

Water: Pumps for all?

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Simple intervention, complex catastrophe

" There are things that are impossible to know, but it is impossible to know these things" - Arthur Bloch.

Well drilling is considered a particularly successful public health intervention. This strategy was also very successful in the short term, until decades later when problems emerged that were many times greater than those that the interventions were intended to solve.

In order to learn from failed interventions in intrinsically dynamic systems, it is necessary to recognise and understand complexity. Living system processes, which are influenced by many factors or even chance, can only be defined in target lines and planning cycles to a limited extent.

A clear description of causal relationships between causes and effects is misleading in complex systems, as living networks of relationships are influenced and changed by coincidences and as yet unknown causal relationships.

As a particularly successful public health intervention, the technique of well drilling is based on a principle that is at least 200 years old: the suction of water in a thin pipe. Until the 1950s, hand-operated pipe pumps were also used in industrialised countries, primarily to supply drinking water to households in rural areas. Increasingly, however, drinking water was only obtained from a few controlled, safe deep boreholes and the population was supplied from there via pipe systems.

In regions of the world that used to be called "colonies", "third world", "underdeveloped" or "developing" countries, however, swing arm pumps were still favoured for water supply. This is because these hand pumps can be installed quickly, easily and inexpensively. As the water can transmit infectious pathogens from shallow borehole pumps, drilling was carried out as deep as water could be lifted with a hand pump (1). At a drilling depth of 50 to 80 metres, crystal-clear and germ-free water was obtained.

In the programmes devised by the authorities "in the North", the focus was on improving a simple technology for the people "in the South" that had long been abandoned in industrialised countries. After all, "quick and cheap" was much more interesting economically than "long-term and sustainable".

The installation of the hand pumping system secured by a concrete slab was an immediately visible success for everyone involved. It also reduced the burden on women. They no longer had to balance water from a distant river on their heads as they had to before.

The traditional, reed-covered rainwater collection ponds used to supply drinking water no longer had to be laboriously maintained as they had been for thousands of years. They could now be used for seemingly more useful purposes: Fattening and breeding fish in them, draining them or using them as rubbish pits (2).

With plenty of water available and the supply of artificial fertilisers and pesticides, "green revolutions" were launched worldwide. It was believed that not only diarrhoeal diseases but also famines had been successfully combated.

In desert or steppe regions, through which nomads used to pass, more and more people were now able to settle, build their huts or even use concrete. This led to the development of a wastewater problem, but this seemed to be easily manageable by digging latrines or draining it "somewhere".

As a result, donors and target groups alike were enthusiastic about these small interventions in seemingly stable geological contexts. It was not until many decades later that people were completely surprised to realise that the relationships proved to be complex and dynamic in their own right.

The public health doctors responsible for population health behaved in the same way as their clinically active colleagues: they looked at short-term healing results for the "others", the "treated". In doing so, they overestimated the possibilities of technical interventions that they did not apply to themselves. Ecological, social, cultural and geological contexts and interactions were usually of no importance to them (3).

When drilling the well, the fact that both the installation and its surroundings changed over time was suppressed, albeit very, very slowly.

Example: Bangladesh and West Bengal

The arsenic poisoning in Bangladesh caused by bore well water has been researched extensively and in detail over decades. They describe a massive, lasting and irreversible catastrophe (4, 5).

As part of international "development aid" programmes, diarrhoeal diseases and cholera were identified as the main problems in Bangladesh, among others, which led to high child mortality. The solution was to supply the rural population with swivel pumps with a drilling depth of 50 to 80 metres. As soon as clean water flowed out of the pipes, the number of gastrointestinal infections and the associated mortality rate fell.

The extracted, clear groundwater was uncontaminated. Germ-contaminated surface water was discharged into rivers from which people no longer drank. Cholera seemed to have been defeated. The organisations involved, users and responsible authorities were all delighted with the great progress made.

Over the following decades, however, arsenic levels rose in the still sterile drinking water from many tube wells. This new health problem came to the attention of individual scientists around thirty years after the first wells were drilled.

However, the organisations involved, including UNICEF, and local authorities initially vehemently denied the connections. Until it was no longer possible to suppress it.

Why?

The reason for the initially absent, and then unnoticed, creeping poisoning was that arsenic occurs as a chemical element in many layers of the earth in a solidly bound form. The plains at the foot of the Himalayas are particularly rich in pyrite (iron-sulphur gravel) and arsenic-pyrite at lower levels. These minerals are harmless as long as arsenic is not released from them as a result of external interference through rock weathering or chemical processes.

This is exactly what happened and is still happening in the tube wells in Bangladesh: because water was and is so easily available through the wells, consumption in Bangladesh alone has risen by more than 60 per cent in the last twenty years.

However, with excessive utilisation, especially in the dry season, the water level also sinks in deeper rock layers. Pebbles containing arsenic then come into contact with air. They are then flooded again during the rainy season, dissolving metal ions. Seepage of chemical products such as fertilisers, pesticides and toxic waste as well as the colonisation of iron oxide-decomposing bacteria accelerate chemical processes.

The well water, which gradually became contaminated with arsenic, was and is not only drunk, but is also used to irrigate the rice fields and other farmland.

The health consequences

Water-soluble arsenic molecules act like cytotoxins, initially in the skin, but then gradually also in the brain, heart, immune system and kidneys. Arsenic replaces the element phosphorus in protein molecules and thus disrupts their function. Although the altered proteins are broken down immediately and the arsenic is excreted again, the organs are ultimately affected by cell dysfunction. Among other things, cancer can also develop.

In Bangladesh alone, more than 70 million people are affected by high concentrations of arsenic, and over four million of them are so highly exposed that serious illnesses requiring treatment occur, such as limb amputations and skin cancer. The health services in this already poor country are completely overwhelmed.

Patients who are suffering greatly often ask their doctors for treatments that are not possible, which further exacerbates the problem. This is because the substance that causes arsenic is flushed out when symptoms appear. Frequently requested "treatments" with medicines that help to excrete heavy metals, so-called chelate complexes, are therefore of no use. The "natural remedies" often offered are not only ineffective but also dangerous, as they are often contaminated with heavy metals, arsenic and pesticides in these regions. In addition, placebo preparations, i.e. "tranquillisers", worsen the situation of those affected. This is because they hinder their ability to understand their own situation and look for self-determined ways out of their crisis.

The WHO considers concentrations above 10 micrograms of arsenic per litre to be very dangerous. In India and Bangladesh, the legal limit has been raised to 50 micrograms per litre in order to solve the problem quickly. However, arsenic concentrations are significantly higher locally and continue to rise.

International organisations, including UNICEF, which caused the new health problem, initially tried to ignore or deny it. When they were forced to accept it after a few years of resistance, they denied any responsibility. Decades earlier, they had acted according to the best available knowledge at the time. Nobody could have foreseen arsenic poisoning.

Those affected were now offered cheap household appliances: for example, clay pots filled with sand and stacked on top of each other to filter arsenic compounds out of the water. However, they were hardly accepted because the effort involved in filtering the water was too great, especially for the already overburdened women of impoverished sections of the population. In addition, bacteria colonised the replacement systems if they were not constantly cleaned. The number of diarrhoeal diseases therefore threatened to increase again.

It is no longer possible to return to traditional drinking water treatment in natural ponds, which have been operated very successfully locally for thousands of years. They had been destroyed, filled with rubbish, levelled or contaminated with pesticides or fertilisers (6, 7).

Since then, geological mapping of the subsoil, large-scale soil analyses and chemical analyses of the water have been carried out. It would be possible to drill over 200 metres deep into aquifers in regions where the arsenic-containing pebbles do not occur, but this would require the installation of an extensive, expensive water pipeline system. This also appears to be too expensive for UNICEF. That is why they are focussing on deep drilling at the sites of contaminated surface wells and proudly write: "Clean water - thanks to UNICEF".

They have already drilled 2,000 new deep wells 250 metres deep. That sounds convincing. A census in 2000 alone registered 11 million, half of which had arsenic concentrations of over 50 micrograms at the time. Today, 24 years later, the situation will have become even less favourable. In addition, the soil and food chains are now also contaminated, affecting at least 35 to 77 million people in Bangladesh alone - excluding West Bengal and Nepal (8).

UNICEF wrote on its website on 26 February 2024 that it was "educating the population". I found no acknowledgement of its own responsibility as one of the perpetrators of the misery, nor any description of the connections that led to the poisoning. It was as if the problem had fallen from the sky as if by fate.

Surprisingly, UNICEF does not mention the obvious risk of drilling through superficial, arsenic-containing aquifers on the way to deep, previously arsenic-free layers. Could this not lead to communication between the water streams, so that previously arsenic-free deep watercourses are not also contaminated many decades later?

To err is human. So is learning.

Arsenic poisoning is one of the most far-reaching man-made disasters. Interventions that were successful in the short term caused a meltdown. In the long term, the new problem proved to be many times greater than what was previously intended to be remedied.

A target-orientated, technical-mechanical "combat" strategy can no longer succeed. This is because the interrelationships are now developing in a highly complex and dynamic way. It is therefore necessary to switch to the management of problems that cannot be "controlled", taking into account all facets of social and ecological development and their interactions.

One should pause. We should mourn the damage done and apologise. We should learn from our terrible mistakes and radically rethink.

Instead, most "development cooperation" brochures (e.g. GiZ, see GIZ links in the sources at the end of the article) describe how to "constantly improve" by learning "lessons from successes" or "best practice". On the other hand: Learning from mistakes? Not a chance.

This is all the more astonishing because it is now known that bore wells in certain regions of Africa, including Ghana and Burkina Faso, are similarly contaminated (9). High concentrations of arsenic are also found in drinking water in Indian regions such as West Bengal or in Nepal, China, Mongolia, Cambodia, Vietnam, in some regions of Canada, the USA and Argentina (see links "British Groundwater Survey" (BGS) under the sources at the end of the article).

It is possible that arsenic is not the only risk associated with drilled wells. As in many other countries in which the water supply for the village population is based on swivel pumps, more and more people in Tanzania are suffering from high blood pressure.

In a survey published by the Tanzanian Ministry of Health in 2023, 11 per cent of women aged between 15 and 49 were classified as hypertensive (10). The prevalence of hypertension increases with age depending on the region, from 3 per cent in women aged 15 to 19 years to 31 per cent aged 45 to 49 years. The causes of this have not yet been investigated. One hypothesis could be that kidney damage caused by various metal ions, particularly manganese, could be responsible for the development of high blood pressure (11, 12).

Government authorities and development cooperation institutions would therefore actually have to test the water from all the 50-80 metre boreholes they have installed for metal ions, at the latest when they are decades old. If necessary, alternative water supply concepts would have to be developed: Water pipeline systems or the renaturalisation of traditional ponds overgrown with reeds.

The ecological and economic interrelationships should be taken into account in the context of sustainable regional development. And, of course, intensive care should also be taken of those affected whose living conditions and health have been worsened by "development" co-operation measures.

Development where to?

In order to learn from failed interventions in intrinsically dynamic systems, it is necessary to perceive and understand complexity (6, 7, 13). Processes in living systems, which are influenced by many factors or even chance, can only be defined in target lines and planning cycles to a limited extent. A clear description of causal relationships between causes and effects is misleading in complex systems, as living networks of relationships are influenced and changed by coincidences and as yet unknown causal relationships.

Interventions are static, usually simple. They bring short-term returns. However, the environment in which they operate changes, albeit very slowly. In growth and profit-orientated strategies, the probability of rare risks, ignorance and long-term interactions is usually ignored (14).

When dealing with systems, as with the immune system and brain development of a newborn, it is more important to create protective, safe framework conditions for flourishing and natural growth than to intervene specifically and purposefully in self-dynamic development processes.

The idea of "development" is part of the neoliberal capitalist notion that mechanical interventions in complex contexts eliminate problems that hinder growth. The term "development" (under-developed, developing countries) goes back to US President Harry S. Truman, who in 1949 called for a new international strategy that would distinguish itself from both the old "colonial civilising mission" and the socialist "liberation movements": "The growth of production is the key to prosperity and peace".

President John F. Kennedy then specified on 20 January 1961: "... if a free society cannot help the masses of the poor, it cannot save the small number of the rich." He created volunteer programmes such as Peace Core and expert services such as USAID, which were immediately followed by the German Development Service and GAVI/GTZ/GIZ, among others. And so the well drilling programmes also took off.

Only a few disagreed at the time, such as the theologian and philosopher Ivan Illich, who called development policy an externally determined "modernisation of poverty" and considered it more dangerous than colonial missionary work (15).

It was and is typical of "development aid" - later called development cooperation - that "billable" projects are carried out. In other words, interventions that end when the budget is used up. The project managers

work for powerful international clients who pay them and to whom they have to justify themselves. The interests of the weak village populations are of secondary importance in comparison. Once the project has been implemented, i.e. "the well has been drilled", a report is drawn up with indicators of target achievement - if possible as a shining example for others. Then you are paid and move on to the next project.

Development cooperation (DC) thus offers local target groups "simple" solutions that appear to be worthwhile for the countries of origin of the "aid", but which would never be realised in wealthy countries.

EWZ's project planning was and is based on different variants of "goal-oriented project planning", a method that would be absurd to apply in capitalist industrialised societies. Because there, reality is complex. In developing countries, on the other hand, it is very simple because it is characterised by interests: You define a problem and then think of it as being eliminated: You already have the goal. All that remains is to define the path between the problem and the goal and to describe the indicators for achieving the goal.

Over time, goal-orientated project planning (ZOPP) has evolved into ever more complicated planning systems that can only be managed with high-performance computers (see GiZ links). But even then, the old concept of "problem elimination" still remains. In other words, the justification for a project that combats a problem.

Once the problem has disappeared, further considerations are superfluous. Long-term accompanying investigations are usually spared, and "responsibility" or "liability for errors" are foreign words in the EWZ.

Many former experts are therefore calling for the EMZ to be dissolved without replacement. In favour of fair economic agreements to support states in determining their own destiny and that of their country (see [Bonn Appeal](#)).

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