

Water and health

by Stephanie Heiland¹

The health of the people is one of the decisive indicators for the success or failure of interventions in the ambit of water and sanitation. Worldwide more than 1.1 billion of people lack access to safe drinking water and around 2.6 billion people lack sanitation. Every year around 2.2 Million people in developing countries die of the consequences of diseases caused by contaminated drinking water or deficient sanitation and hygiene. In the year 2002 around 1.8 million people died of diarrhoea and 1.3 million of Malaria, most of them children under 5 years living in Sub-Saharan Africa and South East Asia. Interventions in the area of water, sanitation and hygiene contribute to reduce these health risks.²

The most important correlation between water and health is the infection of people with water-related diseases because of qualitatively and quantitatively deficient drinking water, sanitation or hygiene. Besides, a frequent cause of death is poisoning by chemicals in the water.

Health does not only refer to the absence of disease and frailty, but also to the state of mental and social wellbeing of a person (definition of "health" of the World Health Organisation). In this sense, there is also a cultural and social determinant of health related to water and sanitation, for example fear and shame because of public defecation (especially women and girls), psychosocial disorders when a family member

dies of a water-related disease, or when people feel ashamed because they are not able to wash themselves, their clothes or their homes on a regular basis.

Another important aspect is the availability of clean water nearby. This has impacts on the health especially of women and children, because women save time and spend more time with their children and they are not exposed anymore to the health risks of far away water points (physical damages because of heavy weight, rape, muggings, lack of sleep, exhaustion).

In this article, the focus will be on water-related diseases and the assessment of health impacts in water and sanitation.

Drinking water

There is a very high health risk arising from microbial germs in the drinking water. Various forms of transmission can be distinguished.

One way of transmission is by consumption of water contaminated with animal or human excrements, which is most of the time a vector for pathogenic bacteria (for example Salmonella, Cholera...), viruses (for example Hepatitis A, Rota viruses) or parasites (for example Guinea worm).

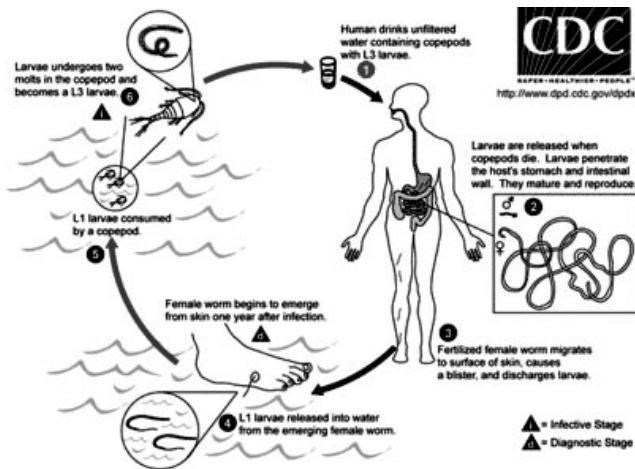
Other forms of transmission are by organisms that reproduce in the tubes of the water supply system or by inhalation of water drops or aerosols that offer a breeding ground for these organisms when there are warm temperatures and appropriate nutrients. An example in both cases is Legionella.

A fourth way of transmission is by contact with water, for example when bathing or getting water and carrying it home. For example the germ of Schistosomiasis or bilharzia is transmitted by water snails in the state of larvae by penetrating the skin of human bodies when these are in contact with the contaminated water.

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² United Nations 2006: *Water – a shared responsibility. The United Nations World Water Report 2. UNESCO and Bergham Book, New York.* <http://www.unesco.org/water/wwap/wwdr2/>

The life cycle of *Dracunculus medinensis* (Guinea worm).



The control of the microbial germs has to occur on different levels between the watershed and the consumer, starting with the control of the water resources, continued by the right choice of water resources appropriate for drinking water, the use of appropriate treatment methods, and the successful management of the pipe system. The priority is on the prevention of the contamination of the raw water, to avoid expensive treatment procedures.

The main difference between microbial germs and chemicals in the drinking water consists in the duration of the consumption. Microbial germs can lead to a disease after short-term consumption, whereas most chemicals cause diseases not until they were consumed for a long time.

The most useful categorization of these chemicals is according to their sources.

- 1) Natural sources, for example rocks, soil conditions, climate
- 2) Industrial sources or human housing, for example mining, construction industry, wastewater, waste, urban draining
- 3) Agricultural sources, for example manuring, sillage, cattle breeding and pesticides
- 4) Chemicals used in water treatment and chemicals arising from substances in contact with water, for example sealants, waste products of disinfections, etc.

- 5) Pesticides in the water for public health, for example larvicides used for vector control
- 6) Cyanobacteria, for example at the eutrophication³ of lakes

Even though many chemicals mean a possible contamination of the water, there are only a few with a major meaning regarding health. For example a high supply with Fluoride, that can also have a natural origin, can lead to tooth or skeleton fluorose. Arsen can show a natural concentration in the water, and with high supply increase the risk of cancer or release skin diseases.

Agricultural manuring and waste water is the main entry source for Nitrate and its metabolized product Nitrite in surface and ground water. There is a danger especially for bottle-fed babies to get Methamoglobinemia⁴.

If the raw water is already contaminated with chemicals, measures should concentrate on the choice of the raw water, the prevention of contamination (for example by water protection areas) and the treatment. If there is a contamination caused by the production and distribution of the drinking water, these processes have to be improved.

Sanitation and wastewater use

As mentioned before, there is a high risk for the transmission of microbial germs by consumption of water contaminated with excrements. Therefore, one should intervene on the different interfaces on the way of the germ from the excrements to the organism of a potential victim. The most effective measure is obviously to intervene on the primary interface, which means between the contaminated water and the fingers, groceries, ground or insects.

³ Eutrophication refers to an increase in the primary productivity of any ecosystem. It is caused by the increase of chemical nutrients, typically compounds containing nitrogen or phosphorus.

⁴ Methamoglobinemia refers to a higher concentration of methamoglobin (Methamoglobin) (Met-Hb) in the blood. It can cause oxygen deficiency in the blood, vertigo, headaches, nausea, accelerated activity of the heart, shortness of breath, somnolence. A concentration of Met-Hb in excess of 70 to 80 % leads to death.

The contamination of groceries or hands should therefore be kept as little as possible from the beginning, for example by hand washing with soap after defecation or by implementing appropriate sanitation systems.

It is necessary to intervene on all levels, emphasizing the household level, because most of the hygiene measures take place in the own house. Other interventions in the field of sanitation have to do with the wastewater caused by washing dishes, laundry or human beings, and with water from the draining of buildings and streets, as well as from waste.

In some regions, the use of wastewater in agriculture is practiced since several centuries. During the last 20 years, the interest in a controlled use of wastewater in irrigation has risen, on the one side because of the growing scarcity of water resources, improper disposal of wastewater and the growing consumption of food because of the population increase; on the other side there is a higher appreciation of the value of wastewater as a resource for agricultural irrigation because of its nutrients.

The risk of using wastewater for irrigation is that microbial germs can survive as much time necessary to get via the plants and field fruits into the food chain of the people and cause diseases. Like this, some chemicals, especially heavy metals, stay in the nourishment circulation for years.

Some possible measures to protect the health of the people that should accompany wastewater irrigation in agriculture are the following:

1. Restrictions for cultivated fruits. The highest health risk exists for fruits that are consumed rawly without pre-treatment. Alternatively, plants can be cultivated that have to be pre-treated before consumption (rice, wheat) or that are not designated for human consumption but for other sales (cotton, colza for Biodiesel).
2. Application techniques for irrigation with wastewater. There is a high health risk for people working in irrigation with wastewater. Flood and furrow irrigation leads to a permanent contact of the workers with the contaminated water, especially when using deficient protective clothing. Sprinkler plants spread bacteria and germs extensively and via aero-

sols to human settlements nearby. Local irrigation that would offer the best protection for the workers is unfortunately the most expensive method. At flood irrigation the treatment before the application can help. When using sprinkler plants there should be a buffer area of 50-100 m to houses and streets or micro sprinkler/directed sprinkler should be used.

3. Preparation of food. Careful washing of raw food (with detergents) leads to a clear decrease of health damaging bacteria.
4. Water treating measures cover a set of biological, chemical or technical procedures to separate the water from pathogenic bacteria, germs or chemicals.

The most current are

- a) stabilization ponds, in which natural components as sunlight, temperature, sedimentation or biological decomposition lead to treatment,
- b) artificial wetlands, in which certain plants decompose part of their pathogenic materials biologically, or
- c) procedures consisting in several processes, as for example first sedimentation tanks, followed by chemical or biological treatment and concluded with filtration.

Malaria

One of the reasons for the spreading of diseases is the geographical proximity of the infected people to ecosystems that favour the brood of insects as vectors of germs. A lot of these insects need water for parts of their life cycle. Typical diseases that are transmitted like this are Malaria⁵, Schistosomiasis⁶, Elephantiasis⁷ und Japanese Encephalitis⁸. Malaria – with 1-3 Million deaths/year, most of them young children in Sub-Saharan Africa – presents the highest risk factor.

During the last years, insects (especially mosquitoes) that carry Malaria germs, were fought with insecticides and other chemical means, causing a growing resistance of the insects against the pesticides.



Another factor for the multiplication of mosquito populations (and with it Malaria) was the deficient hygiene in the context of street construction, irrigation systems, agricultural drainages, flood protection constructions, dams or reforestation.

As it is very expensive to create new pesticides, the actual focus to prevent the spreading of the insects – apart from using mosquito nets and repellents – is environmental management, meaning changes in the ecosystems that lead to a decrease of insect populations carrying the Malaria germs. These are more or less the same measures to fight Malaria that were used at the beginning of the 20th Century!

Health Impact Assessment

In development cooperation, the analysis and presentation of impacts gets more and more importance. This is linked to the necessary increase of impacts (aid-effectiveness) to reach the Millennium Development Goals (MDG). On the level of counterpart countries, impact analysis is relevant especially in the context of Monitoring and Evaluation of Poverty Reduction Strategy Papers (PRSP).

One of the approaches to improve impacts of water and sanitation on the health situation of the people is the so-called Health Impact Assessment (HIA), “a combination of procedures, methods and tools by which a policy, programme or project may be judged as to its potential effects on the health of a population, and the distribution of those effects within the population.” (WHO consensus paper of Göteborg 1999).

An HIA offers a framework for impact analysis to improve the decision foundations and integration of health as a transversal topic. This can be established on project-, programme- or national level.

An HIA is a management instrument that helps to integrate relevant aspects regarding the health of the people into policies and programmes across the sectors.

Two approaches for HIA can be distinguished: (1) the bio-medical approach that investigates the direct health impacts (risk assessment, epidemiological investigations), and (2) the approach of social determinants that investigates the indirect impacts according to a

broad definition of health. In practice, an HIA usually consists of a combination of both approaches and includes quantitative as well as qualitative primary and secondary data.⁹ In this way impact statements can be established for an extensive, all-embracing understanding of health.

⁵ *Malaria is a vector-borne infectious disease that is widespread in tropical and subtropical regions. Malaria parasites are transmitted by female Anopheles mosquitoes. The parasites multiply within red blood cells, causing symptoms that include symptoms of anemia (light headedness, shortness of breath, tachycardia etc.), as well as other general symptoms such as fever, chills, nausea, flu-like illness, and in severe cases, coma and death.*

⁶ *Schistosomiasis or bilharzia is a parasitic disease caused by several species of flatworm. It is an often chronic illness that results from infection of the blood with a parasitic flatworm. It causes debilitation and liver and intestinal damage. It is most commonly found in Asia, Africa, and South America, especially in areas with water that is contaminated with fresh water snails, which contain the parasite.*

⁷ *Lymphatic Filariasis is a parasitic and infectious tropical disease, caused by three thread-like parasitic filarial worms, all transmitted by mosquitoes. The most spectacular symptom of lymphatic filariasis is elephantiasis – thickening of the skin and underlying tissues – which was the first disease discovered to be transmitted by insects. Elephantiasis is caused when the parasites lodge in the lymphatic system.*

⁸ *Japanese encephalitis is a disease caused by the mosquito-borne Japanese encephalitis virus. Domestic pigs and wild birds are reservoirs of the virus; transmission to humans may cause severe symptoms. This disease is most prevalent in Southeast Asia and the Far East.*

⁹ *Manuals that present different methods and instruments of an HIA can be found for example on <http://www.who.int/hia/tools/toolkit/en/index.html>*