as an evaluation of the three main actions responsible for the drinking water supply: water supply assessment, the performance of operational monitoring and the improvement of water management.

Water Safety Plans, or their major components, are now being introduced in many countries; while the European Union intends to review the existing Drinking Water Directive with a view to include WSPs.

The following objectives were identified in the workshop agenda:

- Introduction to the concept of WSPs as an alternative to the existing parametric approach.
- Providing information on the advantages of implementation of WSPs and experience gained in this field.
- Providing guidelines on the assessment methods of existing water supply systems as a possible framework for action in the period 2008-2009.

In addition to the core presentations on Water Safety Plans (5 steps), the WHO experts also gave insight into the "Timescale and cost implications of WSP" and the "Application of GIS to WSP" as well as providing answers to all questions posed during the course of the seminar. The seminar participants presented four case studies which were carried out successfully as a basis for the practical part of the seminar, "The identification of hazards and risk prioritization" and "Operational monitoring", According to the evaluation of WHO/Europe experts and the opinions of the senior experts from the Federal Service on Monitoring of the Protection of Consumers' Rights & Human Well-Being, the seminar was held at a high level.

Following the seminar, a collegial decision was taken to use the planning methodology in the practical activities of Rospotrebnadzor institutions and organisations. The workshop participants express their gratitude to Dr. Susanne Herbst and Dr. Thomas Kistemann for the excellent seminar as well as their hope for further cooperation on the development of Water Safety Plans.

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Moscow, Russian Federation

- translated from Russian by Oksana Krämling, IHPH -

Events on Water, Health and Risk Communication:

Mai 2008

The Sanitation Challenge, 19.05. - 21.05.2008, Wageningen, Netherlands
http://www.sanitation-challenge.wur.nl/UK/

June 2008

Expo Zaragoza 2008: 'Water and Sustainable Development', 14.06. - 14.09.2008, Zaragoza, Spain
http://www.expozaragoza2008.es/

Water Management Congress Europe, 16.06. - 17.06.2008, Prague, Czech Republic
www.watermanagementeurope.com

August 2008

World Water Week, 17.08. - 23.08.2008, Stockholm, Sweden
http://www.worldwaterweek.org/

September 2008

IWA World Water Congress and Exhibition, 07.09. - 12.09.2008, Vienna, Austria
http://www.iwa2008vienna.org/i8/

WaterTech Central Asia: Central Asian International Water Technology Exhibition & Conference, 16.09. - 18.09.2008, Almaty, Kazakhstan
http://www.iwtca.com/en/2008/

2nd European Water and Wastewater Management Conference, 29.09. - 30.09.2008, ThinkTank Birmingham, UK
http://www.thinktank.ac

October 2008

IV International Symposium on Transboundary Waters, 15.10. - 18.10.2008, Thessaloniki, Greece
http://www.inweb.gr/index.php?option=com_content&task=view&id=241&Itemid=146

December 2008

International Conference on Water Scarcity, Global Changes and Groundwater Management Responses, 01.12. - 06.12.2008, University of California, Irvine, USA
http://www.unesco.org/water/ihp/pdf/uci_dec08.pdf

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