Management of errors & development cooperation

Did the arsenic disaster in Bangladesh lead to consequences?

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SSRN Publication 30.05.2018

German:

- Fehler-Management in der Entwicklungszusammenarbeit. Welche Konsequenzen hat die Arsen-Katastrophe u.a. in Bangladesch? Curare 2017, 40(4):329-35 – https://www.medizinisches-coaching.net/wp-content/uploads/2019/06/Curare_Arsenic_2017.pdf
- Einfache Intervention – komplexe Katastrophe, Curare 2007; 2/3: 199–206 – https://www.medizinisches-coaching.net/wp-content/uploads/2019/06/Curare_Arsenic_2007 (pdf)

Summary

The precautionary principle is widely accepted in international law to guide decisions about proposed interventions. The principle is therefore relevant for interventions promoted as part of development cooperation. Disasters such the arsenic problem in Bangladesh and

elsewhere in South and Southeast Asia demonstrate that development interventions are not always guided by the precautionary principle. In Bangladesh, well-intentioned efforts to address a specific problem ended up creating a new problem, i.e., the worst mass poisoning in human history. The arsenic problem in Bangladesh is an example of failures to appreciate and manage complex systems. Concentrating on rapid problem solving can be highly effective on the short run, but reliable sustainability depends on understanding the dynamics of complex and interrelated systems.

Learning requires mistakes

Toddlers learn by trying out spontaneous actions and recognizing effects, especially when things go wrong. With experience, they develop skills that lead to desired goals and limit errors. The period of ignorance of a happily crawling child is followed by the frustrating realization of not being able to stand. This leads to many painful failing attempts to get up. Then the phase of conscious competence appears (shaky standing and staggering walking), which is eventually replaced by unconscious competence (running). If you protect the child from all mistakes on the way, it would never learn to walk. Mistakes make a positive contribution to learning. However, mistakes must be the right size. Learning is best done in a protected environment where something limited and small can be tried, with the results analyzed through self-reflection and communication.

With careful learning processes, short- and long-term damages remain limited. However, mistakes should not be too small. Because only when they hurt, or when they lead to frustration or anger, do they force favorable behavioral adjustments or even radical changes. Sometimes unexpected errors are followed by permanent damage. If such dangerous errors occur, the essential learning experience is to make sure that the same constellation causing the error does not happen again. Such errors should be permanently anchored in the memory: It is bad enough that the Titanic had to sink once.

In technical industries, fault management is a standard daily concern. For example, analysis of the crash of Air France 440 in 2009 (BEA 2009) led to new training programs: pilots have been trained to act prudently when gauges and computers indicate nonsense. How else, without the analysis of the Air France crash, could pilots have learned this? It is extremely dangerous to suppress and forget catastrophic mistakes. Forgetting allows the same errors to recur and even expand. For example, through the early 1950s, Dr. Freeman and others lobotomized more than 40,000 psychiatric patients, i.e., pushing a small pick into the brain through an eye socket and then moving it back and forth to sever connections to the pre-frontal cortex. This catastrophe should have led to a worldwide outlawing of psycho-surgery. Instead, Freeman has been forgotten, while his grossly flawed method paved the way for ever-finer miscarriages of psycho-surgery (MASHOUR 2005, LAPIDUS 2013, STONE 2008), which might ultimately lead to attempted head transplants (Ren 2017).

As this experience illustrates, it is important to keep a constant memory of gross errors so that radically new paths are taken in the long run. However, it is not enough to avoid all known mistakes by looking very carefully at past experiences, and from this to conclude there are no future problems. Strategies based on the avoidance of errors, which often occur as series of minor mishaps, can often prevent future errors. After an error overcomes a first protective security-wall and causes a mishap, a second wall can prevent replication of the identified error. But often there are corresponding holes in multiple walls. In rare, but then particularly catastrophic events, such holes coincidentally line up, as sometimes happens with holes in multiple slices of Swiss cheese, so that a series of errors like an arrow can penetrate all safety barriers (REASON 2004). It is an illusion to think that avoiding old mistakes protects against all possible new mistakes. Therefore, professionals need „…skills that sharpen their perception of situations in which mistakes can occur. To be effective, these skills needto be trained regularly.“(REASON 2004, Page ii33)

Dealing with errors thus requires more than a standardized, quality-assured approach. When intervening in changing systems, such as living organisms or a social system or ecosystem, one risks (not only simple) mistakes with limited consequences that can be easily avoided. In such systems, sudden, avalanche-like, devastating events can develop from a threefold misunderstanding (triplet of opacity, TALEB 2007):

- The illusion of understanding current events only from their known history,
- The underestimation of the distortion of past events by the limited retrospect,
- The overvaluation of factual information by experts caught in the Hall of Mirrors of their theories, who may think they see things as they are, but are unable to see what is not in their theories.

The long-term, often completely surprising consequences of mechanical interventions in complex systems were simulated by the psychologist Dietrich Dörner almost twenty years ago in a computer model of the development of Tana, a fictitious country (DOERNER 2003). His simulation showed that

catastrophes often occur when a specific intervention addresses a single problem taken out of context from a complex system. Interventions aimed at specific features of dynamic systems can be relatively inexpensive, such as replacing a brittle rope on a sailboat with a sturdy rope. Whether a diseased system can recover and develop after such a focused intervention remains an open question. In a dilapidated sailboat, a sturdy rope could cause a broken mast (TENNER 1996). In addition, it is sometimes unknown whether a system is relatively simple and thus accessible to goal-oriented problem solving, or whether many unknown factors are interrelated in a complex and unpredictable system. If the system status is unknown, the precautionary principle applies to avoid unexpected damage.

Sauberes Wasser wird knapp. Bild Büttner BNI, Hainan 19988

Precautionary principle

“Community policy on the environment […] shall be based on the precautionary principle.” Article 174, Amsterdam Treaty of the European Union.

According to the precautionary principle, it is advisable to be vigilant in complex situations. Or, if it seems imperative to act, to do so very cautiously, experimenting and in a controlled manner, so it is possible to turn the wheel around in still good time when hazard signs become visible. The precautionary principle is an internationally accepted part of the decision-making process for interventions that could have an impact on the environment (MARTUZZI 2007). It should therefore be applied to mass interventions by public health services (GOLDSTEIN 2001) and also in development cooperation. In medicine and development cooperation, however, it often seems to be necessary to act radically, especially from the point of view of prevention, and to accept disturbances and „minor“ side effects. After all, interventions for „health“ and „development“ are easily presented as something positive and not to be questioned. Therefore, if a problem in medicine or in development cooperation is identified by diagnosis, the benefits of its goal-oriented elimination are immediately considered.

Not only scientific criteria play a role, but also many other factors such as interests, specifications, market constraints, and exert opinions. If the risks associated with an intervention seem to be small and calculable, the precautionary principle may be transformed into its opposite, i.e., to favor hasty approval and implementation of specific interventions for precautionary reasons. The long-term consequences of hasty and large-scale precautionary interventions to address perceived threats are often completely unknown, such as the experimental vaccination of pregnant women or the release of genetically modified living organisms to prevent Zika infections. Often the lack of knowledge about unknown effects is interpreted as a lack of risk. This is misleading: experience has shown that the optimistic reversal of the precautionary principle („intervention for precautionary reasons!“) to justify courageous interventions leads again and again to problems, because complex, living systems are mistakenly regarded as relatively simple and calculable.

“There is always one more bug.” Lubarsky’s law of cybernetic entomology

The example: arsenic in Bangladesh

The arsenic catastrophe in Bangladesh is particularly suitable as an opportunity to learn from mistakes in development cooperation.
The disaster is massive, lasting and irreversible (ATKIN 2006, LÖWENBERG 2016).
The short-term and long-term consequences for Bangladeshis of relatively simple interventions in complex contexts have been extensively researched and published over decades. The disaster is a result of interventions carried out in good faith, without financial self-interest. Short-term successes resulted in incomparably greater long-term damage, and all subsequent problem-solving

interventions have proved unsatisfactory or extremely expensive. The study of the context leading to this immensely massive problem leads to the question of what could be done differently in development cooperation to avoid problems based on similar situations in many other regions of the world?

The beginning

The history of the arsenic problem in Bangladesh begins with the concept of „development.“ On 20 January 1949, President Harry S. Truman defined a new international strategy that was distinct from both the old colonial civilizing mission and socialist liberation movements: „The growth of production (of underdeveloped countries) is the key to prosperity and peace.“ President John F. Kennedy then clarified on January 20, 1961: „For the inhabitants of huts and villages on the half of the planet struggling to break the chains of mass misery, we promise to do our best to help out… [I]f a free society cannot help the masses of the poor, it cannot save the small number of the rich.“ Few were critical at the time; an exception was the theologian and philosopher Ivan Illich, who called development policy a externally determined „modernization of poverty“ and considered it more dangerous than colonial proselytizing (PAQUOT 2017).

In the context of the then still new international programs of „development aid“ through UNICEF and other organizations, diarrhea and cholera were identified as major problems in Bangladesh, leading to high infant mortality. Technically, this problem could be solved relatively easily, by supplying the rural population with hand pumps, which delivered pure water from 20-80 meter drilling depth. As soon as pure water flowed out of the pipes, the number of gastrointestinal infections and associated mortality dropped. The clear groundwater these tube wells brought to light was unencumbered by organic pollutants. Germ-contaminated surface water could drain without being drunk. The cholera threat seemed to be defeated. And the involved organizations, the users and the responsible authorities were happy about a big development progress. In the course of the following decades, however, the arsenic content increased in the (still germ-free) drinking water of many of these tube wells. In Bangladesh, this new health problem occurred to individual scientists about thirty years after the first well drilling began. However, the participating organizations (including UNICEF) and authorities vehemently denied it.

How could this happen?

The reason for the initially missing, and then unnoticed creeping poisoning was that arsenic occurs asa chemical element in many earth layers in a fixed bound form. The plains at the foot of the Himalayas have a lot of pyrite (iron-sulfur-gravel) and arsenic-pyrite at lower altitudes. These minerals are harmless unless they release arsenic from rock weathering or chemical processes resulting from external interference. This is exactly what happened and happens in the tube wells: During the dry season, the water level in the deep rock layers sinks when they are tapped through the tube wells. Or they dry out when used excessively. Then arsenic pebbles come into contact with air and are then flooded again in the rainy season. In addition, at the usual small depths (50-80 meter), fertilizers or pesticides seep in,accelerating chemical processes (e.g., oxidation). In addition, over the course of many years, iron oxide-decomposing bacteria penetrate into the aquifers via the pipe systems, where they release water-soluble arsenic. The spring water, which gradually becomes contaminated with arsenic, is not only drunk, but also serves to irrigate the rice fields and other usable areas. And because water was (and is) readily available through the wells, consumption of water from this source in Bangladesh has increased more than sixty percent over the past twenty years. As a result, irrigated agricultural landwas also heavily polluted with arsenic. Therefore, the main food crop (rice) today has high concentrations of arsenic in many regions.

Soil conditions are changing so fast that we just cannot keep up. Dipankar Chakraborti, environmental chemist at the University of Calcutta

The health consequences Water-soluble arsenic molecules act like cell toxins, first in the skin, but then gradually in the brain, heart, immune system and kidneys. Arsenic replaces the element phosphorus in protein molecules, thereby interfering with their function. The altered proteins are degraded immediately (and the arsenic excreted again), but due to cell dysfunction, the organs are eventually affected, and even may develop cancer. In Bangladesh alone, more than 70 million people are affected by increased levels of arsenic, and more than four million of them are burdened with serious illnesses requiring treatment, e.g., amputations of limbs with skin cancer. The health services in the already poor country are thus completely overwhelmed. Often physicians are aggravating the problem even more, providing suffering patients with the useless treatments they demand. Because arsenic has long been flushed out when signs of illness appear, requested treatments with drugs that help to excrete heavy metals (chelated complexes) do not help. The natural remedies often offered are not only ineffective, but also dangerous, as they areoften contaminated in these regions with heavy metals, arsenic and pesticides. And placebo supplements (sedatives) also worsen the situation of those affected as they further hinder their ability to understand their situation and to seek their own way out of their crisis.

The solutions are difficult

The WHO considers concentrations of 10 or more micro-grams of arsenic per liter to be clearly dangerous. In India and Bangladesh, therefore, in order to reduce the apparent problem quickly, the legally permitted limit was raised to 50 micro-grams per liter. However, the arsenic concentrations are already much higher locally, and they may continue to rise.

International organizations that co-created the problem, such as UNICEF, are trying to distribute relatively cheap household appliances to filter arsenic out of the water. The cost of water filtration is very great for the impoverished women who have to take on this task. In addition, household devices to remove arsenic must be constantly cleaned, in order to avoid bacterial contamination. Otherwise the number of diarrheal diseases would increase again. The return to traditional drinking water from ponds, which were operated locally and successfully for thousands of years, is no longer possible. When properly maintained, these ponds were covered with reeds and cleaned themselves. After wells were drilled, ponds appeared to be redundant. They were filled with garbage or used for fish farming or loaded with pesticides or fertilizer from the surrounding fields. Possibly, the geological mapping of the subsoil, large-scale soil analyses and water-

chemical
analyses could be useful. Drilling deep wells (more than 200 meters) to aquifers without arsenic pebbles, and from there distributing through large-scale water supply system, would be very expensive. Deep wells at the same points of arsenic-contaminated superficial wells, however, would be dangerous, because (arsenic-containing) water from higher layers could seep into the deeper.

Maximum credible accident

Arsenic poisoning in Bangladesh (and other countries) is one of the most far-reaching man-made disasters. These disasters were caused by interventions that were supposed to solve significant health problems and that were very successful in the short term. In the long term, however, the emerging new problems proved to be many times greater and harder to solve. One of the organizations involved, the British Groundwater Survey (BGS), has now, after initial denialand appeasement, fully researched and acknowledged the problem. By contrast, a German organization, the Gesellschaft für Internationale Entwicklung (GIZ), which mainly implements drilling programs in Africa, did not mention the arsenic problem on its website (31.10.2017). This is all the more astonishing, because it is now known that wells in certain regions of Africa (inter alia, in Burkina Faso), the core continent for the GIZ water department, are similarly affected (BRETZLER 2017).

High arsenic concentrations in drinking water are also found in West Bengal in India, Nepal, China, Mongolia, Cambodia, and Vietnam, some regions of Canada, the USA and Argentina. As an effective response to the arsenic threat, GIZ would have to test all of its 50-80 meter wells for arsenic. In addition, rock samples would have to be taken to rule out the presence of arsenic in the aquifers. Possibly, alternative water supply concepts would have to be developed: deep well and water pipe systems. In addition, one would have to consider water development in the context of sustainable ecological regional development. And, of course, one would also have to look after those whose life situation and health might have been impaired by development cooperation measures.

Could learning from mistakes change the practice of development cooperation?

In order to learn from failed interventions in self-dynamic systems, one would have to perceive and understand complexity (Jäger 2007). Controlling living system processes, which are influenced by many interrelated factors or even by chance, in planning cycles is not effective in the long run. Unambiguous descriptions of causal relationships are misleading in complex systems, since living

networks of relationships are influenced and changed by coincidences and yet unknown interdependencies. In dealing with such systems (e.g., the immune and brain development of a newborn) it is more important to create protective, secure frameworks for prosperity and natural growth than to implement specific interventions. Since the report of previously defined indicators to donors have to be accounted for as a success, systematic analyses of errors are often missing. Instead, development cooperation publications usually contain many examples of „best practice“ describing where and how projects could be successfully implemented (see keyword search at GIZ, WB, KfW, …).

Learning barriers in development cooperation

Development cooperation is a market with
approximately $143 billion in annual spending as of 2016. For service providers
there are mainly two types of customers:

1. (weak) target groups in the host country and
2. (strong) financiers in the country of origin.

Projects must be designed primarily so the
second target group is happy. Pleasing the second group remains the determining
consideration during implementation and even after the plan is fulfilled.
Project designs are based on predictions derived from past experience, which
rules out attention to understand dynamic system development. Donors paying for
projects are supplied with a lots of papers which overlook issues with complex
systems.

Why is the precautionary principle often not
used in development cooperation?

*Personal message from an international expert,
February 2017: „… I totally agree with you: It is incredibly difficult
to find exactly this beneficial learning behavior [“ learning from
mistakes … „] in development cooperation. At conferences, this topic
regularly comes up, with much general approval, but usually without any specific
consequences. At a conference… it was argued that in business 80% of projects
fail – and that development cooperation is no different. But about failures and*

the handling of it is hardly reported. Sad …“

Scientifically it is well documented what mishaps can happen when interventions affect complex systems. Consequently, when dealing with self-dynamics systems, it would be high time to learn from past mistakes and to take the precautionary principle seriously. For this purpose, not only in physics, biology and increasingly in medicine, but also in development cooperation, one should train the appropriate handling of complex systems that develop and respond unpredictably to interventions. Only then can complex systems be sustainably and favorably influenced with low-risk interventions (TALEB 2014, CAPRA 2014, JANASOFF 2016).

The idea of precaution (first do no harm), is more demanding than prevention, which considers only to known risks. In the case of precautionary action, it is in addition necessary to consider that the interaction of many factors in complex systems and communicating networks could have consequences which cannot be anticipated on the basis of previous knowledge. In order to determine how rigorously the precautionary principle should be applied, the scientific evidence accumulated at the time of the intervention is insufficient, as it can only relate to the assessment of historical experience.

Experience has shown that in situations where there is no evidence of future damage, the proposal to apply the precautionary principle usually leads to contradictions and conflicts. The arguments of those who criticize interventions are by nature weak, because they lack the study results that could prove clear dangers. Therefore, it can be relatively easy for proponents of massive interventions to solve obvious problems in the short term to assure there is no risk. For decision makers, politicians, authorities, financiers, corporations, and of course for populists and their audiences, the application of the precautionary principle is therefore a disturbing obstacle, a bureaucratic blockade or even an abusive tool used by protectionist interest groups (GOLDSTEIN 2007).

An objection based on the precautionary principle may be characterized as simply a „stupid, ideological, stubborn“ bullying or even conspiracy theory that could sabotage a great advance of humanity. And so unexpected disasters happen again and again, sometimes only after many years, because scientists who start from the currently known basic assumptions cannot rule out that something will never happen that could endanger their previous world view (TENNER 1997, TALEB 2014, JANASOFF 2016).

With regard to Bangladesh’s arsenic problem, nobody in 1960 was able to guess that after decades of groundwater development a completely new situation would develop. In 1960, based on past experience, no problems were foreseeable. But, taking the precautionary principle into account, it would have been safer but slower to incorporate historically evolved water treatment systems (ponds) into integrated solutions through joint regional support. The question arises as to whether development aid agencies may be motivated or compelled to act in accord with the precautionary principle, because, according to the current legal situation, personsaffected by a bilateral aid measure have no prospects of receiving compensation for their damage.

Science is the belief in the incompetence of the experts. Richard Feynman

Links (2017)

- British Groundwater Survey, BGS www.bgs.ac.uk/arsenic/bangladesh
- Gesellschaft für Internationale Entwicklung (GIZ) www.giz.de/fachexpertise/html/3722.html
- Global Arsenic probability map 2008: www.eawag.ch/en/research/humanwelfare/drinkingwater/wrq/risk-maps/
- World Resources Institute: Water http://www.wri.org/our-work/topics/water

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