Chapter 8
A Major Challenge to the Uncertainty of Modern Times

Introduction

Recent events have shown the heightened uncertainty of the contemporary world. Climate change, terrorism, health issues, and political instability have all contributed towards threats to security and safety in a complex environment where analysis is based on a “post-normal science”. In this environment facts are uncertain, truisms are disputed, and high stakes make adaptive decisions a matter of great urgency (Funtowicz and Ravetz 1993). In a world of great uncertainty, threats to biosecurity and biosafety have become a challenge to the integrity of populations. Biosecurity can be defined as the “[prevention of] the deliberate diversion of deadly pathogens for malicious purposes” (Tucker 2003). Biosafety is slightly—but crucially—different, given that it aims to “prevent losses to biological integrity and public health due to accidental releases of pathogens from research laboratories or other facilities” (Tucker 2003). The former deals with deliberate threats to well-being, while the latter copes with preventing accidental releases of hazards. In contemporary terms, biosecurity deals with potential state and non-state actors attempting biological attacks to further political, social, or religious goals. It is implemented through a strategic and integrated approach that encompasses policy and regulatory frameworks, and analyses risk management in food safety, animal life and health, plant life, and human health sectors, including associated environmental risks. At large, biosafety can be tied to the challenges of environmental disasters given its potential

The man thinks he wants freedom. He’s actually very afraid of it, because freedom forces him to make decisions and decisions involve risks.

Erich Fromm
effects on ecosystems and human health. These potential threats to physical and psychological security and biological safety make the study of crisis situations and risk extremely important. The construction of structures of meaning (patterns of memory and thought) largely depends on variations in emotional experience, which in turn depend on motivational processes. Understanding human thinking, emotions, and mind structures is essential to develop adequate risk assessment and crisis management systems for biosafety and biosecurity.

Crisis Management

Crisis is a word that is semantically tied to situations of uncertainty and discontinuity. Crises are typically driven by threats to fulfil basic needs. These needs not only are material (food safety, physical safety, and physical well-being), but also include psychological needs such as identity, security, resilience, and a sense of justice (Burton 1990). Balancing these needs poses a major challenge to the resilience of policymaking processes. It is understandable that in crisis situation leaders try to make decisions under pressure in a short period of time, trying to avoid as much as possible all bureaucratic and legislative steps that in a certain way could undermine the leadership through the length of time employed. The leader will trust individuals or groups that he or she believes are the top figures to help to handle the crisis and of course to maintain the government in power (Ramsbotham et al. 2011b). It is vital to know that the way these individuals or groups perceive and interpret crisis will define a state’s reactions. The main aim of crisis management is to try to keep the situation under control. It is important to identify crisis; obtain information; evaluate possible solutions; select solutions; implement the chosen response; and cope with the feedback (Aquilar and Galluccio 2008). While there are many forms of crisis management, the general objectives of such form of systems may include:

1. Protecting and preserving the life of citizens
2. Minimizing damages to property, peoples, and/or the environment
3. Managing communication and information effectively
4. Avoiding the deterioration of social relations
5. Ensuring trust between stakeholders

In brief, crisis management could be divided into three phases: preparedness before crisis, responses to limit damages during a crisis, and feedback after the crisis occurred. Preparedness implies gathering knowledge and logistical capacity to potentially cope with all phases. Four fundamental pillars are (a) risk assessment, (b) early warning systems, (c) emergency response, and (d) clear institutional/competence structures. The first implies identifying and analysing potential threats, hazards, and related vulnerabilities; the second aims at building effective contingency plans in the case of threat detection; the third establishes stockpiles, maintains equipment and supplies, and trains emergency forces to strengthen preparedness capacity. Finally, clear institutional structures and competences through legislation and logistics building facilitate fast and fluid preparedness given that stakeholders
are aware of their responsibilities, budgets, and role in crisis management systems. There are many ways of detecting a crisis, beyond monitoring networks, public authorities, and early warning systems, and also citizens, media, and stakeholders can be crucial in activating response procedures. With several sources to monitor crisis development, response actors should be able to create a “big picture” of the event with the help of appropriate intelligence infrastructure. This will in turn facilitate the development and choice of tailored contingency plans and emergency response networks, which will consistently require adequate coordination and strategic planning at the macro and crisis cell level. All crisis response operations should have a solid standard operating procedure (SOP) as a guideline. SOPs should include protocols facilitating information exchange and communication, in addition to scaling-up mechanisms should additional resources be necessary for emergency responses. Strong leadership is also essential in any emergency response situation on a logistical and psychological level with a particular importance in the latter case. This importance is based primarily on the fundamental role of the communication process in the event of a crisis. Communicating with the media and the general public on the development of emergency response is vital to establishing trust towards and between stakeholders, especially emergency responders and elected officials. Trust not only reassures citizens but also facilitates the smooth running of response operations by avoiding the chaos of hostile mass and general panic. Officials must therefore be trained on the importance of crisis leadership and communication. To this end, several steps are key: On very common terms, when speaking to the media, spokesmen and scientists/diplomats/policymakers should avoid evasive responses given that they can be interpreted very negatively. Both the media and the public might think that officials are hiding information or do not know how to respond to crisis, increasing both distrust/hostility and general panic. Secondly, jargon and difficult wording should be avoided consistently as it obscures understanding in crisis situations. Lack of clarity distances stakeholders and citizens at large from policymakers as they may interpret jargon as a way of giving “empty answers”, or they may have the perception that public actors are out of touch with the general public and the severity of a crisis. None of these interpretations are beneficial to building trust among stakeholders. In terms of presentation, correct body language and habits are key to reassure the public in the event of a crisis; strong eye contact and clear language help a lot to get a message across, as this is key in building trust and reassuring people. Evidently, it follows that all effective crisis communication includes briefing spokesmen and policymakers on the latest evidence-informed policies to be transmitted to citizens and other stakeholders. Beyond trust, solid briefings improve response coordination and decrease the risk of misinformation, misperception, and contradictory statements by public actors. These should include pre-drafted messages in preparation for crisis in providing cohesive, coherent, and coordinated narrative through clear guidelines for communication. Statements, news releases, and website modifications are all part of a solid pre-drafted message package. Given the unexpected nature of a crisis, pre-drafted messages should be taken as templates to crisis reaction instead of strict step-by-step guidelines. Good templates leave room for “blank spots” where information is
inserted once a crisis occurs. In the European Union (EU), but not only, effective crisis communication includes two additional dimensions: multiculturalism and multilingualism.¹ So far, attempts to create a European framework for crisis communication have encountered several problems.

**Knowing How to Give a Feedback**

Once a crisis winds down main actors should be able to effectively communicate the end of a crisis, reduce anxieties, and stimulate return to normality in the general public. The final phase of crisis management is coping with the feedback. Actions during every phase should be discussed and analysed between stakeholders to highlight best practices and learn from any limitations or mishaps. Should the feedback conclusions be properly incorporated, preparedness and response processes will be evaluated and improved with cognition of cause and crisis management strategies and actions will be implemented in the event of a future crisis. This is especially important when it comes to maintaining and strengthening trust among citizens, media, crisis responders, and policymakers. Large-scale crises, as it was that of COVID-19, with severe damage strongly impact trust in governments. If stakeholders and citizens at large believe that politicians took wrong decisions or performed mediocre, said trust may severely decrease. Such perception can intensify if the public thinks that the government was not transparent, hiding vital information, or refusing to admit failures during crisis management. In order to avoid internal political crisis, open feedback between policymakers/diplomats and stakeholders could clarify how decisions were made and ensure accountability. Even if there were significant failures, a serious and transparent feedback is an effective tool to undergo damage control on a government’s deteriorated reputation. All crisis management phases and levels should be included in the feedback phase. The importance of the feedback phase of crisis management is strengthened in the context of an international crisis. While classical routines within nations may imply reducing warning levels, this may not be the case if the issue has a transboundary dimension. It will certainly be more difficult to cope with and conclude these crisis situations due to difficult intergovernmental logistics. Communication-wise attitude facilitates disseminating contradictory information to the media and to the general public. When international crises end, stakeholders from all countries should provide feedback to analyse limitations and best practices in order to avoid future setback and build a new response mindset (Baubion 2013).

¹https://www.ecdc.europa.eu/sites/portal/files/documents/use-of-evidence-in-decision-making-during-public-health-emergencies_0.pdf.
Risk Management

The United States Environmental Protection Agency defines risk as “the chance of harmful effects to human health or to ecological systems resulting from exposure to an environmental stressor. A stressor is any physical, chemical, or biological entity that can induce an adverse response” (EPA 2020). The World Health Organization (WHO) defines risk assessment as “the scientific evaluation of known or potential adverse health effects resulting from human exposure to … hazards”. In its most basic form, assessing risk deals with the question of when, where, and how the potential threat could become a reality. Coping with risk therefore includes a tension between the chances of “clear and present” and “potential” threats. To this end, it is important to differentiate between the “uncertain” and the “unlikely” elements of risk: an uncertain but plausible risk is one that is usually complex and conceivable, but not necessarily guaranteed. This does not however make it unlikely. Uncertainty can be managed through investigation, dialogue, procedures, experience, and insight in order to make risk more bearable. The Scientific Council for Government Policy of the Netherlands identifies five “reference points” when it comes to dealing with uncertainty and risk (KNAW 2013):

1. Intertwining opportunities and threats
2. Including the sociological and psychological elements of dangers
3. Using risk comparisons
4. Accepting and managing uncertainty
5. Organizing stakeholder’s approaches to dealing with uncertainty

While most countries may have solid risk assessment approaches, the increasing international dimension of systemic risk complicates scenarios in which governments can act alone. Flexibility, adaptability, all-inclusive behaviour, and comprehensive approach are therefore essential elements to be integrated to new frameworks of risk assessment. Sectorial risk assessment has traditionally been used to identify qualitative and quantitative emergency support for local populations. In order to minimize the impact of natural hazards, pandemics, industrial accidents, or terrorist attacks a coordination is required of vaccine stock assessment, hospital preparedness, road evacuation safety, or containment measures in the case of Chemical, Biological, Radiological and Nuclear (CBRN) attacks or hazards. For such threats, risk assessment must use expertise from relevant agencies to determine a population, infrastructure, or territory’s level of exposure. Such expertise should eventually provide access to findings so that local authorities and emergency services can develop solid emergency plans. Generally speaking, the availability and accessibility of information for risk assessment and mapping have increased alongside improvements in monitoring networks, databases, archives, modelling, and mapping tools. Solid institutional frameworks are vital in guaranteeing information exchange at all levels of risk assessment stakeholders, from central authorities to local actors. In

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2 https://www.who.int/foodsafety/micro/riskassessment/en/.
addition, integrated guidelines allow authorities and emergency services to work on preparedness, relevant methodologies, and standards. The ultimate goal is to ensure a fluid multilevel organization of risk assessment both on a national and international level, developing capabilities for plans and large-scale emergencies that are both global and sectorial in their approach. To this end, the increased potential of international crises should force governments to tackle a series of questions:

1. Territorially: how to develop a multi-hazard/multi-risk approach to include new and emerging threats. This should include, for instance, the use of frequent data updates, horizon timescale, cascading effects, and tipping points for analysis.
2. Efficiently: disseminating risk assessment data to relevant stakeholders in emergency response, including private actors such as NGOs, media, and international actors and relevant third countries. Solid cooperation mechanisms are essential to combine science, intelligence, expertise, and knowledge at large in an understandable and accessible manner. This may imply empowering national authorities with the task of ensuring coordination, cooperation, and data accessibility.

On an international level, countries should share methodologies and tools to create common standards in risk assessment when it comes to borders. Such initiatives will not only increase effectiveness but also prove to reduce costs. The annual Global Risk Report of the World Economic Forum, as well as the European Emerging Risk Radar Initiative, references possible ways through which countries can improve international risk assessment. Conditions to do this have vastly improved given progress in science, technology, and information. These improvements have helped stakeholders make a better use of risk assessment for a more comprehensive and strategic approach through prevention policies and mitigation programs. On an international level, 168 countries adopted the Hyogo Framework for Action 2005–2015 (HFA) during the Second United Nations World Conference on Disaster Risk Reduction in Kobe (Japan). Stressing broader approaches to risk and crisis management, it led to the establishment of risk management cycles in many countries. This included early recovery and reconstruction in addition to feedback.³ Crisis management and risk assessment are essential tools for guaranteeing biosecurity and biosafety in the event of biological attacks or environmental disasters. These issues have become increasingly relevant for national and international actors, especially due to increases in terrorism and unstable environmental conditions.

**Bioterrorism After September 11, 2001**

Bioterrorism could be defined as “the use of biological agents to further the political objectives of the perpetrators” (Tucker 2003). The urgency of bioterrorism responses came to the forefront following the September 11, 2001, attacks. Bioterrorism is

³https://www.unisdr.org/files/1037_hyogoframeworkforactionenglish.pdf.
accessible to terrorist groups with a minimum amount of expertise in isolating and enriching pathogens. Even when terrorist groups do not have access to expertise, they could purchase biological agents from sources such as state and non-state actors. Many countries have historically developed biological weapons for the purposes of warfare. Given the deterioration of the rule of law in many states associated with such programs it could be plausible for terrorist groups to benefit from these situations to acquire biohazards. Beyond corruption, deterioration of safety and security standards facilitates security breaches in laboratories containing dangerous diseases and pathogens. Significant advances in biotechnology exacerbate such threats given that progress in genetic engineering has the potential to be used to the detriment of global security. Examples on the dangerous use of such technologies include altering disease agents to make them deadlier, inconspicuous, and quicker in contaminating populations and spreading contagion. In addition, genetic engineering can manufacture pathogens resistant to drugs and vaccines. The threat of bioterrorism has increased due to regional turmoil and enemy groups seeking opportunities to further geopolitical objectives (Khalil and Shinwari 2014). Of the many outlets for bioterrorism, attacks on agriculture could be of great strategic interest for terrorist groups. In practical terms, most antipersonnel agents available to non-state actors are relatively ineffective in terms of scale. Agents such as anthrax are poorly transmitted among humans and require large amounts in order to significantly impact populations. This is not only costly, but also difficult to operationalize into a terrorist attack. Beyond difficult logistics, improving diffusion of antipersonnel agents could mainly be achieved by creating breathable aerosol. This is not only technically difficult but also dangerous for perpetrators attempting to reduce agents to particle size unless they opt for the costly solution of vaccines or prophylactic antibiotics. As a result, while terrorists may attempt to use antipersonnel agents, the consequences are likely to be psychological and not focused on death tolls (unless groups acquire sophisticated means of contagion and large amounts of biological agents) (Khalil and Shinwari 2014). Attacks on agriculture have the potential to be much more effective. Chalk (2003) defined agricultural bioterrorism as “the deliberate introduction of a biological agent or bio-toxin, either against livestock or into the food chain, for purposes of undermining stability and/or generating fear. Depending on the disease agent or vector chosen, it is a tactic that can be used either to generate mass socio-economic disruption or as a form of direct human aggression”. Agricultural bioterrorism is effective for several reasons. On a logistical level, animal and plant diseases are mostly safe to handle by perpetrators and can rapidly spread throughout specific areas, affecting millions of people consuming agricultural products. Animal virus preparations can be diluted and disseminated with a simple atomizer in close proximity to targeted animals or smeared directly into their nostrils or mouths. In addition, infectious samples can be extracted through rudimentary methods. Scarping from mucosa of FMD-infected animals, ASK-infected animal blood, or wheat infected by stem rust pathogens can cause epidemics (Sherwood et al. 2003). Infectious material can also be smuggled easily across borders given that only small samples are needed. Possible infection areas include rural rounds, animal auctions, or barns. When introducing plant diseases, exposure can be
facilitated by upwind in a targeted field. Should environmental, weather, and seasonal conditions favour the transmission of an infection, combining upwind with a mass of sporulating fungi can be an effective way of infecting crops. This is also facilitated by the fact that, logistically, the large land extension of industrial farming makes it difficult to effectively monitor crops. Humans are not the only vulnerable group given that biodiversity can also be severely affected. Potentially successful attacks have the probability to eliminate the entire species from regions, leading to ecological imbalances that can cause further extinctions as a domino effect (Wheelis et al. 2002).

Potential Global Economic Impact of Agricultural Bioterrorism

So far, we have briefly analysed potential damages to health and ecology. Beyond these vital areas for security, agricultural bioterrorism can severely impact economic conditions on an international level. Given the devastating potential of agricultural bioterrorism, the United States took an early interest in it. The FBI (Federal Bureau of Investigation), the Department of Agriculture (USDA), the Food and Drug Administration (FDA), and the Department of Homeland Security organized two international symposiums in 2005 and 2006 on agricultural bioterrorism with about 1000 participants. Participants came from a wide array of biosecurity stakeholders including legislators, agronomists, academics, researchers, businessmen, police representatives, and military officials. The USDA’s Food Safety and Inspection Service requested its inspectors to incorporate agroterrorism dimensions to their inspections, overlapping the terms “food defence” and “health safety”. Awareness campaigns were also developed in numerous federal agencies in addition to user guides for farmers and businessmen. Public-private programs were also developed on a voluntary basis to strengthen prevention and response in agricultural bioterrorism (Suffert et al. 2008). This was done through the Strategic Partnership Program Agroterrorism (SPPA).

In the EU, both agriculture and the food industry remain critical to the social, economic, and political stability of the 27 member states. In addition to providing food and clothing, agribusiness provides many raw materials used in other industries. This makes both the primary sector and other areas of the economy highly vulnerable to any form of biological disruption (Hassler and Oman 2003). The effects of such disruptions were seen in the 1990s during the bovine spongiform encephalopathy (BSE—also known as mad cow disease) outbreaks in the United Kingdom, which not only led to the deaths of 177 people but also caused a $4.2 billion loss in international markets from direct cattle death/sacrifices. In addition, preventative measures against classical swine fever (CSF) outbreaks led to the slaughter of millions of pigs. Costs related to such practices are not the only ways in which biological agents may damage economies. When plants and animals risk
carrying diseases, members of the World Trade Organization reserve the right to impose phytosanitary restrictions and ban imports from affected countries. In the case of the United Kingdom, both mad cow disease and CSF led to the suspension of beef, sheep, and swine product exports to the EU member states and other countries. The United States offers an interesting example on the consequences of biological agents on crops. When there was an outbreak of Karnal bunt of wheat (caused by fungus *Tilletia indica*) over 80 countries banned wheat imports from affected regions of the United States. Disease issues in plants and animals can lead to billions of dollars in lost trade and severely affect countries with important agricultural sectors (Khalil and Shinwari 2014). Additional cost challenges are found in the prevention of agricultural bioterrorism. Preventative measures for crops and livestock tend to be expensive given that veterinarians and agronomists usually recommend chemotherapeutants. When adding diagnostic kits, chemical reagents, and antibiotics costs are further increased for producers in a sector that deeply impacts a country’s economic production (Sherwood et al. 2003). Given the economic consequences of agricultural bioterrorism, it is useful to understand the psychological reaction of consumers to the risk of biological attacks on their food. By definition, risk is also a perception and that can lead to inaccurate readings of reality. For example, consumers can overstate risks in certain foods, which will lead to economic losses for producers and lost welfare for consumers. On the other hand, underestimating risk can lead to health exposure and problems for producers through accusations of gross negligence. All in all, accurate information and proportional psychological responses to agroterrorism risks are an important part of any crisis and risk management operation, especially given the severe economic consequences that extreme forms of panic or ignorance can have on producers and populations (Just et al. 2009). This is also necessary when considering the negative consequences of environmental disaster from an economic, psychological, and resiliency standpoint.

**Environmental Disasters: A Major Challenge to Biosafety**

According to the United Nations Environment Programme (UNEP 2008), a disaster is “A serious disruption of the functioning of a community or a society causing widespread human, material, economic or environmental losses, which exceed the ability of the affected community or society to cope using its own resources. It is a function of the risk process, and results from the combination of hazards, conditions of vulnerability and insufficient capacity or measures to reduce the potential negative consequences of risk”. As a consequence, disaster risk reduction is “the conceptual framework of elements considered with the possibilities to minimize vulnerabilities and disaster risks throughout a society, to avoid (prevention) or to limit (mitigation and preparedness) the adverse impacts of hazards, within the broad context of sustainable development” (UNEP 2008). Several environmental issues are making disaster risk an increasingly relevant issue to biosafety. These issues are
mostly of significance to climate change, which is defined by the United Nations Framework Convention on Climate Change (UNFCCC)⁴ as a phenomenon attributed "directly or indirectly to human activity that alters the composition of the global atmosphere. It is in addition observed over comparable time periods". To this end, most scientific studies point to a rising in global temperatures beyond their averages, consecutively surpassing five centuries of climate data in a few decades. Consequences of such changes are grave for biosafety as was confirmed by the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report in 2007.⁵ According to the report’s estimates, by 2100 earth would see:

1. 1.1–6.4 °C rise in average global surface temperatures
2. 18–59 cm rise in average sea levels
3. Increase in ocean acidity levels, deteriorating ecosystems
4. Increased frequency of heat waves
5. Increased frequency of tropical cyclones (typhoons and hurricanes)

Changing climate conditions are also affecting water, food, economy, settlements, and health. Given the rise in global surface temperatures, certain regions are seeing an increase in droughts, decreasing water availability in mid-latitudes: dry tropics and regions that depend on meltwater from mountain ranges. This is grave from a water-access standpoint, as one-sixth of the world’s population depends on meltwater for its water supply. Higher temperatures leading to droughts and floods will also impact food production, increasing the risk of hunger and forced displacements due to homelessness. Livelihoods will also be affected given that many key economic sectors are placed in coastal areas. The prospect of floods and typhoons can therefore disrupt activity with worrying ease. Human health will also suffer due to higher temperatures given that floods, storms, fires, and droughts are directly correlated to higher death, disease, and injury rates (ISDR 2008). It is important to remember that, while climate change is not a phenomenon deliberately caused by certain actors, this does not mean that the prospects of environmental disasters due to climate change are not man-made. Greenhouse gases such as carbon dioxide, methane, nitrous oxide, and ozone are emitted by fossil fuel consumption and agriculture in addition to advancing through deforestation. These are all practices that degrade environmental conditions. The UNEP (2008) defines environmental degradation as “the reduction of the capacity of the environment to meet social and ecological objectives and needs. Potential effects are varied and may contribute to an increase in vulnerability and the frequency and intensity of natural hazards”. Tying environmental degradation to negative social, political, and economic consequences is essential given the summary of evidence. Not only are most environmental disasters the consequences of man-made issues, but they are also felt by earth’s poorest inhabitants, especially those in small and developing countries (UNEP 2008). Degraded environments caused by man-made activities are clearly detrimental to

⁴ https://unfccc.int/
⁵ https://www.ipcc.ch/assessment-report/ar4/.
biosafety and to economic and human development. Climate change increases the likelihood of environmental disaster. This does not mean, however, that policy frameworks have not facilitated the ability for such events to take place. Stakeholders in biosafety often focus on response than prevention when it comes to disaster risk. Not only does this make populations potentially face severe consequences, but it is also ineffective from a cost-benefit standpoint. Disasters have high costs from all perspectives (political, psychological, social, economic, etc.) and consequences that last for years. To this end, strong risk management measures must be implemented on all policy levels (Oppenheimer et al. 2012).

**Hyogo Framework for Action**

Prevention in disaster risk reduction is therefore much more effective from a cost-benefit perspective than the response phase of a crisis management cycle. To this end, stakeholders must adopt precautionary and comprehensive approaches to protect vulnerable communities and strengthen preparedness in crisis management. Biosafety depends on the combination of environmental science, information exchange, technological innovations, and good governance. These are challenges that were recognized by the Hyogo Framework for Action, the Millennium Declaration, and the United Nations Millennium Ecosystem Assessment when they linked environmental degradation, poverty, and disaster risk. Of these, the most important in developing a framework for environmental disaster risk reduction was the Hyogo Framework for Action. Developed in 2005 at the World Conference on Disaster Reduction in Hyogo (Japan) it related the notions of environmental degradation, vulnerability, and man-made hazards in the development of a disaster. To this end, the Action Plan recommended:

1. Encouraging a sustainable ecosystem use and management in land planning and development. This should reduce vulnerabilities and risk.
2. Integrating natural resource and environmental management with disaster risk reduction. Structural and non-structural measures such as flood management and managing fragile ecosystems are strongly recommended to this end.
3. Adopting risk reduction measures within the larger context of climate change by identifying local climate-related disaster risks and creating tailor-made risk reduction programs. Access to climate information and expertise should be facilitated.
4. Building a strong national and local institutional framework and awareness in order to increase the sense of urgency for disaster risk reduction.
5. Strengthening all phases of the crisis management cycle for environmental disasters (UNEP 2008).

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6 https://www.unisdr.org/files/1037_hyogoframeworkforactionenglish.pdf.
Biosafety and Resilience Processes

Stakeholders in biosafety have also been working on the concept of resilience. Applied to risk and crisis management, the UNISDR defines resilience as “the ability of a system, community or society exposed to hazards to resist, absorb, accommodate and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions”. Resilience is extremely relevant to prevention and preparedness as it focuses on the durability of peoples and systems in the face of threats and disasters. It is conceptually useful on many different levels, from community organization to national and international policymaking. Strong resilience guarantees that core functions of institutions persist during disasters and recover as quickly as possible. Given the rising risks of bioterrorism and environmental disasters, the EU has taken steps to ensure that biosecurity and biosafety are met with strong preparedness, response, and feedback mechanisms to protect citizens in an uncertain world.

7 https://www.undrr.org/.