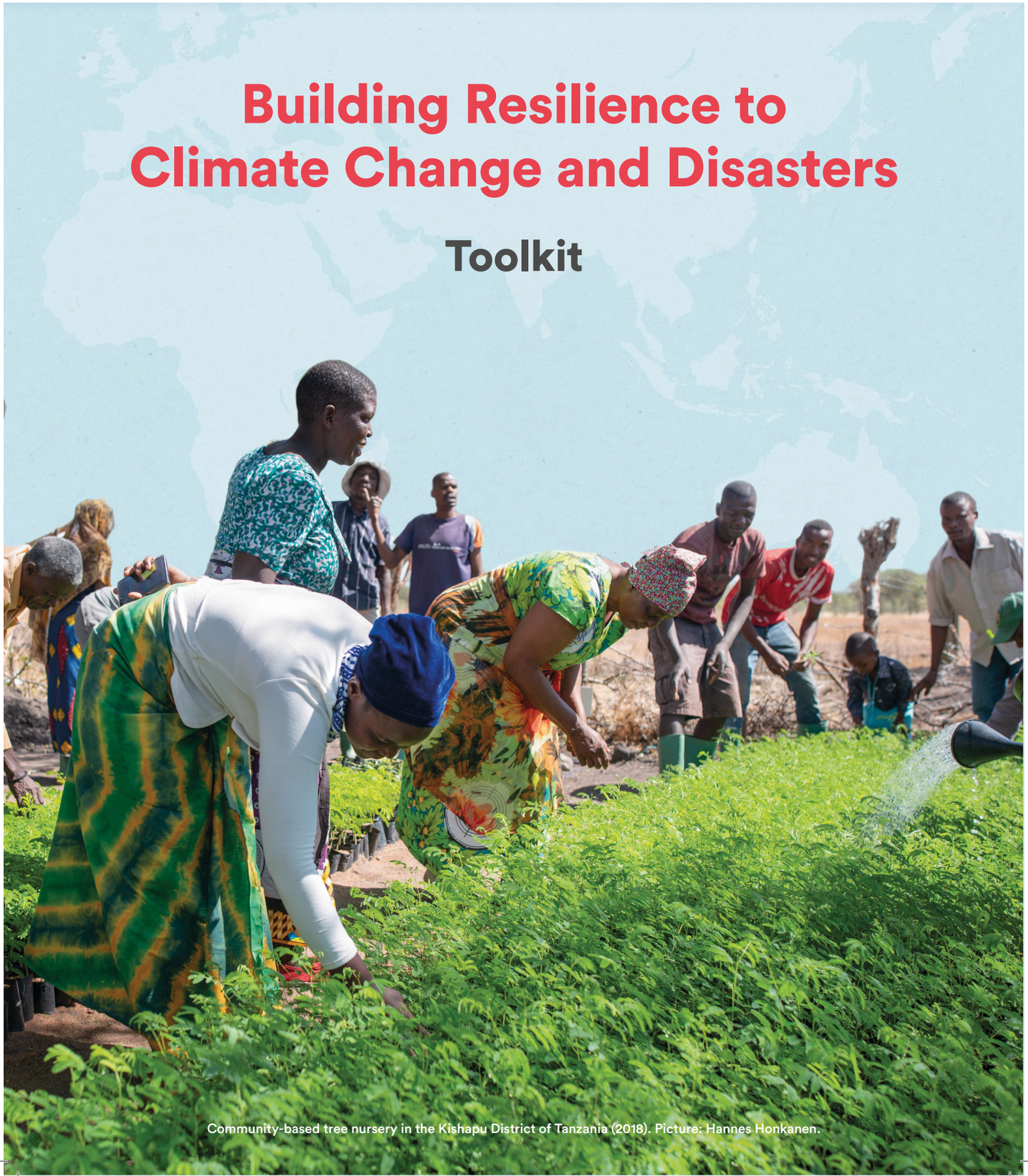
Felm 1859

Building Resilience to Climate Change and Disasters

Toolkit



Community-based tree nursery in the Kishapu District of Tanzania (2018). Picture: Hannes Honkanen.

PRODUCED BY
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Development Cooperation Unit.
October 2019
2nd edition June 2021
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With support from Finland's development cooperation

Contents

Vocabulary

Adaptation: Adaptation means anticipating the effects of climate change and taking measures or actions to prevent or minimize them. Examples of adaptation measures include building flood resistant housing or planting drought resistant crops.

Agroforestry: An agricultural system in which trees are grown around or among crops and livestock on the same plot of land to increase soil fertility, agricultural productivity, and food security. For example, fruit trees can be planted around vegetable crops to increase soil health and to provide diverse crops.

Atmosphere: The atmosphere is a thin layer of gases that surrounds the Earth. The atmosphere absorbs the Sun's heat and keeps the Earth warm.

Biodiversity: Biodiversity is a term used to describe the enormous variety of life on Earth. It refers to every living thing, including plants, bacteria, animals, and humans.

Carbon Dioxide: Carbon dioxide (CO2) is a greenhouse gas that can be found everywhere on Earth, in our air and in our atmosphere. Carbon dioxide can be produced through human activities like driving cars, but creating too much carbon dioxide contributes to climate change. Plants and trees remove extra carbon dioxide from the air, so it is important to protect our forests.

Carbon Emissions: Carbon emissions is a term that refers to the amount of carbon dioxide that a country, organization, or individual person releases into the atmosphere.

Carbon Footprint: The term carbon footprint refers to the measurable amount of carbon emissions caused by a country, organization, or individual person. The goal is to reduce your carbon footprint, which means reducing your carbon emissions (amount of greenhouse gases you put into the atmosphere). For example, someone who drives a car to work has a bigger carbon footprint than someone who rides a bicycle.

Climate Change: The Intergovernmental Panel on Climate Change (IPCC) defines climate change as any change of climate over time as a result of human activity or due to natural variability. For example, the Earth's climate is changing due to human activities (such as the burning of fossil fuels), which has increased global temperatures and made the world hotter.

Climate Refugees: A climate refugee is someone who has been displaced by the effects of climate change. For example, someone who had to leave their home

permanently because of a climate-related drought or flood could be considered a climate refugee. It must be noted that no official definition for “climate refugees” exists, and the term is not recognized by the United Nations and many other international agencies even though it is commonly used.

Compost: Compost is a mixture of decayed organic matter (such as food scraps and plants) that is used for fertilizing crops and land.

Crop Rotation: Crop rotation is an agricultural technique where different types of crops are grown in rotation on the same piece of land to increase soil fertility and food security. For example, on the same piece of land a farmer could grow maize one year and then grow groundnut the next year, which will keep the soil healthy and fertile. Growing the same crop on the same piece of land for many years in a row reduces the amount of nutrients in the soil.

Deforestation: Deforestation is the removal of trees or whole forests due to human activity. Cutting down trees for firewood or removing whole forests for agricultural use are both examples of deforestation. Deforestation not only ruins natural habitats for animals but it is also one of the leading contributors to climate change.

Disaster Risk Management (DRM): Disaster risk management is the organization, planning, and application of measures for preparing and responding to disasters. The goal of disaster risk management is to create plans that will lessen the impact of disasters. Setting up an early warning system (EWS) in a community is an example of disaster risk management.

Disaster Risk Reduction (DRR): Disaster risk reduction (DRR) is aimed at preventing new disaster risks and reducing existing disaster risks. This includes preparing for climate-related disasters that we cannot avoid by taking measures like building flood resistant homes near coastal areas.

Disaster Risk Resilience: Disaster risk resilience refers to the ability of a community to recover quickly from disasters. The goal is to build resilience to disasters, which can be done by implementing certain measures, such as setting up a rainwater harvesting system that provides clean water during times of drought.

Early Warning Systems (EWS): Early warning systems include various monitoring and communication technologies designed to give communities enough time to prepare for disasters. For example, an observation tower can be set up near a river to monitor the water levels, and a hand siren can alert the community that a flood is coming, which will give them enough time to evacuate safely.

Food Security: Food security means that all people, at all times, have access to sufficient and nutritious food that meets their dietary needs. There are certain

measures we can take to increase food security, such as implementing agricultural techniques like agroforestry, crop rotation, and intercropping.

Fossil Fuels: Fossil fuels are fuels formed by natural processes, and include coal, oil, and natural gas. Burning fossil fuels (e.g. by driving a car or flying an airplane) release greenhouse gases into the atmosphere, which makes the world hotter and contributes to climate change.

Global Warming: The term global warming refers to the long-term rise in the average temperature of the Earth's climate due to human activity. Human activities such as driving cars and deforestation increase the amount of greenhouse gases released into our atmosphere, which makes the world hotter and contributes to climate change.

Greenhouse Gases: Greenhouse gases are certain gases in the atmosphere that trap heat from the Sun and keep the Earth warm. The most common greenhouse gases are water vapor, carbon dioxide, and methane. These heat-trapping gases are an essential part of the greenhouse effect. Greenhouse gases can be produced naturally or through human activities such as burning fossil fuels.

Greenhouse Effect: The greenhouse effect is a process that occurs when the greenhouse gases in Earth's atmosphere trap the Sun's heat. Without the greenhouse effect, the Sun's heat would escape back into space and Earth would be too cold for humans and animals to live. Human activities, such as the burning of fossil fuels, increase the amount of greenhouse gases in the atmosphere, which increases the greenhouse effect and makes the world hotter, contributing to climate change.

Improved Cooking Stove (ICS): Improved cooking stoves are affordable stoves made out of local materials with the goal of reducing the negative health impacts of open fire cooking and reducing deforestation by using less fuel wood. Improved cooking stoves are also sometimes called **wood saving stoves**.

Intercropping: Intercropping is an agricultural technique where two or more crops are grown together at the same time on the same plot of land. The purpose of intercropping is to increase yields, make the most use out of the available growing lands, increase food security, and to build resilience to disasters. For example, a farmer can grow maize and wheat on the same plot of land, and if the maize harvest fails, they will still have the wheat crop to rely on.

Loss and Damage: The term loss and damage is used within the UN Framework Convention on Climate Change (UNFCCC) process to refer to the harms caused by climate change, eg. economical or societal damage.

Mitigation: Mitigation refers to the measures or actions that are taken to reduce greenhouse gas emissions and slow down climate change. Examples of mitigation measures include riding a bike to work instead of driving a car, or using solar energy for electricity instead of a generator.

Natural Disasters: A natural disaster is a sudden and destructive event that happens in nature, such as a flood, drought, tropical storm, landslide, earthquake, volcanic eruption, or tsunami. A natural disaster can cause the loss of life or serious damage to property, the severity of which depends on the affected communities level of disaster risk resilience, which is why it is important to always be prepared. Climate change has significantly increased the frequency and intensity of natural disasters all across the world.

Paris Agreement: The Paris Agreement was developed at the Paris climate conference (COP21) in December 2015, where 195 countries adopted the first-ever universal and legally binding climate deal. The main goal of the Paris Agreement is to strengthen the global response to the threats of climate change by keeping the global temperature increase to well below 2 °C above pre-industrial levels, and to limit the increase to 1.5 °C.

Pre-Industrial: Pre-industrial refers to the time before the Industrial Revolution. The Industrial Revolution (a period that lasted from roughly 1750-1900) was a period where machines were introduced to produce goods on a large scale for the first time, which saw a massive increase in the burning of fossil fuels and carbon emissions, significantly contributing to climate change.

The pre-industrial era (the period before the year 1750) is often used as a baseline for climate goals, such as those outlined in the Paris Agreement. We have already heated the world by about 1 °C over pre-industrial levels.

Ring of Fire: The Ring of Fire is a large 40,000km (25,000 mi) horseshoe shaped zone in the Pacific Ocean where the majority of the world's earthquakes and volcanic eruptions happen.

Resilience: Resilience means the capacity and preparedness to recover from difficulties. Climate change changes our living environment and conditions in many ways. But when a community is resilient, prepared, they can bounce back from climate-related disasters and survive the changing conditions.

Wood Saving Stove: Wood saving stoves are affordable stoves made out of local materials with the goal of reducing the negative health impacts of open fire cooking and reducing deforestation by using less fuel wood. The improved cooking stove is also sometimes called an improved cooking stove (ICS).

Foreword

All over the world, communities are feeling the impacts of climate change. It can be seen in the form of rising sea levels and increasingly severe and regular disasters such as floods, storms, and droughts. Climate change has significantly increased the number of extreme weather events, which has resulted in changes to agricultural patterns, threats to livelihoods, and conflicts over land, water, and other resources.

Although the impacts of climate change are being felt all over the world, they are felt most severely by the people who are least responsible for causing the problem, many of them living in developing countries. These are the people who have the least access to the resources and technology needed to build resilience to climate change.

The purpose of the *Building Resilience to Climate Change and Disasters Toolkit* is to explain what climate change is and how it affects us, and to provide accessible and affordable tools and technologies for mitigating and adapting to climate change.

This document is set into 4 chapters:

Chapter I: What is Climate Change?

This chapter explains what climate change is, why it is happening, how it affects all of us and what resilience means.

Chapter 2: Mitigation

This chapter explains the key concept of mitigation and provides simple and affordable tools and techniques that communities can use to mitigate climate change.

Chapter 3: Adaptation

This chapter explains the key concept of adaptation and provides simple and affordable tools and step-by-step guides for applying adaptation measures in your community.

Chapter 4: Disasters

This chapter explains what kind of disasters can occur, how to prepare for them and provides simple tools for disaster risk preparedness.

1. What is climate change?

The Intergovernmental Panel on Climate Change (IPCC) defines **climate change** as any change of climate over time as a result of human activity or due to natural variability[1].

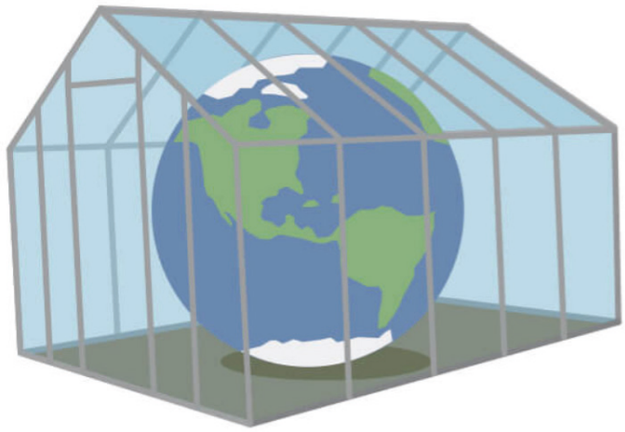
Many natural systems, on every continent and in every ocean, are being affected by regional climate changes, particularly temperature increases, which is also referred to as **global warming**. Global warming is the long-term rise in the average temperature of Earth's climate.

The Earth's temperature is increasing because human activities have been adding **greenhouse gases** into Earth's **atmosphere** at an unprecedented scale and speed, which has increased the **greenhouse effect**.

Greenhouse Effect

The greenhouse effect is a process that occurs when gases in Earth's atmosphere trap the Sun's heat. These heat-trapping gases are called greenhouse gases. The most common greenhouse gases are water vapor, **carbon dioxide**, and methane. Without the greenhouse effect, the Sun's heat would escape back into space and Earth would be too cold for humans and animals to live.

The process of greenhouse gases trapping heat in Earth's atmosphere is called the 'greenhouse effect' because the process works in a similar way to a greenhouse. A greenhouse is a building with glass walls and a glass roof.



1 Definition from the IPCC Special Report: Global Warming of 1.5 °C, https://www.ipcc.ch/sr15/chapter/glossary/.
2 Image from "What is the Greenhouse Effect?" by NASA, https://climatekids.nasa.gov/greenhouse-effect/.

Greenhouses are used to grow plants, such as tomatoes and flowers, because they stay warm even in the colder months. Earth is not inside a greenhouse, but our atmosphere traps the Sun's heat just like the glass walls of a greenhouse.

The greenhouse effect is a natural process that makes the Earth warm enough to live, but scientists believe that human activities are increasing the greenhouse effect. When people drive a car, fly in an airplane, or operate a factory, they burn **fossil fuels** (coal, oil, gas) which releases more greenhouse gases into the atmosphere. When we put more greenhouse gases into the atmosphere, they trap more of the Sun's heat, which makes the world hotter and contributes to climate change.

What human activities contribute to climate change?

- Burning fossil fuels (coal, oil, gas) from driving cars, flying airplanes and operating factories
- Dumping garbage into landfills and oceans
- Cutting down forests (**deforestation**)
- Soil erosion
- Increased livestock farming and overfishing
- Use of harmful chemicals

The gases released into the atmosphere from these human activities act like a glass greenhouse, trapping heat from the sun and warming the Earth, affecting the planet's climate system. Even a small increase in the Earth's temperature can cause serious problems for humans, plants, and animals.

The Consequences of a Global Temperature Increase

The recognition that even a small increase in the Earth's temperature would have disastrous consequences inspired the goals of the **Paris Agreement**, which is an agreement dealing with greenhouse gas emissions, **mitigation**, and **adaptation**. The Paris Agreement was signed in 2016 by almost every country in the world, with each country committing to create a plan to mitigate the effects of climate change.

The long-term goal of the Paris Agreement is to keep the global temperature increase well below 2 °C above **pre-industrial** levels, and to limit the increase to 1.5 °C, since this would substantially reduce the risks and effects of climate change[3]. We have already heated the world by about 1 °C over pre-industrial levels by sending greenhouse gases into the atmosphere, and if we do not decrease the amount of greenhouse gases we emit, the temperature of the world will increase with catastrophic consequences.

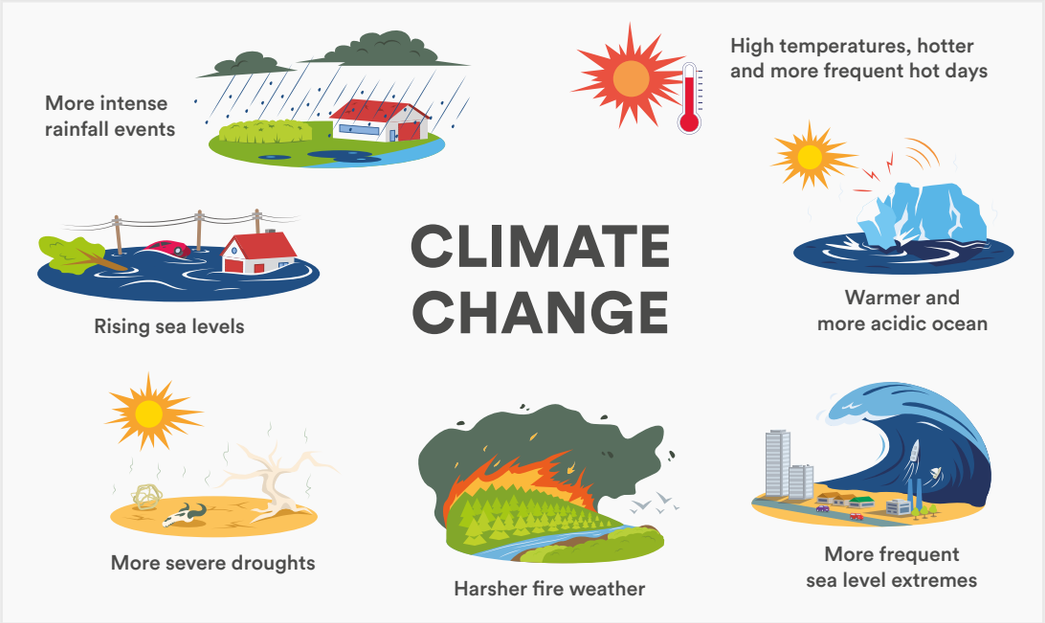
3 "The Paris Agreement" by the UNFCCC, https://unfccc.int/process-and-meetings/the-paris-agreement/d2hhdC1pcy.

The difference between 1.5 °C and 2 °C may seem small, but this slight difference has significant consequences. That half a degree can trigger extreme droughts and heat waves, intense hurricanes and storms, huge migrations of people, and mass extinctions of plant and animal species.

How Climate Change Affects Us

The effects of climate change can be detected worldwide. Regional impacts of climate change are now observable on all continents and across ocean regions with low-latitude, less developed areas facing the greatest risk. In the next 50 years, one to three billion people are projected to be left outside the favourable climate conditions for farming and living. The World Bank estimates that due to climate change, 100 million people will be driven into extreme poverty by 2030[4] and IPCC estimates that 183 million additional people are at risk of hunger.[5]

Biodiversity will suffer significant losses due to climate change, which will again impact humans severely. If the highest greenhouse gas scenarios are met, up to 50% of species are forecast to lose most of their favourable habitats. In many countries a large amount of people relies on nature for food security and income, for example through fishing. Marine ecosystems in the Indo-Pacific, Caribbean and Western coast of Africa will be highly impacted as early as in the 2030s. In these regions, millions of people rely on fish as an essential source of food.



4 https://openknowledge.worldbank.org/bitstream/handle/10986/22787/9781464806735.pdf?sequence=13&isAllowed=y
5 https://www.ipcc.ch/site/assets/uploads/2019/11/08_Chapter-5.pdf

Climate change increases the number of disasters. Not only are the disasters more frequent, but they are also stronger and more disruptive than before. Frequent natural disasters cause developing countries to remain in a constant phase of reconstruction, which means that essential funds that could be used for infrastructure and development would instead have to be used for emergency relief. Disasters also effect food security by destroying crops and cultivation land as well as infrastructures, thus pushing people deeper into poverty. Malnutrition and undernutrition are major health concerns that are expected to increase as climate change continually threatens food security and access to clean drinking water.

Climate change impacts rural, semi-rural and urban settings differently. Each setting faces different challenges. Both rural and urban areas are affected by climate shocks. In urban setting, special consideration might be pollution (air, water and soil). Urban areas can suffer from diseases and pandemics, economic shocks on cash economy, political violence or unrest, homelessness, and migrant influx. Rural areas on the other hand suffer from lack of land and low food production, lack of basic services, housing and infrastructure. Rural areas can also suffer from market chain breakdowns and increased price for equipment and materials.

Migration will significantly increase due to climate change. According to statistics published by the Internal Displacement Monitoring Centre, every year since 2008, an average of 26.4 million people around the world have been forcibly displaced by floods, droughts, storms, and earthquakes[6]. This is equivalent to one person being displaced every second, and the number of **"climate refugees"** is expected to rise in the future.

Climate change is a human rights matter. Its' impacts prevail unequally around the globe and affect different people, ethnic groups, professions, and genders differently. Historically the Western countries are responsible of 79 % of the world's greenhouse gases but the developing countries are carrying the biggest burden.[7]

Therefore, the people who suffer most from climate change are least responsible for it. These people are already the most vulnerable and climate change is making their situation worse. The underlying social inequalities deepen due to climate change. Increasingly unpredictable weather patterns, shifting seasons, and natural disasters disproportionately threaten the most vulnerable people among them women and people with disabilities.

6 Statistic from IDMC report Global Estimates 2015: People Displaced by Disasters, https://www.internal-displacement.org/publications/global-estimates-2015-people-displaced-by-disasters.
7 https://www.cgdev.org/media/who-caused-climate-change-historically

Climate change impacts the availability of clean water and effects women's daily work load.
Picture: Miia Barrow / FELM

1.1. Women

Climate change has a greater impact on those sections of the population, in all countries, that are most reliant on natural resources for their livelihoods and/or who have the least capacity to respond to natural disasters, such as droughts, landslides, floods and hurricanes. Women commonly face higher risks and greater burdens from the impacts of climate change in situations of poverty, and the majority of the world's poor are women.

Women are impacted more because they carry out most of the household work; they often fetch wood and water, take care of small animals, children and elderly and they feed the family. When these household activities become more difficult to carry out due to climate change, the workload of women will become unbearable.

As climate change increases unpredictable weather patterns, leading to more natural disasters, several studies have shown that disaster mortality rates are higher for women than for men. When dealing with the consequences of a disaster, women are often expected to carry out their normal domestic tasks, such as

firewood and water collection, which increases their vulnerability during times of crisis. Women are also often unable to evacuate as they are either unable to swim or carry the children for example.

Women's unequal participation in decision-making processes and labour markets compound inequalities and often prevent women from fully contributing to climate-related planning, policy making and implementation.

Yet, women can, and do play, a critical role in response to climate change due to their local knowledge of and leadership in e.g. sustainable resource management and leading sustainable practices at the household and community level. Women's participation at the political level has resulted in greater responsiveness to citizen's needs, often increasing cooperation across party and ethnic lines and delivering more sustainable peace. At the local level, women's inclusion at the leadership level has led to improved outcomes of climate related projects and policies. On the contrary, if policies or projects are implemented without women's meaningful participation it can increase existing inequalities and decrease effectiveness.

1.2. People with Disabilities

According to the Report of the Office of the United Nations High Commissioner for Human Rights (July 2020) people who are culturally, economically, institutionally, politically, socially or otherwise marginalized, are particularly at risk of harm from the adverse effects of climate change. These marginalised people include persons with disabilities who represent an estimated 1 billion individuals globally. They are often among those most adversely affected in an emergency, sustaining disproportionately higher rates of morbidity and mortality, and are least able to access emergency support.

A 2013 survey of over 5,000 persons with disabilities representing 126 countries conducted by the UNISDR found that only 20% could evacuate their living space without difficulty in the event of an emergency[8], highlighting the importance of physical accessibility and accessible information during natural disasters. Sudden-onset natural disasters and slow-onset events can seriously affect the access of persons with disabilities to food and nutrition, safe drinking water and sanitation, health-care services and medicines, education and training, adequate housing and access to decent work.

8 Statistics from "Living with Disability and Disasters" (2013) by UNISDR, https://www.unisdr.org/2014/iddr/documents/2013DisabilitySurveryReport_030714.pdf

People with disabilities can be active and productive members of society and fight against climate change. Picture: Pusat Rehabilitasi YAKKUM, Indonesia.

Most persons with disabilities live in poverty, as highlighted in the Convention on the Rights of Persons with Disabilities. The Intergovernmental Panel on Climate Change foresees that the poorest people will continue to experience the worst effects of climate change through lost income and livelihood opportunities, displacement, hunger and adverse impacts on their health. Multiple and intersecting factors of discrimination related to gender, age, displacement, indigenous origin or minority status can further heighten the risks of persons with disabilities experiencing negative impacts of climate change.

Because people with disabilities are disproportionately affected by climate change, they must be included in climate action. Their participation would allow for tailored climate action that addresses the specific concerns of persons with disabilities related to the adverse impacts of climate change. A human rights-based approach empowers persons with disabilities as agents of change to address the harmful impacts of climate change in their day-to-day lives. If persons with disabilities are left out of decision-making, that leaves them unable to contribute by identifying risk reduction and adaptation measures that could be effective for, and carried out by, persons with disabilities. It is vital to remember, that persons with disabilities are a heterogeneous group with different requirements. Best practices in terms of disability inclusion may also be relevant for the population at large, helping to avert some of the worst impacts of climate change.[9]

9 Source for the entire chapter: Analytical study on the promotion and protection of the rights of persons with disabilities in the context of climate change: https://undocs.org/A/HRC/44/30

Case Study: Disability Inclusive Disaster Reduction (DIDRR)

Felm Nepal worked in collaboration with the Lutheran World Federation Nepal (LWF) on a project titled *Disability Inclusive Disaster Risk Reduction (DIDRR) in Flood Prone Areas in Flood Affected Areas in Southern Plain of Nepal* that was implemented for three months between October 1st –December 31st 2018.

The purpose of the project was to reduce disaster related vulnerabilities of persons with disabilities in at-risk communities, such as the communities in the Morang and the Sarlahi districts of Nepal, which are prone to severe flooding.

The two main objectives of the project were to empower, strengthen, and support people with disabilities (including women and girls) with risk informed planning and resilience building, and to coordinate and collaborate with municipalities for disability inclusive disaster risk management and response preparedness.

By the completion of the project, one accessible and disaster resilient toilet and one water collection point were constructed in each district at Morang and Sarlahi. Because of this project, a total of 553 people with disabilities now had easy access to accessible and disaster resilient toilets and water collection points, with an additional 2,700 people benefiting indirectly from the project. Both the toilets and water collection points were constructed in public places, which meant they had a bigger potential to serve the wider population.

The project was successful in making sure that people with disabilities are risk informed and better organized to amplify their voices, that organizations are better prepared to respond and recover from future disasters, that municipalities are able to demonstrate increased capacity on inclusive disaster risk resilience by formulating and implementing accessible plans and provisions, and that persons with disabilities have easy access to WASH facilities in public places.

1.3. Loss and Damage

Based on recent scientific studies, the limit of human adaptability to climate change will be reached and **loss and damage** due to climate impacts will be inevitable[10] . The climate crisis threatens communities and entire populations by resulting in loss and damage. The Warsaw International Mechanism is established under the UNFCCC to assist developing countries that are particularly vulnerable to the adverse effects of climate change[11]. It divides loss and damage into economic losses and non-economic losses[12]. Economic losses include loss of income and physical assets such as property and infrastructure. Non-economic losses include loss of life, health, and human mobility as well as cultural heritage, societal and cultural identity, and biodiversity.

Under this mechanism, loss and damage are also cathegorised in slow onset events and extreme events. Slow onset events include increasing temperature, desertification, loss of biodiversity, land and forest degradation, glacial retreat, sea level rise, ocean acidification, and salinization. Extreme events include droughts, tropical cyclones, floods, storm surges and heatwaves.[13]

Climate Resilience

Resilience means knowing how to cope despite setbacks or limited resources. Resilience or community resilience regularly features local knowledge, resources available, economic situation, communication, networks and relationships, preparedness, mental outlook as well as climate change adaptation. In relation to climate change, resilience means the ability to recover from the effect of climate change; to adapt, to renew and to develop to meet the needs of the changing situation and to recognise the vulnerabilities a community might have.

As more and more communities are facing the impacts of climate disruption, it is becoming increasingly obvious that we need to cultivate resilience. **Resilient communities** are capable of 'bouncing back' from adverse situations like those caused by climate change. They can do this by actively influencing and preparing for economic, social and environmental change.

Increasingly, cities and urban regions are working to make themselves more resilient; to be able to prepare better, adapt and get stronger in response to internal and external pressures and stresses. This should be done in ways that not only allow people, businesses, neighbourhoods, and the whole community to main-

10 https://unfccc.int/sites/default/files/resource/Online_Guide_feb_2020.pdf
11 https://unfccc.int/topics/adaptation-and-resilience/workstreams/approaches-to-address-loss-and-damage-associated-with-climate-change-impacts-in-developing-countries#eq-2
12 https://unfccc.int/sites/default/files/resource/Online_Guide_feb_2020.pdf
13 https://unfccc.int/sites/default/files/resource/Slide1_3.JPG

Early warning system practice and simulation in a rural village in Laos in Felm funded project.
Picture: LWF Laos

tain essential functions and bounce back relatively quickly, but also to bounce forward toward an improved environment, social and economic health and well-being.

To improve resilience in communities it is essential that the capacity of communities is improved to implement and sustain climate adaptation and mitigation measures and to prevent loss and damage. Climate change and its impacts will vary greatly from place to place, so preparation must happen at local and regional levels and include the indigenous knowledge of the local people. Resilience can only be achieved in the vulnerable communities by ensuring inclusive participation of women and persons with disabilities.

With the effects of climate change, **disasters** are occurring more frequently and in many cases with higher intensity than previously. When disasters strike, governments and aid organizations are not always able to help communities immediately. First arrive the neighbours, friends, and local people. Then comes to aid the people from nearby towns and villages. This proves it is vital for the communities to be self-resilient, to be able to help themselves, to have the capacity and the means. Managing disaster risks in an inclusive manner improves the resilience of the communities and allows them to be prepared in advance and therefore minimising the effect of sudden-onset natural disasters and slow-onset climate-related hazards.

Responding to climate change involves two possible approaches that often go hand in hand: reducing the level of greenhouse gases in the atmosphere, mitigation, and adapting to climate change.

2. Mitigation

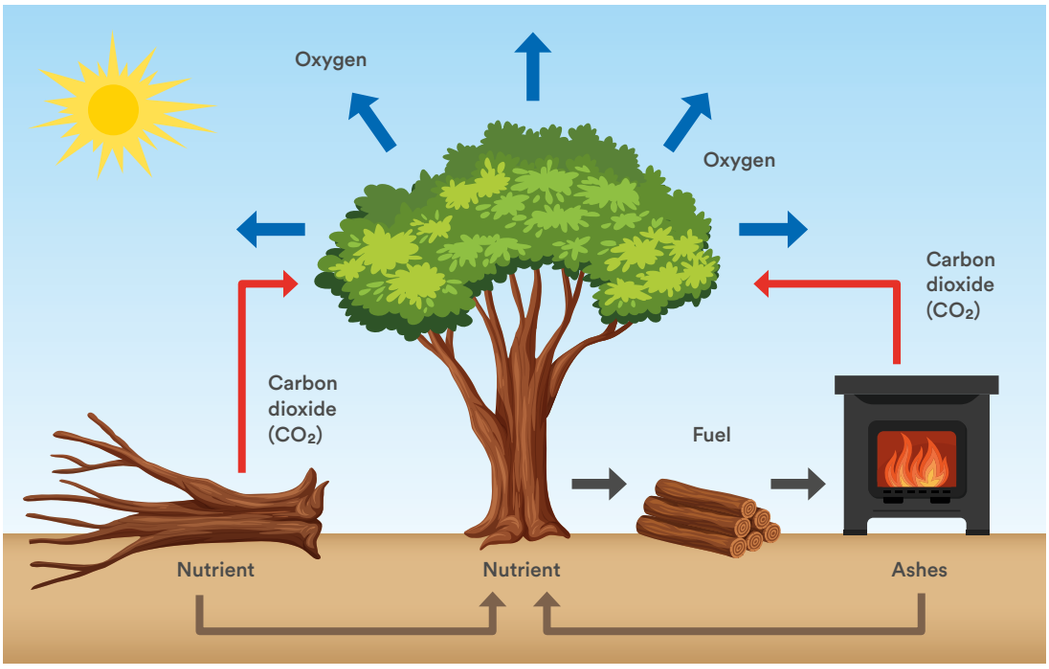
Can We Avoid Climate Change?

Climate change cannot be avoided, but we can mitigate its effects and adapt to its consequences through the application of both small and large measures to help slow down climate change. Through **mitigation**, we can take measures to reduce climate change, and through **adaptation**, we can take measures to be prepared and resilient to climate change and climate-related natural disasters.

As the climate changes, extreme weather events are becoming more frequent and intense, sea levels are rising, prolonged droughts are putting pressure on food crops, and many animal and plant species are being driven to extinction. To help slow down climate change and keep global temperatures from increasing to over 1.5 °C above pre-industrial levels, we need to reduce the amount of greenhouse gases that are released into our atmosphere. This can be achieved through mitigation.

Mitigation can mean using new technologies to reduce or prevent the emissions of greenhouse gases, and can be as simple as improvements to a cook stove design or planting trees. Trees play a vital role in reducing carbon dioxide from the atmosphere because they absorb it from the air and produce oxygen for us humans to breath. Therefore, planting trees is the most efficient and most affordable method of mitigating climate change.

In the below image the importance of trees is explained in detail.



Note that mitigation can take place on an individual level or in the community, and different measures can be adopted at home, at work, and in the community. Here are some things we can do to help mitigate climate change:

1. Reduce Emissions

- Use public transit
- Car-share
- Ride a bike
- Take fewer flights

2. Save Energy

- Turn off the lights when not in use
- Limit water usage
- Unplug computers, TV's, and other electronics when you're not using them
- Remove your phone from the charger once it has been fully charged
- Try using a fan instead of an air conditioner
- Read the instructions for how to correctly and efficiently use your appliances, such as refrigerators, washing machines, and air conditioners

3. Implement the 3 Sustainability "R's" (Reduce, Reuse, and Recycle)

- *Reduce* your need to buy new products, resulting in a smaller amount of waste
- *Reuse* bottles, plastic containers, clothes, furniture, and other items instead of throwing them away to keep landfills clean
- *Recycle* paper, glass, aluminium, and plastic, at your local recycling facilities
- Find out where you can safely dispose of hazardous waste (batteries, lightbulbs, oil, paint, pesticides, chemically-treated wood, etc.)

4. Take action to save forests

- Plant more trees
- Use less paper and paper products
- Protect existing forests

5. Demand sustainable measures

- Talk to your local leaders about what they can do to mitigate climate change and demand support for your climate action
- Educate others about the impacts of climate change and how to reduce them
- talk to the media and tell about your climate initiatives
- Speak with your neighbours about what you can do as a community to help reduce the effects of climate change
- Support businesses and products that are environmentally sustainable
- Make noise! Organize local climate campaigns in your community

Everyone can play a part in mitigating the effects of climate change, including the government, businesses, and you. There are a lot of things you can do to help, like turning off the lights when you leave a room, taking shorter showers, planting a tree, or recycling.

The second thing we can do is to prepare for life in a changing climate. We need to make sure our communities and all the services they use can withstand the climate changes that we cannot avoid. We can do this through adaptation and Disaster Risk Resilience.

Below you can find some mitigation methods that you might find useful:

Meeting of a community-based clean up group in Senegal (2019). Picture: Ruusa Gawaza / Felm

Taking Action at Home

Here are **5 steps** you can adopt to mitigate climate change at home:

1. Reduce, Reuse, and Recycle

The increasing amount of waste being dumped into landfills and bodies of water threaten public health and contribute to climate change. Here are some steps you can do to decrease the amount of waste you use:

- Collect your household waste into two separate containers - one for **organic** waste like food scraps, and another one for **inorganic** waste like plastic, glass, metal, and paper. You can compost your organic waste and recycle other waste.
- Find a nearby recycling drop-off site. If you do not have one, consider re-using or reselling items that can be salvaged. You can make jewelry, clothing, and furniture from recycled goods.
- Try to use as little plastic as possible, including plastic bags and bottles
- Find out where you can safely dispose of hazardous waste (batteries, lightbulbs, oil, paint, pesticides, chemically-treated wood, etc.)

2. Compost Organic Waste

There is a lot of organic waste, that end up in landfills that can be composted. By repurposing compostable waste such as food scraps, we can reduce the greenhouse gas emissions, such as methane, from landfills and add nutrients to our crops. [See Composting]

3. Reduce Fossil Fuel Emissions

One of the leading contributors to greenhouse gas emissions, such as carbon dioxide, is the burning of fossil fuels (coal, oil, gas). Fossil fuels originate for example from factories, driving cars and flying airplanes. Here are some ways you can reduce fossil fuel emissions:

- Drive less and drive smart. Consider riding a bike or taking public transit instead of driving. If you need to drive, consider sharing a ride with someone
- Use Skype and other online methods to communicate with your work colleagues instead of travelling, when possible.
- Take fewer flights. If you are travelling on business or visiting relatives, consider taking a bus or sharing a car instead of flying if it is possible

4. Save Energy

Conserving energy is a great way to reduce your **carbon footprint** while also saving money on energy bills. Carbon footprint means the amount of carbon dioxide that arises from your living or from the activities that you do. Here are some ways to save energy at home:

- Remember to turn off your lights when you are not using them
- Unplug all your appliances when they are not in use
- If you have an air conditioner in your home, consider using a fan instead to save energy
- Consider using renewable energy sources if they are available to you, like solar panels or biogas.
- Eat responsibly: For example, the production of beef is almost 4 times more polluting than the production of chicken.
- Build a Wood Saving Stove and cook with Dry Dung Fuel

5. Conserve Water

Climate change has led to irregular rainfall patterns and more droughts, so it is important to conserve water, as more and more people in the world have less access to clean water. Here are some ways to conserve water:

- Take shorter showers
- Turn off your taps when they are not in use
- Fix broken water pipes and leaking taps and toilets
- Maintain wells and water sources
- For more tips, see Rainwater Harvesting and Drip Irrigation

Adding the final touches to the Wood Saving Stove in Gwai, Zimbabwe, after the Felm training 2019. Picture: Ruusa Gawaza / Felm

2.1. Wood Saving Stoves

Around 3 billion people still cook using solid fuels (such as wood, crop wastes, charcoal, coal, and dung) in open fires. Cooking in open fires is inefficient and produces high levels of household air pollution which has many damaging effects on our health, especially on our eyes and lungs. Around 3.8 million people a year die prematurely from illness attributable to household air pollution caused by inefficient stoves, and exposure is particularly high among women, who spend a lot of time cooking indoors.

"**Wood saving stoves**", also known as **Improved Cooking Stoves (ICS)**, provide a simple and affordable solution to reduce household air pollution as well as being sustainable by using less wood fuel.

Wood saving stoves are easy and affordable to build, and materials are usually available for free locally. The most basic improvement to the open fire stove involves filling in two sides with a mud or clay wall to prevent drafts that will put out the fire, requiring more wood. Clay can be found for free near forests or riverbanks. Mud stoves are primarily for firewood, but can also be adapted for charcoal. Here are some instructions for how to create a wood saving stove:

Materials needed:

- Earthen mixture (sand, clay, and/or cow dung)
- Sawdust (optional, for additional insulation and to make the stove lightweight)
- 3 x bricks
- 1 x cooking pot
- 1 x scraper (piece of wood or cardboard to make the clay smooth)
- 1 x ruler

Mix clay with some water. Build stove on plastic if you need to move it to another location when ready.

Draw a circle the size of your pan on the ground. Lay three bricks equal distance apart on the circle. Start building walls for the stove.

A small part of the three bricks are embedded in the wall (as in picture 5B) but the bigger part of the bricks are left on the inside of the walls to hold the pot. The walls should be around 4–5cm thick (see blueprint p. 27).

Smoothen the walls and measure the right height. There should be a finger sized gap between the wall and the pot.

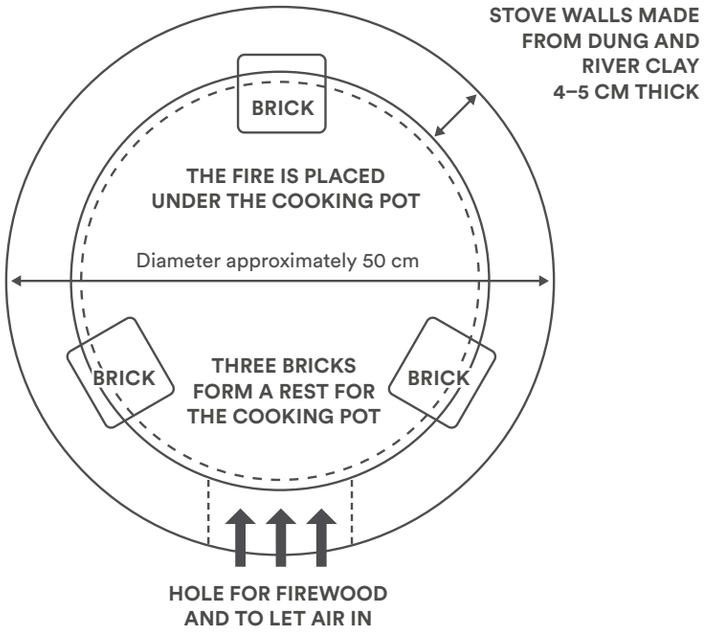
Finalise the hole where wood is added from. Wood can be added without lifting the pot off the fire. Different models of the stove can have different styles of holes (see pictures 5B and 6).

Some models can have a hole on a side to add the wood.

Leave to dry naturally. Once dry it can be carefully moved to another location if built on plastic.

Stove ready to be used with wood or cow dung sticks or cakes.

You can use the following blue print to help you.



The advantages of using a wood saving stove include:

- It heats up very fast and the clay retains heat, which enables food to cook longer with less firewood
- It can be portable
- It produces less smoke than an open fire
- It lasts for a long time
- You can modify the design to suit your purposes

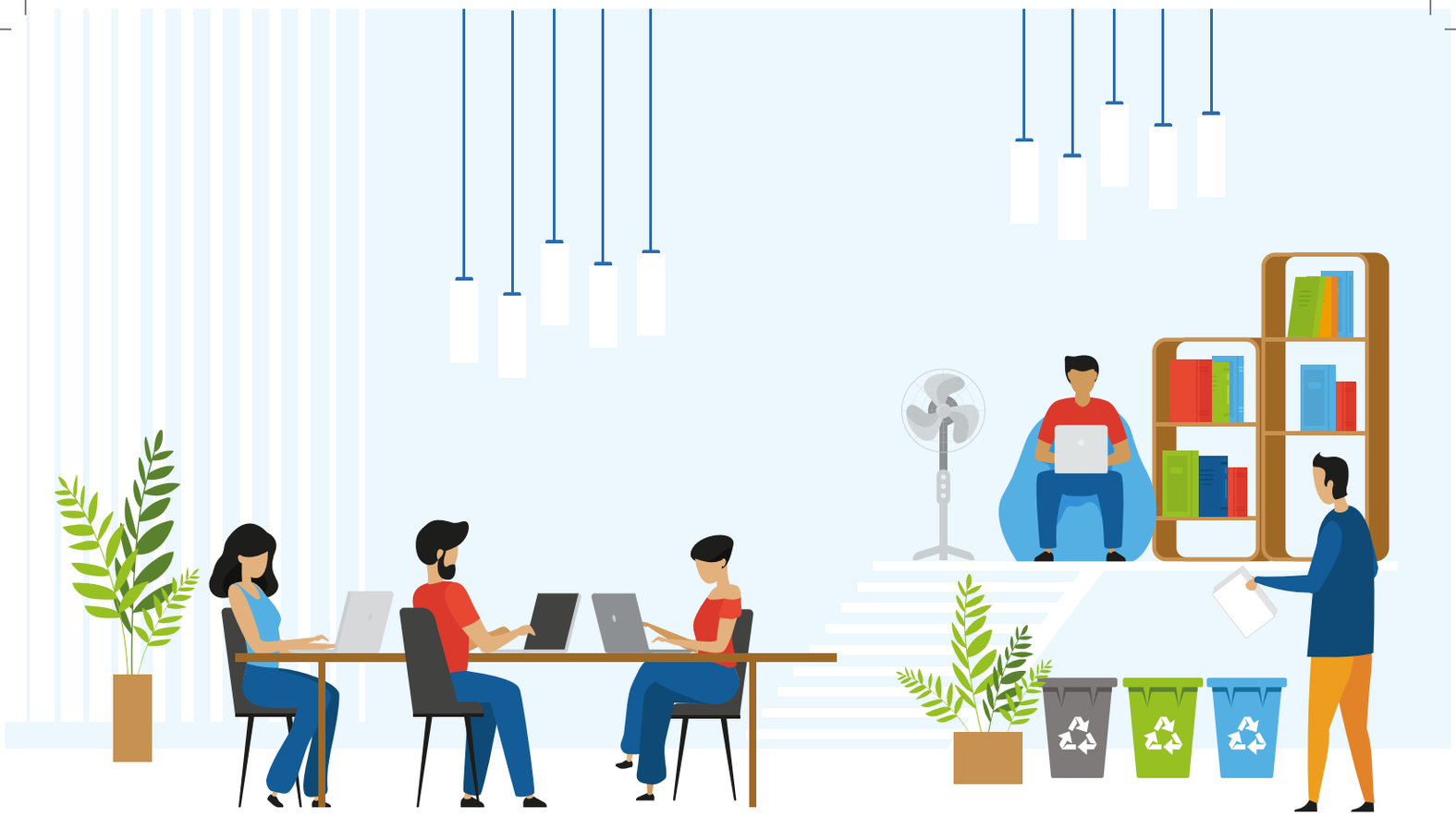
Tip: Plant fast-growing trees for wood use to save time on travel

2.2. Dry Dung Fuel

Dry dung fuel is animal faeces that has been dried in order to be used as a fuel source. Typically, cow dung is collected and mixed with water to create a thick paste. The dung paste is shaped into round cakes or wrapped onto sticks and left to dry in the sun. Once the dung has dried, it can be burned as fuel for cooking or heating your home, and it is one of the best fuels for Wood Saving Stoves.

Dry dung fuel is affordable and easy to make, and it also decreases the use of wood, which contributes to deforestation. Some benefits of using dry dung fuel include:

- Sustainable and renewable energy source
- Less environmental pollution compared to other fuels
- Affordable and readily available
- Generates powerful heat
- Easy to store



Taking Action at the Office

Many organizations and companies are interested in taking action to slow down climate change, and a great way to start is by making changes in the office. All offices, no matter how big or small, can take steps to reduce climate change. Here are 5 steps you can adopt to mitigate climate change at work:

1. Avoid Printing

Printing less will not only save money on paper, ink, and electricity, but it will also save trees from being cut down for paper, which contributes to deforestation and climate change. Most documents can now be sent via email or PDF, but if you must print, make sure it is double sided.

2. Use Public Transport or Carpool

How we travel to work can have a big impact on the climate. If you can, try walking or taking a bike to work, which is not only good for the environment but is also great exercise. If you must travel to work, consider taking public transport or sharing a car with some co-workers. It is also important to take less flights; with access to the internet, it is possible to have video meetings with colleagues across the world.

3. Save Energy

Conserving energy is a great way to reduce your carbon footprint while also saving money on energy bills. Here are some ways to save energy at work:

- Turn off all the lights when you leave the building for the day

- Turn off all computers and electronics at the end of the day
- Consider using a laptop instead of a desktop as they are more energy efficient
- Remove your phone from the charger once it has been fully charged
- Try using fans instead of air conditioners to save energy
- Consider using renewable energy sources if they are available to you. Solar panels can be used to create electricity instead of generators.
- Read the instructions for how to correctly and efficiently use your appliances, such as refrigerators, washing machines, and air conditioners

4. Recycle

The increasing amount of waste being dumped into unmanaged landfills and bodies of water threaten public health and contribute to climate change. Here are some steps you can do to decrease the amount of waste you use:

- Separate waste from recycling at the office. Have separate bins for recyclables, such as paper, cardboard, glass, metal, and plastic
- Reduce the use of plastic in the office by using reusable cups, mugs, plates, and cutlery. Consider getting a refillable water dispenser to use in the office instead of individual water bottles.
- Find out where you can safely dispose of hazardous waste (batteries, lightbulbs, oil, paint, pesticides, chemically-treated wood, etc.)

5. Raise Awareness

To ensure that everyone in the office remembers to be environmentally conscious you should consider doing an office training on the topic, and putting up reminder signs and posters. It could also be a good idea to hold office competitions for who is the most energy-efficient to get everyone aware and involved.

Tips for saving energy with air conditioners (aircon):

- Read the instructions for your aircon unit to make sure you are using it correctly and efficiently
- Clean and maintain your aircon regularly
- Replace any old or broken aircon machines
- Close all doors and window when the aircon is on
- Try raising the thermostat a few degrees, especially if it feels too cold
- During the day, keep sunlight out by using blinds and curtains, which will keep the room cool
- During the night, turn off your aircon or raise the thermostat by a few degrees

Taking Action in the Community

While it is great to take individual actions to reduce your carbon emissions, to make the biggest impact, action needs to be taken at a community level. There are many ways to mitigate the effects of climate change as a community, including these 3 steps:

1. Raise Awareness

- Talk to your local leaders about what they can do to mitigate climate change
- Speak with your neighbours about what you can do as a community to help reduce the effects of climate change
- Support local businesses and products that are sustainable and environmentally conscious

2. Start Community Projects

Get the whole community involved and engaged with being more involved in mitigating climate change.

- Start a community compost project [See **Composting**]
- Plant trees as a community [See **Agroforestry**]
- Collect rainwater for the whole community to use [See **Rainwater Harvesting**]
- Make noise! Organize local climate campaigns in your community

3. Responsible Waste Management

As a community, we can work together to make sure that you dispose of waste in a sustainable way:

- Organize a community clean-up to pick up all the plastic and rubbish on the ground and in bodies of water
- Locate the closest recycling facility and reuse and recycle as a community
- Get creative and use recycled goods to make jewelry, bags, clothing, rugs, and furniture that can be used at home or sold for additional income
- Do not burn trash, as this is very harmful for the environment and to your neighbours

2.3. Plastics

While plastic has many valuable uses, the overuse of single-use or disposable plastic has severe environmental consequences. Many of us use these products every day, without thinking about where they might end up.

About 79 % of all plastic waste ever produced has accumulated in landfills, dumps, or the natural environment, which is why it is essential that we reduce our use of single-use plastics and recycle as often as possible. Here are some more facts about plastic:

Fact 1
We produce around 300 million tonnes of plastic waste every year. That's nearly equivalent to the weight of the entire human population.

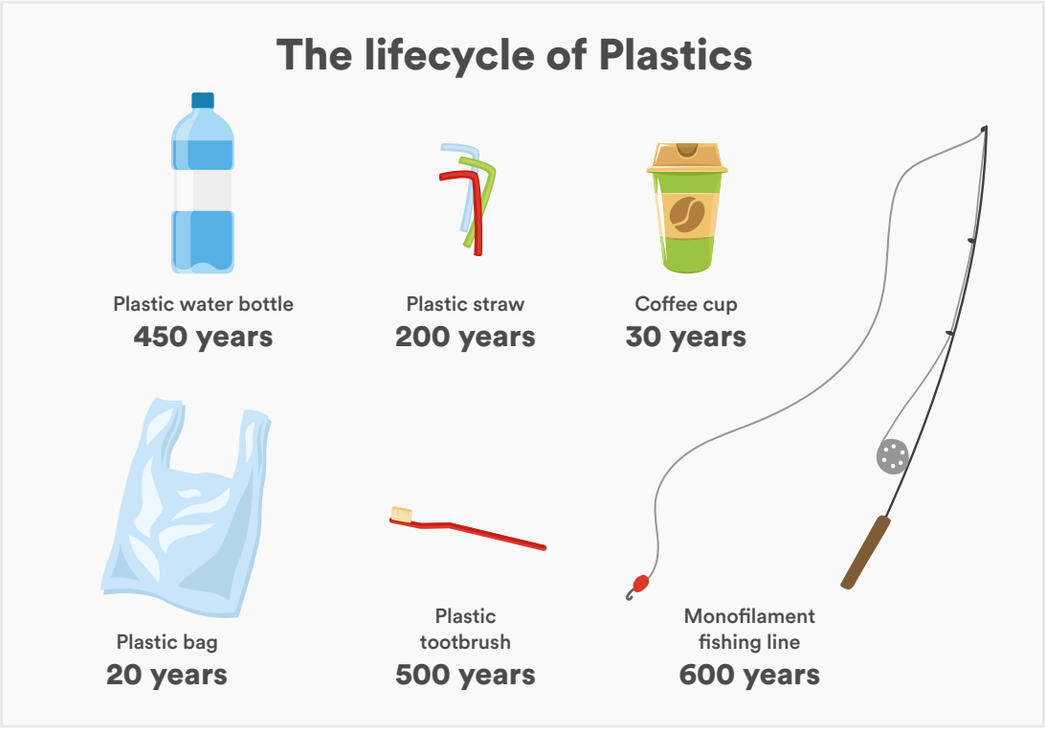
Fact 2
Around the world, 1 million plastic drinking bottles are purchased every minute & over 5 trillion single-use plastic bags are used worldwide every year.

Fact 3
Plastic is almost impossible for nature to break down. Most plastic items never fully disappear, they just get smaller and smaller into microplastics.

Fact 4
Cigarette butts are the most common type of plastic waste found in the environment. Drink bottles, bottle caps, food wrappers, grocery bags, drink lids, and straws were the next most common items.

Fact 5
If current trends continue, our oceans could contain more plastic than fish by 2050. Many animals, like fish and cattle, end up eating our plastic waste, which can kill them. This also means that plastic waste ends up in our food.

Plastic takes for a long time to disappear and decompose. In some cases, hundreds of years. See below, how long different plastics takes to decompose.



Tips for reducing the use of single-use plastic:

- Use a reusable bag instead of single-use plastic bags
- Use a reusable bottle or mug
- Stop using plastic straws
- Recycle all plastic, cardboard, paper, glass, and metal materials
- Avoid using plastic cutlery, plates, and cups

3. Adaptation: Sustainable Farming and Food Security

Climate change will bring hotter temperatures, greater rainfall variability, and more severe and frequent extreme weather events, leading to an expected decrease in agricultural productivity in the developing world. Most people in developing countries rely on agriculture for their food security and livelihoods, but climate change carries many negative consequences for farmers and rural communities, such as a decrease in food productivity and an increase in land degradation.

People who are already vulnerable and food insecure are likely to be the first affected by climate change, and face the risks of increased crop failure, new patterns of pests and diseases, lack of appropriate seeds and planting material, and loss of livestock. These affects will threaten food security and economic stability for thousands of people, which means that **adaptation** and **building resilience** is becoming increasingly necessary.

Contents:

Diversification methods

3.1. Livelihood Diversification[14]

During times when crops fail, it is important to have other sources of income so that families are not only dependant on agriculture for their food and their income. When a family's income comes from a range of different economic activities, there is a greater degree of protection against failed harvests due to drought.

Some options for livelihood diversification include:

- Diversify agricultural production by growing a wider range of crops
- [See Agroforestry]
- Produce livestock in addition to crops [See Small Livestock Production]
- Processing agricultural goods (grain milling, oil pressing, making jam and peanut butter, fruit and vegetable drying, or beekeeping) [See Solar Drying and Beekeeping]
- Skilled trades (carpentry, construction, etc.)
- Handicraft (jewelry, pottery, sewing, etc.)

If communities are only dependant on one or two key resources for food and income, they will be more likely to suffer when disasters occur. Resilient livelihoods means having access to a number of resources and different strategies to provide food throughout the year, and to have an income that can be saved for times of need.

Think about what skills your community could learn to increase their livelihood security.

3.2. Small Livestock Production

Livestock has the potential to strengthen resilience to climate change because livestock is more resilient against extreme weather events, such as heat and drought, than crops are.

Different types of livestock include:

- Goats
- Sheep
- Pigs
- Cattle
- Donkeys
- Camels

14 Information about Livelihood Diversification from "Alternative Livelihoods" by Practical Action.

The type of livestock you choose to keep depends on the region you are from. Local livestock is the best for production since they have already adapted to the environment where they come from. Indigenous breeds are more disease resistant and drought tolerant. It could also be beneficial to keep a number of different species of livestock at the same time.

Livestock can also be integrated into crop farming to create a mixed farming system. Mixed farming systems can serve several purposes:

- Livestock manure can be used as crop fertilizer
- Animals can be used for ploughing and transport
- Crop residue can be used as a livestock feed
- Animals produce additional sources of nutrition through meat and milk
- Livestock can be sold for additional income in case of failed crops

The production of poultry (chicken, ducks, etc.) also increases food security by providing fast-growing and low-cost animal protein to rural households. The eggs and meat from poultry also cook faster than other meat, which uses less fuel to cook.

Poultry are particularly important to women because they can be tendered close to the home and do not need grazing. It is also possible to sell poultry eggs for additional income.

It could also be beneficial to keep different types of poultry. For example, if you live in a flood-prone area, you could raise ducks instead of chickens because they know how to swim and will have a better chance of surviving a flood.

3.3. Beekeeping

Many species of bees all around the world produce honey that can be collected and stored as a food source. By keeping bees, you can obtain large quantities of honey and raw beeswax for home consumption and for sale. It provides a source of income as well as a source of nutrition. Other benefits for beekeeping include:

- Most of the necessary materials for beekeeping are available locally and affordably, even in rural communities
- Bees can produce honey and beeswax, which are non-perishable commodities that can be sold locally or abroad for additional income
- The beekeeper usually does not need to own land in order to keep bees
- Bees improve the local ecology through pollination, which helps the food production process
- Honey is nutritious and can be used for cooking and baking instead of sugar
- Protects local trees from being cut down

Honey produced by a community in Kishapu, Tanzania.Picture: Hannes Honkanen 2018.

To start beekeeping, you need 4 essential items:

1. A Beehive

A beehive is any container provided for honey bees to nest in. Beehives can be made from whatever materials are available locally, including: hollowed-out logs, bark formed into a cylinder, clay pots, woven grass, cane, gourds, or timber boxes.

2. Protective Clothing

It is important for beekeepers to wear protective clothing. It is most important to protect the face, especially the eyes and the mouth. A protective hat can be created by adding some veiling or mesh to a broad brimmed hat.

Always wear white or light-coloured clothing when working with bees because they are much more likely to sting dark coloured clothing. Wear long pants and long-sleeved shirts. You can use rubber bands to prevent bees from crawling up trousers or shirtsleeves. Long boots are important for protecting your feet, but you can also wear shoes with long socks.

White leather gloves are the best for protecting your hands from bee stings, but if they are not available, a simple way to protect your hands is to put a plastic bag over each hand, secured at the wrist with a rubber band.

3. A Smoker

A beekeeper uses a smoker to produce cool smoke to calm the bees. The smoker consists of a fuel box containing smouldering fuel (for example dried cow dung or cardboard) with a bellows attached. The beekeeper puffs a little smoke near the entrance of the hive before it is opened, and gently smokes the bees to move them from one part of the hive to another.

4. A Hive Tool

The hive tool is a handy piece of metal which is used to take boxes apart or scrape off odd bits of beeswax. They can be made from pieces of flat steel, and screw-drivers are often used. It is also possible to use a strong knife.

3.4. Drought Resistant Crops and Intercropping[15]

As farmers worldwide experience more frequent drought and erratic rainfall linked to climate change, the race to find and improve drought-resistant crops and new farming methods grows ever more important.
Along with growing more drought resistant crops, it is also important to grow a wide range of different crops, also called intercropping. Intercropping is when two or more crops are grown together, which means there is another crop to fall back on if one of them fails.

Below are some crops that are naturally drought tolerant, and can be used for intercropping:

- Sorghum
- Cassava
- Sweet Potato
- Pearl Millet
- Cowpea
- Groundnut
- Chickpea
- Chia
- Tarwi

New strains and varieties of maize and beans that have been genetically modified to be more drought tolerant are also becoming increasingly available.

Tip:

Intercropping and drought resistant crops are not the only solution. Soil degradation and deforestation worsens the effects of drought because soil loses its ability to retain water, so farmers must improve soil fertility and irrigation practices. Please use some of our other resources and agricultural tools to combat drought:

- Agroforestry
- Crop Rotation
- Composting
- Rainwater Harvesting
- Drip Irrigation
- Community Cereal and Seed Banks

15 Information about Drought Resistant Crops and Intercropping from "Climate Change, water, and food security" by the Food and Agriculture Organization of the United Nations (FAO), http://www.fao.org/3/i2096e/i2096e.pdf.

Rainwater harvesting tanks in Felms project in Shangalala institutes dormitory, Angola. Picture: Maritta Peltokangas / Felm.

Water-saving methods

3.5. Rainwater Harvesting

Climate change is affecting the world's rainfall patterns, leading to both significant increases and decreases in rainfall. Significant decreases in rainfall mean that some parts of the developing world are suffering from dangerous water shortages.

One possible solution to this problem is to harvest rainwater as it falls and keep it stored in a container to use later. Rainfall can provide some of the cleanest naturally occurring water that is available, and can be an important source of water for both drinking and irrigation.

Rainwater harvesting is a particularly suitable technology for areas where there is no surface water or groundwater, where water is too salty or acidic, or where local water sources dry up for a part of the year.

Rainwater harvesting is a simple mechanism to collect and store rainwater, mainly for drinking and cooking. It may be household based or community based. The system uses a collection surface such as a roof, gutters to guide the rainwater, and a container to store the water.

Tip: When building your rainwater harvesting system, remember to consider how to clean the tank from the inside, if necessary!

Drip irrigation system built in Gwai, Zimbabwe from a plastic bucket and a hosepipe.
Picture: Ruusa Gawaza / FELM

3.6. Drip Irrigation

Drip irrigation is a system that allows farmers to nourish and grow their crops even when rainfall is low or erratic. Drip irrigation saves water and nutrients by slowly dripping water directly into the roots of the crops.

Materials Needed:

- A large drip buck (20-litre)
- 30 metres of pipe or hose
- Wood or metal poles (1 metre in length)

How drip irrigation works:

- A large, water harvesting tank in the village catches the rain and stores it
- Fill a 20-litre drip bucket and place it one metre above the ground on poles
- The drip bucket is attached to a long hose that criss-crosses the crop field, with small holes poked in the hose to release the water onto the crops
- Water drips through the holes in the hose, directly onto the roots of the plants

Tips: A more affordable and simple method for drip irrigation uses only recycled water bottles. You can use any size water bottle you have available as long as it is clean.

- Take a water bottle, and use a knife or a nail to poke 4–5 holes into the bottle cap. Make sure the holes are not too small or too big.
- Cut off the bottom of the bottle
- Dig a hole next to your plant and place the bottle in the ground, cap down
- Fill the bottle with water

Farming methods

3.7. Agroforestry

Agroforestry is an agricultural system in which trees are grown around or among crops and livestock on the same plot of land. Agroforestry is especially popular in developing countries because it allows small shareholder farmers to maximize their resources. They can plant vegetable and grain crops around trees that produce fruits, nuts, and wood for cooking fires.

Types of trees to consider planting:

- Trees that improve soil health and fertility by adding nitrogen into the soil
- Fast-growing trees for fuel wood
- Indigenous fruit trees to provide more nutrition and income
- Trees that can provide medicinal plant products

The intentional combination of agriculture and forestry has many benefits, including increasing soil health and fertility, decreasing soil erosion, and cleaning our air.

Benefits of Agroforestry:

- Reduced poverty through increased production of wood and other products
- Increased food security by restored soil fertility for food crops
- Reduced deforestation
- Reduced greenhouse gas emissions
- Improved human nutrition through more diverse farm crops
- Growing space for medicinal plants
- Increased wildlife habitat
- Provides shade and feed for livestock

The practice of agroforestry helps farmers be more resilient and adaptable to changing growing conditions while also mitigating climate change. Agroforestry has direct benefits for local adaptation while contributing to global efforts to reduce greenhouse gases.

Tip: Mulching is a method that can be combined with agroforestry and other sustainable farming practices. Mulching means covering up the soil around your plant with some organic matter, such as dry leaves or wood chips. Mulch applied around the plant on top of the soil conserves soil moisture, improves fertility and health of the soil and reduces weed growth.

3.8. Crop Rotation

Crop rotation means growing different types of crops in rotation on the same piece of land. Growing the same crop in the same place for many years in a row

degrades the soil by taking nutrients out of it. By using the crop rotation technique, you can increase soil fertility, increase yields, and maximize land use. Rotating certain crops adds nutrients in the soil, like nitrogen, which helps prevent soil erosion, and it also minimizes disease and pest problems. Crop rotation can be used with other farming methods, such as intercropping or agroforestry.

3.9. Composting

Composting is the natural process of decomposing organic matter, and it can be used to improve the quality of your soil. You can use plant materials, animal manure, and food waste to create compost.

Compost is a sustainable agricultural technique and plays an important role in sustaining soil fertility. As a result of composting, the soil becomes rich in plant nutrients and more resistant to stresses such as drought and diseases. These advantages help lower risks and create higher yields.

There are two types of compost:

Type 1: Garden waste
This method of composting you can use to decompose organic matter from your garden eg. leaves, hay, grass, and animal dung.

Type 2: Household waste (see p 43)
This method is to compost your food waste such as vegetable peels and rotten food.

Both compost types produce black soil that you can use to fertilise your garden, but the methods of composting are a little bit different.

Type 1: Garden waste compost

Materials needed:

- 6 x wood poles (per compost pile)
- String
- A manure fork or shovel
- A ruler
- A wrist-thick wooden stick

Step 1: Select and prepare a site for your compost pile

To create your compost pile, you will first need to select an appropriate site. The site should be on soil, on level ground, and be accessible all year around. The site should be under shade to protect the compost materials from direct sunlight and rain. You can build a fence around your compost or dig it into the ground. Once

you have selected your site, you must prepare it; create a rectangular shape with your 6 wood poles and string.

Step 2: Layer the compost materials

Once your site is prepared, it is time to layer the materials using soil, grasses, and manure.

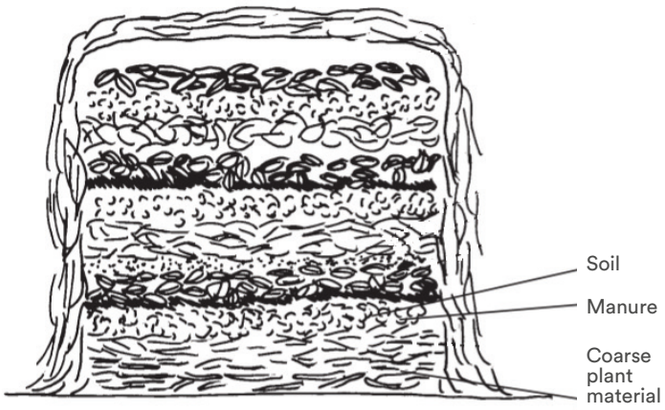
- The first layer of your compost should be a mixture of dry and green grasses about 15cm tall. You can use a ruler to measure the layer on all sides.
- The second layer should be 10cm of manure.
- The third layer should be 5cm of soil. Forest soil is the best to use.
- Once your pile has been created, water the pile using a watering can.
- Then repeat the layers until all of the materials have been used. Once completed, the pile should be roughly 2m x 2m and 1.5m tall.

Step 3: Turn your compost pile

Once you have completed your compost pile, it should be left for 21 to 28 days to mature.

Once your compost has matured, carefully turn each separate layer of your pile upside down using a manure fork or shovel, starting with the first layer and continuing until the last. The compost should be black and crumbly.

The layers of a compost heap



Tips:

- One way to see if the material is turning into compost is to place a wrist-thick wooden stick in the middle of the pile. Pull the stick out, and if it is damp and hot to the touch, then the process is working.
- You can also dig a pit and put the compost entirely or half-way into the ground in order to avoid leakage of water.

16 Image of compost layers adapted from "Composting in the Tropics" by HDRA, https://www.infonet-biovision.org/res/res/files/496.Compost102.pdf.

Step 4: Use your compost

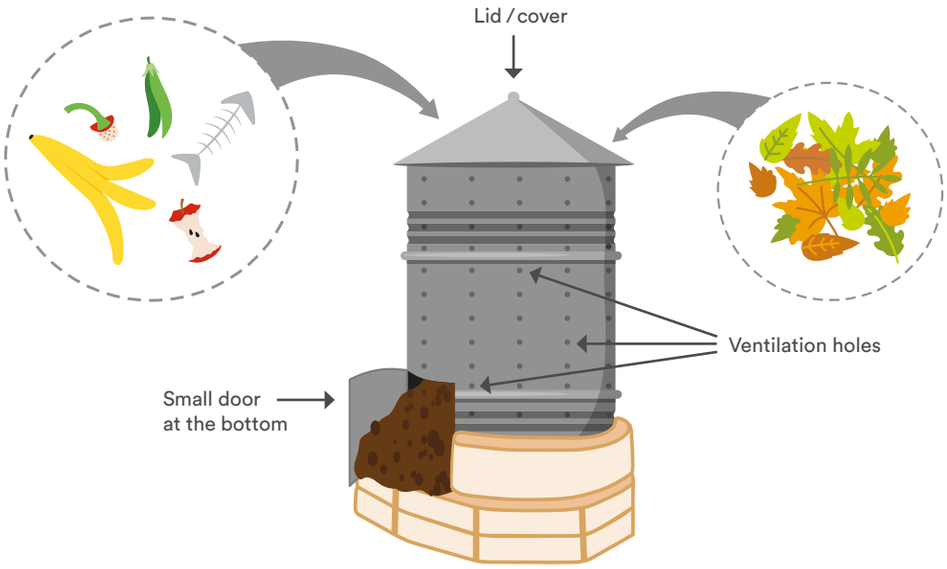
It can take anywhere from 14 days to 1 month to produce your finished compost. The time it takes can vary widely depending on the materials and methods used. In general, compost is ready when the material is dark and crumbly and has an earthy and soil-like smell to it.

Compost can be used for: Soil amendment and fertilizer, flower and vegetable beds,and both new and established planting areas[17].

Type 2: Household waste compost

- Build a compost with wood, an old oil drum or bricks. The compost needs to have holes for air, a lid and a small door on the bottom. It is important that this compost is covered well so that animals don't come eat the food waste.
- Start filling the compost with your food waste and remember to add some dry leaves or other dry material to prevent rotting
- Mix the compost every now and then to enhance the process.
- When your compost is full, you can start using the black soil by taking it out from the small door on the bottom. This way the material that is not yet decomposed, will not be mixed with your black soil.

Adding certain materials into your pile is dangerous because of the chance of poisoning and disease or attracting vermin. This is why materials like meat and human or pet faeces should never be added to your compost pile. Note that cow dung or chicken droppings are not dangerous because these animals are not carnivores (don't feed on meat unlike humans and dogs). Therefore, they are excellent manure for your compost.



17 Steps for composting adapted from "Home Composting Systems" by Practical Action, https://answers.practicalaction.org/our-resources/item/home-composting-systems.

If you wish to compost your food waste on a daily basis, you can also dig a pit in your yard, someplace safe from children and animals, and start adding your organic waste to the pit and cover it up with hey, leaves or other organic matter to avoid insects and rats. Once the pit is full, you can cover it up and leave it to decompose.

Do Add

Leaves	Fruit & Vegetable Peelings	Fresh Manure
Hay & Straw	Coffee Grounds	Woodfire Ash
Eggshells	Green Plant Cuttings	Teabags

Do NOT Add

Meat & Bones	Dairy Products
Poultry & Fish	Human & Pet Feces
Whole Eggs	Treated Wood

3.10. Keyhole Gardens

Keyhole gardens are a sustainable gardening technique that allows families and communities to grow vegetables throughout the year, even in harsh climates. The keyhole garden is essentially a circular and raised planter that uses a composting system to give nutrients to a variety of plants, providing a reliable food source.

Keyhole gardens are sustainable because they use recycled materials that might otherwise end up in a landfill, and they require less water than other gardens.

Here are the instructions for creating a keyhole garden:

Step 1: Pick a location and build the walls

A keyhole garden is a circular and raised planter that is about 1,8 m in diameter, so the site you pick should be large enough to fit the garden with extra space for moving around the structure easily. Gather materials that are available locally (rocks, stones, bricks, blocks, wood, old tires, etc.) and build a circular wall that is a diameter of about 1,8 m and is 90 cm in height.

Step 2: Construct the compost bin

Use a wire mesh material to create a tube that will act as the compost bin. The tube should be about 30 cm in diameter and 1,2 m in height. Place the tube in the middle of the circle. The compost bin can also be constructed using wooden poles.

Step 3: Construct the access area

Remove a small section of the outer wall and rearrange the material to form two walls that run to the compost bin at the center. Picture a pie with one slice removed.

Step 4: Line and fill the garden

Line the inside walls and floor of the garden with wet cardboard, newspaper, and other compostable material. Above the layer of cardboard, add other organic matter like leaves, grass, and twigs. The last and top layer should be soil and compost. The soil should slope down from the compost bin at the center and toward the outer wall.

Step 5: Fill the compost bin and plant your fruit and vegetables

Fill the compost bin with organic food scraps and other compostable materials and begin planting your fruits and vegetables. All kinds of plants can be planted in a keyhole garden, but the best plants would be root plants such as carrots, beets, radishes and leafy vegetables like spinach, lettuce, and herbs.

A keyhole garden increases food security in El Alto, Bolivia. Picture: Leena Korpivaara / Felm

Recommended crops

Root Crops


Carrot


Onion


Beetroot


Garlic


Radish


Turnips

Leafy Crops


Spinach


Swiss-chard


Lettuce


Rapeseed


Mustard-Spinach


Herbs

Storage and processing methods

3.11. Seed and Crop Storage

Seed and crop storage loss is one of the main contributors to food insecurity for farmers in developing countries. While considerable losses can happen in the field, both before and during the harvest, the greatest losses usually happen during storage. Most of these losses occur because of ineffective storage methods, where crops become ruined by insects, pests, or mold.

Traditional storage containers that are typically used include baskets, woven bags, clay pots, cloth sacks, or wood boxes, but these traditional storage methods are prone to losses. Improved storage methods do not need to be expensive, including:

- Pre-storage pest management by thoroughly cleaning and drying all seeds and crops, especially if they are going to be stored for a longer period of time
- Keeping seeds and grains in tightly sealed plastic bags or boxes. Seeds can also be kept in tightly sealed glass jars
- Seeds can be stored at home, while grain and crops can be stored in small-scale storage facilities that are cleaned regularly
- Store grains with natural biopesticides like dried walnut leaves, mint leaves, eucalyptus, lime, or mustard oil to protect them from insects and pests
- No matter what storage method you use, seeds and crops should be stored in cool dry temperatures, and kept away from sunlight and too much moisture

It is important to store seeds and crops properly because keeping a readily available supply of food increases food security and helps build resilience to climate change and climate-related disasters such as floods, drought, and tropical storms which can destroy standing crops.

3.12. Community Cereal and Seed Banks[18]

A cereal bank or a seed bank is a community-based institution involving a village or a group of villages that stocks and manages the operations of acquiring, pricing, and supplying grain or seeds. The purpose of a cereal bank is to improve food supplies during times of shortages, especially during extended drought periods, while the main objective of a seed bank is to save and exchange local seeds. The local community has to decide what type of cereal or seed bank would best answer its needs.

18 Practical Action, "Community Cereal Banks" https://answers.practicalaction.org/our-resources/item/community-cereal-banks

Cereal Banks:

Grain is bought either from the village or from elsewhere when the prices are low, just after harvest; it is stored until it is needed, and then sold to villagers at a reasonable price. Since the bank is in the village, no one has to travel long distances to buy grain and then transport it back home, saving time and money.

Seed Banks:

Seed banks are not only used for saving and exchanging local seeds, but they can also be used for conserving seeds, multiplying seeds, and increasing access and availability of seeds to farmers. The community seed bank is a place where knowledge is exchanged between farmers and can be used as learning platforms for training farmers in seed production, storage, preservation, and conservation. Crop diversification is central for building resilience among farmers facing the challenges of climate change.

Things to consider when starting a community cereal or seed bank:

The Store

The store should be built in a place where everyone has easy access to it. The place should be secure, easy to guard, and weathertight. The whole village should agree on where to place it. The village should discuss thoroughly on the materials to be used in building the store. They must decide whether they need a permanent structure, a temporary structure, or a borrowed or rented store.

Getting Started

There are three possible ways of getting the grain or seeds to the community bank: a loan, a gift, donations from the community, or a combination of the three.

Bank Management Committee

The cereal or seed bank members should elect a management committee, which consists of a chairperson, secretary, treasurer, storekeeper, and buyers. There can also be deputies for the different posts, in case of sickness or absence.

Tip: A cereal and seed bank is a great way to get the community together, to learn and share information about traditional wild plants that can be used for medicinal and nutritional purposes (eg. Aloe Vera, Baobab)

3.13. Solar Drying

Food preservation is an important element in global food security. Globally, drying is the most widely used method for preserving foods for use in the home or for sale. The most common method involves simply laying the product in the sun on mats, roofs, or drying floors. This is known as sun drying.

Solar dryers use a simple construction to more efficiently make use of the sun's heat. They can provide many advantages over sun drying, including:

- Higher drying temperatures which results in shorter drying times
- Protection from contamination by dust and from rain showers
- They are low cost and simple to construct

There are many variations of solar dryers, but the tent solar dryer is cheap and simple to build.

This solar dryer was built from plastic sheets and bamboo poles in Cambodia, costing only few dollars. Picture: Miia Barrow / Felm

Materials Needed:

- Wood poles for the frame
- Plastic sheets
- A rack to place the food

Instructions:

1. Construct the tent using polls and plastic sheets. The base of the tent should be black plastic or material to absorb the sun's heat. The sides should be of clear material. Make sure the air can circulate into the tent, but that all the sides are covered so that it wont rain in or let animals or dust to get in.
2. Place the food to be dried on a rack above the ground.

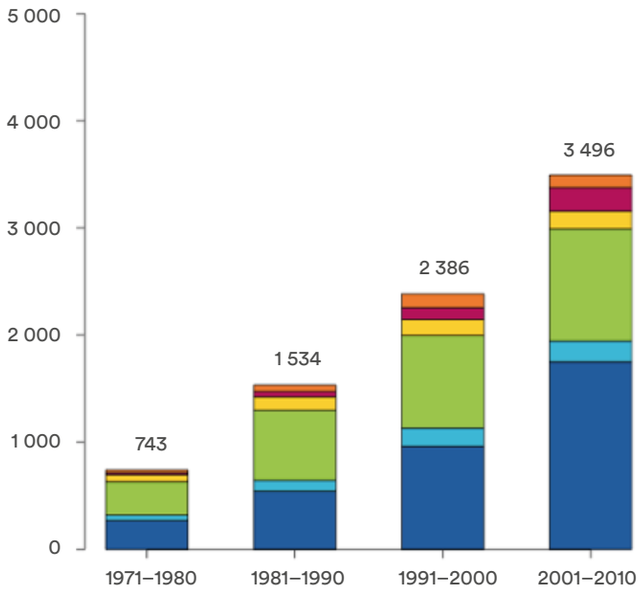
Tips:

- Tent dryers can be taken down and stored when not in use
- You can use a solar dryer to dry grains, fruits, vegetables, spices, herbs, and nuts

4. Disasters

Because of climate change, natural disasters are occurring nearly five times as often as they were in the 1970s, with both developed and developing countries bearing the burden of repeated floods, droughts, and extreme temperatures.

Number of reported disasters by decade by hazard type (1971–2010)



Dark Blue = floods. **Light blue** = landslides and mudslides. **Green** = storms. **Yellow** = drought. **Red** = extreme temperature. **Orange** = wildfires.

Climate change will continue and accelerate in the years ahead, with significant impacts on the frequency and intensity of natural disasters, which we cannot avoid.

It is important to prepare for disasters and adapt to climate change so that we can reduce the severity of a disaster's effects. There are measures that we can take to lessen the impact of disasters on vulnerable populations, which will help reduce the loss of lives and the destruction of property.

Chapter 4 provides important information about various natural disasters and how they are related to climate change. This chapter also provides tools that you and your community can use build resilience to natural disasters, and is organized by disaster.

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19 Graph and statistics from UNFCCC, "WMO Report: The Escalating Impacts of Climate-Related Natural Disasters", https://unfccc.int/news/wmo-report-the-escalating-impacts-of-climate-related-natural-disasters.

Case Study: Why Preparation is Important

15 of the 20 deadliest-ever storms have formed in the Bay of Bengal, which is one of the most vulnerable regions to flooding in the world, where the combination of poor quality housing, dense populations, and flash flooding frequently lead to high casualties.

On May 3, 2019, Cyclone Fani passed through the region, first hitting India's Odisha state, one of the countries poorest states, before moving onto Bangladesh, affecting hundreds of densely populated and low-lying communities across the region. Cyclone Fani was the most severe storm to hit the Indian subcontinent in two decades, and it destroyed many major roads, power lines, and homes, leaving a death toll of around 50 people.

While Cyclone Fani left a path of destruction, greater preparation had a significant impact on reducing the death toll. Only twenty years earlier in 1999, a powerful storm in the same region of Odisha flooded hundreds of villages and killed more than 10,000 people.

Indian governments had to vastly improve their responses to such natural disasters as they became more frequent. Better weather forecasting and early warning systems that were able to reach people in isolated villages were crucial for reducing the death toll. The government was able to evacuate over 1 million people from their homes and move them into one of the 5,000 shelters that were set up for evacuees. Hundreds of disaster management personnel and volunteers were also deployed across the state, along with the Indian army, navy, and air force, which were on alert to assist with rescues.

Preparation measures such as improved forecasting models, early warning systems, public awareness campaigns, and well-designed evacuation plans helped significantly minimize the loss of life.

Information from The Guardian article "Cyclone Fani: at least eight dead in India's biggest storm in decades", https://www.theguardian.com/world/2019/may/03/tropical-cyclone-fani-india-biggest-storm-in-decades-makes-landfall.

General Disaster Preparation

This section provides you with tools that you can use in any disaster, whether it is a flood, drought, tropical storm, landslide, earthquake, volcanic eruption, or tsunami. It is always important to be prepared for the unexpected so that you can keep your family and community safe when disaster strikes.

Prepare an Emergency Kit

An emergency kit is a collection of basic items that you might need in the event of an emergency after a natural disaster. You should keep at least one emergency kit at home, and prepare it well in advance of an emergency. Each family or individual kit should be customized for specific needs, such as medications and infant formula, but there are some basics every kit should have:

Pack in a lightweight, waterproof bag the following:

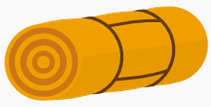
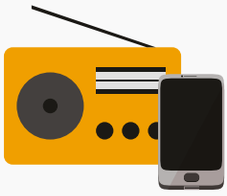
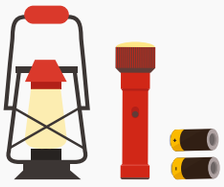
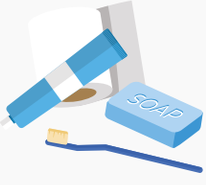
- Water and rehydration sachets
- High-energy food
- First aid supplies
- Emergency blanket
- A change of clothes
- Waterproof raincoat
- Sturdy shoes and work gloves
- Fully charged mobile or portable radio
- Torch or portable lamp and batteries
- Multipurpose pocket knife tool
- Matches
- A whistle to attract attention
- Personal toiletries for hygiene
- Cash
- Keep important personal documentation (passports, birth certificates, etc.) in a waterproof bag

You may need to survive on your own after an emergency. This means having your own food, water, and other supplies in sufficient quantity to last for at least 72 hours. Local officials and relief workers will be on the scene after a disaster but they cannot reach everyone immediately. You could get help in hours or it might take days.

Additionally, basic services such as electricity, gas, water, and telephones may be cut off for days and weeks. Your emergency kit should contain items to help you manage during these outages.

Emergency Kit Essentials

The key to surviving a natural disaster is preparation. Fail to prepare, prepare to fail. Gear up for anything mother nature can throw at you by ensuring you always have the following items prepared.

			
PACK IN A LIGHTWEIGHT, WATERPROOF GO-BAG THE FOLLOWING:	WATER AND REHYDRATION SACHETS	HIGH ENERGY FOOD	FIRST AID SUPPLIES
			
EMERGENCY BLANKETS	A CHANGE OF CLOTHES	WATERPROOF RAIN COAT	STURDY SHOES AND WORK GLOVES
			
FULLY CHARGED MOBILE OR PORTABLE RADIO	TORCH OR PORTABLE LAMP AND BATTERIES	MULTIPURPOSE POCKET KNIFE TOOL	MATCHES
			
A WHISTLE TO ATTRACT ATTENTION	PERSONAL TOILETRIES FOR HYGIENE	EMERGENCY AND VITAL RECORDS IN WATERPROOF BAG	CASH

Early Warning Systems

Early warning systems (EWS) are a major element of disaster risk reduction. Early action can help prevent the loss of life and reduce the negative economic impacts of natural disasters, and they should be a part of any **Disaster Risk Management (DRM)** plans, especially at the community level.

Early warning systems can be set up to avoid or reduce the impact of hazards such as floods, landslides, storms, and forest fires. The more time we can give communities to prepare, the greater chance there is to save human lives, assets, and livestock. Even a few extra minutes of warning can allow people to move livestock, seeds, and other household necessities, the loss of which might otherwise set back a household or community for years.

The role EWS can play in livelihood protection cannot be overstated, and not all early warning systems need to be high-tech or high cost.

In general, there are two necessary stages to establish a successful EWS[20]:

Step 1: Risk Awareness

The local population should have an awareness and understanding of what risks can potentially affect their communities and how they should respond, which will better prepare them for risk and has the potential to save lives. There are a few ways to achieve this:

- Distribute posters and pamphlets with information regarding local natural disaster risks (provided in the local language)
- Create radio advertisements or "jingles" about local risks
- Start a social media campaign or hashtag to raise risk awareness
- Develop a calendar that can be distributed with important risk information and phone numbers
- Involve children by teaching about disaster risks in school
- Create an evacuation plan that the whole community is involved in planning and aware of

Step 2: Establishing Real Time Risk Information

The monitoring and communication of real time risk information should be done in a meaningful, timely, and understandable way for communities. There are a few options for affordable risk monitoring and communication:

- Erect an observation tower to monitor risks such as the rise of river waters. People in the community can take turns watching the river
- Purchase a hand siren or a battery powered siren to warn others in the community of a risk or the need to evacuate

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20 Steps for creating an Early Warning System adapted from "Early Warning Saving Lives" by Practical Action, https://infohub.practicalaction.org/bitstream/handle/11283/366216/4f7301f5-9680-44d4-96d9-35e40ae4f5bb.pdf?sequence=1.

- Establish community relay systems where volunteers go door-to-door to pass on risk warnings
- Announce any risks over the local radio station and encourage others to spread the message
- Make sure there are people in the community with reliable FM radios, cellphones, landlines, or walkie-talkies for communication purposes

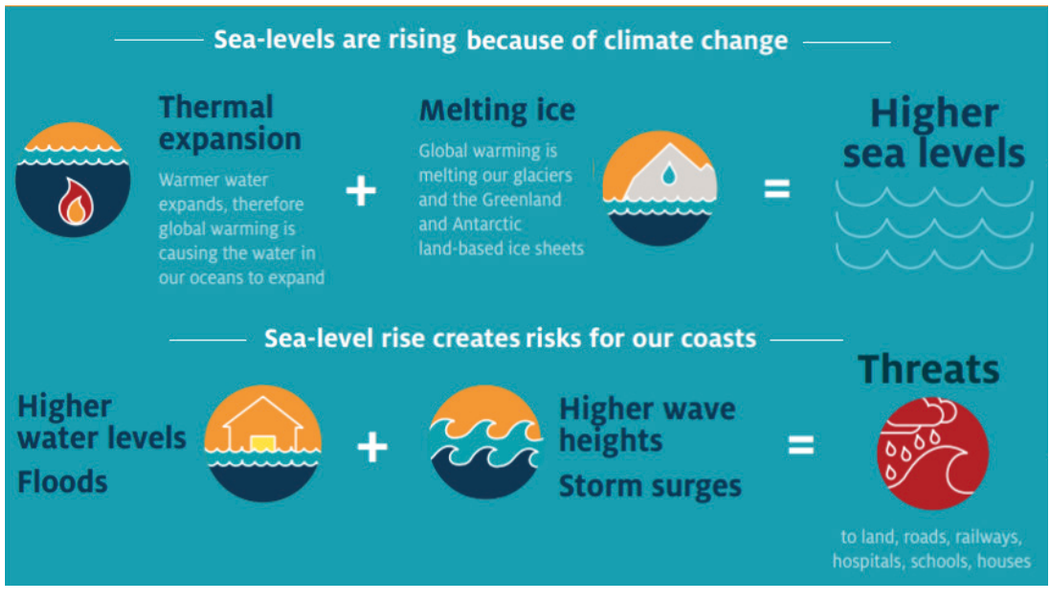
4.1. Floods

Extreme flooding happens all over the world, but when it happens in developing countries, it has the power to destroy buildings, standing crops, fertile lands, livestock, and cause multiple casualties. Climate change has made flooding more common and more extreme due to increased rainfall patterns and rising sea levels.

Losing standing crops can have an immediate impact on food security, but loss of lives and cultivable land can have long lasting effects on the living standards of people in the community.

Multiple actions must be taken to proactively manage the risk of floods. A multiple mitigation approach would consider measures such as: restricting new developments in flood prone areas; building flood resistant structures; and controlling land use practices near bodies of water.

This guide will give you general tips to take into consideration if the region you live in is prone to flooding, and will provide you with some tools you can use to help adapt.



21 Image adapted from infographic by CoastAdapt, https://coastadapt.com.au/sites/default/files/infographics/15-117-NCCARFINFOGRAPHICS-4-03%2827Feb%29-UPLOADED.pdf.

Adapting to Sea Level Rise

Here are some general tips to consider if you live in a region or area prone to flooding:

22 Image adapted from infographic by CoastAdapt, https://coastadapt.com.au/sites/default/files/infographics/15-117-NCCARFINFOGRAPHICS-3-Updated.pdf.

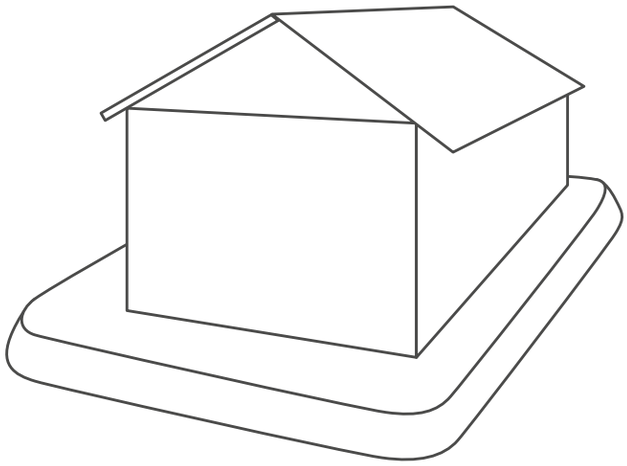
Stilt houses are built primarily as a protection against flooding. Picture: Freepik

Flood Resistant Housing

Any new constructions should be flood proofed to reduce further damages, but there are many ways to make existing structures flood resistant, ranging from expensive options to more affordable measures, depending on the materials available.

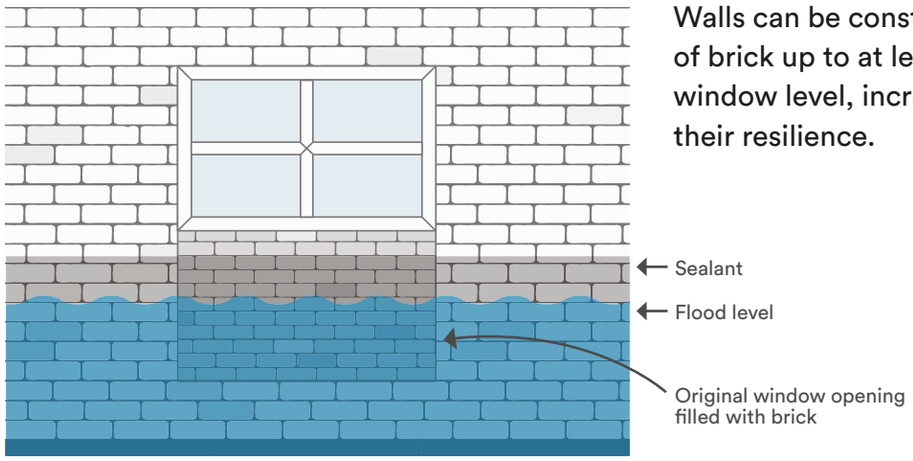
Step 1: Construct a flood resistant house

Option A: Raise your structures



Buildings can be raised above flood levels by constructing them on stilts. Stilt houses are houses built on elevated platforms. They can be built in a variety of locations, but are commonly found in tropical climate countries. Stilt houses are usually constructed above water, but they may also be built on sand or dry land. Stilts houses also keep away vermin and dangerous animals such as snakes.

Option B: Construct brick walls



Walls can be constructed of brick up to at least the window level, increasing their resilience.

Step 2: Surround your house with water-absorbing plants

Surround your house with water-absorbing plants such as bamboo and banana trees. These plants absorb the flood water and help keep water away from your house. Most of these plants can be found growing wild locally.

Step 3: Protect livestock and food supplies

Animals should also be protected from flooding. Poultry and livestock can be kept on raised platforms to protect them from floodwater. Chicken coops and cages should be easy to pick up and carry away to safety during a flood.

Food, crops, and other household items should also be kept above flood levels. They can either be kept on high shelves or on a raised platform in the main living room[23].

Tips:

- Keep all important documents (passports, birth certificates, etc.) in waterproof bags so that they are not damaged by floodwater
- If you have a well in your community, consider building raised concrete walls around the well to protect it from any contamination from the floodwater
- Consider raising ducks instead of chickens because they can fly and swim, and have a better chance of survival during a flood

23 Steps for building Flood Resistant Housing adapted from “Flood resistant housing” by Practical Action

Bio-Dykes

A bio-dyke is a vegetative measure of controlling the erosion of riverbanks by using local materials. It is a sustainable form of embankment made of locally available resources like sand, rocks, soil, shrubs, and bamboo trees. The cost of construction and maintenance of bio-dykes are significantly cheaper than the construction of concrete structures, making them more suitable for developing countries.

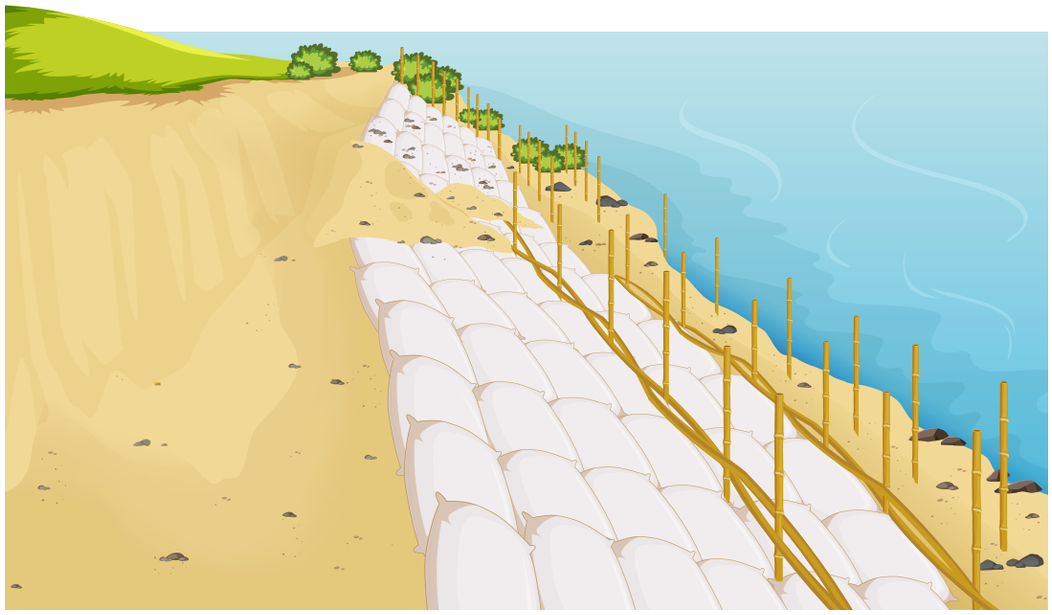
Bio-dykes are a bioengineering measure to manage and control flood water movement. It combines biological, mechanical, and ecological concepts to stabilize the slopes of the river banks.

Besides flood control, this concept can also be used in landslide mitigation as it offers a sustainable and highly cost and time efficient solution for slope instability in mountainous and hilly areas.

Materials Needed:

- Green bamboo poles
- Sand bags
- Nylon or plastic rope
- Sand
- Fertile soil
- Plants that are fast growing and deep-rooted (preferably local to the region)

To create a bio-dyke, trees are planted alongside sandbags in dykes at the slope of the riverbank to break the water force and act as a barrier for river bank erosion, which protects the nearby cultivable land (see picture below).

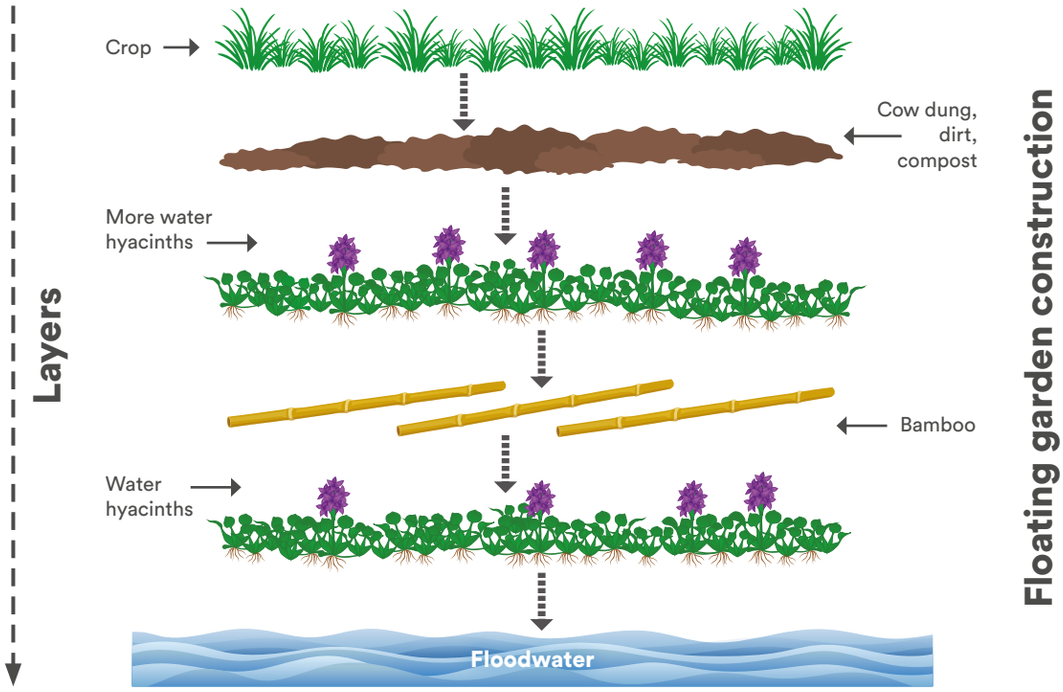


Floating Gardens

For people who live in areas covered by water during the monsoon season or on frequently flooded land, it is impossible to grow crops. The floating garden offers a clever solution to this problem by growing crops on a raft that can float.

Materials needed:

- Water hyacinths
- Bamboo sticks
- Soil and vegetable seeds



Step 1: Create the raft

The rafts should be 8 metres long and 1 metre wide, and constructed from alternating layers of water hyacinth and bamboo, which is usually available for free locally. The top layer of the raft should be enough soil to plant vegetables.

Step 2: Plant your vegetables

Summer and winter vegetables such as gourd, okra, and leafy vegetables can be grown on the raft. Make 30cm x 30cm holes for planting your vegetable seeds.

Tips:

- Floating gardens can also provide an additional source of income by selling any surplus produce at the market
- The rafts can move from place to place, which means they are suitable for those that have temporarily or permanently lost their homes and land
- A new raft needs to be built every year, but the old one can be used as fertilizer during the dry season

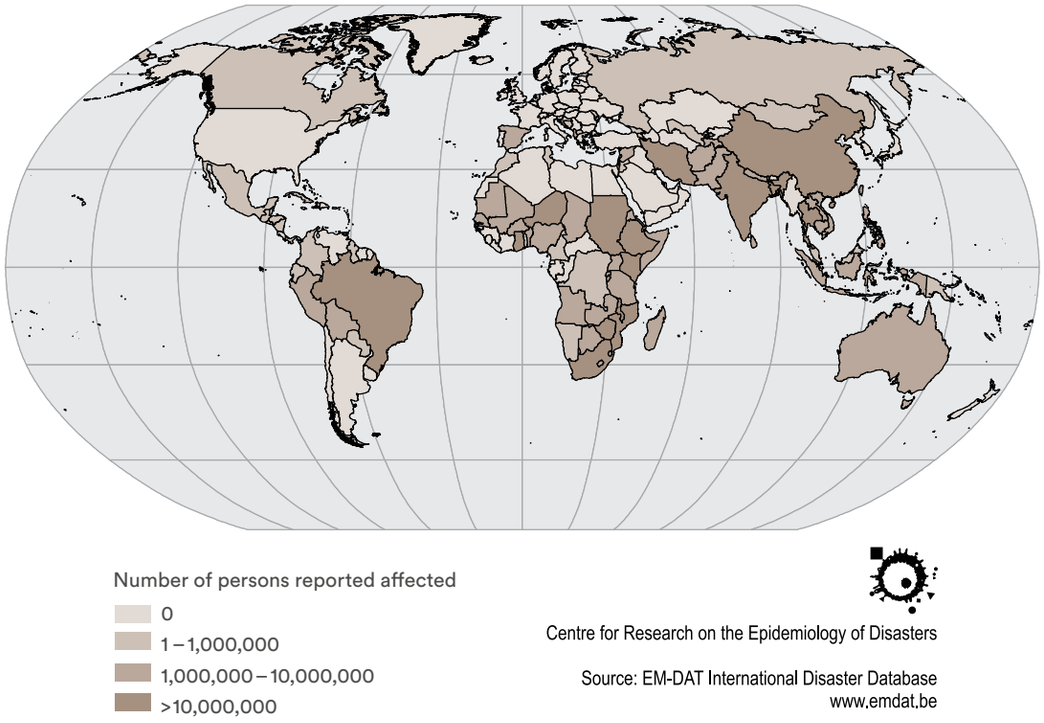
4.2. Droughts

A broad definition of drought is a lack of rain over an extended period of time, usually a season or more, which results in a water shortage. Climate change affects the length and severity of droughts because of increasing temperatures and irregular rainfall patterns.

Drought is a major threat to people's livelihoods and to their future development. Each year, disasters originating from long droughts affect tens of millions of people, including famine and starvation.

Some regions are more prone to drought disasters, and each country differs in its capacity to effectively prepare for and respond to the effects of drought.[24]

Number of drought disasters reported by country: 1970–2008



This guide will give you general tips to take into consideration if the region you live in is prone to droughts, and will provide you with some tools you can use to help adapt.

See adaptation page

24 Infographic and information adapted from "Drought Risk Reduction Framework and Practices" by UNISDR, https://www.unisdr.org/files/11541_DroughtRiskReduction2009library.pdf.

Destroyed home in the Chimanimani District of Zimbabwe after Cyclone Idai (2019). Picture: Jairos Jiri Association.

4.3. Hurricanes/Cyclones/Typhoons/Tropical Storms

Hurricanes, cyclones, and typhoons are all types of tropical storms. There is no difference between these storms, but they are given different names depending on where they appear.

Hurricanes are tropical storms that form over the North Atlantic Ocean and Northeast Pacific.

Cyclones are formed over the South Pacific and Indian Ocean.

Typhoons are formed over the Northwest Pacific Ocean.

Tropical storms bring very strong winds and heavy rains which can cause a lot of damage. When the storms are over the ocean, they can bring in large waves that can flood towns and cities. When the storms reach land, the strong winds can knock over trees and damage homes.

Climate change will likely make these tropical storms more intense and more deadly, leaving people in developing countries at particular risk. If you live in an area that is prone to tropical storms, it is important that you prepare for them.

Prepare for a Tropical Storm

If you live in an area that is prone to tropical storms, here are some things you should do to prepare so that you can safely survive the storm until it passes.

1. Prepare an emergency kit

An emergency kit is a collection of basic items you might need in the event of an emergency after a natural disaster. You should keep at least one emergency kit at home, and prepare it well in advance of an emergency. [See information on how to Prepare an Emergency Kit]

2. Know where to evacuate

Tropical storms can hit very quickly, which can make them hard to escape, so it is important to have an evacuation plan. Make sure that you have a designated meeting place for your family, and try your best to stay together. It is also good to practice your evacuation plan regularly so that everyone is aware of the procedure and can keep calm. [See the Practical Guide on Early Warning Systems]

3. Evacuate uphill if you live by the coast or in a light weight house

Tropical storms can often bring floods and high winds, so it is important to evacuate uphill to higher ground before the storm hits. You are less likely to be affected by flooding the higher you are, and if your house lacks the structural support to withstand a tropical storm, it is also best to evacuate because it will not be safe to stay in your house. Evacuate to a shelter if possible.

4. Build your house with shutters and securely fastened roofs

Tropical storms have the power to destroy buildings, but with some extra planning, the damage to buildings by these forces can be greatly reduced. Making sure your windows and roof are secure will mean there is a higher chance that your house will not be damaged by high winds and heavy rainfall.

5. Store important items high above flood-level

If your house floods after a tropical storm, the water can damage important documents and items. It is important to always keep important items stored above flood-level, such as important documents (passports, birth certificates, deeds, etc.) and food supplies. It is also a good idea to keep important documents in a sealed plastic bag in case they get wet.

6 . Keep trees well trimmed

Keeping your trees trimmed regularly is important because it will make them more wind-resistant and less likely to fall over. This is also important for protecting your home. Branches that are weak or dead can fall during a storm and cause serious damage to your property, so it is important to remove them. You should trim your trees regularly all year around.

7. Maintain your roof and repair loose tiles

Tropical storms bring strong winds, which can cause serious damage to your roof, especially if you have a tiled roof. Make sure that all loose tiles are secured before a storm, because if they become loose and blow away, they can cause damage or injury.

4.4. Landslides[25]

A landslide is when rocks, earth, or other materials move quickly down a slope or mountain, and they can occur with little or no warning. Landslides move very fast, and they have the power to destroy buildings, bridges, and roads.

Landslides are caused by disturbances in the natural stability of a slope. They can happen after heavy rains, droughts, earthquakes, or volcanic eruptions.

Climate change has increased the risk of landslides. With hotter temperatures, snow and frost melt sooner, causing the ground to become soft and unstable. Climate change has also contributed to an increase in heavy rainfall, droughts, and wildfires, which can disturb the stability of a slope, causing landslides. Human activity such as deforestation has also contributed to the instability of slopes.

25 Information about Landslides from "Landslide and Mudslides" by the Centers for Disease Control and Prevention (CDC), https://www.cdc.gov/disasters/landslides.html.

Areas most likely to experience landslides include:

- Areas where wildfires or deforestation have destroyed vegetation
- Areas where landslides have occurred before
- Areas located near steep slopes
- Areas where slopes have been altered by construction and human activity

If you live in an area that is at risk of landslides, appropriate measures should be taken to prepare the community.

Prepare for a Landslide

Since landslides can happen with little or no warning, it is important to be as prepared as possible if you live in an area that is at risk. Here are some steps you can take to prepare:

Step 1: Prepare an Emergency Kit

An emergency kit is a collection of basic items you might need in the event of an emergency after a natural disaster. [See information on how to Prepare an Emergency Kit]

Step 2: Know Where to Evacuate

You and your family should have an evacuation plan in case of a landslide, and decide how you will communicate in an emergency. [See the Practical Guide on Early Warning Systems]

Step 3: Know the Warning Signs of a Landslide

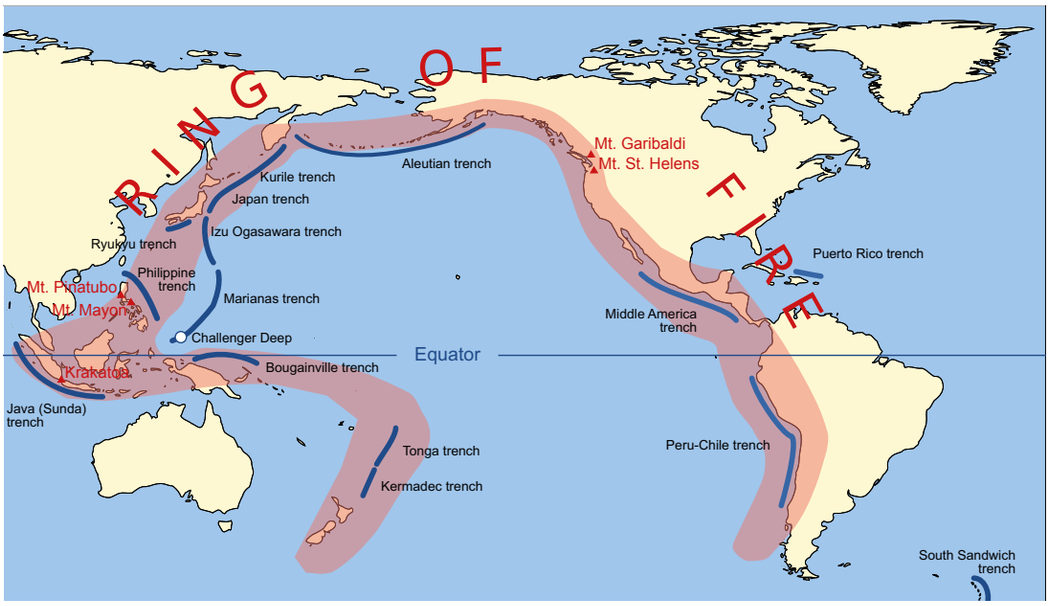
If you live near a steep slope or an area that has had landslides before, you should be able to recognize the warning signs of a landslide:

- Look for tilted trees, telephone poles, fences, walls, and for any new bare spots on hillsides
- Listen for rumbling sounds that might indicate an approaching landslide
- Be particularly aware after a heavy rainfall

Step 4: Take Preventative Measures

Many landslides are caused by human activities, such as deforestation and construction. Here are some tips to prevent landslides caused by human activities:

- Avoid building near the top or bottom of a steep slope
- Consider using nets or artificial walls to prevent falling rock or earth from hitting roads or buildings
- Avoid dumping water down steep slopes and consider using a draining system to direct surface water away from the slope
- Plant more vegetation and trees on hillsides when possible
- Construct a Bio-Dyke to increase slope stability



4.5. Earthquakes and Volcanic Eruptions

Earthquakes and volcanic eruptions are both natural phenomena that can be very powerful and dangerous for those affected. Earthquakes can cause the ground to shake and crack apart, damaging roads and making buildings and bridges collapse. Volcanic eruptions also pose many dangers, including lava flows and landslides. Both earthquakes and volcanic eruptions have the potential to cause high casualties.

Earthquakes are caused by the sudden movement of tectonic plates in the Earth's crust. Tectonic plates are large pieces of the Earth's crust underneath us, and when the plates move or touch each other they can create earthquakes or volcanic activity.

The boundaries where the plates meet are called fault lines. Earthquakes and volcanoes occur along these fault lines where Earth's tectonic plates meet.

The majority of the Earth's earthquakes and volcanic eruptions take place along an area called the **Ring of Fire**, a 40,000km (25,000 mi) horseshoe shaped zone in the Pacific Ocean. This area hosts 90 percent of the world's recorded earthquakes and some 75 percent of the world's active volcanoes. The abundance of volcanoes and earthquakes along the Ring of Fire is caused by the amount of movement of tectonic plates in the area[27].

26 Image from "Power and Mercy in the Ring of Fire" by Worldkids, https://en.wikipedia.org/w/index.php?title=Ring_of_Fire&oldid=1001646851.

27 Information and statistics from "Ring of Fire" by National Geographic, https://www.nationalgeographic.com/science/earth/ring-of-fire/.

Volcanic eruptions ca pose many dangers, including lava flows and landslides. Picture: Marc Szeglat / Unsplash

Prepare for a Volcanic Eruption[28]

A volcanic eruption may involve lava and other debris that can flow up to 160 km/h (100 mph), destroying everything in its path. Volcanic ash can travel hundreds of kilometres and cause severe health problems. Most volcanoes are monitored, and while there is often advanced warning before an eruption, it is still important to prepare beforehand, especially if you live near an active volcano. Here are some steps that can help you prepare before a volcano erupts:

Step 1: Prepare an Emergency Kit

An emergency kit is a collection of basic items you might need in the event of an emergency after a natural disaster. [See information on how to **Prepare an Emergency Kit**]

Step 2: Know Your Community's Warning System

If you live near a volcano, your community likely has a plan in place to warn people that the volcano may erupt. In many cases, sirens and emergency alerts on televisions are used to alert people about volcanic activity. Local radio stations will also broadcast important advisories. [See the Practical Guide on **Early Warning Systems**]

Step 3: Know Where to Evacuate

You and your family should have an evacuation plan in case of a volcanic eruption, and decide how you will communicate in an emergency.

Tips to help you prepare during a volcanic eruption:

- If advised to evacuate, do so early
- Avoid areas downstream of the eruption
- Protect yourself from falling ash. Make sure to close all doors, windows, chimneys, and vents to prevent ash from coming inside

28 Information about preparing for a volcanic eruption from Ready, https://www.ready.gov/volcanoes.

- Do not drive in heavy ash fall, as there will be limited visibility. Ash also causes damage to engines and metal parts, so if you have to drive, drive slowly
- If you have to go outside, wear a mask and protective goggles, and keep your skin covered with long pants and long sleeve shirts. If you do not have a mask, use a wet cloth to cover your mouth

Prepare for an Earthquake[29]

An earthquake is a sudden, rapid shaking of the earth caused by the shifting of underground rock. Earthquakes can cause buildings to collapse and cause heavy items to fall, resulting in injuries and property damage. Earthquakes can happen anywhere, and they can happen without warning. Earthquakes can cause fires, tsunamis, landslides, and avalanches, so you need to be prepared for when an earthquake happens, especially if you live in an area where they are frequent. Here are some steps that can help you prepare **before** an Earthquake strikes:

Step 1: Prepare an Emergency Kit

An emergency kit is a collection of basic items you might need in the event of an emergency after a natural disaster. [See information on how to Prepare an Emergency Kit]

Step 2: Know Where to Evacuate

You and your family should have an evacuation plan in case of an earthquake, and decide how you will communicate in an emergency.

Step 3: Secure Objects That Could Fall

Secure items such as TV's, bookcases, and objects that hang on the wall. Store heavy and breakable objects on low shelves.

Step 4: Make Your Home Earthquake Resistant

Consider renovating your home to make it less vulnerable to collapse during an earthquake. [See the Practical Guide on Earthquake Resistant Housing].

Tips to help you prepare during an earthquake:

- If you feel an earthquake, you should drop to your hands and knees and crawl to seek cover under a sturdy piece of furniture, like a table, and hold onto it until the shaking stops - **Drop! Cover! Hold On!**
- You should try to move away from windows, glass, or heavy objects
- If you are in a vehicle, pull over and stop
- If you are in bed, stay in bed and put a pillow over your head
- If you are outdoors, stay outdoors
- Do not run outside

29 Information about preparing for an earthquake from Ready, https://www.ready.gov/earthquakes.

- Expect more aftershocks to follow
- If you are near cliffs or mountains, be alert for falling rocks and landslides
- If you are in an area that may experience tsunamis, go inland or to higher ground
- Once safe, listen to local authorities for information and follow their instructions

Earthquake Resistant Housing

A few simple changes can turn a structurally unsound home into one that can withstand another earthquake, and many of these changes can be done affordably. If you live in an area that is prone to earthquakes, you should consider making your home earthquake resistant to protect your family and property when an earthquake strikes.

Here are some tips for how to make your home more earthquake resistant:

1. Building a good **foundation**, with good quality large stones.

2. Building a **plinth** beam is essential to make a stronger house. Plinth beams distributes the load of the wall over the foundation evenly.

3. Interlock walls together with tiestones to make them stronger and use good quality and size stones.

30 Image adapted from infographic by ShakeOut, https://www.shakeout.org/graphics/.

4. Use a **horizontal band**. It can be defined as a method of reinforcing the masonry buildings by providing **bands** with higher tension strength. Horizontal bands can be also termed as *seismic bands* which consist of reinforced concrete running flat throughout all the external and internal masonry wall elements.

5. Tie the floors to walls

6. Small windows and small regularly spaced openings create fewer weak spots in walls

7. Tie cables up to support the roof and tie the roof down

8. Light metal roofs on wooden trusses are more resilient than heavy roofs

By following local earthquake resistance house building codes and using strong and safe materials, the house should be more safe in case of an earthquake.

Tips:

- Select a solid site for constructing your home. Avoid drainage paths and steep slopes if possible
- Make roofs out of light materials to avoid them pushing walls sideways and falling inwards, such a metal sheet roofing
- Try to use flexible materials during construction, such as timber[31]

31 Pictures on pages 68–69 on how to make your home more earthquake resistant by SAHAS / Nepal.

4.6. Tsunamis

A tsunami is a series of big and powerful waves caused by an underwater earthquake, landslide, or volcanic eruption. Tsunamis are rare, powerful, and unpredictable natural hazards, with devastating consequences for many coastal communities all across the world.

Although tsunamis are usually triggered by underwater earthquakes, the rising sea levels due to climate change have made the power of tsunamis even more deadly.

Tsunamis are the deadliest type of natural disaster on the planet in terms of the proportion of victims killed. The 2004 tsunami in the Indian Ocean was one of the most deadly disasters ever recorded. It claimed approximately 226,000 lives in 12 countries, the vast majority of people in Indonesia, Sri Lanka, India, and Thailand.

Even though tsunamis are rare, it is only a matter of time until the next one happens, so it is important to be prepared. It is especially important to prepare with education and evacuation plans and drills, so that communities are prepared to react without panic when a tsunami reaches them.

Worldwide coastline at risk of large tsunamis

32 Map and statistics adapted from "Tsunami Disaster Risk" by UNISDR, https://www.unisdr.org/files/50825_credtsunami08.pdf.

Tsunami Warning Signs

Tsunamis are hard to detect and they can arrive completely unexpectedly, but fortunately there are a few natural warning signs that can help warn you that a tsunami is approaching, and they can be easily recognized. Natural tsunami warning signs include:

- Strong ground shaking from an earthquake
- A sudden rise or draining of ocean water - If the water recedes quickly and unexpectedly from a beach exposing the ocean floor or a sudden rise of the sea level
- An abnormally large wave
- A loud roaring sound from the ocean, similar to a train or a jet airplane
- Unusual animal behaviour (e.g. birds and other animals leaving the beach and moving to higher ground)

What to do when you recognize the natural signs of a tsunami:

- If you feel an earthquake, you should protect yourself from the earthquake first: drop, cover, and hold on
- Evacuate. Leave as soon as you see any natural signs of a tsunami or receive an official tsunami warning
- Get to high ground as far inland as possible
- Listen to emergency information and alerts
- If you are in a boat, go out to sea

Tips:

- The first wave of a tsunami is generally not the largest, so stay away from the coast until wave activity has subsided
- Tsunamis can travel up rivers and streams so it is best to avoid them
- Stay away from damaged buildings, roads, and bridges
- Be aware of downed power lines and do not touch electrical equipment if you are wet or standing in water
- Avoid flood water if possible, which can be deeper than it appears and can contain dangerous debris
- Listen to local authorities for information about shelters and areas to avoid

Tsunami Evacuation Plans

To respond effectively to the impact of tsunamis it is necessary to have an evacuation plan that has been regularly tested.

A distant tsunami can take hours to reach the coastline, but sometimes it takes only a few minutes, which means people in tsunami-prone areas need to be able to recognize the natural warning signs of a tsunami and be able to evacuate immediately. Coastal communities should have an evacuation route, and everyone in the community should know the evacuation routes.

Regular drills of the evacuation plans will help create a more resilient community that is able to evacuate quickly and efficiently during a real tsunami.

Here are tips to create an effective tsunami evacuation plan:

- **Plan an evacuation route:** The evacuation route should lead to a meeting spot on higher ground. The route should be large enough to accommodate the population of the community, be kept clear of obstacles, and be clearly marked with signs and directions.
- **Do drills:** Gather some people from the community and try the evacuation route. Time how long it takes to evacuate. Set a time and date for the drill and make it an annual event.
- **Get the community involved:** The whole community should be aware of the evacuation plan, and they should be involved in emergency drills so they are better prepared for the real event. Get children involved by teaching them the evacuation plan in schools.
- **Consider the most vulnerable:** When planning an evacuation route, it is important to identify groups that are likely to have difficulty evacuating without some form of assistance, such as children, people with disabilities, and the elderly, and plan for how to evacuate vulnerable groups safely.

It is important that everyone in the community knows the natural warning signs of a tsunami, and how to safely evacuate.

4.7. Climate change and pandemics

Climate change has already made conditions more favourable to the spread of some infectious diseases, including Lyme disease, waterborne diseases such as Vibrio parahaemolyticus, which causes vomiting and diarrhea, and mosquito-borne diseases such as malaria and dengue fever. Future risks are not easy to predict, but climate change hits hard on several fronts that matter to when and where pathogens appear, including temperature and rainfall patterns.

There have been increasing number of infectious diseases in recent decades. Most of these diseases have entered into people from animals, especially wild animals. This trend has many causes. We have massive concentrations of domesticated animals around the world, some of which can be home to pathogens, like the flu (e.g. swine flu and bird flu), that can make people sick. We also have massive concentrations of people in cities where diseases transmitted by sneezing may find fertile ground. And we have the ability to travel around the globe in less than a day and share germs widely.

Another major cause of species loss is climate change, which can also change where animals and plants live and affect where diseases may occur. When changing

The Corona pandemic changed the way people interacted. Picture: Freepik

the climate and life on earth, we have to expect that it will affect our health. Covid-19 pandemic started to spread around the world in 2020, reaching almost every corner of the globe. To prevent the next pandemic, we also need to take climate action. For example, preventing deforestation — a root cause of climate change — can help stem biodiversity loss as well as slow animal migrations that can increase risk of infectious disease spread. The recent Ebola epidemic in West Africa probably occurred in part because bats, which carried the disease, had been forced to move into new habitats because the forests they used to live in had been cut down to grow palm oil trees.

We can make many smart investments to avert another outbreak. Rethinking our agricultural practices, including those that rely on raising tens of millions of animals in close quarters, can prevent transmissions between animals and spillover into human populations. By eating less meat and animal produce, there is less need for keeping large amounts of animals, and more vegetable based foods can be cultivated to feed more people. Reducing air pollution caused by burning fossil fuels like coal, oil and natural gas also helps keep our lungs healthy, which can protect us from respiratory infections like coronavirus. Federal, state, and local agencies can support public health leadership and science and we can provide more funding for needed research, early response to outbreaks, and supplies for testing. Finally, we can do much more to control the illegal wildlife trade, which again brings the wild animals closer to humans giving opportunities for transmissions between animals and humans.[33]

33 Source for the entire chapter: https://www.hsph.harvard.edu/c-change/subtopics/coronavirus-and-climate-change/

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Images on pages 12, 20, 21, 27, 28, 32, 43, 45, 52, 56, 57, 58, 59, 62 and 70 illustrated by Nici Lönnberg.

Felm's work aims to promote human dignity and justice around the world.

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