Nature strikes, and forces human-beings under its yoke. This is the geo-deterministic argument. Hazard research contributes an alternative understanding, pointing to how humans attempt to bring nature under their control, in the belief that the more developed the technology, the better our control. The effect, however, is heightened vulnerability.

Earthquake – Tsunami – Nuclear Accident

Geo-Risk-Space and Risk Society Japan in Light of the Triple Disaster 2011

By Winfried Flüchter

Hazard research has a long tradition in the field of geographic research, both in relation to the human-environment paradigm as well as in the relationship between society andnature. In the common public perception, the so-called "thousand year" occurrence of an earthquake on March 11, 2011, off the Pacific Coast of north-eastern Japan, might be seen as a violent act of nature, as a matter of fate, against which human beings are powerless. Nature strikes, and forces human-beings under its yoke. This is the geo-deterministic argument.

Hazard research contributes an alternative understanding, pointing to how humans attempt to bring nature under their control, with the belief that the more developed the technology, the better our control. The effect, however, is heightened vulnerability.[1] As the Eastern Japan

Winfried Flüchter. Foto: Max Greve

Great Earthquake Disaster (Higashi Nihon Daishinsai) of 2011 exemplifies, this can lead to a disastrous chain reaction, to a three-fold catastrophe – earthquake, tsunami and nuclear crisis.

Geo-Risk-Space Japan: from natural hazards ("threats") to man-made hazards ("risks")

In an increasingly differentiated and high technology world, the problem of hazards lies less in threats posed by nature, and more in the notion of risks, which signals hazards willingly adopted by humans. It is important to make a clear distinction between (natural) hazards ("threats") and man-made hazards ("risks").[2] From the perspective of a natural scientist, a Tsunami in an unpopulated region is an "act of nature", in a populated area, a "natural hazard". For the social scientist however, the "natural hazard" becomes a "natural risk" when individuals are conscious of the danger and have the capacity to prevent, mitigate and to make decisions about measures to take, or even not to take. Risk research is confronted with having to deal with unavoidable dangers on the one hand ("being at the mercy of dangers", the passive dimension) and future projections of calculated risks ("taking risks", the active dimension).[3]

Hazard research has concentrated too much on the analysis of so-called natural disasters, on the understanding of nature and the dangers resulting from this, and too little on man-made hazards, which people themselves initiate by weighing risks and trying to defuse these through hazard management.[4] The Geo-Risk-Space Japan serves as an excellent case for addressing the shortcomings of much natural hazard research.[5] (Fig. 1). The constant threat faced by humans from natural disasters is a part of the history of Japan. Now and again the island nation is called "unique" since they say there is nowhere else on earth so frail, where the people are so vulnerable to the forces of nature. Japan is of course not alone in the region, with a number of other countries located along the fault zones of the continental plates. The Japanese archipelago, stretching out over the north-west rim of the Pacific Ocean, comprises only a small part of the pan-Pacific "ring of fire".

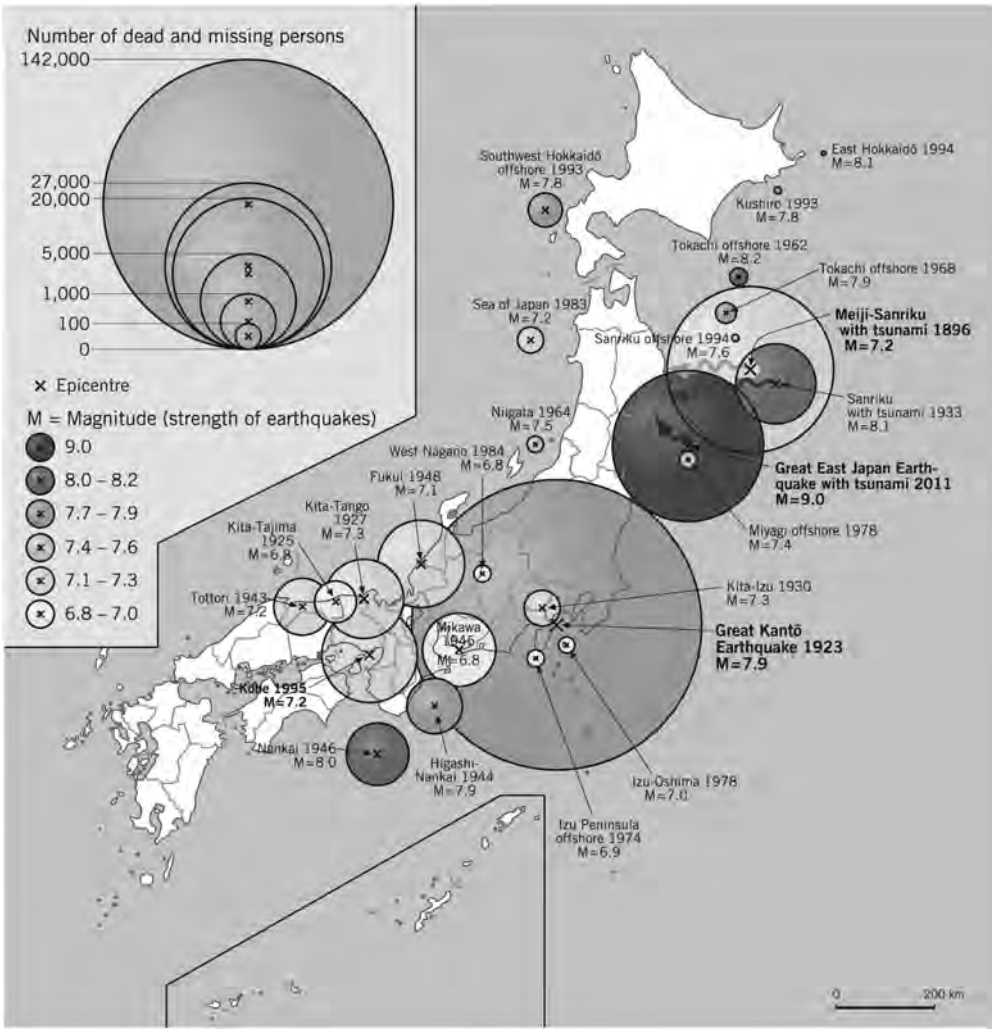
What makes Japan especially vulnerable is the concentration of its population, in some cases in extremely narrow spatial regions. This problem does not concern the average density of the country at 340 inhabitants/km² (in international comparison this is not exceptional), rather the unbalanced distribution of the population, whether we mean the general concentration of people along the (Pacific) coast focusing on the Metropolitan regions Tōkyō, Ōsaka and Nagoya or the concentration of two-thirds of the entire population in so-called Densely Inhabited Districts (with a minimum average density of 4,000 inhabitants/km², actual average density 6,714 inhabitants/km²). Such districts in Japan make up only 3.32 (!) percent of its total land mass. The most severe problem is the extreme spatial concentration of people, property and power in the capital city Tōkyō, known as the "unipolar concentration on Tōkyō" (Tōkyō ikkyoku shūchū).[6]

The Eastern Japan Great Earthquake Disaster of 2011: measuring magnitudes, estimating damage

The trigger of the chain of disasters on March 11, 2011, 14:46:23 local time, was a sub-marine quake with a magnitude of M=9.0 (Richter Scale), 24–32 kilometers deep, 370 kilometers north-east of Tōkyō, 130 kilometers east of Sendai (the center of the greater Tōhoku region), 67 kilometers east of the most proximate coastline (the Oshika Peninsula), the strongest quake in Japan's recorded history. Among the earthquakes registered world-wide since 1900, this one ranks an estimated fourth in terms of magnitude.

We should be precise about the tremendous destructive potential lurking behind the value M=9.0. In the entire 20th century there were only three extremely strong earthquakes in the range of M=8.0 and 8.2 in Japan (Fig. 2). The difference between M=8.0 and 9.0 is not on a linear, but a logarithmic scale, a 32-fold increase in force. The corresponding difference in magnitude between M=7.0 and 9.0 is about 1000-fold. With construction regulations and safety measures on the north-east coast of Japan made to protect against damage from an earthquake of "only" a maximum M=8.0, the enormous potential destructive force of magnitudes above this level becomes clear. The Great Kantō Earthquake of 1923 was a watershed in Japanese history, with a magnitude of "only" 7.9, resulting in 143,000 deaths/missing persons. The immense Hanshin-Awaji (Kōbe) Earthquake of 1995, registering "only" M=7.2, brought 6,300 casualties.

Of course the real meaning of magnitude M stands in a definite relation to the potential injury to people and property, with other criteria such as location of the epicenter and hypocenter, as well as geo-local particularities playing a role. The Great Kantō Earthquake of 1923, like the most recent Eastern Japan Great Earthquake Disaster of 2011, was an off-shore-type (kaiyō-gata), the Great Hanshin-Awaji Earthquake of 1995 was an urban-underground-type (toshi chokka-gata). In relation to Kōbe 1995, the catastrophic Eastern Japan Great Earthquake Disaster of 2011 would have wreaked far more damage had it struck directly underneath or nearer-by to Tōkyō, but it "only" struck the peripheral region of eastern Tōhoku. The pictures televised around the globe depicted the gruesome natural force and threat to life, the unending per-



(1) Japan: Strong Earthquakes (M ≥ 6,8) since 1896.
Source: Asahi Shinbun 25-1-1995: 3; http://en.wikipedia.org/wiki/2011_Tohoku_earthquake_and_tsunami (3-9-2011); http://en.wikipedia.org/wiki/1896_Meiji-Sanriku_earthquake (19-9-2011)
Editing: Winfried Flüchter, cartography: Harald Krähe

sonal suffering and immeasurable damage to property. The claims to life and property covered an estimated 26,000 dead and missing, 100,000 houses completely destroyed and 400,000 persons left homeless. The focus of the media on the violent wall of water moving inland left the impression that a great part of Japan was destroyed. The flat even coastline in the prefectures of Miyagi and Fukushima contributed to this optical illusion. According to the calculations of the state-run geo-spatial information bureau (Kokudo Chiriin), "only" about 400 km² (i.e., less than half of the area of metropolitan Berlin's 892 km²) along the coast of eastern Tōhoku was directly ravaged by the tsunami (exactly 0.1 % of the total land area of Japan: terrible local, but not massive destruction). It is a wonder that in the city of Sendai, 130 km away from the epicenter, the strength of 9.0 magnitude left no significant damage behind. The core economic regions of Japan were spared from the catastrophe. We are not on the brink of the "Untergang Japans" [7]. According to the projections of the Institute of International Finance, Inc., the losses incurred by the Eastern Japan Great Earthquake Disaster of 2011 are at 150 to 250 billion US dollars (in comparison to Kōbe 1995: 114 billion dollars). If the next link in the chain, mass destruction caused by the Fukushima disaster, is excluded from the calculation, the losses add up to about 4–6 % of the gross national product. Japan will shoulder the economic consequences of the earthquake and tsunami. However, the effects of the nuclear catastrophe are not as easily known.

Japan's seismic warning system, disaster prevention and emergency measures – How well did they perform in the Eastern Japan Great Earthquake Disaster of 2011?

Conscious of the seismic vulnerability of the nation through natural and man-made hazards, the Japanese state has thought through a range of measures. There is hardly another land which is better equipped for dealing with natural disa-

sters as Japan. What can be done against earthquakes – before, during and after such a catastrophe: even foreigners in Japan are relatively well-informed by the Japanese state. When registering a place of residence, an obligation in Japan, local municipalities provide vivid pamphlets about how to behave during earthquakes, with indications of the local escape routes and gathering points. These pamphlets are not only provided in Japanese, but in large cities also in English, Chinese and Korean. The residents of the coastal areas threatened by tsunami are extremely well prepared for the event, the threat of which hangs over them like the Sword of Damocles. This is especially true for those people living along ria coastlines (ria are geographic formations of dendritic ridges separated by narrow ocean bays). The Sanriku coastal landscape on the Pacific side of Tohoku is a ria formation, and among the most vulnerable to natural hazards in Japan. As infernally as the Eastern Japan Great Earthquake Disaster of 2011 raged, the destruction would have been much greater if strategies and behaviors intended to minimize seismic damage had not been taken.

Seismic early warning

No country in the world is better prepared for natural catastrophes than Japan.
Example 1) Earthquakes. A quick, dependable and spatially precise prediction of earthquakes does not yet exist, and any attempt to make such predictions on a scientific basis are not sound and could result in panic. Yet as soon as an earthquake occurs, a very effective early warning system kicks in. The different velocities of earthquake-waves are utilized in this system to great advantage. The P-wave (primary wave), a compression wave, races at a velocity of 7 km/sec (=25,200 km/h), the S-wave (secondary wave), is a traverse wave "only" moving at a speed of 4 km/sec (=14.400 km/sec). The much faster P-wave transports less energy. The S-waves which arrive later are far more destructive. Consequently, the early warning potential for Tōkyō, with a distance of 370 km from the focus of the earthquake, was 40 seconds, for greater Sendai, with a distance of 130 km, 14 seconds. This was a very valuable time-frame for avoiding further catastrophic consequences. Bullet trains could be stopped immediately, nuclear reactors could be shut-down, flood gates closed, emergency exits opened, bridges blocked. A fact-in-case: despite the permanent threat of earthquakes, the Japanese Shinkansen bullet trains have never experienced an accident with casualties since they began running in 1964.
Example 2) Tsunami. That a seismic wave travels much faster than a tsunami wave is a fact that creates time for sufficient early warnings. The conditions for this were present: technically, through a dense network of seismic sensors, gauges and buoys, as well as physically, with the nearest coastline being a sufficient 67 km away from the focus of the earthquake. Reports so far are that the tsunami took 10 to 30 minutes to reach various points along the coastal region, 60 minutes to reach the Sendai regional airport: valuable time for saving human lives. It seems that ten thousands of people took the opportunity to flee, though many elderly and otherwise disadvantaged people were not able to escape in time.

Earthquake-resistent and earthquake-receptive construction engineering

The cutting-edge engineering advances in oscillation control and containment technologies have made Japanese advancements the model for other urban regions facing a similar level of vulnerability, for example San Francisco and Istanbul, both of which still leave much to be desired in terms of adopting earthquake-resistant construction practices. But even Model Japan still has much work ahead. Advancements are far ahead for modern skyscrapers, which, relatively speaking, are more securely built than is true for a large segment of private housing, or for timber construction, cases where improvements in earthquake and fire-resistance are long over-due. Indeed the secondary effects of conflagrations in Japan are just as threatening as the destructive force of earthquakes themselves.

Emergency behavior and reactions of the population

The reaction of those directly affected by the Eastern Japan Great Earthquake Disaster, especially as seen through the eyes of foreign observers, was remarkably calm and disciplined. How can the near-complete absence of panic be explained? The population of Japan is long accustomed to having to deal with natural disasters. Respect shown to the forces of nature and their unpredictability may be anchored deep in the consciousness of the Japanese people. Cultural clichés of Japanese as "the other" or "unique" are enjoying new popularity in this light. The virtues of *gaman* (patience, perseverance, self-control, endurability), *ganbaru* (sticking it out, not giving up, trying harder, making an effort), *shikata/shōga nai* (it cannot be helped) may well have environmental, cultural-historical or religious (Buddhist) roots, but all of these traits and behaviors are just as much (if not more) practiced behavior, the result of social rules of conduct, learned from a young age in schools and in family life. Drills for disaster prevention take place at least once a year, and are ritualized in the annual calendar on September 1 (disaster day), the memorial day for the Great Kantō Earthquake of 1923.

"Restrisiko" – towards a flexible conflict economy

Two epistemological standpoints characterize the many ways in which risk, as a concept, is understood: the objective-natural scientific perspective (not considered here), and the constructivist-social scientific approach.[8] In the sociological risk research according to Beck (1986), modern industrial societies are faced with a new quality of risks, as the optimism of technical progress which characterized the industrial and technical revolutions of the "first" modernity, has given way to the technological skepticism of the present age, which Beck terms the Risk Society of the current "second" modernity.[9] Risks are too complex to be governed. A disaster, even a "natural" one, can shake the foundations of the social order, disrupt normality or even destroy it. The earthquake, from a societal perspective, is on the same plane as a nuclear accident, a military attack or an act of terrorism.[10]

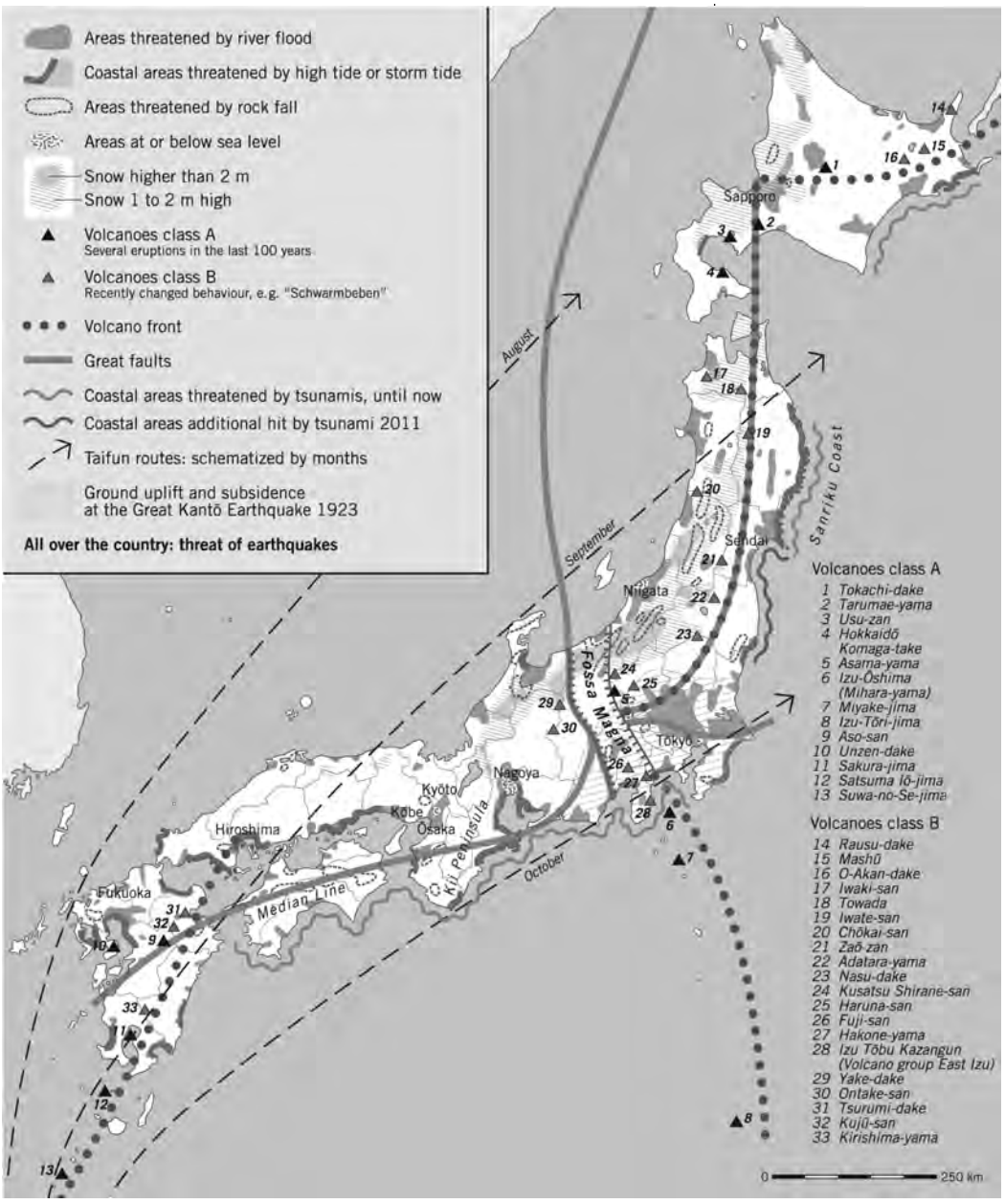
These theoretical discussions have found new confirmation in the Eastern Japan Great Earthquake Disaster and its three-fold catastrophe – earthquake, tsunami and nuclear accident. The events have ripened internationally into very different sets of perceptions, understandings and reactions. More than the earthquake itself, the series of disasters triggered by the tsunami in the nuclear power complex Fukushima re-launched a fundamental discussion, especially in Germany, about the safety of nuclear power. What seemed unthinkable beforehand, now counts as a Restrisiko: uncalculable scientifically, but no longer to be ignored. The crass acknowledgement now of a so-called Restrisiko (residual risk) has provided the opportunity in Germany for a re-consideration of energy policy and the phasing out of nuclear energy until 2022.

Why must events, with a normal statistical probability of occurring every 100,000 or 10,000 years, or even only "once in a thousand years" (the latter is held for the probability of a strong quake in Japan) have to actually happen before we consider them possible? Risks only can be estimated on the basis of the past (which time-frame?) bracketing-out consideration of Restrisiko, with future projections based on "historical" data, even in cases where less than a few decades of empirical information is available. The serious accident at the Harrisburg Three-Mile-Island plant in 1979, admittedly not a catastrophe of the same scale, is nonetheless a statistically negligible event. The great catastrophe at the Chernobyl nuclear power plant in 1986 is interpreted as the result of the immature technologies of a failed socialist economy, unthinkable in democratic countries with sophisticated technologies. Rational explanations for observed data points are overestimated, while Restrisiken are normatively bracketed-out with the motto: what should not happen, will not happen ("dass nicht ist, was nicht sein darf"). But after March 11, 2011, the impossible is clearly possible; the statistically unlikely event has become a statistical observation. The Eastern Japan Great Earthquake Disaster gives us a new chance to think about high-risk events. Can we make the world more calculable? The different evaluations of the safety of atomic energy reached by the German and French, experts as well as the general publics, provide an example for how deeply conclusions based on the same sort of rational calculations can differ. The question of how Japan will deal with this in the future is of great interest.

"Safety has the highest priority." This recurring popular slogan of Japanese decision-makers since what is now called 3/11 no longer elicits trust. Safety, if pursued as the highest priority, cannot be funded publically (or privately), nor may citizens agree to the trade-offs in lifestyle and liberties which would be required for complete safety. Those who wish to use the opportunities provided by complex technologies must accept their risks. Yet even experts can only estimate the magnitude of these risks in reality. The central question, as noted by the risk researcher Klaus Heilmann, is not whether we want more safety. Everyone wants this. Instead, the question is: how much financial burden is a citizenry ready to bear for more safety (or less risk)? Safety is less a matter of principles, and more a matter of priorities when negotiating between that which is technologically possible and economically feasible. "What we require is a flexible conflict economy." Chances and risks, uses and dangers need to be brought into a socially acceptable relation to each other. Full safety is not something that can ever be fully achieved, but we can come closer. "There will always be a degree of Restrisiko. Above all we have to learn to live with unsolved and in part, unsolvable problems. A certain degree of permanent instability cannot be avoided in our lives."[11] But who are "we" and what is "the society" which determines the degree of instability to be tolerated? Is "the society" adequately informed about the chances and risks? How is Japan dealing with risks and safety in relation to the tsunami and atomic energy?

The 2011 tsunami catastrophe in perspective

The accident at the Fukushima nuclear power plants caused by the tsunami, rather than the tsunami launched by the oceanic earthquake, received the most attention from world observers. By comparison, the massive destruction to human life and property wreaked by the tsunami itself was regrettably ignored. An important factor in the scale of the natural catastrophe was the height of the seismic wave. A length of about 500 km of coastline in eastern Tohoku was hit, with varying force and impact, depending on the characteristics of the coastal formations. At the tip of coastal inlets



(2) Geo-Risk-Space Japan.
Source: Schwind, Martin: Das Japanische Inselreich. Berlin 1967: 478, 269; Yamamura, Junji (ed.): Shintei zusetsu Nihon chiri. Nihon rettō no chiiki henyō: Tokyo: Tameido 2001, 26; Asahi Shinbun, 11-2-2003, 22, after Asahi Shimbun Dahlem, No. 262, 15-5-2003, 16 f.; Yagasaki, Noritaka (ed.): Japan. Geographical Perspectives on an Island Nation. Tokyo 1997, 8, 14.
Editing: Winfried Flüchter, cartography: Harald Krähe

along the rias coast of Sanriku the seismic waves slashed at a height of over 20 meters into embankments, at the extreme up to 38.9 meters (at the Omoe peninsula, municipal Miyako).[12] The even coastlines further south, in Sendai and Fukushima, which in the history of tsunami are less affected, were hit by much lower waves, which nonetheless reached catastrophic heights for this region. The waves hitting the nuclear power plant Fukushima No. 1 were as high as 14 meters, twice the height of those estimated in safety analysis for the facility.

Learning from the tsunami catastrophe

Tsunami protections are especially important in city building codes. To improve safety it would be necessary to abandon housing altogether in the areas of the city most exposed to flooding and to promote the development of new locations in higher, terraced hillsides. This most important strategy has hardly been given any attention so far. The burden would have been too great: high costs of terracing (necessary for the preparation of building sites)

as well as measures to protect hill sides from the effects of earthquakes and typhoon, but also measures to address the distance between the harbor and residential settlements and the separation of residence and work locations (fishing and aquaculture), which can only be seen as functionally unproductive, and from the perspective of the elderly and aging local populations, inconvenient and unattractive.

From the perspective of a flexible conflict economy the priority lies in accelerating evacuation measures. Most important for potential victims is that they accept responsibility for speedy evacuation and that such efforts are technically supported by well-developed monitoring systems. All in all, the most important principle is "better to live in harmony with nature, than to fight against it."[13]

The nuclear chain reaction at Fukushima Daiichi: from natural disaster to man-made disaster

Eleven reactors in four nuclear power facilities in Japan were shut-down within seconds of the massive oceanic earthquake on March 11, 2011, among these the three reactors at the Fukushima I (Daiichi) facility. The emergency shut-down procedures functioned well, as did the operation of the emergency power generators. So far, so good. The tsunami caused by the earthquake hit the Fukushima I facility 40 minutes later with 14 meter high waves, knocking out the emergency power generators, and thus also the emergency cooling of the nuclear reactors. At 15:42 local time, TEPCO, the Tokyo Electric Power Company operating the facility, announced a nuclear accident. The cooling of the nuclear fuel rods in reactor blocks 1, 2 and 3 and the spent fuel pit of block 4 failed – there is no nuclear waste repository, which explains why more and more fuel rods had been packed into the spent fuel pits, an inexpensive interim storage solution for atomic waste. The electrical power sources and the emergency diesel generators shut-down. The nuclear chain reaction kicked in. At 19:03 the Japanese government declared a state of nuclear emergency. A hydrogen explosion occurred, radioactivity was released, contaminated water flowed into the sea. Blocks 1, 2 and 3 experienced a nuclear meltdown. This "maximal credible accident" (super GAU in German, Größter Anzunehmender Unfall), which was assumed to have occurred from the beginning, was only officially confirmed on April 12, 2011 with the upgrading of the accident to the highest grade of atomic emergency – formally the same level as the nuclear power catastrophe in 1986 at Chernobyl. Three heavily damaged reactors and four full spent fuel pits continuously fed the conflagration of the nuclear fuel elements, which even with continuous cooling take time to cool down. It is a Herculean effort to deal with the heat of a nuclear afterglow. Joining the efforts to find a solution, alongside TEPCO experts and firefighters, were the dispatched workers of temporary help agencies, who placed their own health and safety on the line to attempt the humanly impossible.

The Japanese government erected an evacuation zone of 20 kilometers around the Fukushima nuclear facility on April 20, 2011: affecting the homes and property of about 80,000 persons. No one was allowed to enter the zone without a government permit. The manner and size of this official zone are hotly debated. Why not a radius much larger than 20 kilometers, considering the known presence of contaminated hotspots outside this range? Especially elderly residents wanted to return quickly to their homes, rather than staying on in evacuation centers, despite the risks posed by radioactivity. The uninhabitability of the area around the damaged Fukushima reactors is a problem, which drew a strong reaction from the population. Prime Minister Naoto Kan (Democratic Party of Japan, DPJ) accidentially slipped by admitting up-front of 300 years of uninhabitability – a statement that was immediately repudiated by the government as the personal opinion of Kan. In reaction to the sensitivity of the Japanese public, influential media are dealing with the topic of atomic power with reservation. This is true in reports about contamination of soil and air as well as agricultural products yielded well outside the evacuation zone of 20 kilometers, as well as for the seawater pollution from the reactors and fuel pits at Fukushima: the Pacific Ocean as a dilutor for radioactive cooling water. There is no expectation of an "all-clear" for Fukushima anytime soon. The damaged nuclear power plant remains a source of radioactivity and continuous uncertainty.

What began as a natural disaster (*tensai*) has become a purely man-made social catastrophe (*jinsai)*. It could have been avoided, had measures for more safety been implemented. TEPCO as the operator of the totally destroyed nuclear plants ignored the dangers, in what can only be described as criminal negligence. Immediately following the disaster, TEPCO attempted to deflect attention from its own responsibility through the channels of the nuclear lobby in Japan by making geo-deterministic arguments. A natural disaster of these proportions was thought to be unforeseeable (*sōteigai*), had never been present (*mizō*). Such claims are absurd, in light of the fact that such natural disasters have occurred regularly throughout Japanese history.

Fukushima I (with a capacity of 3600 megawatt) is the oldest nuclear facility in Japan, in operation since 1970. It was originally commissioned to operate for 30 years. The facility should have been de-commissioned already in the year 2000. Despite a number of accidents at the facility, about which the public was never or only insufficiently informed, hush-ups and delay tactics of the operators led to an extension of operation even

over the ten years agreed upon (until 2010). The location is barely above sea level. Having been warned by a large earthquake a few years earlier (2007: M=6.6), TEPCO improved the seismic resistance of its old power plant up to a maximum M=8.0, and built a protective wall, 5.7 meters high. It ignored problems with the emergency diesel generators, criticized by safety experts for years. These were located close to the sea at ground level at Fukushima, in a turbine container, which was not sufficiently protected from flooding. Necessary upgrades remained undone in this old facility, out of reluctance to shoulder the high costs involved in improving safety. The extension of operation secured high profits for TEPCO. The operation of nuclear facilities, which have already depreciated in value, is essentially a "money printing machine", which, as the saying goes in this industry, earn millions daily. For TEPCO, generating even more profits by saving costs had priority over maintaining sufficient safety standards. This strategy led to an economic disaster after the catastrophe, for which the company TEPCO is to blame. The financial burden of the resulting costs of dealing with the nuclear waste, costs which have no identifiable ceiling, are so high for TEPCO that the survival of the world's largest energy concern is jeopardized.

The nuclear accident at Fukushima: focus of systemic weakness – catalyst of institutional change?

What the Yale University organizational sociologist Charles Perrow analyzed several decades ago using the example of the nuclear accident at Harrisburg (1979) reads like a "recipe for the next disaster", easily applied to Fukushima. In the case of complex disasters, a number of factors converge, which had they occurred alone, could have been solved, but which in their convergence become threatening. The more complex and tightly coupled the technical systems, according to Perrow, the more frequent the unforeseen breakdowns, especially at the fault-prone human – machine interface. Disastrous chain reactions in complex systems are not completely or continually avoidable, i.e. they are "normal accidents" and as such are hardly predictable. Highly complex technical systems, like nuclear power plants, demand a degree of reliability from their organizations, well beyond that which is humanly possible. In his conclusion, Perrow emphasizes the deeply political character of all attempts to analyze risks. In the end, it is not about risk, but about power – the power of the few, in their own interest, to burden the masses with enormous risks.[14]

Perrow's concept of "normal accidents" generates insights into the systematic weaknesses of security systems in cases like Fukushima, both in terms of expertise and safety controls. Safety specialists, not only in Japanese nuclear plants, are responsible for very specific functions, for example, for the reactors, for the pumps, for the fuel pits. The failure of one of these functions is generally not a problem. If they all fail, in the absence of an interrelated procedural strategy, apparently chaotic decisions above the level of the functional experts ensue, involving general managers lacking the overall expertise demanded by the situation. The larger the organization operating them, the more vulnerable the complex technological systems are to catastrophe. The operating companies who again and again consciously take risks motivated by economic reasons are the ones responsible for the negative consequences of large technological facilities.[15] This is especially true for the management at the top of the energy concern TEPCO, but also for the Japanese Nuclear and Industrial Safety Agency (NISA). Both appeared helpless in the crisis and reacted painfully unprofessionally. Closely related to the problem of technological expertise is the problem of "institutional failure". How was it possible that the Japanese Nuclear and Industrial Safety Agency, which is under the Japanese Ministry for Economy, Trade and Industry (METI), did not fulfill its responsiblities? How can it be that the energy giant TEPCO, despite numerous warnings about safety problems at the Fukushima nuclear plant, could ignore the complaints of the ministry? How is it that the Japanese people, despite the continual threat of natural disasters and the painful experience of the nuclear bomb at Hiroshima and Nagasaki, approved uncritically of nuclear power as an energy source and believed the myth of safe nuclear energy? Does the question of who was responsible for the nuclear disaster play almost no role at all?

Fukushima raises the question of the nuclear and information policy of the political system, which many experts believed was settled, and no longer important. The reference is to the "iron triangle", the mutual action of the government, ministerial administration and industry, which for the last decades has been referred to as the "Japan Co.", "Network", "Client State" or "Construction State". In reference to the nuclear power industry, one speaks in Japan of the "nuclear power village" (*genshiryoku mura*), the tight relationship between government, the nuclear power agency and the powerful energy corporations, connected as well with the mainstream scientific community and the media. A give and take relationship has developed between these actors, through delegating lucrative positions and construction projects, paired with financial, political and symbolic support. All of this is based on an informal institutionalized and largely intransparent system.[16]

The philosopher Kenichi Mishima, a respected facilitator of dialogue between Japan and Europe, describes the situation precisely: "Legal yet corrupt, law-abiding yet

criminal, such is the atomic interest group lobby, a structure of continual terror against our citizens. A myth of safety has emanated from this impenetrable atomic Mafia, presented as legitimate."[17]

The indecency and self-perpetuation of the "atomic village" went unnoticed, or was even tolerated in light of the growing welfare of the masses, based not least of all on the availability of inexpensive energy. The nuclear lobby is not unique to Japan (not part of a group orientation or a cultural proclivity for harmony) – the industry everywhere in the world is open to corruption.

There are rational reasons for the focus of Japanese energy policy on the expansion of nuclear power and entry into the closed fuel cycle of the plutonium economy.[18]

1. The establishment of an additional domestic energy source, in order to minimize the extreme dependence on other energy sources, which Japan faced dramatically since the oil crisis of 1973/74. Even today, with nuclear power, the country is dependent on energy imports (oil, coal, gas) for 80 % of its energy needs.
2. Maintaining clean air and reducing CO_2 emissions in line with the Kyoto Protocol (1997), the target of which Japan, with a renewable energy quotient of just 8 %, is still unable to meet. The expansion of nuclear power for civilian purposes was widely accepted by the Japanese public until 3/11: because it is regarded as a reliable, inexpensive and environmentally sustainable form of electricity. The externalization of significant open-ended costs for tax-payers has been put out of mind: "Research and storage of nuclear waste is paid by the state and the effects of accidents are born by the society because no insurance company in the world would take on this risk."[19]

The triple disaster triggered by nature on 3/11 is often compared with the Great Kantō Earthquake (Sept. 1, 1923), and in the meantime, even with the unconditional surrender of Japan at the end of WWII in 1945 – dramatic events in the history of modern Japan, which shook the social-political institutions and launched a period of renewal and reform. Fukushima has initiated a revision in Japan's energy policy. The plans for expanding nuclear energy have been halted and the share of renewable energy sources enlarged. The departure from the old policies are evident in the fact that the majority of the Japanese people now question the safety of nuclear power and are engaged in an active discussion of alternative energy sources and ways to conserve energy. Large-scale crises, as the saying goes, are often purifying. Fukushima has mercilessly exposed the systemic failings of Japan. Will this have consequences for institutional change? "Change" was the slogan of the Democratic Party of Japan (DPJ) when in 2009 it replaced the Liberal Democratic Party (LDP), which had been in power since 1955 and in its nearly continuous rule had characterized the "system Japan." The DPJ Prime Minister Naoto Kan, who has since resigned, dared to enter into a struggle against nuclear power, which may have won him respect, but which he had no chance of winning. The path dependency of the atomic network was too strong, a network in which not only the LDP is involved. Kan, who was already unpopular and became further weakened by the poor crisis management of his government, was struggling against the majority of his own DPJ party, whose most important decision-makers have their roots in the LDP, as well. The new DPJ Prime Minister, Yoshihiko Noda, is the sixth leader of the Japanese government in five years, and in comparison to his predecessor, appears positively disposed toward nuclear energy. The Prime Minister in Japan is generally weak in terms of the powers of his office, regardless of which party or faction is in power. The policy-making competence of the German Prime Minister, for example, would have been helpful. In Japan, a decisive step in the direction of bold political reform is not on the horizon.

Zusammenfassung

Bei der Analyse sogenannter Naturkatastrophen hat sich die Hazardforschung zu sehr auf die Bedeutung der Natur und der daraus resultierenden Gefahren konzentriert, zu wenig jedoch auf *man-made hazards*, die der Mensch durch das Wagnis zum Risiko hervorruft und durch Hazardmanagement zu entschärfen sucht. Der Georisikoraum Japan dient dafür als hervorragendes Beispiel. Der Beitrag nimmt das Große Erdbeben von Ostjapan 2011 zum Anlass, zunächst die Bebenstärke, die seismischen Wirkungen und den Katastrophenschutz Japans zu analysieren. Er fokussiert auf die Optionen einer Risikogesellschaft: den Umgang mit dem Restrisiko unter Aspekten einer flexiblen Konfliktökonomie. Im Zentrum steht der durch die Tsunami-Naturkatastrophe ausgelöste menschengemachte Atomunfall von Fukushima als Brennpunkt systemischer Schwächen – und Auslöser institutionellen Wandels?

Notes

1) Pohl 1998): 154 f. ; Pohl und Geipel 2002.
2) Luhmann (990/1993.
3) Bohle 2009: 190f.
4) Geipel 1992; Hewitt 1997; Müller-Mahn 2005; Dikau 2008; Wisner/Blaikie/Canon/Davis 2010.
5) Flüchter 2007.
6) Flüchter 1997.
7) The reference is to the Japanese prize-winning fictional best-seller and film by Sakyō Komatsu *Nihon Chinbotsu* "Japan sinks" (1973), which takes the geologically instable location of Japan in the subduction-zone of the Pacific and Eurasian continental plates as the context for calling the socio-cultural and political-economic stability of the country into question.

8) Müller-Mahn 2007.
9) Beck 1986.
10) Pohl 1998: 155.
11) Heilmann, Klaus: Atom-GAU. Die Illusion von der Sicherheit der Kernenergie. In: Financial Times Deutschland, „Wissen", 25-3-2011; Heilmann 2010.
12) http://www.yomiuri.co.jp/science/news/20110415-OYT1T00389.htm
13) ZDF Heute Journal, 2-4-2011: Japan: Tsunami-Opfer räumen auf.
14) Perrow 1984/²1999; Perrow 1987/²1992; Lay, Conrad, Deutschlandradio http://www.dradio.de/dlf/sendungen/andruck/1423062, Zugriff 28-03-2011.
15) Heilmann: Atom-GAU. Die Illusion von der Sicherheit der Kernenergie. In: Financial Times Deutschland 25-3-2011.
16) Flüchter 2002; Feldhoff 2005, 2011a, 2011b; Kevenhörster 2010; Doege und Köllner 2011.
17) Mishima, Kenichi: Des Pudels Kern. In: Die Zeit, 5-5-2011: 54.
18) Feldhoff 2011a.
19) Frankfurter Allgemeine Sonntagszeitung 13-3-2011: 59

References

– Beck, Ulrich (2007): Weltrisikogesellschaft. Auf der Suche nach der verlorenen Sicherheit. Frankfurt a.M.
– Beck, Ulrich (1986): Risikogesellschaft. Auf dem Weg in eine andere Moderne. Frankfurt a.M.
– Bohle, Hans-Georg (2008): Krisen, Katastrophen, Kollaps – Geographien von Verwundbarkeit in der Risikogesellschaft. In: Kulke, Elmar und Herbert Popp (Hrsg.): Umgang mit Risiken. Katastrophen – Destabilisierung – Sicherheit. Bayreuth/Berlin: 69-82.
– Dikau, Richard (2008): Katastrophen – Risiken – Gefahren: Herausforderungen für das 21. Jahrhundert. In: Kulke, Elmar und Herbert Popp (Hrsg.): Umgang mit Risiken. Katastrophen – Destabilisierung – Sicherheit. Bayreuth/Berlin: 47–68.
– Doege, Felix und Patrick Köllner (2011): Trotz Fukushima-1: Japans „atomares Dorf" hält an der Nuklearenergie fest. Hamburg: GIGA Focus Asien Nr. 5.
– Feldhoff, Thomas (2005): Bau-Lobbyismus in Japan. Institutionelle Grundlagen – Akteursnetzwerke – Raumwirksamkeit. Dortmund.
– Feldhoff, Thomas (2011a): Kernenergie in Japan. In: WeltTrends – Zeitschrift für Internationale Politik 78/19: 88–91.
– Feldhoff, Thomas (2011b): Japan's quest for Energy security. Risks and opportunities in a changing geopolitical landscape. Frankfurt: Frankfurt Working Papers on East Asia Nr. 5.
– Flüchter, Winfried (2007): Georisikoraum Japan: Physiogene Verwundbarkeit und präventiver Katastrophenschutz. (Geo-Risk-Space Japan – Physiogenetic vulnerability and disaster prevention). In: Glaser, Rüdiger und Klaus Kremb (Hrsg.): Planet Erde: Asien. Darmstadt: 239–251.
– Flüchter, Winfried (2003/2000): Tokyo before the next earthquake. Agglomeration-related risks, town planning and disaster prevention. In: Town Planning Review Vol. 74 (2003), Number 2: 213–238. Tokyo vor dem nächsten Erdbeben: Ballungsrisiken und Stadtplanung im Zeichen des Katastrophenschutzes. In: Geographische Rundschau 52-7/8 (2000): 54–61.
– Flüchter, Winfried (2002): Eine neue Hauptstadt für Japan? Bauwirtschaft und Geographie der Macht. (A new capital for Japan? The construction industry and the geography of power). In: Geographische Rundschau 54-6: 36–43.
Flüchter, Winfried (1997): Tōkyō quo vadis? Chancen und Grenzen (?) metropolitanen Wachstums. (Tōkyō quo vadis? Chances and limits (?) of metropolitan growth). Duisburger Arbeitspapiere Ostasienwissenschaften, Heft 15.
– Geipel, Robert (1992): Naturrisiken: Katastrophenbewältigung im sozialen Umfeld. Darmstadt.
– Heilmann, Klaus: (2010): Das Risikobarometer: Wie gefährlich ist unser Leben wirklich? München.
– Hewitt, Kenneth (1997): Regions of Risk. A Geographical Introduction to Disasters. Harlow/Essex.
– Kevenhörster, Paul (2010): Politik. In: Kevenhörster/Pascha/Shire: Japan. Wirtschaft, Gesellschaft, Politik. Wiesbaden: 237–363.
– Luhmann, Niklas (1990): Risiko und Gefahr. St. Gallen. (1993): Risk: A Sociological Theory. Berlin, New York.
– Müller-Mahn, Detlef (2005): Von „Naturkatastrophen" zu „Complex Emergencies". Die Entwicklung integrativer Forschungsansätze im Dialog mit der Praxis. In: Forum Institut für Länderkunde Leipzig, Heft 2: 69–89.
– Müller-Mahn, Detlef (2007): Perspektiven der geographischen Risikoforschung. In: Geographische Rundschau 59 Heft 10: 4–11.
– Perrow, Charles (1984/²1999): Normal Accidents: Living with High-Risk Technologies. Princeton, NJ. in: Ders.: (1987/²1992): Normale Katastrophen. Die unvermeidlichen Risiken der Großtechnik. Frankfurt a.M.
– Pohl, Jürgen und Robert Geipel (2002): Naturgefahren und Naturrisiken. In: Geographische Rundschau 54-1: 4–8.
– Pohl, Jürgen (1998): Die Wahrnehmung von Naturrisiken in der „Risikogesellschaft". In: Heinritz/Wießner/Winiger (Hrsg.): Nachhaltigkeit als Leitbild der Umwelt- und Raumentwicklung in Europa. Stuttgart: 153–163.
– Wisner, Ben, Blaikie, Piers, Canon, Terry and Ian Davis (2010): At risk. Natural Hazards, People's Vulnerability and Disasters. London.

The Author

1969 Staatsexamen University of Freiburg i. Br., Germany; 1975 PhD Ruhr University Bochum, Faculty of Geoscience (Thesis "Land Reclamation and Industrial Development of Near-shore Coastal Areas in Japan. Function, Structure and Impact of Filled-up Areas (umetate-chi)"; 1975–77 visiting professor at Tsukuba University, Japan, Faculty of Area Studies; 1977–85 assistant professor at Ruhr University Bochum, Department of Geography; 1985 habilitation thesis, Ruhr University Bochum, Faculty of Geoscience ("University Locations and Educational Behaviour with Regard to Regional Policy in Japan"); since 1986/87 professor at the University of Duisburg-Essen, Chair of Human Geography; 1994–96 foundation director of the Institute of East Asian Studies, University of Duisburg-Essen; 1995–96 research fellow at Tokyo Metropolitan University, Center for Urban Studies; 1999–2000 visiting professor at Dokkyo University, Japan; 2006 visiting professor at the Institute of Social Science, University of Tokyo; 2006–2008 director of the Institute of East Asian Studies, University of Duisburg-Essen; since 2008/09 retired. Research on Economic, Urban and Social Geography (particularly on the Geography of Risks), with emphasis on East Asia.

DOI: 10.17185/duepublico/73890
URN: urn:nbn:de:hbz:464-20210204-110535-2