GUIDELINES FOR CITIZEN-LED DISASTER RISK MAPPING

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Association for Research and Social Innovation „Analysis, Design, Transformation“ is a non-governmental organization established in 2014 with commitment to creation of open and knowledge-based communities in Bosnia and Herzegovina that foster inclusive and sustainable development that protects the public interest and the common goods. The organization utilizes novel methods in social engineering and uses design thinking, mixed-method analysis and multistakeholder approach in fostering social innovations. One of its hallmarks is utilization of the feminist action participatory research method that ensures that organization's programs, initiatives and activities are aligned with the needs of communities and stakeholders involved in the social innovation design and implementation. The organization works with diverse audiences, depending on the initiative. However, it always strives to include researchers, experts, entrepreneurs, civic activistS, journalists and social media professionals, relevant governmental officials, students/youth and community representatives directly affected by a specific social intervention.

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Table of Contents

1. Introduction

1.1 Purpose of the Guidelines

The purpose of these Guidelines for Citizen-Led Disaster Risk Mapping is to provide a practical, step-by-step framework for communities, civil society organisations, researchers, and local institutions to design and implement citizen-led disaster risk mapping initiatives in a structured, ethical, and scientifically robust way. While citizen science and participatory approaches are increasingly promoted at the policy level—particularly within the European Union, UNDRR frameworks, and climate adaptation agendas—there is still very limited practical guidance on how such projects can be implemented on the ground, especially in complex, post-industrial and environmentally burdened contexts.

These guidelines are directly informed by the experience of the Association for Research and Social Innovation (ADT) in implementing the project Citizen Science for Disaster Risk Preparedness Policy Development in Kakanj, Bosnia and Herzegovina, supported by the EU-funded IMPETUS project. During the design and implementation of this initiative, ADT identified a significant gap between high-level policy aspirations around citizen science, disaster risk reduction, and community participation, and the lack of concrete methodological tools available to practitioners, activists, and local communities. In particular, there was little accessible guidance on how to move from abstract concepts—such as participation, co-creation, and community resilience—to operational mapping processes, data collection tools, validation methods, and actionable outputs.

As a result, ADT systematically documented, tested, and refined a methodology throughout the project, responding to real-world constraints, community feedback, and local risk dynamics. These guidelines consolidate that experience into a transferable framework that can be adapted to different territories, risk profiles, and community contexts, particularly in regions with limited institutional capacity, high environmental burdens, and strong civic engagement.

Disaster risk mitigation is a critical issue for local communities because disasters—whether sudden events such as floods and landslides, or slow-onset processes such as pollution, environmental degradation, and climate change—disproportionately affect those with the least resources, least political influence, and least access to information. Community-level knowledge about risks is often extensive, but it remains undocumented, fragmented, or ignored in formal planning processes. Citizen-led mapping helps bridge this gap by making local knowledge visible, spatially explicit, and usable for decision-making, advocacy, and policy development.

Involving communities directly in disaster risk mapping strengthens local ownership, improves the relevance and accuracy of data, and builds trust between citizens, civil society, and institutions. It also enhances preparedness by increasing awareness of risks and encouraging collective responsibility for mitigation and adaptation. For civic groups and grassroots organisations, engagement in disaster and pollution risk mapping is not only a technical activity but also a form of civic action and environmental justice practice. It enables communities to document cumulative harms, challenge unequal exposure to risks, and demand accountability from decision-makers and polluters.

These issues are particularly prevalent in Bosnia and Herzegovina and the wider Western Balkans, where the legacy of heavy industry, mining, weak environmental governance, post-conflict institutional fragmentation, and limited enforcement of environmental regulations has resulted in widespread pollution and high disaster vulnerability. Climate change is further intensifying existing risks, increasing the frequency and severity of floods, heatwaves, droughts, and wildfires. In many cases, affected communities lack access to reliable data, early warning systems, or meaningful participation in environmental decision-making. Citizen-led disaster risk mapping therefore plays a crucial role in addressing structural inequalities, environmental injustice, and democratic deficits in the region.

These guidelines are intended for a wide range of users, including:

- local communities and informal citizen groups,
- civil society and environmental organisations,
- youth groups and schools,
- researchers and academic institutions,
- local governments and public authorities,
- disaster risk management and civil protection actors.

They can be used to design new citizen-led mapping initiatives, strengthen existing projects, support policy advocacy, inform local disaster risk reduction strategies, and contribute to broader efforts in climate adaptation, environmental justice, and sustainable development. By translating lived experience into structured evidence, these guidelines aim to support communities not only in understanding their risks, but in actively shaping safer, healthier, and more resilient futures.

Tools, Methods and Resources

Throughout these Guidelines, red boxes are used as practical learning aids to highlight key tools, methods, and resources. These red boxes provide short descriptions of specific tools, methodological approaches, and participatory techniques, along with references and links for further learning and real-world examples. Their purpose is to support users who wish to deepen their understanding, adapt methods to their local context, or explore tested practices without overloading the main text with technical detail.

1.2 What Is Citizen-Led Disaster Risk Mapping

Citizen-led disaster risk mapping is a participatory approach to identifying, documenting, and analysing disaster risks in which citizens play a central role as active contributors of knowledge, rather than passive data providers. Through this approach, local residents—often those most exposed to hazards—collect geolocated information on natural, technological, and environmental risks based on their lived experience, observations, and local knowledge. These data are then combined with scientific methods, spatial analysis, and institutional data sources to produce maps and analyses that reflect both technical evidence and community realities.

Unlike traditional, expert-driven risk assessments that are typically conducted by institutions or external consultants, citizen-led disaster risk mapping emphasises co-creation, transparency, and local relevance. It acknowledges that communities possess valuable insights into historical events, recurring hazards, slow-onset environmental degradation, and everyday risks that may be overlooked in official datasets. By integrating citizen-generated data with established disaster risk reduction frameworks, this approach enhances the accuracy, inclusiveness, and usability of risk information for preparedness, mitigation, and policy development.

Citizen-led disaster risk mapping is not only a technical exercise but also a social and civic process. It strengthens community awareness, builds collective capacity to understand and respond to risks, and supports environmental justice by making unequal exposure to hazards visible. When embedded in participatory action research, it enables communities, civil society organisations, and institutions to jointly interpret findings and translate them into advocacy, planning, and concrete risk reduction measures, thereby contributing to more resilient, informed, and engaged societies.

1.3 Participatory Action Research Approach

Participatory Action Research (PAR) is a research approach that combines knowledge generation with collective action, aiming not only to understand social and environmental problems but also to contribute to meaningful change. In the context of citizen-led disaster risk mapping, PAR provides a methodological and ethical foundation for involving communities as equal partners in the research process. Rather than treating local residents as subjects of research, PAR recognises them as co-researchers who actively shape research questions, methods, interpretation of findings, and subsequent actions. This approach is particularly well suited to disaster risk reduction, where local knowledge, trust, and collective learning are essential for effective preparedness and mitigation.

Within PAR, research is understood as an iterative and reflexive process that evolves in response to community feedback, changing conditions, and emerging insights. Data collection, analysis, and action are closely interconnected: findings are continuously shared with participants, validated through dialogue, and used to inform decisions, advocacy, and policy proposals. In citizen-led disaster risk mapping, this means that risk maps and analyses are not treated as final outputs, but as living tools that support discussion, awareness-raising, and collective problem-solving. PAR also places strong emphasis on power relations, ensuring that knowledge production does not reinforce existing inequalities but instead creates space for marginalised voices to be heard.

A feminist participatory action research (feminist PAR) perspective further strengthens this approach by explicitly addressing issues of gender, power, care, and lived experience. Feminist PAR recognises that disaster risks and environmental harms are not experienced equally: women, elderly people, children, persons with disabilities, and economically marginalised groups often face higher exposure and fewer resources to cope with disasters. It values embodied knowledge, everyday experiences, and emotional labour, acknowledging that care work, household responsibilities, and informal community roles are central to how risks are perceived and managed. In practice, this means designing mapping processes that are accessible, inclusive, and sensitive to different forms of participation, including those that may not conform to traditional notions of "expert" knowledge.

Applying PAR and feminist PAR in citizen-led disaster risk mapping helps shift the focus from purely technical assessments toward a more just, inclusive, and transformative understanding of risk. It encourages shared ownership of data, collective interpretation of findings, and joint responsibility for action. By embedding disaster risk mapping within participatory and feminist research principles, communities are not only better equipped to document hazards and vulnerabilities, but are also empowered to challenge structural causes of risk—such as environmental injustice, inadequate governance, and unequal access to resources—and to advocate for safer, healthier, and more resilient living environments.

Participatory Action Research: A Toolkit (University of Reading)

A practical toolkit that outlines the stages of PAR and explains how to build collaborative research teams, choose topics, collect and analyse data, and mobilise action. It focuses on equity, trust, and relationship building in community research projects, making it especially helpful for groups doing PAR with limited prior experience.

Toolkit of Methods for Feminist Participatory Action Research (Oxfam)

This toolkit presents specific methods and tips for implementing FPAR — research that centres gender equity and power dynamics. It includes step-by-step processes and examples of applying feminist approaches in participatory research, particularly in water governance and community contexts.

Guide to Participatory Feminist Research (McGill)

This guide explains key elements of participatory feminist research, highlighting how to design and conduct research rooted in participants' lived experiences and structural transformation goals. It contains practical methods, visual tools, and ethical reflections for feminist PAR.

1.4 Target Audience

These Guidelines are intended for a broad range of actors who play complementary roles in disaster risk reduction, environmental protection, and community resilience. Citizen-led disaster risk mapping is most effective when it is multi-actor, inclusive, and collaborative, bringing together local knowledge, civic engagement, scientific expertise, and institutional responsibility. Understanding who the target audiences are—and how to identify, contact, and engage them—is therefore a critical first step in implementing successful mapping initiatives.

Local communities and citizen groups are at the core of citizen-led disaster risk mapping. These include residents of urban, rural, peri-urban, and industrial areas, informal neighbourhood groups, community leaders, and individuals directly affected by disasters, pollution, or environmental degradation. They can be identified through local networks, community meetings, social media groups, neighbourhood associations, and existing grassroots initiatives. Engagement should be based on trust-building, clear communication of purpose, and respect for local knowledge. Direct, face-to-face outreach, community workshops, and collaboration with trusted local actors are often the most effective ways to involve these groups.

NGOs and civil society organisations play a key role as facilitators, organisers, and advocates. Environmental organisations, humanitarian NGOs, youth organisations, and community-based groups often already work on issues related to disaster risk, pollution, climate change, or environmental justice. They can be identified through civil society registries, local networks, thematic coalitions, and prior project partnerships. Engagement with NGOs should emphasise shared objectives, complementary capacities, and opportunities for co-creation, data sharing, and joint advocacy. NGOs are also well positioned to support training, outreach, and long-term sustainability of mapping initiatives.

Researchers and academic institutions contribute methodological rigour, analytical capacity, and links to broader scientific communities. Universities, research institutes, and individual researchers working in fields such as environmental sciences, geography, social sciences, public health, and disaster studies can be approached through academic networks, research centres, and ongoing projects. Engagement should focus on collaborative research design, ethical standards, data validation, and co-authorship or joint dissemination of findings, ensuring that academic involvement supports—not dominates—community-led processes.

Local and national authorities, including municipalities, civil protection services, environmental agencies, and line ministries, are essential stakeholders for translating mapping results into policy and action. They can be identified through formal institutional structures and existing mandates related to disaster risk reduction and environmental management. Initial engagement should be transparent and constructive, clearly explaining the purpose of citizen-led mapping and how it can complement official data and planning processes. Involving authorities as observers, contributors, or citizen scientists themselves can help build trust and improve the uptake of findings.

Schools and youth groups represent a particularly important audience for long-term impact and sustainability. Schools, youth clubs, student organisations, and informal youth networks can be contacted through education authorities, teachers, youth workers, and local NGOs. Young people often bring digital skills, creativity, and strong motivation to environmental and climate issues. Engagement should be adapted to their needs, using interactive training formats, digital tools, and project-based learning, while ensuring safeguarding and age-appropriate participation.

By tailoring engagement strategies to each target audience and fostering collaboration among them, citizen-led disaster risk mapping initiatives can build strong, inclusive partnerships that support both immediate risk awareness and long-term resilience and environmental justice.

2. Conceptual and Policy Framework

This section outlines the key conceptual, policy, and ethical foundations that guide citizen-led disaster risk mapping, ensuring alignment with international disaster risk reduction frameworks, citizen science standards, and human rights principles. It provides a shared reference point for integrating community-generated data into credible, ethical, and policy-relevant processes that support risk reduction, environmental justice, and resilience-building.

2.1 Disaster Risk Reduction Frameworks

Disaster risk reduction (DRR) provides the overarching conceptual foundation for citizen-led disaster risk mapping. Rather than focusing solely on emergency response, contemporary DRR frameworks emphasise understanding, preventing, and reducing risk before disasters occur, while strengthening the capacity of communities to cope with and adapt to hazards. For citizen-led initiatives, these frameworks are essential because they help situate local knowledge and community-generated data within internationally recognised concepts and policy priorities, increasing the legitimacy, comparability, and policy relevance of mapping outcomes.

The Sendai Framework for Disaster Risk Reduction (2015–2030) is the central global policy framework guiding DRR efforts. It shifts the focus from managing disasters to managing risk and explicitly recognises the role of local communities, civil society, and citizens in risk identification and governance. Sendai highlights four priority areas: (1) understanding disaster risk, (2) strengthening disaster risk governance, (3) investing in disaster risk reduction for resilience, and (4) enhancing disaster preparedness for effective response and "Build Back Better." Citizen-led disaster risk mapping directly contributes to the first priority by generating granular, place-based data on hazards, vulnerabilities, and impacts that are often missing from official datasets.

Within the Sendai Framework and broader UNDRR guidance, disaster risk is commonly understood through four interrelated components: hazard, exposure, vulnerability, and capacity. Hazards refer to potentially damaging physical, environmental, or human-induced events, such as floods, landslides, industrial accidents, or pollution. Exposure describes the people, infrastructure, assets, and ecosystems located in hazard-prone areas. Vulnerability reflects the conditions—social, economic, environmental, and institutional—that increase susceptibility to harm, while capacity refers to the strengths, resources, and abilities of individuals and communities to anticipate, cope with, and recover from disasters.

Citizen-led disaster risk mapping is particularly well suited to capturing the relational and lived dimensions of these components. Communities are often best positioned to document recurrent hazards, identify who and what is exposed, explain why certain groups are more vulnerable, and highlight existing coping strategies and capacities. By structuring mapping activities around these four components, citizen-generated data can move beyond isolated incident reporting and instead support integrated risk analysis, making visible how environmental degradation, pollution, inequality, and governance failures interact to produce disaster risk.

Applying DRR frameworks in a participatory way also strengthens the connection between local action and policy processes. When citizen-led mapping aligns with Sendai terminology and UNDRR concepts, results can more easily feed into local disaster risk reduction strategies, climate adaptation plans, civil protection assessments, and environmental policies. This alignment helps ensure that community knowledge is not only documented but can also influence decision-making, resource allocation, and long-term risk reduction efforts.

Sendai Framework for Disaster Risk Reduction (2015–2030)

The primary global framework guiding disaster risk reduction, outlining priorities for action and emphasising inclusive, community-based approaches.

Sendai Framework Monitor

An online tool used by countries to track progress on Sendai targets, helpful for understanding how local data can contribute to national and global reporting.

Words into Action Guidelines (UNDRR)

Practical guidance documents translating Sendai priorities into operational steps, including guidance on risk assessment and community engagement.

2.2 Citizen Science Principles

Citizen science principles provide the methodological and ethical backbone for citizen-led disaster risk mapping, ensuring that community participation contributes to credible, inclusive, and usable knowledge. When applied rigorously, these principles help bridge the gap between grassroots engagement and scientific standards, allowing citizen-generated data to inform research, policy, and decision-making without compromising quality or integrity. In disaster risk contexts—where data gaps, uncertainty, and power imbalances are common—adhering to clear citizen science principles is essential for trust, legitimacy, and impact.

Inclusiveness and accessibility are foundational to citizen science. Citizen-led disaster risk mapping should be designed so that participation is open to people of different ages, genders, educational backgrounds, abilities, and socio-economic positions. This includes removing technical barriers (such as overly complex tools or jargon), addressing digital divides, and creating multiple entry points for engagement (online, offline, individual, and group-based). Inclusive design recognises that those most affected by disasters and pollution—such as rural communities, informal settlements, women, elderly people, and marginalised groups—often face the greatest obstacles to participation. Accessibility therefore requires intentional outreach, culturally sensitive communication, multilingual materials, and flexible participation formats that fit people's daily realities.

Scientific validity and transparency ensure that citizen-generated data are reliable, interpretable, and fit for purpose. While citizen science values experiential and local knowledge, it does not reject scientific standards; instead, it adapts them to participatory contexts. This includes clear research questions, well-designed data collection tools, documented methodologies, and transparent criteria for data validation and analysis. Transparency is particularly important: participants should understand why data are being collected, how they will be analysed, what their limitations are, and how results will be used. In disaster risk mapping, transparency also helps manage uncertainty and subjectivity, making it clear that citizen data complement—rather than replace—other forms of evidence.

Open data and FAIR principles (Findable, Accessible, Interoperable, Reusable) are increasingly central to citizen science and disaster risk reduction. Open data practices enable broader use of citizen-generated information by communities, researchers, civil protection authorities, and policymakers, while avoiding the enclosure of community knowledge within closed systems. Applying FAIR principles means ensuring that data are properly documented (metadata), stored in accessible formats, and shared under clear conditions that respect privacy and ethical constraints. In citizen-led disaster risk mapping, open and FAIR data practices support transparency, replication, cross-scale learning, and long-term sustainability, while also reinforcing community ownership over knowledge production.

Together, these principles help ensure that citizen-led disaster risk mapping is not extractive or symbolic, but instead contributes to empowerment, accountability, and evidence-based action. By embedding inclusiveness, scientific rigour, and open data practices into project design and implementation, civic groups and communities can produce knowledge that is both socially meaningful and institutionally relevant.

EU-Citizen.Science Platform
An EU-supported platform offering tools, guidelines, training materials, and examples of citizen science projects, including participatory and community-led initiatives.

Citizen Science Association (CSA) Resources
A collection of guidance documents, toolkits, and case studies addressing data quality, ethics, and participation in citizen science projects.

FAIR Data Principles
An overview of the FAIR principles for data management, widely used in open science and increasingly applied to citizen science and environmental data.

Open Data Handbook (Open Knowledge Foundation)
Practical guidance on publishing and using open data responsibly, including legal, technical, and ethical considerations.

2.3 Ethics, Human Rights, and Do-No-Harm Principles

Ethical considerations and human rights principles are fundamental to citizen-led disaster risk mapping, particularly in contexts where communities have experienced repeated disasters, environmental harm, conflict, or institutional neglect. Mapping risks is not a neutral technical exercise: it involves people's lived experiences, memories of loss, health impacts, and exposure to injustice. For this reason, citizen-led initiatives must be grounded in a do-no-harm approach that prioritises dignity, safety, autonomy, and well-being of all participants. Ethical practice is essential not only to protect individuals, but also to build trust, legitimacy, and long-term engagement.

Informed consent is a core ethical requirement. Participants must clearly understand the purpose of the mapping activity, what kind of data they are being asked to provide, how the data will be used, who will have access to it, and what potential risks or benefits may arise from participation. Consent should be voluntary, informed, and ongoing, meaning that participants have the right to withdraw at any stage without negative consequences. In citizen-led disaster risk mapping, informed consent must be communicated in clear, non-technical language and adapted to local contexts, literacy levels, and cultural norms. Special care is required when working with children, vulnerable groups, or communities affected by trauma.

Data protection and privacy are particularly important in disaster and pollution risk mapping, where data may reveal sensitive information about individuals, households, locations, health conditions, or conflicts with authorities or private actors. Ethical practice requires collecting only data that are necessary, minimising personal identifiers, and anonymising or aggregating information wherever possible. Digital tools must be chosen and configured with privacy in mind, and data storage should follow secure practices. Where applicable, data protection standards such as the EU General Data Protection Regulation (GDPR) should be applied, even in contexts where legal enforcement may be weak. Protecting participants' privacy is not only a legal obligation but also a key condition for trust and safety.

Avoiding harm and preventing retraumatisation is a central element of a do-no-harm approach. Discussing disasters, pollution, illness, displacement, or environmental loss can reopen traumatic experiences, particularly in post-conflict or environmentally burdened settings such as Bosnia and Herzegovina and the wider Western Balkans. Mapping activities should therefore be designed with sensitivity, allowing participants to choose how much they share, avoiding intrusive questioning, and creating safe spaces for dialogue. Facilitators and citizen scientists should be trained to recognise signs of distress, respect boundaries, and prioritise care over data collection. Ethical citizen-led mapping recognises that people's well-being is more important than complete datasets.

Embedding ethics and human rights into citizen-led disaster risk mapping also supports environmental justice. Many disaster and pollution risks are unevenly distributed and linked to structural inequalities, weak governance, or economic marginalisation. Ethical mapping practices help ensure that documenting these risks does not further expose communities to retaliation, stigmatisation, or exploitation, but instead supports accountability, solidarity, and collective action. By integrating informed consent, data protection, and do-no-harm principles throughout the research process, citizen-led disaster risk mapping can contribute to safer, fairer, and more just pathways to resilience.

EU General Data Protection Regulation (GDPR) – Overview
A comprehensive framework for data protection and privacy, relevant for handling personal and geolocated data in citizen science projects.

WHO Ethical Standards for Research in Emergencies
Ethical guidance relevant to research and data collection in disaster and emergency settings, including issues of consent and participant protection.

ALNAP – Do No Harm Principles
Practical guidance on applying the do-no-harm approach in humanitarian and development contexts, useful for disaster risk mapping in sensitive environments.

UN Office of the High Commissioner for Human Rights – Human Rights–Based Approach
Guidance on integrating human rights principles such as participation, accountability, non-discrimination, and dignity into research and development work.

3. Types of Disaster Risks to Be Mapped

Citizen-led disaster risk mapping should encompass a broad and context-specific range of risks that affect communities' safety, health, livelihoods, and environments. This section outlines the main categories of disaster risks relevant for mapping, recognising that risks often overlap, interact, and are shaped by local environmental, social, and economic conditions. The selection of risk types should always be grounded in local realities, preliminary research, and community knowledge, ensuring that mapping efforts focus on the most pressing and relevant threats.

A disaster is a serious disruption of the functioning of a community or society that causes widespread human, material, economic, or environmental losses and impacts, exceeding the ability of the affected community to cope using its own resources. Disasters are not caused by hazards alone; they result from the interaction between hazards, exposure, vulnerability, and capacity. This means that the same hazardous event can have very different consequences depending on social, economic, environmental, and governance conditions.

3.1 Natural Hazards

Natural disasters are disasters triggered by natural hazards such as earthquakes, floods, droughts, storms, landslides, or wildfires. While the hazards themselves originate from natural processes, the scale of their impact is strongly influenced by human factors, including land use, environmental degradation, infrastructure quality, preparedness, and social inequality. As a result, natural disasters are not purely "natural" in their consequences, as human decisions and systems shape who is exposed and how severe the impacts are.

1. Geological (Geophysical)

Earthquakes – Sudden ground shaking caused by the movement of tectonic plates, potentially leading to structural damage, landslides, and loss of life.

Volcanic eruptions – Release of magma, ash, gases, and lava from the Earth's crust, posing risks to health, infrastructure, and ecosystems.

Tsunamis – Large sea waves generated by underwater earthquakes, volcanic eruptions, or landslides, causing coastal flooding and destruction.

Landslides and rockfalls – Downward movement of soil, rocks, or debris due to gravity, often triggered by rainfall, earthquakes, or human activity.

Avalanches – Rapid flow of snow down a slope, threatening lives, infrastructure, and transport routes in mountainous areas.

2. Hydrological

Floods (river, flash, coastal, urban) – Overflow of water onto normally dry land, caused by heavy rainfall, snowmelt, storm surges, or inadequate drainage.

Glacial lake outburst floods (GLOFs) – Sudden release of water from glacial lakes due to dam failure, often causing catastrophic downstream flooding.

Storm surges – Abnormal rise of sea level driven by storms, leading to coastal flooding and erosion.

Erosion (riverbank, coastal) – Gradual loss of land due to water flow or wave action, undermining ecosystems, settlements, and infrastructure.

3. Meteorological

Storms (windstorms, thunderstorms, tropical cyclones, hurricanes, typhoons) – Severe weather events characterised by strong winds, heavy rainfall, and sometimes lightning or tornadoes.

Extreme temperature events (heatwaves, cold waves, frost) – Periods of unusually high or low temperatures that affect human health, agriculture, and ecosystems.

Hailstorms – Storms producing ice pellets that can damage crops, buildings, vehicles, and injure people.

Lightning strikes – Electrical discharges during storms that can cause fires, injuries, fatalities, and infrastructure damage.

4. Climatological

Droughts – Prolonged periods of insufficient rainfall leading to water scarcity, crop failure, and ecosystem stress.

Wildfires / forest fires – Uncontrolled fires in forests or grasslands, often intensified by drought, heat, and human activity.

Desertification – Long-term land degradation in dry areas caused by climate variability and unsustainable land use.

Long-term climate variability (e.g., El Niño, La Niña impacts) – Large-scale climate patterns that influence weather extremes, rainfall distribution, and temperature trends.

5. Biological (natural in origin)

Epidemics and pandemics – Widespread outbreaks of infectious diseases affecting large populations across regions or globally.

Vector-borne diseases – Diseases transmitted by vectors such as mosquitoes or ticks, often influenced by climate and environmental conditions.

Locust swarms and pest infestations – Rapid spread of insects or pests that devastate crops and threaten food security.

Animal and plant disease outbreaks – Diseases affecting livestock, wildlife, or crops, with impacts on ecosystems and livelihoods.

6. Extraterrestrial

Meteorite impacts – Collision of space objects with Earth, potentially causing localized or global damage.

Solar flares / geomagnetic storms – Bursts of solar radiation that can disrupt satellites, power grids, and communication systems.

Cosmic radiation – High-energy radiation from space that can affect technology and, in rare cases, human health.

3.2. Man-made Disasters

Man-made (human-induced) disasters arise from human activities, technological failures, or socio-political processes, including industrial accidents, pollution, nuclear and chemical incidents, armed conflict, and infrastructure collapse. These disasters are often linked to weak regulation, poor governance, economic pressures, or deliberate actions, and they frequently interact with natural hazards, amplifying overall risk. Understanding the distinction—and the interconnections—between natural and man-made disasters is essential for effective disaster risk reduction, as many communities face compound and cascading risks where environmental, technological, and social factors overlap.

1. Technological / Industrial

Nuclear power plant accidents – Failures in nuclear facilities leading to radiation release with long-term health and environmental impacts.

Radiological contamination – Exposure to radioactive materials from lost, stolen, or improperly managed sources.

2. Chemical

Industrial chemical spills and leaks – Accidental release of hazardous chemicals into air, water, or soil.

Toxic gas releases – Emission of poisonous gases that can cause acute health emergencies.

Pesticide and fertilizer accidents – Improper handling or release of agricultural chemicals contaminating ecosystems and food chains.

3. Biological (man-made origin)

Laboratory accidents – Unintended release of pathogens due to inadequate biosafety measures.

Bioterrorism – Deliberate use of biological agents to cause harm or fear.

4. Transportation accidents

Air crashes – Aircraft accidents resulting in casualties and infrastructure damage.

Train derailments – Rail accidents that may involve hazardous materials.

Maritime disasters – Accidents at sea, including oil tanker spills.

Road accidents involving hazardous materials – Transport incidents releasing dangerous substances.

5. Structural failures

Building collapses – Structural failure due to poor construction, ageing, or external stressors.

Dam failures – Collapse or malfunction of dams causing sudden flooding.

Mining accidents – Explosions, collapses, or toxic releases in mining operations.

6. Environmental Degradation & Resource Risks

Deforestation and land degradation – Loss of forests and soil quality due to unsustainable land use.

Industrial pollution (air, water, soil) – Contamination from industrial activities affecting health and ecosystems.

Oil spills – Release of petroleum into marine or terrestrial environments.

Overexploitation of natural resources – Unsustainable extraction of water, fisheries, or minerals leading to depletion.

Human-induced desertification – Land degradation driven by unsustainable agricultural and industrial practices.

7. Socio-Political

War and armed conflicts – Organized violence causing destruction, displacement, and humanitarian crises.

Weapons of mass destruction – Use of chemical, biological, or nuclear weapons with catastrophic consequences.

Insurgencies and terrorism – Non-state violence aimed at destabilising societies.

Civil unrest – Riots, strikes, or violent protests linked to political or social instability.

8. Economic & Systemic

Financial crises and economic collapse – Sudden economic downturns affecting livelihoods and public services.

Food insecurity due to market disruptions – Reduced access to food caused by economic or logistical failures.

Energy crises – Fuel shortages or power outages disrupting daily life and critical services.

Supply chain disruptions – Breakdown of production or distribution systems affecting essential goods.

9. Cyber and Information

Cyberattacks – Digital attacks targeting systems, data, or services.

Critical infrastructure disruption – Cyber or physical attacks on power, water, health, or communication systems.

Disinformation and information warfare – Manipulation of information to create panic, mistrust, or instability.

10. Public Health & Safety (human-induced)

Pandemics of human origin – Disease outbreaks driven by poor biosafety, governance failures, or laboratory incidents.

Industrial-scale food contamination – Widespread food safety failures affecting public health.

Unsafe urbanisation – Informal settlements, lack of sanitation, and fire hazards increasing disaster vulnerability.

3.3 Climate-Related and Environmental Risks

Climate-related and environmental risks are increasingly central to disaster risk reduction, as climate change and environmental degradation are intensifying both the frequency and severity of hazards while undermining the natural systems that support human life. These risks often develop gradually and remain under-recognised in formal disaster assessments, yet they play a decisive role in shaping vulnerability and exposure, particularly for communities that depend directly on natural resources. Citizen-led disaster risk mapping is especially well suited to capturing these risks, as local communities are often the first to observe environmental change and its cumulative impacts.

Climate change impacts manifest through rising temperatures, altered precipitation patterns, more frequent and intense extreme weather events, and increased climate variability. In practice, this means longer and more severe heatwaves, prolonged droughts, heavier rainfall leading to floods and landslides, increased wildfire risk, and stress on water and food systems. Climate change also acts as a risk multiplier, exacerbating existing vulnerabilities linked to poverty, weak infrastructure, and environmental mismanagement. Mapping climate-related risks at the local level helps translate global climate trends into concrete, place-based evidence that can inform adaptation planning, early warning systems, and community preparedness.

Ecosystem degradation significantly increases disaster risk by weakening the natural buffers that protect communities from hazards. Degraded soils reduce water infiltration and increase runoff, contributing to floods and landslides. Damaged wetlands and river systems lose their capacity to absorb excess water, while degraded forests become more vulnerable to pests, drought, and fire. Ecosystem degradation is often driven by unsustainable land use, industrial pollution, mining, infrastructure development, and poorly planned urbanisation. Citizen-led mapping can document changes in ecosystem health over time, identify hotspots of degradation, and link environmental damage to increased disaster impacts on livelihoods, health, and safety.

Deforestation and biodiversity loss are critical environmental risks that directly affect disaster vulnerability and long-term resilience. Forests play a key role in stabilising soil, regulating water cycles, storing carbon, and supporting biodiversity. When forests are cleared or fragmented, the risk of landslides, floods, erosion, and wildfire increases, while biodiversity loss reduces ecosystem resilience and adaptive capacity. In many regions, including Bosnia and Herzegovina and the Western Balkans, deforestation is often linked to extractive industries, illegal logging, infrastructure projects, and weak enforcement of environmental regulations. Biodiversity loss also undermines food security, traditional livelihoods, and cultural relationships with nature.

Climate Risk Dashboard – PROVIDE

A global climate risk dashboard that lets you explore future climate impacts under various emissions scenarios. It provides interactive data on temperature increases, heat stress, soil moisture, fire weather, and other climate indicators at global and city scales. This tool helps users visualise and compare climate risks and understand how adaptation measures might reduce impacts in specific locations.

Global Forest Watch

Global Forest Watch (GFW) is an open web platform that monitors forests in near real-time, showing tree cover loss, forest gain, deforestation alerts, and land use change across the world. It supports interactive maps and downloadable data, making it useful for analysing deforestation as a climate-related and environmental risk. GFW also offers alerts and trend indicators that can be integrated into community risk assessments and advocacy

Climate Impact Explorer

The Climate Impact Explorer is an interactive tool that provides projections of future climate impacts—such as flood exposure, wildfire risk, and temperature change—across countries and regions. Users can select scenarios and indicators to see how climate-related risks evolve over time, supporting planning and adaptation efforts at local to global scales.

Climate-related and environmental risks are closely tied to environmental justice, as their impacts are often unevenly distributed across populations and territories. Communities with fewer resources, limited political influence, or proximity to industrial activities tend to bear a disproportionate share of environmental harm while having the least capacity to adapt. By involving citizens in mapping climate change impacts, ecosystem degradation, and deforestation, participatory approaches make these inequalities visible and support evidence-based advocacy for more equitable and sustainable policies. Citizen-led disaster risk mapping thus becomes a tool not only for risk identification, but also for strengthening community resilience, environmental protection, and climate justice.

3.4 Infrastructure and Urban Risks

Infrastructure and urban risks are a critical yet often under-recognised dimension of disaster risk, particularly in rapidly urbanising, post-industrial, and under-maintained environments. These risks arise from the interaction between the built environment, governance failures, socio-economic inequality, and environmental pressures, and they frequently transform otherwise manageable hazards into disasters. Citizen-led disaster risk mapping plays a vital role in documenting infrastructure and urban risks because these hazards are experienced daily by residents and are closely linked to issues of environmental justice and social justice.

Unsafe buildings represent a major source of risk in many urban and peri-urban areas. Poor construction quality, ageing infrastructure, lack of maintenance, informal or illegal building, and failure to comply with building codes significantly increase vulnerability to earthquakes, floods, fires, and extreme weather events. In many cases, the most unsafe buildings are occupied by low-income households, displaced populations, or marginalised groups who have limited housing options and little influence over urban planning decisions. Mapping unsafe buildings allows communities to identify structural risks, document patterns of neglect, and highlight inequalities in access to safe housing, making visible how social and economic marginalisation translates into physical vulnerability.

Poor drainage systems are a common driver of urban flooding, water contamination, and public health risks. Inadequate or poorly maintained drainage infrastructure can cause even moderate rainfall to result in flash floods, sewage overflows, and standing water, increasing exposure to water-borne diseases and environmental pollution. These impacts disproportionately affect neighbourhoods with limited public investment, informal settlements, and areas located near industrial zones or waste sites. Citizen-led mapping of drainage problems—such as blocked channels, damaged culverts, or flood-prone streets—provides concrete, location-specific evidence of infrastructural inequality and supports claims for fairer allocation of public resources and preventive maintenance.

Transport and energy infrastructure risks include unsafe roads and bridges, railway hazards, fuel storage facilities, power plants, transmission lines, and energy distribution networks. Failures in these systems can lead to accidents, spills, fires, power outages, and disruptions of essential services such as healthcare, water supply, and emergency response. These risks are often concentrated in communities living near major transport corridors, industrial facilities, or energy infrastructure, raising concerns of environmental injustice when certain populations are systematically exposed to higher levels of danger. Citizen-generated data can document near-miss incidents, chronic safety problems, and cumulative impacts that may be overlooked in official assessments focused only on major accidents.

Infrastructure and urban risks are deeply embedded in social and political processes, including planning decisions, investment priorities, regulatory enforcement, and historical patterns of exclusion. Citizen-led disaster risk mapping makes these connections visible by linking physical

Mapillary (by Meta)

A street-level imagery platform that allows users to upload geotagged photos of streets, buildings, drainage systems, roads, bridges, and public spaces. Mapillary is particularly effective for documenting unsafe buildings, poor drainage, damaged roads, missing sidewalks, blocked culverts, and hazardous urban conditions. It provides visual, time-stamped evidence that complements maps and survey data, and is widely used in urban planning, disaster risk reduction, and humanitarian mapping.

hazards to questions of responsibility, governance, and rights. When communities document unsafe buildings, failing drainage systems, or hazardous infrastructure, they are not merely identifying technical problems—they are asserting their right to safe living conditions, healthy environments, and equitable access to public services.

By integrating infrastructure and urban risks into citizen-led disaster risk mapping, communities and civil society organisations can strengthen environmental and social justice efforts, advocate for preventive action rather than reactive response, and contribute to more inclusive, resilient, and accountable urban development.

4. Methodological Approach

This chapter outlines the methodological foundation of citizen-led disaster risk mapping, presenting a structured yet flexible process that integrates scientific standards with participatory practice. It describes how risks are identified, analysed, and prioritised through a combination of desk research, institutional data, media and civil society knowledge, and community experience. The approach is designed to be step-by-step, iterative, and adaptive, allowing methods and tools to evolve in response to local contexts, community feedback, and emerging insights while maintaining methodological rigour and transparency.

4.1 Overview of the Citizen-Led Mapping Process

The citizen-led disaster risk mapping process follows a clear, step-by-step workflow designed to guide communities and practitioners from initial risk identification to actionable outputs, while remaining flexible enough to adapt to different local contexts. The process typically begins with preliminary research to understand the risk landscape, followed by the co-design of mapping tools, data collection with citizen scientists, validation of information, and analysis and dissemination of results. Each step builds on the previous one, ensuring that data collection is grounded in evidence, community knowledge, and clearly defined objectives rather than ad hoc reporting.

Step-by-Step Workflow for Citizen-Led Disaster Risk Mapping

1. Define the scope and objectives
Clearly define the geographic area, types of risks to be mapped, and the intended use of the data. Establish whether the focus is on awareness-raising, preparedness, advocacy, or policy development.

2. Conduct preliminary risk research
Review existing studies, strategies, institutional assessments, and historical records to understand known hazards, past disaster events, and existing risk patterns within the selected territory.

3. Review media, civil society, and community knowledge
Analyse media reports, NGO documentation, and community narratives to identify underreported risks, recurring problems, and lived experiences that may not appear in official data sources.

4. Select and prioritise risks for mapping
Based on relevance, feasibility, and community priorities, decide which risks will be included or excluded from the mapping process, ensuring alignment with local conditions.

5. Design the mapping framework and data collection approach
Define risk categories, indicators, and data collection questions in a way that is understandable, inclusive, and aligned with disaster risk reduction concepts.

6. Pilot the mapping process
Test the methodology with a small group of participants to identify technical, methodological, or ethical issues and assess clarity and usability.

7. Revise and refine the methodology
Incorporate feedback from the pilot phase to adjust categories, questions, procedures, and participation formats as needed.

8. Train and prepare participants
Provide clear guidance on the purpose of the mapping, ethical principles, safety considerations, and how to collect and document information responsibly.

9. Implement the mapping process
Collect data through a combination of individual and group activities, ensuring representation across different community types and risk contexts.

10. Monitor data quality and validate information
Regularly review collected data to ensure accuracy, completeness, and consistency, and validate findings through cross-checking and community feedback.

11. Analyse and interpret the data
Examine spatial patterns, trends, and relationships between hazards, exposure, and vulnerability, integrating quantitative data with qualitative insights.

12. Share findings and gather feedback
Present preliminary results to participants and stakeholders to verify interpretations, identify gaps, and ensure transparency.

13. Finalise outputs and disseminate results
Revise analyses based on feedback and prepare final maps, reports, and summaries for public dissemination and institutional engagement.

At the same time, citizen-led mapping is inherently iterative and adaptive. Methods, tools, and categories are continuously reviewed and refined based on feedback from participants, emerging risks, and practical experience during fieldwork. Pilot testing, regular check-ins with communities, and ongoing data review allow the process to respond to challenges such as unclear questions, underrepresented areas, or new risk patterns. This adaptive approach strengthens both the quality of data and community ownership, ensuring that the mapping process remains relevant, inclusive, and responsive to real-world conditions rather than fixed to a rigid research design.

Examples of an Iterative and Adaptive Process

Citizen-led mapping does not follow a straight line. Below are examples of how iteration happens in practice.

Iteration 1: Survey refinement

Citizens report that questions are unclear.

Language is simplified and examples added.

New answer options introduced.

Iteration 2: Risk category adjustment

During mapping, a new risk emerges (e.g. illegal waste dumping).

A new category is added mid-process.

Iteration 3: Spatial focus change

Data show underrepresentation of rural areas.

Additional outreach is launched in villages.

Iteration 4: Method adaptation

Elderly participants struggle with digital tools.

Paper forms or assisted mapping sessions introduced.

Iteration 5: Analysis refinement

Community feedback challenges initial interpretations.

Qualitative narratives added to quantitative maps.

EM-DAT: The International Disaster Database

A comprehensive global database of historical disaster events, useful for analysing frequency, impacts, and trends over time.

4.2 Preliminary Risk Research

Preliminary risk research is a foundational step in citizen-led disaster risk mapping. It establishes an evidence-based understanding of the risk landscape before engaging communities in data collection and mapping activities. This phase ensures that citizen-generated data are contextualised, relevant, and aligned with existing knowledge, while also helping to identify data gaps, inconsistencies, and areas where local knowledge is particularly needed. Preliminary research strengthens both the scientific credibility and the policy relevance of the overall mapping process.

Desk Research and Data Review

Desk research involves the systematic review of existing documentation related to disaster risks in the selected territory. This includes scientific studies, policy documents, development strategies, environmental impact assessments, risk assessments, and previous project reports. The aim is not only to compile information, but to critically assess how risks have been defined, measured, and prioritised in the past, and whose knowledge has been included or excluded.

During desk research, it is important to identify:

- types of hazards previously documented,
- geographic areas repeatedly affected by disasters or environmental harm,
- known drivers of vulnerability (e.g. poverty, informal housing, environmental degradation),
- gaps between official assessments and lived experience.

This review helps avoid duplication of effort and allows citizen-led mapping to build on existing knowledge rather than start from scratch, while also challenging outdated, incomplete, or overly technocratic assessments.

Institutional Data Sources

Institutional data sources are a key component of preliminary risk research. These include data produced by public authorities, technical agencies, and international organisations responsible for disaster risk reduction, environmental protection, public health, and infrastructure management. Examples include civil protection services, meteorological and hydrological institutes, environmental agencies, statistical offices, and municipal departments.

Institutional data often provide:

- hazard maps (e.g. flood zones, landslide susceptibility),
- monitoring data (rainfall, river levels, air and water quality),
- damage and loss assessments,
- demographic and infrastructure data relevant to exposure and vulnerability.

However, such data may be incomplete, outdated, aggregated, or unevenly distributed, particularly in post-conflict or resource-constrained contexts. Preliminary research should therefore critically examine institutional data, noting limitations, assumptions, and blind spots. This critical engagement helps define where citizen-led mapping can add value by producing more granular, up-to-date, or socially grounded information.

Historical Disaster Analysis

Historical disaster analysis focuses on understanding past events, patterns, and trends to inform present and future risk reduction. This includes identifying previous disasters and hazardous events, their frequency and severity, and their social, environmental, and economic impacts. Historical analysis is essential for recognising recurring risks, slow-onset processes, and cumulative impacts that may not be captured through short-term datasets.

Sources for historical disaster analysis include:

- official disaster records and archives,
- media reports and investigative journalism,
- NGO and community documentation,
- oral histories and community memory.

In citizen-led approaches, historical analysis is not limited to dates and damages; it also considers how communities experienced events, how they coped, and how recovery processes unfolded. This perspective helps reveal structural vulnerabilities, such as repeated rebuilding in high-risk areas, long-term pollution exposure, or persistent neglect of certain communities. Historical analysis also supports intergenerational learning and strengthens community awareness of risk trajectories over time.

Together, desk research, institutional data review, and historical disaster analysis provide a robust analytical baseline for citizen-led disaster risk mapping. They inform the selection of risks to be mapped, guide the design of data collection tools, and ensure that community participation is embedded in a broader understanding of risk rather than isolated observations. By combining formal data with critical analysis, preliminary risk research lays the groundwork for meaningful, informed, and action-oriented citizen science.

4.3 Media and Civil Society Knowledge Review

A media and civil society knowledge review is a critical component of preliminary research in citizen-led disaster risk mapping, as it captures forms of evidence that are often absent from institutional datasets. Investigative journalism, NGO documentation, and community narratives frequently reveal early warning signs of risk, chronic environmental harm, governance failures, and social impacts that remain invisible in official assessments. For citizen science projects, this type of knowledge provides both contextual depth and practical guidance for designing relevant, locally grounded mapping activities.

The role of investigative journalism is particularly important in identifying disaster and pollution risks linked to industrial activity, infrastructure neglect, corruption, or regulatory failure. Investigative media often document patterns of environmental degradation, unsafe construction, illegal logging, or repeated incidents long before they are formally acknowledged by authorities. In citizen-led mapping projects, journalistic investigations can be used to identify priority locations for mapping, understand the political and economic drivers of risk, and frame research questions that address accountability and prevention rather than isolated events. Media reports also help situate local risks within broader national or regional trends, strengthening the credibility and advocacy potential of citizen-generated data.

NGO and activist reports provide another essential layer of knowledge, particularly in contexts where civil society plays a monitoring or watchdog role. Environmental organisations, human rights groups, community associations, and informal activist networks often collect long-term observations, testimonies, and evidence related to disasters, pollution, health impacts, and environmental injustice. These reports can reveal cumulative and slow-onset risks, such as long-term air pollution, contaminated water sources, or progressive land degradation, which are rarely captured through short-term monitoring. In citizen science projects, NGO and activist documentation helps define risk categories, refine indicators, and ensure that mapping addresses issues of greatest concern to affected communities.

Community narratives and lived experience are central to citizen-led disaster risk mapping and represent a core contribution of citizen science. Local residents possess detailed, place-based knowledge of when and where risks occur, how they affect daily life, and which groups are most exposed or vulnerable. Stories of past floods, recurring infrastructure failures, health problems linked to pollution, or informal coping strategies provide insights that cannot be derived from quantitative data alone. In citizen science projects, these narratives inform the design of survey questions, support the interpretation of mapped data, and help validate findings through community feedback. They also humanise risk maps, making them more accessible and meaningful for both communities and decision-makers.

Together, media analysis, civil society reports, and community narratives help ensure that citizen science projects are problem-driven rather than data-driven. They guide the selection of what to map, where to focus effort, and how to interpret findings in ways that reflect social realities and power dynamics. By systematically integrating these sources into the research process, citizen-led disaster risk mapping transforms dispersed knowledge into structured evidence that supports awareness-raising, policy dialogue, and collective action.

4.4 Risk Selection and Prioritisation

Risk selection and prioritisation are essential steps in ensuring that citizen-led disaster risk mapping remains focused, relevant, and feasible. Given the wide range of potential hazards and limited time, resources, and capacity available to communities, it is neither practical nor desirable to map all possible risks. Instead, this stage translates preliminary research and community knowledge into a clear, shared decision about which risks will be actively mapped and analysed.

Criteria for inclusion and exclusion should be defined transparently and collectively, involving community members, civil society organisations, and, where appropriate, researchers or institutional partners. Common criteria for inclusion include the frequency and severity of the risk, the number of people or assets affected, documented impacts on health, livelihoods, or the environment, and the potential for citizen-generated data to add new or missing information. Risks may be excluded if they are not present in the territory, are extremely rare, fall outside the scope of community influence, or require highly specialised technical measurements that cannot be safely or ethically collected by citizens. Clear criteria help manage expectations and protect participants from unnecessary exposure to danger.

Local relevance and feasibility are central to effective prioritisation. Risks selected for mapping should reflect what communities experience as urgent and meaningful, rather than what external frameworks or institutions define as priorities. Community consultations, focus groups, and feedback from preliminary research help ensure that selected risks align with lived experience. Feasibility considerations include the accessibility of locations, safety of participants, availability of basic data, and the capacity of citizens to observe and document risks using simple methods. Prioritising risks that are both locally significant and practically mappable strengthens participation, data quality, and the likelihood that results will be used for awareness-raising, advocacy, and policy engagement.

By applying clear inclusion criteria and grounding decisions in local relevance and feasibility, risk selection becomes a collective and empowering process rather than a technical filtering exercise. This step ensures that citizen-led disaster risk mapping focuses on the most pressing and actionable risks, maximising both community engagement and the potential for real-world impact.

5. Tools for Citizen-Led Disaster Risk Mapping

This chapter introduces the key tools that support citizen-led disaster risk mapping across all stages of the process, from data collection to analysis, visualisation, and storage. The tools presented here are selected for their accessibility, adaptability, and suitability for participatory contexts, enabling communities and civic groups to document risks effectively while maintaining data quality, ethical standards, and transparency. Rather than prescribing specific technologies, this chapter provides guidance on categories of tools and their appropriate use, allowing practitioners to choose solutions that best fit local capacities, resources, and risk contexts.

5.1 Digital Data Collection Tools

Digital data collection tools are a cornerstone of citizen-led disaster risk mapping because they enable structured, scalable, and geolocated data gathering while supporting participation from diverse groups. These tools allow citizens to report hazards, document environmental and infrastructure risks, and share lived experiences in a systematic way that can be analysed and used for advocacy and policy engagement. Selecting appropriate tools requires balancing accessibility, data quality, privacy, and technical capacity, as different tools serve different purposes and contexts.

In practice, effective citizen-led mapping initiatives often rely on a combination of online surveys, mobile field data collection tools, and offline options, rather than a single platform.

Online Survey Platforms

Online survey platforms are web-based tools that allow participants to submit responses via a browser. They are best suited for broad outreach, perception surveys, and initial risk screening, particularly in areas with reliable internet access.

Google Forms (https://forms.google.com)
What it is: A free, easy-to-use online survey tool integrated with Google services.
Best suited for: Rapid data collection, awareness campaigns, perception-based questions, and early-stage scoping of risks.
What it is missing: Limited geospatial functionality, no native mapping interface, limited data protection options for sensitive information.

SurveyMonkey (https://www.surveymonkey.com)
What it is: A commercial online survey platform with advanced analytics and survey logic.
Best suited for: Large-scale surveys, structured questionnaires, and projects requiring detailed response analysis.
What it is missing: Advanced features require paid plans; limited integration with GIS and spatial mapping; less suitable for offline or field-based mapping.

EU Survey (https://ec.europa.eu/eusurvey)
What it is: An official survey tool provided by the European Commission.

Best suited for: EU-funded projects, institutional engagement, multilingual surveys, and formal consultations.
What it is missing: Less intuitive for grassroots users; limited spatial and visual data collection; not designed for participatory mapping.

LimeSurvey (https://www.limesurvey.org)
What it is: An open-source survey platform that can be self-hosted.
Best suited for: Projects requiring strong data control, GDPR compliance, and multilingual surveys.
What it is missing: Requires technical setup and maintenance; mapping features are basic.

Dryad (https://datadryad.org/)
What it is: A curated, open digital repository for research data underlying published scientific studies. Data stored in Dryad are typically reusable, well-documented, and citable.
Best suited for: Storing, preserving, and sharing datasets produced by research projects (including citizen science) so they can be referenced by others.
Strengths: Ensures long-term preservation of data, offers DOIs (permanent identifiers) for citation, and supports open science principles.
Limitations: Not a data collection tool itself; focuses on post-project storage and sharing rather than field data entry.

Online survey platforms are most effective when used to complement spatial tools, rather than as stand-alone mapping solutions.

Mobile Data Collection Tools

Mobile data collection tools are designed for field-based, geolocated data collection, making them particularly suitable for disaster risk mapping and citizen science.

KoBoToolbox (https://www.kobotoolbox.org)
What it is: An open-source platform developed for humanitarian and disaster response contexts.
Best suited for: Citizen-led mapping of hazards, pollution, infrastructure risks, and environmental degradation, including GPS points, photos, and offline collection.
What it is missing: Limited built-in visualisation and dashboard options; requires additional tools for advanced mapping.

ODK (Open Data Kit) (https://getodk.org)
What it is: A robust open-source suite for mobile data collection.
Best suited for: Long-term or large-scale projects requiring complex forms, validation rules, and offline-first workflows.
What it is missing: Higher technical complexity; less accessible for small community groups without support.

Epicollect5 (https://five.epicollect.net)
What it is: A lightweight mobile and web-based data collection tool.
Best suited for: Simple citizen science projects, educational use, and quick mapping exercises.
What it is missing: Limited survey logic and data validation; less suitable for complex risk assessments.

Participatory Mapping Platforms

Some tools are designed specifically for spatial collaboration and mapping, making them valuable for visualising urban and infrastructure risks.

OpenStreetMap (OSM) (https://www.openstreetmap.org)
What it is: A global, open-source, community-driven mapping platform.
Best suited for: Mapping buildings, roads, drainage systems, critical infrastructure, and urban risks; humanitarian and disaster mapping.
What it is missing: Requires training to ensure data quality; not designed for narrative or survey-based inputs.

uMap (https://umap.openstreetmap.fr)
What it is: A tool for creating custom maps using OpenStreetMap data.
Best suited for: Visualising citizen-collected risk data in a simple, public-facing way.
What it is missing: Limited data validation and survey functionality.

Offline Data Collection Options

Offline data collection options are essential for inclusive participation, especially in rural areas, low-connectivity settings, or among populations with limited digital access.

Offline mobile data collection
Many mobile tools allow data to be collected without internet access and uploaded later, making them suitable for fieldwork in remote or marginalised areas.
Limitation: Requires careful coordination to avoid data loss or duplication.

Paper-based surveys and printed maps
What they are: Physical forms and maps used during workshops or facilitated sessions.

QGIS

A free, open-source desktop GIS application. Best suited for analysing and visualising citizen-collected spatial data, creating risk maps, and combining multiple datasets. Requires basic training; less suitable for quick, browser-only mapping.

OpenStreetMap (OSM)

A collaborative, open map of the world built by volunteers. Best suited for mapping buildings, roads, drainage systems, and other infrastructure relevant to disaster risk. Limited analytical tools; best used together with GIS software like QGIS.

Ushahidi
It is an open-source platform that enables crowdsourced data collection and crisis mapping, allowing users to report incidents via mobile, web, or SMS and visualise them on interactive maps.

uMap

A web-based tool for creating simple custom maps using OpenStreetMap data. Best suited for public-facing visualisation of risks and community sharing. It is missing advanced spatial analysis and data validation features.

Best suited for: Elderly participants, low digital literacy contexts, and participatory workshops.
What they are missing: Manual digitisation is time-consuming and may introduce errors.

Hybrid offline–online workflows
What they are: Combined approaches where data are collected offline and later digitised.
Best suited for: Ensuring broad participation while maintaining a digital dataset.
What they are missing: Additional coordination and quality control efforts.

In citizen-led disaster risk mapping, no single tool is sufficient on its own. The most robust and inclusive projects combine online surveys for broad outreach, mobile tools for field-based geolocated data, participatory mapping platforms for spatial analysis, and offline options to ensure equity and accessibility. This layered approach strengthens data quality while ensuring that diverse community voices are included in documenting disaster risk.

5.2 Geographic Information Systems (GIS)

Geographic Information Systems (GIS) are essential for citizen-led disaster risk mapping because they allow spatial data to be organised, analysed, and visualised on maps in a way that reveals patterns, hotspots, and relationships between hazards, exposure, and vulnerability. For citizen science projects, GIS does not require advanced technical expertise; when introduced in an accessible way, it becomes a powerful tool for communities to better understand their environment and communicate risks to decision-makers. The aim is not to turn citizens into GIS experts, but to enable meaningful use of spatial thinking in documenting and interpreting disaster risks.

Basic GIS concepts for non-experts focus on understanding maps as layers of information linked to location. In GIS, each piece of data is connected to a geographic position, allowing different datasets—such as flood locations, unsafe buildings, pollution sources, or infrastructure—to be viewed together. Key concepts include coordinates (latitude and longitude), layers (different types of information stacked on a map), and attributes (descriptive information linked to each mapped feature). Introducing these concepts in simple language helps participants understand how their observations become part of a larger spatial picture.

A core element of GIS is point, line, and polygon mapping, which provides a simple but powerful way to represent different types of risks. Points are used for specific locations, such as a polluted water source, a collapsed building, or a blocked drainage outlet. Lines represent linear features, such as rivers, roads, pipelines, or fault lines. Polygons are used to map areas, such as flood zones, landslide-prone slopes, industrial sites, or deforested areas. Teaching participants how to choose the appropriate geometry for different risks improves data consistency and supports clearer analysis and communication.

Open-source GIS tools are particularly well suited for citizen-led disaster risk mapping because they are free, transparent, and widely supported by global communities of practice. Open-source tools reduce dependency on proprietary software and allow projects to be replicated and sustained beyond short-term funding cycles. They also align well with open data and FAIR principles, making it easier to share results and collaborate across organisations and regions.

In citizen-led projects, GIS is often used after data collection to:
- visualise citizen-reported risks on maps,
- identify clusters and high-risk areas,

Dryad

A curated, open digital repository for research data underlying published scientific studies. Data stored in Dryad are typically reusable, well-documented, and citable. Best suited for storing, preserving, and sharing datasets produced by research projects (including citizen science) so they can be referenced by others. Ensures long-term preservation of data, offers DOIs (permanent identifiers) for citation, and supports open science principles. Limitations: Not a data collection tool itself; focuses on post-project storage and sharing rather than field data entry.

OpenAIRE Research Graph & Catalogue

A European research information platform that aggregates research outputs — publications, datasets, projects, and software — from funded research including EU projects, institutional repositories, and open access sources. Best suited for discovering existing research, datasets, and tools relevant to disaster risk, environment, climate adaptation, and citizen science. Helps situate a citizen science project within broader scientific and policy evidence, find open datasets that might complement local mapping, and discover collaborators or related research. Not a data collection or mapping platform; it is a research discovery and linkage service that supports contextual understanding and literature review.

Zenodo

An open-access repository supported by CERN and the EU. Best suited for archiving datasets, reports, and project outputs with persistent identifiers. Not suitable for real-time collaboration or sensitive raw data.

Google Drive

A widely used cloud storage and collaboration service. Best suited for small to medium projects prioritising ease of use and collaboration. Data stored on third-party servers; limited control over data governance.

- compare citizen data with institutional datasets,
- support discussion, validation, and advocacy.

5.3 Visual and Multimedia Tools

Visual and multimedia tools play a crucial role in citizen-led disaster risk mapping by making risks visible, tangible, and understandable to both communities and decision-makers. While maps and datasets provide structure and analytical power, photographs, videos, audio recordings, and satellite imagery capture the lived reality of disasters, pollution, and environmental degradation. These tools help document conditions that may be difficult to describe through numbers alone and are particularly effective for awareness-raising, validation of findings, and advocacy.

Photo documentation is one of the most accessible and widely used multimedia methods in citizen science. Citizens can document unsafe buildings, blocked drainage systems, polluted rivers, erosion, deforestation, or flood impacts using smartphones or cameras. Photographs provide time-stamped and location-specific evidence that supports data validation and enhances credibility. When used systematically—following basic ethical and quality guidelines—photo documentation helps bridge the gap between technical assessments and everyday experience. It is especially effective for monitoring changes over time and for communicating risks to non-technical audiences.

Video and audio testimonies add narrative depth to disaster risk mapping by capturing voices, emotions, and contextual information that static images cannot convey. Short videos can show dynamic processes such as flooding, landslides, traffic hazards, or industrial emissions, while audio recordings allow people to share experiences, observations, and concerns in their own words. These formats are particularly valuable for documenting slow-onset risks, health impacts, and cumulative harm, and for ensuring that marginalised voices are heard. In citizen-led projects, testimonies are often used alongside maps to support community validation, storytelling, and engagement with policymakers and the public.

Drone and satellite imagery, when used appropriately and ethically, provide a broader spatial perspective on disaster risks and environmental change. Drones can capture high-resolution images of areas that are difficult or unsafe to access, such as landslide-prone slopes, flooded zones, or degraded industrial sites. Satellite imagery allows analysis of land-use change, deforestation, urban expansion, flood extent, and ecosystem degradation over time. These tools are particularly useful for complementing ground-level citizen observations, identifying large-scale patterns, and strengthening the evidence base of citizen science projects. However, their use requires careful consideration of legal, safety, and privacy issues, as well as clear communication with communities about how imagery will be used.

Visual and multimedia tools are most effective when integrated into a broader participatory process, where citizens are not only data collectors but also co-interpreters of visual evidence. Combining maps, photos, videos, and satellite data creates a multi-layered understanding of risk that supports learning, dialogue, and action.

Copernicus Programme (EU Earth Observation)
The European Union's Earth observation programme providing free satellite data.
Best suited for monitoring land-use change, deforestation, flood extent, wildfire scars, and environmental degradation over time. Requires basic training to interpret data; not designed for individual citizen data entry.

Sentinel Hub / Copernicus Browser
A user-friendly interface for accessing and visualising Copernicus satellite imagery.
Best suited for non-expert exploration of satellite data and visual comparison across time periods.
Analytical capabilities are limited compared to full GIS platforms.

5.4 Data Management and Storage

Effective data management and storage are essential for ensuring that citizen-led disaster risk mapping produces reliable, secure, and reusable evidence. Poor data handling can undermine trust, compromise participant safety, and limit the long-term value of collected information. This section outlines good practices for organising, storing, versioning, and protecting data throughout the lifecycle of a citizen science project, from collection to analysis, sharing, and archiving.

Cloud-based storage enables teams to centralise data, collaborate efficiently, and reduce the risk of data loss. Storing datasets, photos, videos, maps, and documentation in a shared cloud environment allows multiple contributors to access up-to-date information and supports transparency and continuity, especially in projects involving multiple organisations or volunteers. Cloud storage should be organised using clear folder structures, consistent naming conventions, and basic metadata (e.g. date, location, data type). For citizen-led projects, it is important to choose platforms that balance ease of use with compliance with data protection standards, particularly when handling sensitive or geolocated information.

Version control is a critical but often overlooked aspect of citizen science projects. As surveys are revised, datasets cleaned, maps updated, and reports edited, multiple versions of files are created. Without clear versioning practices, teams risk confusion, data inconsistency, or accidental overwriting of important information. Version control helps track changes over time, document decisions, and maintain transparency in how data and analyses evolve. Even simple practices—such as systematic file naming, change logs, and dated folders—can significantly improve data integrity and accountability.

Data security measures are essential to protect participants, particularly when projects involve sensitive locations, personal information, or politically or economically contested issues such as pollution, infrastructure failures, or environmental injustice. Security measures should be proportionate to the level of risk and include access controls, secure passwords, restricted sharing permissions, and data anonymisation where appropriate. Projects should clearly define who has access to raw data, who can edit or publish it, and under what conditions data can be shared publicly. Applying privacy-by-design principles helps ensure that ethical commitments made during informed consent are respected throughout the project.

Good data management is not only a technical requirement but also a matter of ethics, trust, and sustainability. Well-managed datasets are easier to analyse, validate, reuse, and share with communities, researchers, and decision-makers. They also allow citizen-led disaster risk mapping projects to contribute meaningfully to open science, policy dialogue, and long-term risk reduction efforts.

By combining clear organisational practices with appropriate tools for storage, version control, and security, citizen-led disaster risk mapping initiatives can ensure that their data remain safe, credible, and impactful well beyond the life of the project.

6. Survey and Data Collection Design

This chapter focuses on how to design clear, ethical, and citizen-friendly surveys that translate disaster risks and lived experiences into structured, usable data. It outlines how to define meaningful categories and indicators, formulate accessible questions, and integrate geolocation and visual evidence in a way that supports data quality while remaining inclusive and safe for participants. Thoughtful survey and data collection design is essential for ensuring that citizen-led disaster risk mapping produces information that is both scientifically robust and grounded in community realities.

6.1 Defining Categories and Indicators

Defining clear categories and indicators is a critical step in translating complex disaster risks into structured, comparable, and analysable data. In citizen-led disaster risk mapping, categories and indicators must balance scientific relevance with simplicity and accessibility, ensuring that non-experts can provide meaningful and consistent information. Well-defined categories also improve data quality, reduce ambiguity, and make it easier to interpret results across different locations and time periods.

Risk type refers to the specific kind of hazard or threat being documented. Categories should be based on the risks identified during preliminary research and prioritisation, and expressed in language that is understandable to participants. For example, instead of using highly technical terms, risk types can be framed in everyday language while still aligning with disaster risk reduction concepts.

Example: Flooding, landslides, air pollution, unsafe buildings, industrial spills, forest fires.

Location captures where the risk occurs and is central to disaster risk mapping. Location indicators may include a precise point (e.g. a blocked drain), a line (e.g. a damaged road section), or an area (e.g. a flood-prone neighbourhood). In addition to geolocation, descriptive location information—such as street names, landmarks, or neighbourhood names—can help validate and interpret data.

Example: GPS coordinates of a polluted river segment, name of a settlement affected by flooding, outline of a landslide-prone slope.

Frequency and severity describe how often a risk occurs and how serious its impacts are. These indicators help distinguish between isolated incidents and recurring or chronic problems. Frequency can be measured using simple categories that reflect local experience, while severity can be captured through perceived impact levels rather than technical measurements.

Example: Frequency options such as "once," "seasonal," or "every year"; severity options such as "minor," "moderate," or "severe."

Impacts and consequences capture the effects of risks on people, property, livelihoods, health, and the environment. These indicators are especially important in citizen-led projects because they reflect lived experience and social dimensions of risk. Impacts can be recorded through predefined categories and open-ended responses, allowing participants to explain consequences in their own words.

Example: Impacts on homes (flooded basements), health (respiratory problems due to pollution), livelihoods (crop loss), or ecosystems (fish die-offs).

By clearly defining categories and indicators across these dimensions, citizen-led disaster risk mapping creates a shared language between participants, researchers, and decision-makers. This structured approach allows diverse observations to be aggregated and analysed while preserving the richness of local knowledge and experience.

6.2 Designing Citizen-Friendly Survey Questions

Designing citizen-friendly survey questions is essential for ensuring broad participation and high-quality data in citizen-led disaster risk mapping. Surveys must be understandable to people with different educational backgrounds, ages, and levels of technical knowledge, while still capturing information that is meaningful for analysis and decision-making. Clear and inclusive question design reduces confusion, increases response accuracy, and helps participants feel confident and respected as contributors.

Clear and simple language should be the guiding principle in all survey questions. Questions should be short, direct, and focused on one idea at a time. Whenever possible, they should refer to observable situations or personal experience rather than abstract concepts. Using concrete examples and simple answer options helps participants respond consistently.

Example: Instead of asking "Assess the hydrological hazard intensity in your area," ask "Does your street or neighbourhood get flooded after heavy rain?" with answer options such as "No," "Sometimes," "Often."

Avoiding technical jargon is particularly important in disaster risk mapping, where scientific and institutional terminology can create barriers to participation. When technical terms are unavoidable, they should be clearly explained in plain language or accompanied by examples. Surveys should also avoid acronyms and administrative language unfamiliar to the general public.

Example: Instead of "industrial effluent discharge," use "wastewater or chemicals released from factories into rivers or land." If terms like "landslide" or "air pollution" are used, brief clarifications can be added in parentheses.

Multilingual considerations are essential in diverse communities and regions where multiple languages or dialects are spoken. Providing surveys in relevant local languages increases inclusiveness and reduces misinterpretation. Translation should prioritise meaning rather than literal wording, and local terms for places, hazards, or everyday practices should be used where appropriate. In multilingual surveys, consistent structure and answer options across languages are important for comparability.

Example: A survey should be available in local languages, with locally familiar terms for floods, pollution, or informal settlements, while maintaining the same question logic in all versions.

By using clear language, avoiding unnecessary technical terms, and respecting linguistic diversity, citizen-friendly survey design supports equitable participation and reliable data collection. Well-designed questions empower citizens to contribute their knowledge confidently and help ensure that the resulting data genuinely reflect local realities and concerns.

6.3 Geolocation and Spatial Data

Geolocation and spatial data are at the core of citizen-led disaster risk mapping, as they link observations and experiences to specific places. Accurate and well-structured spatial data allow risks to be visualised on maps, compared across locations, and analysed in relation to environmental, social, and infrastructural factors. For non-experts, geolocation does not need to be technically complex, but it does require clear guidance on when and how to use different spatial representations.

GPS point collection is the most common and simplest form of spatial data in citizen science projects. A GPS point represents a specific, identifiable location and is best used when a risk can be associated with a single place. Points are suitable for documenting hazards such as a blocked drainage outlet, a polluted water source, a damaged bridge, an unsafe building, or a recurring accident location. When collecting point data, participants typically rely on the GPS function of their mobile devices, which automatically records latitude and longitude. To support interpretation and validation, point data should be accompanied by a short description and, where possible, visual evidence such as a photograph.

Area and zone mapping is used when risks affect a broader space rather than a single location. In this case, participants outline an area (polygon) that represents the extent of a risk, such as a flood-prone neighbourhood, a landslide-prone slope, an industrial zone, or a deforested area. Area mapping is particularly useful for representing diffuse or recurring risks that do not have a single point of origin. In some cases, linear features (lines) are also used to represent risks along rivers, roads, pipelines, or coastlines. Clear guidance should be provided on when to choose a point versus an area: if the risk is localised and fixed, a point is appropriate; if it is spread across space or varies in intensity, an area or line is more suitable.

Accuracy considerations are important to ensure that spatial data are reliable while remaining realistic for citizen-led projects. GPS accuracy can vary depending on device quality, environmental conditions, and signal availability, especially in dense urban areas, forests, or mountainous terrain. Rather than aiming for technical precision, citizen science projects should focus on practical accuracy—ensuring that mapped locations are close enough to represent the risk meaningfully. Participants should be encouraged to stand as close as safely possible to the location being mapped, avoid collecting data in dangerous situations, and clearly describe any uncertainty. For area mapping, approximate boundaries are acceptable as long as they reflect local understanding of the affected zone.

To improve data quality, projects can include simple practices such as:

- allowing participants to confirm or adjust GPS locations on a map,
- combining geolocation with descriptive location information,
- reviewing and validating spatial data during analysis,
- using community feedback to correct or refine mapped locations.

By clearly explaining the difference between points, lines, and areas, and by setting realistic expectations around accuracy, citizen-led disaster risk mapping can produce spatial data that are both accessible and analytically valuable. This approach ensures that maps reflect local realities while remaining robust enough to support learning, planning, and advocacy.

6.4 Visual Evidence Collection

Visual evidence is a powerful component of citizen-led disaster risk mapping because it documents conditions directly, supports data validation, and helps communicate risks in ways that are accessible and compelling. Photographs and other visual materials can capture details that are difficult to describe in words alone, such as infrastructure damage, pollution sources, erosion patterns, or flood impacts. However, collecting visual evidence also raises ethical, safety, and privacy considerations that must be addressed through clear guidance and responsible practices.

Ethical photo guidelines are essential to protect participants and affected individuals. Visual documentation should never put citizens at risk or violate the dignity and rights of others. Participants should be instructed to avoid photographing people without their explicit consent, especially children, vulnerable individuals, or those in distress. Images should not expose private property details, personal identifiers, or sensitive locations if this could lead to harm, retaliation, or stigmatisation. Safety must always come first: citizens should never enter hazardous areas, unstable structures, polluted sites, or restricted zones to obtain images. Clear ethical guidelines help build trust and ensure that visual evidence supports risk reduction rather than creating new risks.

Image quality and relevance are important for ensuring that visual evidence is useful for analysis and communication. Photos should clearly show the risk or issue being documented, with sufficient lighting, focus, and framing to make key details visible. Whenever possible, images should include contextual elements—such as nearby landmarks or surrounding conditions—that help interpret scale and location. Participants should be encouraged to take multiple photos if needed and to accompany images with short descriptions explaining what is shown, when it was observed, and why it is relevant. Emphasising relevance over aesthetics helps maintain consistency and analytical value across the dataset.

Anonymisation techniques are necessary when visual evidence may reveal personal or sensitive information. This includes blurring faces, license plates, house numbers, company logos, or other identifiable features before images are shared publicly. Anonymisation can be applied during analysis or dissemination, even if raw images are securely stored. Projects should clearly define which images can be made public and which should remain restricted, in line with informed consent agreements and data protection principles. In some cases, alternative approaches—such as photographing objects, environments, or impacts rather than people—can reduce privacy risks altogether.

When collected responsibly, visual evidence strengthens citizen-led disaster risk mapping by enhancing credibility, supporting validation, and amplifying community voices. Clear ethical guidelines, attention to quality and relevance, and appropriate anonymisation practices ensure that visual documentation contributes positively to understanding risks and advancing environmental and social justice.

7. Community Engagement and Inclusion

Community engagement and inclusion are at the heart of citizen-led disaster risk mapping, as meaningful participation is essential for capturing diverse perspectives, building trust, and ensuring that mapped risks reflect lived realities. This chapter focuses on how to identify and engage different groups within communities, create participatory spaces for co-creation and validation, and address structural inequalities related to gender, ability, and access to technology. By prioritising inclusive and equitable engagement, citizen-led mapping becomes not only a data collection exercise, but also a process of empowerment, learning, and collective action.

7.1 Identifying and Engaging Target Groups

Effective citizen-led disaster risk mapping depends on intentional and context-sensitive engagement strategies. Different groups within a community require different entry points, communication channels, and forms of participation. This section focuses on practical techniques for identifying, contacting, and engaging key target groups in ways that are respectful, motivating, and sustainable.

Youth and Schools

Engaging young people is most effective when activities are embedded in existing educational and social structures rather than introduced as stand-alone initiatives. Schools, youth clubs, sports associations, and informal youth groups provide stable entry points. Initial contact should be made through teachers, school administrators, youth workers, or trusted mentors who already have relationships with young people.

Concrete techniques include:

- Integrating mapping activities into project-based learning, extracurricular clubs, or civic education modules.
- Using short, task-based activities (e.g. mapping one risk near school or home) rather than long surveys.
- Framing participation as skill-building (digital skills, environmental literacy, civic engagement).
- Encouraging peer-to-peer engagement, where trained students support other students.

Youth engagement benefits from visual tools, group work, and clear links between data collection and real-world outcomes.

Rural and Marginalised Communities

In rural and marginalised communities, engagement should prioritise presence, trust, and flexibility. Identification of participants is best done through local gatekeepers such as community leaders, farmers' associations, women's groups, religious organisations, or local NGOs. Digital outreach alone is rarely sufficient.

Concrete techniques include:

- Organising in-person meetings in familiar community spaces (village halls, community centres).
- Scheduling activities at times that fit work, agricultural or care-related responsibilities.
- Using facilitated group mapping sessions rather than individual digital reporting.
- Combining mapping with discussions about concrete local issues (e.g. floods affecting fields, water access, road safety).

Providing offline participation options and allowing collective rather than individual reporting often increases inclusion and data quality.

Local Activists and Informal Groups

Local activists and informal groups are often highly motivated and knowledgeable but may be wary of formal projects. Identification typically occurs through issue-based networks, social media, community actions, or previous advocacy efforts. Engagement should be framed as collaboration rather than consultation.

Concrete techniques include:

- Inviting activists to co-design risk categories or indicators.
- Recognising their existing documentation efforts and integrating them into the mapping process.
- Offering roles beyond data collection, such as facilitators, validators, or co-authors of findings.
- Ensuring transparency about how data will be used to avoid perceptions of extractive research.

Working with activists requires clear communication, respect for autonomy, and alignment with shared goals.

Across all target groups, engagement is strengthened by clear purpose, visible outcomes, and ongoing communication. Participation should not be treated as a one-off activity but as a relationship that evolves over time, reinforcing trust, ownership, and collective responsibility for disaster risk reduction.

7.2 Co-Creation with Communities

Co-creation is a core principle of citizen-led disaster risk mapping, ensuring that communities are not only sources of data but active partners in shaping the process, interpreting results, and deciding how findings are used. Co-creation strengthens relevance, trust, and ownership, and helps align mapping outcomes with local priorities and capacities. This section outlines practical approaches for facilitating co-creation through workshops, validation meetings, and continuous feedback mechanisms.

Workshops and focus groups are effective spaces for collective learning, discussion, and design. In the early stages, workshops can be used to jointly define risk categories, clarify survey questions, and agree on mapping priorities. Focus groups allow for deeper exploration of specific risks, particularly those affecting certain groups such as women, youth, or residents of high-risk areas. Facilitators should use participatory methods—such as small-group discussions, printed maps, scenario exercises, and visual prompts—to encourage inclusive participation and balance power dynamics. Clear documentation of discussions is essential to ensure that community inputs are reflected in subsequent project decisions.

Community validation meetings are a key step in ensuring the accuracy and legitimacy of mapped data. After initial analysis, preliminary maps and findings should be presented back to the community in accessible formats. These meetings allow participants to confirm locations, correct errors, add missing information, and challenge interpretations that do not reflect lived experience. Validation should be framed as a collaborative review rather than a technical presentation, encouraging open dialogue and shared problem-solving. This process not only improves data quality but also reinforces transparency and accountability.

Feedback loops ensure that co-creation continues throughout the project lifecycle rather than ending after data collection. Regular updates, short summaries of findings, and opportunities for ongoing input help maintain engagement and trust. Feedback loops can be formal (scheduled check-ins, follow-up meetings) or informal (online comments, messaging groups), depending on context and capacity. Importantly, feedback should be acknowledged and acted upon, with clear communication about how community inputs influenced decisions or outcomes.

Participatory Methods Toolkit (FAO)

Practical guidance on participatory workshops, facilitation techniques, and community engagement.

Miro / Mural

Digital whiteboards for collaborative workshops, useful for remote co-creation and visual brainstorming. Requires internet access and basic digital skills.

By embedding co-creation into workshops, validation processes, and feedback mechanisms, citizen-led disaster risk mapping becomes a shared learning process that builds collective understanding and supports sustained engagement.

7.3 Gender, Inclusion, and Accessibility

Ensuring gender sensitivity, inclusion, and accessibility is essential for producing equitable, representative, and credible citizen-led disaster risk mapping. Disaster risks are not experienced equally: gender roles, disability, age, income, and access to technology shape exposure, vulnerability, and the ability to participate in risk reduction processes. This section outlines practical approaches to address these dimensions and ensure that citizen science initiatives do not reinforce existing inequalities.

Gender-Sensitive Approaches

Gender-sensitive approaches recognise that women, men, and gender-diverse people often experience disaster risks differently due to social roles, caregiving responsibilities, employment patterns, and access to resources. To address this, mapping activities should intentionally create space for gender-diverse participation and perspectives.

Practical approaches include:

- Organising women-only focus groups where appropriate, to allow open discussion of safety, health, and care-related risks.
- Scheduling activities at times that accommodate caregiving and domestic responsibilities.
- Including gender-specific questions, such as impacts on care work, health, or access to water and energy.

Ensuring gender balance among facilitators and community coordinators.

Example: In flood-prone areas, women may identify risks related to childcare, access to sanitation, or household recovery that are often overlooked in technical assessments.

Inclusion of Persons with Disabilities

Persons with disabilities are frequently among the most affected by disasters, yet their experiences are often excluded from risk assessments. Inclusive mapping requires intentional adaptations to participation formats, tools, and communication methods.

Practical approaches include:

- Using accessible venues for workshops and meetings.
- Providing surveys in easy-to-read formats or with audio support.
- Allowing assisted participation, where trusted facilitators support data entry.
- Including questions about mobility barriers, access to services, and evacuation challenges.

Example: Mapping may reveal that evacuation routes are inaccessible to wheelchair users or that warning systems do not reach people with hearing impairments.

Digital Divide Considerations

The digital divide—differences in access to devices, connectivity, and digital literacy—can significantly limit participation in citizen-led mapping. Addressing this divide is crucial for inclusion, especially in rural areas, low-income communities, and among older populations.

Practical approaches include:

- Offering offline participation options, such as paper-based mapping or facilitated group reporting.
- Providing basic digital literacy support during trainings.
- Using shared devices during workshops.
- Combining online campaigns with in-person outreach.

Example: In rural communities with limited internet access, facilitated mapping sessions using printed maps can ensure participation without reliance on smartphones.

By integrating gender sensitivity, disability inclusion, and strategies to overcome the digital divide, citizen-led disaster risk mapping becomes a tool for social justice as well as risk reduction. These approaches ensure that data reflect the realities of all community members and that participation itself contributes to empowerment and resilience.

Training Session for Citizen Scientists (Example)

Target group: Community members, youth, activists (15–25 participants)
Duration: 4 hours (can be split into two shorter sessions)

Session 1: Introduction and Purpose (30 minutes)
- What disaster risk is (hazard + vulnerability + exposure).
- Why local knowledge is critical and often missing from official data.
- How citizen-generated data can support prevention, preparedness, and advocacy.

Session 2: Understanding Risks and Categories (45 minutes)
- Overview of risk types relevant to the local context (e.g. floods, pollution, unsafe buildings).
- Difference between point risks (single locations) and area risks (zones or neighbourhoods).
- What should and should not be mapped (safety boundaries).

Session 3: Ethics, Safety, and Responsibility (30 minutes)
- Do-no-harm principle.
- Informed consent and privacy.
- When not to collect data (dangerous locations, sensitive situations).

Session 4: Practical Data Collection Skills (60 minutes)
- How to describe a risk clearly (what, where, when, impact).
- Basics of geolocation (approximate accuracy is acceptable).
- Taking useful photos (focus, relevance, context).
- How data is reviewed and validated.
- How maps and reports are created.
- How results are shared with communities and institutions.

8. Training and Capacity Building

Training and capacity building are central to ensuring the quality, credibility, and long-term sustainability of citizen science initiatives. Well-designed training equips participants with the knowledge, skills, and confidence needed to collect, document, and interpret data accurately, while also fostering a shared understanding of ethical standards, safety considerations, and the broader purpose of the research. Beyond technical skills, training strengthens participants' sense of ownership, motivation, and engagement, enabling them to act as informed contributors and advocates within their communities.

This chapter outlines the approach to training citizen scientists, focusing on clearly defined objectives, essential competencies, and inclusive learning formats adapted to diverse backgrounds and levels of experience. It presents a combination of in-person, online, and self-learning training formats to ensure accessibility and flexibility, alongside a range of practical training materials designed to support consistent data collection and continuous learning. Together, these elements aim to build a capable, resilient, and empowered community of citizen scientists able to contribute meaningfully to research, policy dialogue, and local decision-making.

8.1 Training Citizen Scientists

Training citizen scientists is a critical step in ensuring that disaster risk mapping is safe, accurate, ethical, and meaningful. The purpose of training is not to turn citizens into technical experts, but to equip them with the essential knowledge and skills needed to observe, document, and communicate risks responsibly. Well-designed training builds confidence, improves data quality, and helps participants understand how their contributions fit into a broader disaster risk reduction and environmental justice effort.

Objectives of training focus on enabling citizens to participate effectively and safely in the mapping process. Participants should understand what disaster risk mapping is, why it matters for their community, and how the collected data will be used. Training should clarify the scope of the project, the types of risks being mapped, and the ethical principles guiding participation. Citizens also need to understand their role as contributors to a collective knowledge process, including the importance of accuracy, honesty, and respect for others. A key objective is to ensure that participants can recognise risks without exposing themselves to danger and know when not to collect data due to safety or ethical concerns.

Core competencies for citizen scientists include a combination of practical, ethical, and contextual skills. Participants should be able to identify different types of disaster and environmental risks in their surroundings and distinguish between point-based and area-based risks. They need basic spatial awareness to record locations meaningfully, even if only approximately. Citizens should also be able to document risks clearly through short descriptions and, where appropriate, visual evidence, while following ethical guidelines related to consent and privacy. In addition, training should cover how to recognise uncertainty, report incomplete information honestly, and understand that their observations contribute to a larger dataset rather than providing definitive conclusions on their own.

Beyond technical skills, citizen scientists should develop an understanding of risk in context—how hazards interact with vulnerability, infrastructure, and social conditions. They should also be aware of the limits of citizen data and the importance of collaboration with other community members, civil society organisations, and institutions. By focusing on these core competencies, training empowers citizens to contribute responsibly to disaster risk mapping and strengthens the credibility and impact of citizen-led initiatives.

8.2 Training Formats

To ensure broad participation, inclusivity, and effective learning, the project applies a blended training approach that combines in-person workshops, online sessions, and self-learning materials. This mix of formats responds to different learning preferences, availability, digital access levels, and geographic constraints, while ensuring that all participants can acquire the core competencies required for meaningful participation in citizen science activities.

In-person workshops serve as the foundation of the training programme, particularly at the initial stages of engagement. These workshops provide hands-on learning opportunities, direct interaction with trainers and peers, and practical demonstrations of tools, methods, and data collection procedures. They are especially important for building trust, motivation, and a shared understanding of project goals, as well as for addressing ethical, safety, and quality assurance issues. In-person formats also enable immediate feedback, group problem-solving, and peer-to-peer learning, which are essential for participants with limited prior experience in research or digital tools.

Photovoice (Participatory Visual Method)

Photovoice is a widely used participatory method in both PAR and FPAR where participants use photography to document their lived experiences and perspectives. It supports community dialogue and is especially useful in environmental justice and risk perception projects.

Art of Hosting (Group Process Method)

Is a methodological approach to facilitation and dialogue that helps groups surface collective knowledge and design solutions collaboratively. It is useful for PAR workshops, community feedback sessions, and participatory analysis with diverse participants.

Canva / Google Docs

Tools for collaboratively developing visually clear manuals, handbooks, and printable guides.

YouTube / Vimeo

Tools for hosting and sharing short, accessible video tutorials.

Moodle or Google Classroom

Tools for organizing training materials and self-learning modules in one accessible space.

Online sessions complement face-to-face training by offering flexibility and continuity throughout the project lifecycle. Delivered through accessible digital platforms, online sessions are used for follow-up training, thematic deep dives, refresher courses, and experience exchange among participants from different locations. This format allows trainers to respond to emerging needs, introduce updates or new methodologies, and maintain regular contact with citizen scientists. Online sessions also support inclusiveness by enabling participation for those who cannot attend in-person events due to time, mobility, or distance constraints.

Self-learning materials provide participants with the opportunity to learn at their own pace and revisit content as needed. These materials include step-by-step guides, short videos, manuals, and visual instructions that can be accessed independently via mobile devices or computers. Self-learning resources are particularly valuable for reinforcing knowledge, supporting new participants who join later in the project, and ensuring long-term usability of the training beyond the project duration. Together with facilitated formats, they contribute to the sustainability and scalability of the capacity-building approach.

8.3 Training Materials

Training materials are designed to support clear, consistent, and high-quality participation of citizen scientists throughout all phases of the project. They are developed using plain language, visual aids, and practical examples to ensure accessibility for participants with different educational backgrounds, levels of digital literacy, and prior research experience. All materials are modular, reusable, and adaptable, allowing them to be updated as project needs evolve and to remain useful beyond the project's lifetime.

Manuals and handbooks serve as the core reference materials for participants. They provide structured explanations of the project objectives, roles and responsibilities of citizen scientists, ethical principles, data protection requirements, and quality assurance standards. In addition, they include methodological guidance on data collection, observation protocols, and reporting procedures. Manuals are designed in both digital and printable formats to ensure accessibility in low-connectivity contexts and to support use during field activities.

Video tutorials are used to demonstrate practical tasks in a clear and engaging way. Short, focused videos show how to use digital tools, collect and submit data, follow safety procedures, and avoid common errors. Video formats are particularly effective for visual learners and for participants using mobile devices, allowing them to quickly revisit instructions while working in the field. Where possible, videos are subtitled and kept concise to maximize usability and inclusiveness.

Step-by-step guides translate complex procedures into simple, actionable instructions. These guides break down tasks such as registering on platforms, completing forms, uploading data, or conducting observations into clearly sequenced steps supported by screenshots, icons, or diagrams. Step-by-step guides reduce entry barriers for new participants, support independent learning, and help maintain data consistency and reliability across different contributors.

9. Pilot Mapping and Testing

Pilot mapping and testing represent a critical transition from planning and training to practical implementation. This phase allows the project to validate tools, methods, and workflows in real-world conditions before full-scale deployment. By conducting pilot activities on a limited scale, the project can assess whether data collection procedures are clear, feasible, and appropriate to the local context, while minimizing risks and resource inefficiencies.

This chapter outlines the objectives and process of pilot mapping, including the testing of tools and methodologies, the organization of initial fieldwork, and the systematic revision of approaches based on participant feedback and observed challenges. Through iterative testing and refinement, pilot mapping ensures that the final tools and methods are reliable, user-friendly, and well aligned with both scientific standards and the capacities of citizen scientists.

9.1 Purpose of Pilot Mapping

Pilot mapping is a critical preparatory phase in citizen-led disaster risk mapping that takes place before full-scale data collection begins. Its primary purpose is to test whether the chosen tools, methods, and processes work as intended in real-world conditions. Pilot mapping helps translate plans and assumptions into practice, revealing practical challenges that may not be apparent during desk research or training sessions. By starting on a small scale, project teams can reduce risks, improve data quality, and protect participants from unnecessary frustration or harm.

Testing tools and methods during pilot mapping allows teams to assess the usability of surveys, mapping categories, geolocation functions, and visual documentation procedures. This includes checking whether questions are clear and understandable, whether participants can easily record locations, and whether data are being captured in a consistent and meaningful way. Pilot mapping also tests training effectiveness—showing whether citizen scientists feel confident using the tools and applying ethical guidelines. Feedback from pilot participants provides concrete insights into what needs adjustment before wider rollout.

Identifying gaps and risks is the second key purpose of pilot mapping. Pilots often reveal missing risk categories, underrepresented areas or groups, and unexpected safety or ethical concerns. They may also highlight technical issues, such as inaccurate locations, incomplete responses, or difficulties in uploading data. Importantly, pilot mapping helps identify social and contextual risks, such as low participation in certain neighbourhoods, misunderstandings about project goals, or sensitivities around specific locations or topics. Addressing these gaps and risks early strengthens the overall methodology and ensures that full-scale mapping is more inclusive, accurate, and aligned with community realities.

9.2 Conducting Pilot Fieldwork

Pilot fieldwork is conducted to test data collection tools, protocols, and workflows under real-world conditions while maintaining a manageable scope. This stage focuses on learning, adjustment, and validation rather than on producing comprehensive datasets. By carefully selecting pilot sites and limiting the scale of activities, the project can identify practical challenges early and ensure that methods are suitable for wider implementation.

Site selection is based on predefined criteria that reflect the objectives of the project and the diversity of local conditions. Pilot sites are chosen to represent different environmental, social, and risk-related contexts relevant to the mapping activities, such as varying levels of exposure, accessibility, and population density. Practical considerations—including safety, ease of access, and the presence of engaged local participants—are also taken into account. Where possible, sites are selected in consultation with citizen scientists and local stakeholders to ensure relevance, local knowledge integration, and community acceptance.

Small-scale testing involves implementing data collection activities with a limited number of participants, observations, or data points. This controlled approach allows the project team to assess whether instructions are clear, tools function as intended, and participants can complete tasks independently and consistently. During testing, attention is given to the time required for tasks, technical issues, data quality, and adherence to ethical and safety guidelines. Observations and feedback gathered during small-scale testing are systematically documented and used to identify strengths, weaknesses, and areas for improvement before scaling up to full field implementation.

9.3 Revising Tools and Methods

Revising tools and methods is a core outcome of the pilot mapping and testing phase. This step ensures that insights gained from practical implementation are systematically used to improve the effectiveness, reliability, and accessibility of the project's data collection approach. Revisions are treated as an iterative process, recognizing that refinement is essential for aligning scientific requirements with the real capacities and experiences of citizen scientists.

Integrating feedback involves collecting and analyzing input from multiple sources, including citizen scientists, trainers, and project coordinators. Feedback is gathered through short debrief sessions, surveys, observation notes, and informal discussions during and after pilot fieldwork. Particular attention is paid to recurring issues such as unclear instructions, technical difficulties, safety concerns, or tasks that are too time-consuming or complex. This feedback is reviewed in a structured manner and prioritized based on its impact on data quality, participant engagement, and ethical or safety considerations.

Improving usability focuses on simplifying processes and enhancing the overall user experience without compromising methodological rigor. Based on pilot findings, tools and methods may be adjusted by clarifying terminology, reducing the number of required steps, improving visual guidance, or modifying digital interfaces to be more intuitive. Training materials and instructions are updated accordingly to reflect these changes. By improving usability, the project lowers participation barriers, reduces errors, and supports consistent, confident data collection during full-scale implementation.

10. Implementation of Mapping Activities

The implementation of mapping activities marks the full-scale application of the project's tools, methods, and capacities developed through earlier training and pilot phases. At this stage, citizen scientists actively contribute data through coordinated field and online mapping efforts, transforming individual observations and local knowledge into structured, actionable information. Effective implementation requires clear procedures, strong coordination, and continuous attention to safety, inclusiveness, and data quality.

This chapter outlines how mapping activities are carried out in practice, combining field-based data collection with online mapping campaigns and hybrid approaches. It describes how individual and group mapping is organized, how public outreach and digital engagement are used to broaden participation, and how online and offline methods are integrated to ensure diverse, representative, and reliable contributions. Together, these approaches enable comprehensive mapping while maintaining methodological consistency and community engagement.

10.1 Field Mapping

Field mapping is a core component of the project, enabling citizen scientists to collect first-hand data through direct observation in their local environment, while being complemented by online mapping contributions. The approach is designed to be flexible and inclusive, allowing participation through individual, group, and digitally supported mapping activities, while ensuring consistency in methods, data quality, and ethical standards.

Individual, group, and online-supported mapping are organized to accommodate different participant capacities, availability, and contexts. Individual field mapping allows participants to contribute observations independently and at their own pace, making it suitable for routine monitoring and localized reporting. Group mapping activities are organized as guided field visits, community walks, or thematic mapping events, enabling shared learning, peer support, and collective validation of observations. In parallel, online mapping enables participants to submit observations remotely, upload previously collected data, validate or complement field entries, and contribute contextual information such as photos, descriptions, or historical knowledge. This combined approach broadens participation and allows engagement even when direct fieldwork is not possible.

Safety considerations are integrated into all field and online-supported mapping activities. Participants receive clear guidance on assessing personal and environmental risks, including terrain, weather conditions, traffic, and proximity to hazardous sites. Field activities are designed to avoid high-risk areas, and participants are instructed to prioritize personal safety over data collection at all times. Online mapping provides a safer alternative for contributing information related to sensitive or inaccessible locations, reducing exposure to potential hazards. Clear protocols are established for working individually or in groups, reporting risks, and suspending activities in unsafe conditions, ensuring responsible participation and the well-being of all contributors.

10.2 Online Mapping Campaigns

Online mapping campaigns are used to broaden participation, increase visibility, and collect data beyond the reach of structured field activities. By combining open calls with targeted digital outreach, the project enables a wide range of community members to contribute observations, experiences, and local knowledge through accessible online channels.

Public calls and outreach are launched to invite citizens to participate in mapping activities through simple, clearly communicated instructions. Calls are disseminated via project websites, partner networks, local media, schools, and community organizations, using clear language and visual materials to explain what to map, how to contribute, and why participation matters. Outreach efforts are designed to lower participation barriers by emphasizing ease of use, voluntary engagement, and the relevance of contributions to local decision-making and community safety.

Social media engagement plays a key role in sustaining momentum and reaching diverse audiences. Platforms such as Facebook, Instagram, and other locally relevant channels are used to share mapping prompts, examples of contributions, short tutorials, and updates on project progress. Social media also enables two-way communication, allowing participants to ask questions, receive feedback, and see how their contributions are being used. By combining structured public calls with ongoing social media engagement, online mapping campaigns support continuous participation, data enrichment, and stronger community ownership of the mapping process.

10.3 Combining Online and Offline Methods

Combining online and offline methods allows the project to leverage the strengths of both approaches while addressing their individual limitations. Hybrid mapping approaches integrate field-based data collection with digital contributions, enabling more comprehensive coverage, higher participation, and improved data validation. This combination supports flexibility in engagement and ensures that mapping activities remain inclusive, resilient, and responsive to local conditions.

Hybrid approaches link in-person field mapping with online tools and platforms, allowing data collected in the field to be uploaded, reviewed, and complemented digitally. Participants may collect observations offline and submit them later via online forms, while others contribute remotely by adding contextual information, validating entries, or mapping areas they know well but cannot physically access. Hybrid approaches also enable coordinated campaigns where field activities are synchronized with online outreach, increasing visibility and reinforcing participation across different channels.

Ensuring representativeness is a key objective of combining online and offline methods. Sole reliance on digital tools can exclude individuals with limited internet access or digital skills, while purely field-based approaches may miss broader perspectives or less visible locations. By offering multiple modes of participation, the project engages diverse groups across age, gender, location, and socio-economic background. Participation patterns are monitored throughout implementation to identify gaps or biases, and targeted outreach or facilitated field activities are introduced where needed. This approach helps ensure that collected data reflects a broad range of experiences and conditions, strengthening the reliability and legitimacy of mapping outputs.

11. Data Quality Assurance and Validation

Ensuring data quality and credibility is essential for citizen-led disaster risk mapping to be trusted, useful, and ethically sound. This chapter outlines practical approaches for reviewing, validating, and interpreting citizen-generated data, recognising both its strengths and its inherent limitations. By combining technical checks with community-based validation and transparent handling of uncertainty and bias, citizen science projects can produce evidence that is robust, accountable, and fit for informing action and decision-making.

11.1 Data Review and Cleaning

Data review and cleaning are the first steps in ensuring that citizen-generated data are usable, consistent, and credible. Because data are collected by many participants with different levels of experience, variation and minor errors are normal and expected. The goal of data cleaning is not to eliminate this diversity, but to identify and correct issues that could distort analysis or interpretation.

Detecting errors and duplicates involves systematically reviewing datasets to identify obvious mistakes, such as incorrect locations, inconsistent category selection, or repeated entries referring to the same event or site. Duplicates may occur when multiple participants report the same risk location or incident. Rather than removing such entries automatically, it is important to assess whether they provide complementary information or confirm the significance of a risk. In many cases, multiple reports of the same location can strengthen evidence by showing recurrence or shared concern. Clear criteria should be applied to decide when records are merged, retained, or flagged for further review.

Completing missing information focuses on addressing gaps that reduce the analytical value of data, such as missing locations, incomplete descriptions, or absent photos. Where possible, missing information can be completed by reviewing accompanying notes, visual evidence, or follow-up communication with participants. In some cases, gaps cannot be filled and should be clearly marked rather than guessed. Transparent handling of missing data helps maintain integrity and prevents over-interpretation. Importantly, data cleaning should be documented so that changes and assumptions remain traceable throughout the analysis process.

11.2 Validation Mechanisms

Validation mechanisms are essential for confirming the accuracy, relevance, and credibility of citizen-generated data. Validation does not mean verifying every detail to a technical standard, but rather ensuring that data reliably reflect real conditions and experiences.

Cross-checking sources is a key validation approach. Citizen data can be compared with institutional datasets, satellite imagery, historical records, media reports, or NGO documentation. Consistencies strengthen confidence in findings, while discrepancies highlight areas that may require further investigation. In some cases, citizen data may reveal risks not present in official sources, which should be treated as valuable signals rather than errors. Cross-checking helps situate citizen observations within a broader evidence landscape.

Community validation sessions are a defining feature of citizen-led approaches. These sessions involve presenting preliminary maps and findings back to participants and community members for review and discussion. Community members can confirm locations, correct inaccuracies, add missing context, and challenge interpretations that do not align with lived experience. Validation sessions also help identify power dynamics or blind spots in the data. This collective review process strengthens legitimacy, reinforces trust, and ensures that final outputs reflect shared understanding rather than external interpretation alone.

11.3 Managing Uncertainty and Bias

Citizen-led disaster risk mapping inevitably involves uncertainty and subjectivity, which must be acknowledged and managed rather than hidden. Individual perceptions, personal experiences, and uneven participation influence what is reported and how risks are described. Recognising these factors is essential for responsible interpretation and use of data.

Subjectivity in citizen reporting can arise from differences in risk perception, personal impact, or local knowledge. For example, residents living closer to a hazard may perceive higher severity than those farther away. Rather than treating subjectivity as a flaw, it should be understood as part of the social reality of risk. Aggregating data, analysing patterns rather than single reports, and combining quantitative and qualitative inputs help balance individual perspectives.

Transparency in limitations is critical for ethical and credible reporting. Final outputs should clearly explain how data were collected, what they represent, and what they do not capture. Limitations related to coverage, accuracy, participation, or missing data should be openly communicated to communities, institutions, and decision-makers. Transparency builds trust and prevents misuse of findings, ensuring that citizen-generated data are used appropriately—as a valuable complement to other forms of evidence rather than a definitive or exhaustive account.

Together, data cleaning, validation, and transparent handling of uncertainty form the backbone of quality assurance in citizen-led disaster risk mapping, enabling projects to produce evidence that is both socially grounded and analytically sound.

12. Data Analysis and Interpretation

Data analysis and interpretation transform collected mapping inputs into meaningful evidence that can inform understanding, decision-making, and action. By systematically analyzing both quantitative and qualitative data, the project moves beyond individual observations to identify broader patterns of risk, exposure, and vulnerability. This chapter outlines the analytical approaches used to ensure that citizen-generated data are interpreted in a rigorous, transparent, and context-sensitive manner.

The chapter combines quantitative analysis of frequencies, spatial distributions, and risk hotspots with qualitative analysis of narratives, testimonies, and lived experiences of risk. By integrating these perspectives, the project captures not only where risks occur and how often, but also how they are experienced, perceived, and managed by affected communities. The final section brings these strands together through integrated risk analysis, linking hazards with exposure and vulnerability to provide a holistic understanding of local risk dynamics and support evidence-based policy and community responses.

12.1 Quantitative Analysis

Quantitative analysis helps transform citizen-generated data into measurable patterns and trends that can support decision-making, planning, and advocacy. In citizen-led disaster risk mapping, quantitative analysis does not aim for complex statistical modelling, but rather for clear, interpretable insights that show where risks occur, how often, and with what intensity.

Frequency and spatial patterns are the starting point of quantitative analysis. Frequency analysis examines how often specific risks are reported, whether seasonally, annually, or repeatedly over time. Spatial pattern analysis focuses on where reports are concentrated, allowing teams to identify clusters of hazards, recurring incidents, or areas of persistent exposure. Even simple counts and visual summaries can reveal important trends, such as neighbourhoods experiencing repeated flooding or zones with chronic pollution complaints.

Risk hotspots emerge when frequency and location data are combined. Hotspots are areas where multiple reports overlap or where different types of risks coincide, such as flood-prone areas near industrial sites or unsafe buildings located in densely populated neighbourhoods. Identifying hotspots helps prioritise action, target field visits, and communicate urgency to authorities and communities. Quantitative analysis is most powerful when it is grounded in citizen experience and used to support prevention rather than merely describe damage.

12.2 Qualitative Analysis

Qualitative analysis focuses on understanding the meanings, experiences, and social dimensions of disaster risk as expressed through citizen narratives, testimonies, and open-ended survey responses. This type of analysis is essential for capturing aspects of risk that cannot be reduced to numbers, such as fear, loss, coping strategies, and perceived injustice.

Narratives and testimonies collected through surveys, interviews, focus groups, or audio recordings provide insight into how people experience risk in their daily lives. Qualitative analysis involves identifying recurring themes, concerns, and explanations across these narratives. For example, repeated references to illness, fear during heavy rainfall, or lack of institutional response can reveal underlying vulnerability patterns that are not visible in spatial data alone.

The lived experience of risk is central to citizen-led approaches. Qualitative analysis helps contextualise quantitative findings by explaining why certain risks matter, who is most affected, and how people adapt or struggle to cope. This type of analysis is particularly important for environmental justice issues, where harm may be cumulative, invisible, or normalised over time. When combined with maps, qualitative insights humanise data and strengthen communication with policymakers and the public.

Online Learning Platforms

https://www.edx.org

https://www.coursera.org/

https://www.ukdataservice.ac.uk

https://www.futurelearn.com

https://www.datacamp.com

https://olc.worldbank.org

12.3 Integrated Risk Analysis

Integrated risk analysis brings together quantitative and qualitative findings to create a holistic understanding of disaster risk. This approach reflects the disaster risk reduction framework, which recognises that disasters result from the interaction of hazards, exposure, and vulnerability rather than from hazards alone.

Linking hazards, exposure, and vulnerability allows citizen-led mapping projects to move beyond identifying where risks exist to understanding why they have such severe impacts. For example, flood hazards may be linked to exposure through informal housing in floodplains and to vulnerability through poverty, lack of drainage, or limited access to insurance. Integrated analysis helps reveal these connections by combining spatial hotspots, frequency data, and lived experience narratives.

This type of analysis supports action-oriented outcomes, such as identifying priority areas for intervention, recommending preventive measures, or advocating for policy change. Integrated risk analysis is especially valuable in post-industrial, post-conflict, or environmentally burdened regions, where multiple risks overlap and compound over time. By synthesising different forms of knowledge, citizen-led disaster risk map

13. Mapping Outputs and Visualisation

Mapping outputs and visualisations are key instruments for transforming analysed data into clear, accessible, and actionable knowledge. Effective visualisation enables complex information on risks, hazards, and vulnerabilities to be understood by diverse audiences, including citizens, local authorities, policymakers, and other stakeholders. By presenting data in intuitive and transparent formats, visual outputs support informed decision-making, public awareness, and meaningful dialogue around risk reduction and preparedness.

This chapter describes the development of risk maps, dashboards, and other visual outputs, focusing on both static and interactive formats designed for public use. It also outlines principles for communicating risk visually, including the careful use of symbols, colours, and design choices to ensure clarity, accuracy, and accessibility. Through user-oriented visualisation, mapping outputs become not only analytical tools but also communication and advocacy instruments that support community engagement and policy action.

13.1 Risk Maps and Dashboards

Risk maps and dashboards are the primary outputs through which analysed data are presented in a clear, structured, and actionable way. They translate quantitative and qualitative findings into spatial representations that support understanding of where risks are located, how they evolve, and who or what is most affected.

Static and interactive maps are used in complementary ways. Static maps provide clear snapshots of key findings, such as the distribution of hazards, exposure levels, or identified risk hotspots. They are suitable for reports, policy briefs, presentations, and printed materials, ensuring that core messages can be easily shared and referenced. Interactive maps, on the other hand, allow users to explore data dynamically by zooming, filtering layers, and accessing detailed information linked to specific locations. These maps enable deeper engagement, support transparency, and allow different stakeholders to explore the data according to their needs and interests.

Public-facing visualisations are designed to be understandable to non-expert audiences while maintaining analytical integrity. Dashboards combine maps with charts, indicators, photos, and short explanatory texts to provide context and interpretation. Public-facing outputs prioritize clarity, relevance, and usability, helping citizens, local authorities, and decision-makers quickly grasp key risks and trends. Where appropriate, visualisations are accompanied by short explanations that clarify data sources, limitations, and intended use, strengthening trust and responsible interpretation.

13.2 Communicating Risk Visually

Effective visual communication of risk requires careful design choices to ensure that maps and graphics convey information accurately, ethically, and inclusively. Visualisation is not only a technical task but also a communication process that shapes how risks are perceived and understood.

Use of symbols and colours follows clear and consistent conventions. Symbols are selected to be intuitive and easily recognizable, avoiding unnecessary complexity. Colours are used to distinguish different types or levels of risk, with attention to avoiding misleading associations or excessive contrast. Gradients and legends are clearly explained, and visual hierarchies are applied to guide users' attention to the most critical information. Wherever possible, standard risk-mapping conventions are followed to support comparability and comprehension.

Accessibility of maps is a core consideration in visual design. Maps and dashboards are developed to be readable on different devices, including mobile phones, and to accommodate users with varying levels of digital literacy. Colour-blind–friendly palettes, clear font sizes, and simplified layouts are used to reduce barriers to understanding. Accessibility is further enhanced by providing alternative explanations, captions, or downloadable formats, ensuring that visual outputs can be used by a broad and diverse audience.

ArcGIS Online

Tool for creating interactive maps and dashboards.

Mapbox

Tool for creating custom interactive web maps.

kepler.gl
Tool for advanced interactive spatial visualisation.

Datawrapper
Tool for creating accessible charts and map visualisations.

14. Reporting and Knowledge Sharing

Reporting and knowledge sharing are essential for transforming citizen-led disaster risk mapping into actionable evidence that supports learning, accountability, and change. This chapter outlines how to communicate findings in ways that are credible, accessible, and ethically responsible, ensuring that knowledge produced with communities is returned to them and shared more widely to inform policy, advocacy, and practice. Effective reporting balances technical rigour with clarity, while open data and transparency strengthen trust and long-term impact.

14.1 Preparing Reports and Policy Briefs

Reports and policy briefs are key outputs of citizen-led disaster risk mapping, serving different audiences and purposes. Technical reports document the methodology, data sources, analysis, findings, and limitations of the project in detail. They are intended for researchers, institutions, and technical stakeholders who require transparency and methodological clarity. Technical reports should clearly explain how data were collected and validated, how analyses were conducted, and how uncertainty was handled, allowing others to assess credibility and reuse findings responsibly.

Community-friendly summaries translate technical findings into accessible formats for participants and the wider public. These summaries should use plain language, visual elements such as maps and charts, and concrete examples drawn from local contexts. The goal is not simplification for its own sake, but meaningful communication that allows communities to understand what was found, why it matters, and how it can be used. Community summaries also reinforce reciprocity by ensuring that participants see the value of their contributions.

14.2 Feedback and Co-Interpretation

Feedback and co-interpretation are central to ethical and participatory knowledge sharing. Before finalising outputs, results should be shared with participants and affected communities through meetings, workshops, or accessible online formats. This allows community members to review findings, confirm interpretations, and identify missing or misrepresented information. Co-interpretation acknowledges that data do not speak for themselves and that local knowledge is essential for understanding context, causality, and implications.

Incorporating community feedback strengthens both accuracy and legitimacy. Feedback may lead to revisions of maps, reclassification of risks, or reframing of conclusions. Importantly, this process should be documented and communicated transparently, showing how community input influenced final outputs. Co-interpretation also builds capacity and ownership, helping communities use findings for advocacy, dialogue with authorities, or further monitoring.

14.3 Open Data and Transparency

Open data and transparency are key principles of citizen science and responsible disaster risk reduction. Data sharing principles should ensure that datasets are findable, accessible, and reusable while respecting ethical commitments, privacy, and safety. Not all data should be openly shared in raw form; sensitive information may require anonymisation, aggregation, or restricted access. Clear decisions about what is shared, how, and with whom should be made early and communicated to participants.

Licensing and reuse provide clarity on how data and outputs can be used by others. Applying open licences where appropriate supports learning, replication, and collaboration, while preventing misuse or misrepresentation. Transparency about methods, limitations, and data handling builds trust with communities, institutions, and the public, reinforcing the credibility of citizen-led disaster risk mapping as a source of knowledge and action.

Safety Checklist for Citizen Scientists and Field Mapping Activities

A. Before Participation

☐ Participation is voluntary and based on informed consent
☐ I understand the purpose of the activity and my role
☐ I have received clear instructions on what to do and what not to do
☐ I know that I can stop or withdraw at any time without consequences
☐ I have contact information for the project team or coordinator

B. Personal Safety Preparation

☐ I am physically and mentally fit to participate in the activity
☐ I am wearing appropriate clothing and footwear for the location and weather
☐ I have basic necessities (water, phone, charged battery, ID if needed)
☐ I have informed someone (friend/family) where I am going, if relevant
☐ I am aware of current weather conditions and potential risks

C. Fieldwork Safety (If Applicable)

☐ I do not enter restricted, private, or clearly dangerous areas
☐ I avoid unstable terrain, traffic-heavy areas, polluted sites, or hazardous materials
☐ I do not take risks to collect data (safety comes first)
☐ I work in pairs or groups where recommended
☐ I keep a safe distance from industrial sites, machinery, animals, or conflict situations

D. Sensitive Locations and Situations

☐ I do not photograph or record people without their consent
☐ I avoid documenting sensitive sites if doing so could cause harm or conflict
☐ I do not confront individuals, authorities, or companies
☐ I stop the activity immediately if I feel unsafe or uncomfortable
☐ I report sensitive observations through designated channels, not publicly

E. Digital and Online Safety

☐ I do not share personal information publicly when submitting data
☐ I upload content only through official project tools or platforms
☐ I understand how my data will be used and shared
☐ I avoid posting sensitive locations or personal details on social media
☐ I report any misuse, harassment, or concerns to the project team

F. After the Activity

☐ I safely leave the site and confirm I am well
☐ I submit observations according to instructions
☐ I report any incidents, risks, or near-misses encountered
☐ I provide feedback if tools or instructions were unclear
☐ I know who to contact if concerns arise later

15. From Mapping to Action

Mapping activities reach their full value only when the generated data are actively used to inform decisions, influence policies, and strengthen community resilience. This chapter focuses on translating citizen-generated evidence into concrete action, ensuring that mapping outputs contribute to disaster risk reduction, environmental governance, and long-term institutional change. By linking data to advocacy, planning, and sustained engagement, the project moves from documentation of risks to practical solutions.

15.1 Using Data for Advocacy

Citizen-generated data provide a powerful evidence base for advocacy, particularly in contexts where official data are incomplete, outdated, or insufficiently granular. When systematically collected and clearly visualised, mapping results can support credible calls for policy change and improved governance.

Supporting policy change involves translating mapping findings into clear, actionable messages tailored to policy and institutional contexts. Risk maps, dashboards, and summaries are used to demonstrate spatial patterns, recurrent hazards, and cumulative impacts on communities. These outputs can inform policy briefs, public consultations, and submissions to local or national authorities, helping to justify regulatory changes, targeted investments, or enforcement of existing regulations.

Engaging decision-makers requires proactive and structured communication. Mapping results are presented through meetings, workshops, and public events involving municipal authorities, emergency services, sectoral institutions, and elected representatives. By grounding discussions in locally generated evidence and lived experience, the project strengthens dialogue between citizens and institutions and increases accountability in decision-making processes.

15.2 Integration into Disaster Risk Reduction Planning

For mapping to contribute to resilience, its outputs must be integrated into formal disaster risk reduction (DRR) frameworks and operational planning processes.

Local DRR strategies can be strengthened by incorporating citizen-generated data on hazards, exposure, and vulnerability. Mapping outputs support risk assessments, prioritization of interventions, and identification of high-risk locations requiring mitigation or preparedness measures. By aligning community data with municipal planning processes, the project helps ensure that DRR strategies reflect real conditions on the ground and community priorities.

Early warning systems benefit from citizen science by enhancing situational awareness and local monitoring. Community-reported observations can complement official monitoring systems, particularly for slow-onset or localized risks. When linked to existing early warning mechanisms, citizen-generated data support faster detection, localized alerts, and improved communication between authorities and communities, contributing to more effective preparedness and response.

15.3 Sustainability and Long-Term Engagement

Sustained impact depends on maintaining active participation and embedding mapping practices within institutional and community structures beyond the project duration.

Maintaining citizen networks involves continuous communication, feedback, and recognition of contributions. Regular updates on how data are used, opportunities for further engagement, and visible outcomes help sustain motivation and trust. Training new participants and enabling peer-to-peer learning support the renewal and growth of citizen networks over time.

Institutional partnerships are essential for long-term sustainability. Collaboration with municipalities, public institutions, schools, research organizations, and civil society actors helps integrate citizen mapping into routine practices, policies, and educational programmes. Formal partnerships, shared data platforms, and joint initiatives strengthen ownership and ensure that mapping remains a living process rather than a one-off activity.

16. Ethical, Legal, and Safety Considerations

Ethical, legal, and safety considerations provide the normative framework within which all project activities are carried out. These considerations ensure that participation is voluntary, informed, and respectful, that data are handled responsibly, and that risks to individuals and communities are minimized. Rather than treating ethics and safety as procedural requirements, the project embeds them as continuous practices guiding decision-making, communication, and implementation.

16.1 Data Protection and Privacy

Responsible data handling is essential to maintaining trust and protecting the rights of participants and affected communities.

Personal data handling follows the principle of data minimization. Only information that is strictly necessary for the project's objectives is collected, and personal identifiers are avoided wherever possible. When personal or location-linked data are required, they are stored securely, access is restricted to authorized personnel, and retention periods are clearly defined. Anonymization or pseudonymization techniques are applied before data sharing or publication to prevent identification of individuals.

GDPR compliance is ensured through clear legal bases for data processing, transparent information to participants, and respect for individual rights. Participants are informed about how their data will be used, stored, and shared, and are provided with mechanisms to access, correct, or request deletion of their data. Data processing agreements and internal protocols are established where external tools or partners are involved, ensuring compliance with applicable European and national data protection regulations.

16.2 Safety of Citizen Scientists

Protecting the well-being of citizen scientists is a priority and shapes how activities are designed and implemented.

Fieldwork safety is addressed through clear guidance on risk awareness, appropriate conduct, and decision-making in uncertain or changing conditions. Participation does not require individuals to enter unsafe environments or confront hazards directly. Activities are structured to allow participants to withdraw or adapt their involvement at any time without negative consequences. Safety considerations also extend to physical, psychological, and social well-being, including avoiding situations that may cause stress, intimidation, or harm.

Sensitive locations and conflicts require particular caution. Mapping activities avoid actions that could escalate tensions, expose participants to confrontation, or interfere with ongoing disputes, investigations, or emergency responses. Information related to sensitive sites may be generalized, delayed, or excluded from public outputs when necessary. Decisions on handling such data are guided by precaution, consultation with relevant stakeholders, and respect for local contexts.

16.3 Accountability and Transparency

Clear accountability and transparent communication are essential for ethical implementation and sustained trust.

Roles and responsibilities are clearly defined for project coordinators, partners, and participants. Responsibilities related to data management, safety oversight, communication, and decision-making are documented and communicated from the outset. This clarity helps prevent misunderstandings and ensures that ethical and legal obligations are consistently met.

Managing expectations involves honest and continuous communication about the scope, limitations, and potential outcomes of the project. Participants are informed about what the project can and cannot achieve, how their contributions will be used, and the extent to which change depends on external actors and processes. By avoiding overpromising and ensuring transparency at all stages, the project fosters responsible participation and long-term credibility.

17. Good Practices and Lessons Learned

This chapter consolidates practical insights gained through the implementation of mapping and citizen science activities, focusing on what has proven to work well and what requires careful attention. By reflecting on both successes and challenges, the chapter identifies transferable good practices that can inform future initiatives and support adaptation in different contexts. Emphasis is placed on approaches that strengthen participation, improve data quality, and enhance the long-term relevance of mapping efforts.

17.1 Key Success Factors

Several factors consistently contribute to the effectiveness and sustainability of mapping initiatives.

Trust and transparency are foundational to sustained participation. Clear communication about project objectives, data use, limitations, and decision-making processes helps build confidence among participants and stakeholders. Regular feedback on how contributions are used and what outcomes they produce reinforces credibility and motivates continued engagement.

Local ownership strengthens relevance and impact. When communities are involved not only as data contributors but also in defining priorities, interpreting results, and discussing next steps, mapping activities become more meaningful and context-sensitive. Local ownership supports long-term engagement and increases the likelihood that findings will be used in advocacy, planning, and community action.

17.2 Common Challenges and How to Address Them

Despite careful design, mapping initiatives face recurring challenges that require adaptive responses.

Low participation may result from limited awareness, time constraints, or uncertainty about the value of engagement. Addressing this challenge involves simplifying participation processes, offering multiple modes of engagement, and clearly communicating the relevance of contributions. Partnerships with local organizations, schools, and community leaders can also help broaden reach and sustain participation over time.

Data quality issues can arise from inconsistent reporting, unclear instructions, or varying levels of experience among participants. These challenges are mitigated through clear guidance, iterative training, and built-in validation mechanisms such as peer review, cross-checking, and moderation. Treating data quality as a shared responsibility rather than a one-time requirement supports continuous improvement.

18. Annexes

Annex A. Glossary of Key Terms

Citizen science
Research and data collection activities in which non-professional researchers actively contribute to scientific or policy-relevant knowledge.

Hazard
A potential source of harm or adverse effect, including natural, environmental, technological, or human-induced events.

Exposure
The presence of people, infrastructure, or assets in areas that could be adversely affected by hazards.

Vulnerability
The characteristics and conditions that make individuals or communities more susceptible to harm from hazards.

Risk
The combination of the likelihood of a hazardous event and its potential impacts on exposed and vulnerable elements.

Mapping

The process of collecting, organizing, and visualizing spatial information related to hazards, exposure, and vulnerabilities.

Data validation
Procedures used to check the accuracy, consistency, and reliability of collected data.

Anonymization
The process of removing personal identifiers from data so that individuals cannot be identified.

Informed consent
A voluntary agreement to participate based on clear information about the purpose, methods, risks, and use of data.

Annex B. Sample Survey Questions

The following sample questions can be adapted for field or online data collection:

Location
Where did you observe the issue? (Pin on map or describe location)

Type of risk
What type of risk did you observe? (e.g. flood, landslide, pollution, infrastructure damage)

Description
Please describe what you observed in your own words.

Frequency
How often does this situation occur?
☐ Once ☐ Occasionally ☐ Frequently ☐ Constantly

Impact
Who or what is affected by this issue? (people, homes, environment, infrastructure)

Perceived severity
How serious do you consider this risk?
☐ Low ☐ Medium ☐ High

Evidence
Can you upload a photo, video, or other supporting information? (optional)

Additional comments
Is there anything else you would like to add?

Annex C. Sample Consent Form

Project title:

Purpose of participation:
You are invited to participate in a citizen science project that collects information on local risks and environmental conditions. Your contribution will support research, awareness, and policy-related activities.

What participation involves:
Participation is voluntary and may include submitting observations, photos, or descriptions through field or online mapping tools.

Data use and protection:
Data will be used for research, mapping, and communication purposes. Personal data will be minimized, protected, and processed in accordance with applicable data protection regulations. Public outputs will not identify individuals.

Risks and safety:
You are not required to enter unsafe locations or take risks. You may stop participation at any time.

Your rights:
You have the right to withdraw your consent, request access to your data, or ask for corrections or deletion.

Consent statement:
☐ I have read and understood the information above.
☐ I voluntarily agree to participate in this project.

Name (optional): ________________________
Date: ________________________
Signature (if applicable): ________________________