

ENVIRONMENTAL IMPACTS

of ARMED CONFLICTS

When battlefields scar the planet



Dr B S Sandha

Environmental Impacts of Armed Conflicts

**Humanity's
Collective spirit is
Wounded by wars, which
Leaves permanent scars on the earth,
Destroying ecosystems and contaminating landscapes
Long after the final shot is fired.
It also leaves generations of
People grieving
And lost.**

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Preface

Environmental Impacts of Armed Conflicts

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The realisation that the effects of armed conflict go well beyond the battlefield is what gave rise to this book. Although the human cost of war is widely known, less is known about the frequently subtle, protracted, and transboundary effects, it has on the environment. The environmental impact of war necessitates immediate research and policy attention, from burned forests and poisoned rivers to the silent loss of biodiversity and the disturbance of native ecological knowledge.

As an observer of the dynamics of international conflicts, I have always been spellbound by the contradiction that countries spend a lot of money on defence and reconstruction but very little on ecological restoration. The goal of our endeavour is to close that gap. I have attempted to investigate how violent conflicts weaken ecosystems, undermine climatic resilience, and jeopardise the fundamental tenets of sustainable development by drawing on a variety of academic sources, from anthropology and ethics to environmental science and international law.

This book is more than just a history of devastation. It is a call to conscience as well. I encourage readers to think about how environmental stewardship must be integrated into peacebuilding initiatives through case studies, theoretical frameworks, and policy research. Ecological restoration must be at the heart of our vision of justice and reconciliation, whether in post-conflict areas or in diplomatic corridors.

The communities, activists, and academics whose perspectives and experiences have influenced this study deserve my sincere gratitude. They remind us that mending the land is inextricably linked to healing ourselves, and their voices reverberate across these pages.

May this book be a cautionary tale as well as a manual, a celebration of nature's tenacity and an appeal for its defence in both peace and conflict.

Abstract

There is an urgent need to comprehend how warfare alters ecosystems since the natural world has been permanently scarred by the increasing intensity of contemporary armed conflicts. This book argues that environmental degradation is not just collateral damage but a key aspect of conflict, shedding light on the various ways that conflicts alter landscapes, taint water sources, and hasten the loss of biodiversity. It uncovers patterns that have been hidden in traditional security studies by following the contours of ecological degradation from frontline conflicts to post-war reconstruction. In the end, it advocates for a broader meaning of "security" that considers the condition of our common surroundings.

The book looks at how institutional frameworks; private, governmental, and military; influence choices that either worsen or lessen environmental damage. The book challenges the moral obligations of fighters, decision-makers, and businesses using this conceptual framework, arguing that moral leadership is essential to averting ecological collapse in the face of conflict. This theoretical framework can be used as a guide for transformative activity as well as a diagnostic tool.

The study's methodology blends qualitative case studies from conflicts around the world with evaluations of pollution levels and habitat degradation. This method reveals latent connections between resource thievery, scorched earth practices, and long-term ecological resilience. Additionally, it highlights local perspectives, demonstrating how indigenous knowledge and cultural history influence adaptive responses to environmental disruption.

Important research shows that armed conflicts cause deforestation, soil erosion, and water contamination at a rate that frequently exceeds the rate of natural recovery by decades. While displacement upends customary land management practices, resource extraction for wartime economies further entangles local and global supply systems in cycles of environmental injustice. According to the research, health concerns persist long after ceasefires because abandoned battlefields become breeding grounds for invading species and poisonous legacies. By combining these concepts, the book pinpoints leverage points where harmful feedback loops can be broken by governmental measures.

The book hopes to motivate policymakers, government officials, and grassroot level activists by fusing academic rigour with useful tools. It affirms that pursuing peace is inextricably linked to maintaining the health of our world and provides a way to balance environmental care with human security.

Dedication

May your tenacity lead us towards recovery, to the mute witnesses of armed conflict, the shell-scarred soil, the oil-choked rivers, and the burned-out forests.

Every insight in these pages is shaped by the bravery and tales of the people and communities who suffer the most from the environmental toll of war.

To my professors, teachers and mentors, whose compassionate and probing questions sharpened my beliefs and broadened my perspective.

To my family, thank you for your steadfast support and for reminding me that protecting the environment starts at home.

May this effort serve as a reminder to future generations to take wise and determined care of Earth's delicate beauty.

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The Land Cries in the Shadow of Battle.

A proverb

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Section A

Introduction

Environment and Armed Conflicts

Chapter 1

Environmental Impacts of Warfare and Armed Conflicts

In this chapter

1.1 Examples of Specific Military Conflicts and Their Environmental Impacts

1.2 Environmental Effects of Bombing Campaigns during Military Operations

The environment has been significantly and permanently impacted by armed conflicts and wars throughout history. It has permanently altered the natural world, from the radioactive damage from nuclear weapons to the forests brought on by ancient armies.

Armed and military conflicts can have both short-term and long-term effects on the environment. Forests and other natural ecosystems are frequently cleared for bases, training areas, and infrastructure during military operations. Ecosystems are disrupted and biodiversity is lost as a result. Numerous types of pollution are produced by these battles, such as heavy metals from weapons testing, oil leaks from cars and aeroplanes, and chemical spills from bombs. These contaminants can endanger human health and the ecosystem by contaminating soil, water, even seas, and air.

Natural resources including water, oil, and minerals are consumed in enormous quantities during such conflicts. This may worsen already-existing environmental stressors and result in the depletion of resources. According to some estimates, the military is accountable for approximately 5.5% of global greenhouse gas emissions brought on by its operations. This covers emissions from the manufacture and operation of military hardware as well as the devastation brought on by war. Conflict-related environmental harm can continue long after hostilities have stopped. This covers desertification, soil erosion, and the long-term consequences of chemical pollution.

Efforts to lessen these effects include post-conflict environmental evaluations and restoration initiatives, as well as international accords and legislation designed to safeguard the environment during conflicts.

1.1 Examples of Specific Military Conflicts and Their Environmental Impacts

The Vietnam war is often quoted as one of the important examples of environmental impact of military conflicts. The region's ecosystem was significantly and permanently impacted by the Vietnam War. The U.S. military's use of herbicides, including Agent Orange, resulted in extensive deforestation and persistent soil contamination. The U.S. military destroyed crops and defoliated forests with herbicides, including Agent Orange. In addition to depriving the area of plants, this caused significant soil erosion and a decline in biodiversity. Long-term

health problems for the local population and the environment resulted from the deployment of chemical defoliants like Agent Orange, which damaged water and soil supplies.

The terrain was severely damaged by extensive bombing campaigns, particularly in places like Laos and Cambodia. Soil layers were disturbed by the bomb disturbance process, which resulted in enhanced and changed hydrology. Bomb perturbation is the term used to describe the disruptions or disturbances brought on by an explosion or bomb. The surrounding environment may be impacted by shockwaves, heat, and other phenomena that emanate from the explosion. The hydrology of the Mekong River Basin and other water systems was impacted by the bombing and deforestation, which changed the way rivers and streams naturally flowed.

Large-scale bombing campaigns seriously damaged the terrain, particularly in places like Laos and Cambodia. Bomb perturbation was a process that caused soil layers to be disturbed, which increased and changed the hydrology. The disruptions or disturbances brought on by a bomb or explosion are referred to as bomb perturbations. Heat, shockwaves, and other phenomena that spread from the explosion and affect the immediate surroundings can be a part of this. Deforestation and bombing changed the way rivers and streams flowed naturally, which had an impact on the hydrology of the Mekong River Basin and other water systems.

Another instance of how conflicts have a negative impact on the environment is the Gulf War. The 1991 oil fires started by fleeing Iraqi soldiers resulted in severe air pollution and influenced the temperature in the area. Large volumes of carbon dioxide and other pollutants were emitted into the atmosphere when oil fields burned. Without a doubt, the Gulf War had a big impact on the environment. Over 600 oil wells were burned by Iraqi forces during the fight, resulting in enormous oil lakes and the discharge of several pollutants into the atmosphere. For months, these flames blazed, severely polluting the air and soil.

Furthermore, the devastation of oil infrastructure in the Persian Gulf resulted in oil spills that poisoned marine habitats, causing harm to species and damaging local fishing enterprises. This is an obvious illustration of how war may have a catastrophic impact on the environment, harming both human health and natural ecosystems over time.

Due to the use of heavy machinery, explosives, and infrastructure destruction, the Iraq and Afghanistan Wars have caused considerable soil degradation and water contamination. Reduced agricultural output and health hazards for nearby residents are among the long-term consequences. human health and natural ecosystems.

Due to military operations, the ongoing conflict between Russia and Ukraine has resulted in pollution and habitat degradation. In impacted areas, the movement of military vehicles and the deployment of heavy weapons have contaminated the water and eroded the soil.

1.2 Environmental Effects of Bombing Campaigns during Military Operations

Large-scale forest fires, soil erosion, and chemical contamination from munitions and other military materials were all consequences of the bombing campaigns and military actions during World War II. It had significant and long-lasting impacts on ecosystems all around the world. The employment of weapons of mass destruction and military activities caused Russia to clear large areas of forest. Long-term environmental effects and a considerable loss of biodiversity resulted from this.

Widespread forest destruction brought on by bombing operations and military actions in Europe, particularly in France and Poland, resulted in habitat loss and soil erosion. Both the environment and human populations suffered greatly as a result of the use of chemical weapons like mustard gas. As a result of increasing industrial activity brought on by the war effort, pollution and greenhouse gas emissions rose.

Soil erosion and habitat loss resulted from the extensive destruction of woods caused by bombing campaigns and military manoeuvres in Europe, particularly in France and Poland. The environment and human populations were severely impacted by the use of chemical weapons, such as mustard gas. Increased industrial activity brought about by the war effort increased greenhouse gas and pollution emissions.

Retrenchment army used scorched earth tactics in several areas, polluting soil and water supplies and destroying agricultural infrastructure. Land mines in agricultural areas presented long-term hazards to soil health and human safety. Local ecosystems and biodiversity were impacted by the extensive loss of urban green spaces and infrastructure caused by bombings of cities.

These are but a handful of instances of how military conflicts affect the environment. The conflicts had a long-lasting impact on the environment in addition to changing the political and socioeconomic landscapes. These illustrations show how military conflicts have a significant and frequently enduring effect on the environment. We can better comprehend the environmental effects of military wars and try to lessen their influence in the future by looking at their historical background. The next chapters will examine the specific environmental effects of the armed engagements.

Chapter 2

Importance of Studying Environmental Impacts of Warfare

In this chapter

- 2.1 Scope of Studying Environmental Impacts of Military Conflicts**
- 2.2 Principles for Studying the Environmental impact of Armed Conflicts**
- 2.3 The Destruction of Civil Infrastructure during Military Campaigns**
- 2.4 Environmental Degradation and Disruption of Ecosystems**

Warfare has profound and long-lasting impacts on the environment. Military conflicts often result in widespread environmental destruction. Wars often lead to the destruction of natural habitats, which can result in the loss of biodiversity and the extinction of species. The destruction of natural habitats during wars can have devastating and far-reaching effects on the environment. Explosions from bombs, missiles, and artillery can obliterate entire ecosystems, leaving craters and rubble in their wake. This not only destroys plant and animal life but also disrupts soil and water systems.

For strategic purposes like building roads, establishing military outposts, or establishing firebreaks, military activities frequently entail the clearance of forests. Deforestation can result in changes to the local climate, soil erosion, and biodiversity loss. Herbicides and defoliants are examples of chemical agents that can have long-term effects on wildlife and vegetation. For instance, the deployment of Agent Orange during the Vietnam War led to extensive forest loss and water and soil contamination.

2.1 Scope of Studying Environmental Impacts of Military Conflicts

Researching how armed conflicts affect the environment is an important area that crosses several academic fields, such as ecology, international law, and geopolitics. Deforestation, soil erosion, contaminated water, and habitat degradation are all consequences of armed conflicts that damage biodiversity and upset ecosystems. Climate problems are made worse by fires, explosions, and the usage of large machinery during wartime, all of which increase carbon emissions. Conflict-related environmental damage, such as air and water pollution, puts the health of the local populace at serious danger. The preservation of the environment during armed conflicts is covered by international humanitarian law, while there is still opportunity for improvement in this area.

Rebuilding infrastructure and recovering natural resources are common post-conflict tasks that might take decades. In order to evaluate and lessen environmental harm during conflicts, emerging technologies such as agent-based modelling are being investigated. By drawing attention to these problems, we may increase awareness of the sometimes disregarded effects of conflict and promote peacekeeping and preventative actions. This field influences policies

and procedures to minimise environmental harm in addition to helping us comprehend the immediate and long-term effects of combat.

2.2 Principles for Studying the Environmental impact of Armed Conflicts

Understanding and reducing the harm done to ecosystems both during and after conflicts is at the heart of the research on the environmental effects of armed conflicts. Guidelines for preserving the environment during armed conflicts are provided by international humanitarian laws, such as the Geneva Conventions and the ENMOD Convention. In order to evaluate long-term repercussions, studies frequently take into account the environmental impact before to, during, and following wars.

It is advised to designate regions of cultural or environmental significance as protected zones during times of conflict. Special precautions are made to safeguard the habitats of conflict-affected communities and indigenous peoples. The idea that serious environmental harm caused by war is a crime of ecocide is gaining traction. It is essential to address cross-border environmental impact, such as pollution or species displacement. These guidelines seek to strike a balance between human rights, environmental protection, and military goals.

2.3 The Destruction of Civil Infrastructure during Military Campaigns

Forests are frequently cleared for strategic purposes during military operations, such as establishing highways, firebreaks, or military outposts. Deforestation can result in soil erosion, biodiversity loss, and alterations to the surrounding climate. The application of chemical agents, such herbicides and defoliants, can affect wildlife and vegetation for a long time. For instance, the application of Agent Orange during the Vietnam War led to the extensive devastation of forests and the poisoning of water and soil.

Conflict-related landmines and explosive munitions can endanger people and wildlife for decades. These leftovers have the potential to render land unusable and hinder the restoration of natural habitats. Destroying habitat during a conflict can have serious long-term effects that may take years or even decades to reverse. In post-conflict areas, efforts to repair and revitalise damaged ecosystems are essential for fostering biodiversity and ecological health.

Toxicity from chemical weapons, explosives, and military waste can pollute soil, rendering it unusable for farming and endangering the health of both people and wildlife. Oil spills, the release of toxic materials, and the destruction of infrastructure are all ways that war can contaminate water sources. Forests may be cut down for strategic reasons during military operations, creating long-term ecological imbalances.

Unexploded bombs and landmines can linger in the environment for decades, endangering both people and wildlife. Due to ecosystem disruption and rising carbon emissions, the environmental harm brought on by war can exacerbate climate change. Developing methods to reduce environmental damage and encourage recovery in post-conflict settings requires an understanding of these repercussions.

2.4 Environmental Degradation and Disruption of Ecosystems

Deforestation, soil erosion, and habitat loss are examples of environmental degradation. Comprehending these effects aids in evaluating ecological harm over the long term. Whole ecosystems can be upended by war, which results in a decline in biodiversity and the extinction of species. We can create plans for restoring ecosystems by researching these disturbances.

Military operations have the potential to pollute the air, water, and land, endangering the health of civilian populations. For the sake of public health, harmful pollutants must be identified and addressed. Long after hostilities have finished, communities are still at serious risk from landmines and unexploded munitions. Analysing their impact and distribution aids in improving safety and guiding demining operations.

Policies and regulations targeted at reducing environmental harm during conflicts can be informed by knowledge of the effects that military operations have on the environment. The creation of treaties and accords aimed at protecting the environment during times of conflict might result from environmental impact studies, which can also promote international collaboration.

Vulnerable groups, such as economically disadvantaged and indigenous communities, are frequently disproportionately impacted by military conflicts. Examining environmental effects aids in addressing environmental justice and equality concerns. Evaluating the harm that war causes on the environment can help in attempts to hold those who are at fault accountable and pursue compensation for impacted communities.

For sustainable growth and successful post-conflict rehabilitation, it is essential to comprehend how war affects the environment. Rebuilding livelihoods requires the restoration and rehabilitation of devastated environments. Understanding how conflicts affect the environment can help with initiatives to stop future wars and encourage amicable dispute resolution.

The public, decision-makers, and military leaders become more conscious of the importance of environmental preservation when the effects of military conflicts on the environment are brought to light. Understanding the effects on the environment enables campaigners and advocacy organisations to demand more robust environmental protections in areas of conflict.

We can lessen harm, comprehend the entire extent of the effects of conflict, and strive towards a more sustainable and peaceful future by researching how it affects the environment.

Section B

Military Conflicts in Historical Context

Chapter 3

Ancient and Medieval Military Conflicts - Historical Contexts

In this chapter

- 3.1 Ancient Warfare and Colonial Consequences**
- 3.2 Medieval Warfare and Military Campaigns**
- 3.3 Famous Battles and Military Campaigns of Medieval Era**
- 3.4 The Period of Holy Crusades**
- 3.5 The Mongol Invasions**
- 3.6 The Other Significant Medieval Period Military Conflicts**

Since the beginning of time, there have been wars and military confrontations throughout human history. It helped to influence how cultures, civilisations, and the environment evolved. The history of military wars is unique. Since human societies first developed language, there has been historical documentation of military battles and wars. We can examine it in relation to both ancient and contemporary fighting strategies.

3.1 Ancient Warfare and Colonial Consequences

The military tactics and strategies employed in fights from the earliest recorded history until the end of the ancient era are referred to as ancient warfare. As city-states and empires grew during this time, more specialised and organised armed armies were made possible. Infantrymen with bows and spears made up the majority of early armies. These troops were separated into shock troops and ranged units.

Chariots and cavalry gained prominence on the battlefield as technology developed. Armies were able to attack defended cities because to the development of siege engines like battering rams and catapults. In order to dominate the seas, certain ancient societies, such as the Greeks and Romans, also established naval troops.

Ancient Indian warfare, for instance, used chariots, elephants, and a well-organised army structure, all of which were distinctive to their own locations.

Ancient Egypt, the Indus Valley, and Mesopotamia are the sites of the first hostilities ever documented. The goals of these early conflicts were frequently domination over rival cities and governments, resource control, and territory expansion. There were massive military wars during the rise of empires like the Persian, Greek, and Roman Empires. The Peloponnesian War, the Punic Wars, and the Greco-Persian Wars are notable conflicts. Ancient warfare saw a number of well-known conflicts that had a significant influence on history.

One of the first wars ever documented was the Battle of Kadesh, which took place in 1274 BC and pitted the Hittites against the Egyptians under Ramses II. It is renowned for having resulted

in the earliest known peace pact and for being one of the biggest chariot wars in history. The courageous stand of 300 Spartans under King Leonidas against the far larger Persian army under King Xerxes I is what made the Battle of Thermopylae, fought in 480 BC, famous.

Even if the Greeks lost in the end, their valour was only imagined in history books. Themistocles led the Greek fleet at the Battle of Salamis, a naval conflict between the Persian and Greek fleets that took place at the same time. The Greek fleet's victory severely hampered Xerxes' invasion of Greece. The Persian invasion of Greece came to an end when the Greek forces soundly defeated the Persian army in the Battle of Plataea, which took place the year after the Battle of Salamis.

The numerous important clashes in ancient warfare are exemplified by these battles. Each had a significant influence on how history unfolded and how military campaigns developed.

3.2 Medieval Warfare and Military Campaigns

The military operations and tactics employed during the Middle Ages, which spanned the fifth century to the fifteenth, are referred to as mediaeval warfare. During this time, there were major shifts in army organisation, tactics, and technology. Knights and cavalry forces are used in mediaeval combat. The elite warriors of the Middle Ages, particularly in Europe, were heavily armoured knights mounted on horses. They were tough on the battlefield because of their speed, strength, and armour. Mediaeval armies still relied heavily on foot infantry. They frequently employed a range of weapons, such as pikes, swords, and spears. In several wars, archers—particularly longbowmen in England—were crucial.

In addition, the mediaeval era is well-known for its fortified cities and castles. These buildings served as both emblems of authority and defensive fortifications. With the development of several siege machines, such as catapults and hammering strikes, siege warfare became a crucial component of mediaeval military strategy. A more potent and user-friendly ranged weapon than the conventional bow was made available with the advent of the longbow. The introduction of gunpowder weaponry, such as handguns and cannons, later in the Middle Ages transformed warfare. Feudal lords frequently supplied soldiers for mediaeval armies in exchange for territory and security. The military forces' loyalty and organisation were impacted by this arrangement.

3.3 Famous Battles and Military Campaigns of Medieval Era

There are a few well-known mediaeval battles. The Norman conquest of England began in 1066 when William the Conqueror's Norman army overthrew Anglo-Saxon King Harold II in the Battle of Hastings. The English longbowmen were instrumental in defeating the French soldiers in the Battle of Agincourt in 1415, a significant English victory in the Hundred Years' War. The Siege of Constantinople in 1453 is another example of a mediaeval conflict. With the conquest of Constantinople by the Ottoman Turks under Sultan Mehmed II, the Byzantine Empire came to an end and a major power shift occurred.

Feudalism, with lords and knights fighting for territory and power, was a defining feature of the mediaeval era. The goal of the Great Crusades was to free the Holy Land from Muslim rule

through a series of religious conflicts. During the Middle Ages, feudal conflicts were common and were sparked by dynastic rivalries, power battles, and territorial disputes. The Hundred Years' War, a protracted conflict between England and France that lasted from 1337 to 1453, was characterised by a number of important conflicts, such as the Battle of Crecy and the Battle of Agincourt.

The French eventually regained their territory and their national identity as the war came to a close. The House of Lancaster and the House of York, two branches of the royal House of Plantagenet, fought each other in a series of civil wars in England from 1455 to 1487. There was a great deal of political instability as a result of these battles for control of the English monarchy.

3.4 The Period of Holy Crusades

In order to retake the Holy Land from Muslim rule, the European Christian Latin Church organised a series of military battles known as the Crusades between 1096 and 1291. Europe and the Middle East's political, social, and cultural landscapes were significantly impacted by the Crusades.

When the Byzantine emperor Alexios I asked for assistance, Pope Urban II launched the First Crusade, which lasted from 1096 to 1099. Jerusalem was effectively taken during this crusade, and other Crusader nations were founded. In an attempt to retake the County of Edessa, European rulers such as King Louis VII of France and Emperor Conrad III of Germany conducted the Second Crusade from 1147 to 1149, but it was unsuccessful. The Holy Roman Emperor Frederick I, Philip II of France, and Richard I of England led the Third Crusade, often known as the Kings' Crusade, which took place between 1189 and 1192.

While some areas were retaken as a result of the crusade, Jerusalem was not reclaimed. Between 1202 and 1204, the Fourth Crusade veered off course and ultimately resulted in the fall of Constantinople, a Christian city, and the founding of the Latin Empire. The Children Crusade of 1212 is an unofficial and tragic movement in which thousands of children attempted to retake the Holy Land but either died on the arduous journey or were sold into slavery. The later crusades, which took place between 1217 and 1270, showed diminishing benefits and mostly failed to accomplish their goals. The Crusades had a significant impact on politics, the economy, and cross-cultural interactions in both Europe and the Middle East. Long-lasting disputes between various religious groups were also caused by them.

3.5 The Mongol Invasions

During the 13th century, the Mongol Empire, led primarily by Genghis Khan, launched a number of military expeditions throughout Europe and Asia as part of the Mongol Invasion. The biggest contiguous empire in history was established as a result of the profound political and cultural changes these invasions brought to the areas they overran. These are some salient features of these invasions. The nomadic tribes of the Mongolian steppe were brought together by Genghis Khan, the Mongol invader, who also conducted wars throughout Central Asia. Among his conquests were portions of China. The Yuan Dynasty was established under Kubla

Khan, the grandson of Genghis Khan, after the Mongols overran the Jin and Southern Song dynasties in northern China in 1211.

During their invasion of eastern and western Russia in the 1230s, the Mongols also pillaged cities including Ryazan, Vladimir, and Kiev. The Russian provinces were subjugated as a result of the Mongols' victory at the Battle of the Kalka River in 1223 and the full-scale invasion that followed. As the Mongols advanced westward, they captured cities in Eastern Europe, including Hungary and Poland. The Abbasid Caliphate came to an end in 1258 when the Mongols invaded the Middle East and sacked Baghdad.

Their conquests had a profound effect on the political and cultural climate of the area. The extensive conquests of the Mongol Empire promoted trade and cultural interchange throughout Eurasia, but they also left many areas in ruins. A pivotal moment in world history, the Mongol invasions altered the political borders and cultural landscapes of the areas they overran.

3.6 The Other Significant Medieval Period Military Conflicts

The Wars of Scottish Independence, which took place between the Kingdom of England and the Kingdom of Scotland in the late 13th and early 14th centuries, were the other major military battles of the mediaeval era. Scotland's fight for independence served as the impetus for these conflicts. In these battles, notable individuals like Robert the Bruce and William Wallace were crucial. From 1296 to 1328, the first War of Scottish Independence was waged. The dispute started when Scotland had no heir apparent following the deaths of King Alexander III in 1286 and his young granddaughter Margaret, Maid of Norway, in 1290. Although he was asked to mediate the succession, Edward I of England took advantage of the occasion to establish his dominance over Scotland.

In 1296, Edward I invaded Scotland, taking control of important strongholds and compelling King John Balliol to surrender. A major Scottish resistance led by Andrew Moray and William Wallace resulted in the defeat of the English soldiers in the Battle of Stirling Bridge in 1297. Numerous battles and skirmishes followed throughout the conflict, but the Battle of Bannockburn in 1314—where Robert the Bruce's forces routed the English army—was the pivotal event. The Treaty of Edinburgh-Northampton, which acknowledged Scotland's independence, was signed in 1328, marking the end of the war.

Edward Balliol's invasion, which was backed by England and claimed the Scottish crown, was the catalyst for the second war. Although Balliol was initially victorious, the Scots continued to oppose him. Numerous battles and changes in territorial control occurred during the period. The Treaty of Berwick, which reaffirmed Scotland's independence, was signed in 1357, marking the conclusion of the war. Scotland's national identity and its ties with England were significantly shaped by these battles. They also emphasised the rise of important individuals who came to represent Scottish independence and resistance, such as Robert the Bruce and William Wallace. These wars had a long-lasting effect on the evolution of contemporary countries and moulded the political, social, and cultural fabric of mediaeval Europe.

Chapter 4

Environmental Consequences of Ancient and Medieval Warfare

In this chapter

- 4.1 Resource Management in Ancient Military Campaigns**
- 4.2 Effects of Warfare Tactics on Environment in Ancient Times**
- 4.3 Weaponizing of Animals during Ancient Warfare**
- 4.4 Role of Climate Change and Natural Disasters on Ancient Warfare**

Edward Balliol, who claimed the Scottish crown, invaded with English help, starting the second war. Despite his early success, Balliol encountered constant opposition from the Scots. There were multiple battles during the period, and territory control changed. The Treaty of Berwick, which was signed in 1357 and reaffirmed Scotland's independence, marked the conclusion of the war. Scotland's ties with England and its sense of national identity were greatly influenced by these battles. They also emphasised how important individuals like Robert the Bruce and William Wallace came to represent Scottish independence and struggle. These wars influenced mediaeval Europe's political, social, and cultural environment and had a long-lasting effect on how contemporary countries developed.

4.1 Resource Management in Ancient Military Campaigns

Ancient societies frequently modified their war tactics to fit the ecological and physical features of their environments. For instance, militaries used geographical features like rivers and mountains to their advantage. In ancient battles, resource management entailed the planned distribution and use of supplies necessary to support military operations. Food supply, weapons, and labour were all effectively managed, enabling civilisations to make efficient use of their resources.

The means by which ancient armies ensured resource availability were varied. The methods included cultivating crops to feed troops, establishing routes for transporting materials and provisions and forming partnerships to share or procure resources. Commanders often prioritized resource preservation to maintain troop morale and effectiveness. This included safeguarding settlements and utilizing local resources, thus integrating environmental factors into their strategic assessments.

The results of numerous historical conflicts were influenced by effective resource management. Ancient civilisations' military and environmental prowess was greatly influenced by their capacity to outlast adversaries while preserving logistical support.

4.2 Effects of Warfare Tactics on Environment in Ancient Times

The enemy's food supplies and production systems were destroyed by means of methods including burning fields, salting croplands, and poisoning wells. Through famine, these scorched-earth policies undermined civilisations. The Scorched Earth Policy, which may be characterised as "the act of an army destroying everything in an area that could be useful to an enemy," included agricultural warfare as one of its main facets in antiquity. Once-prosperous areas were rendered useless and unproductive by methods like the Scythians' burning, the Assyrians' weed-planting, the salting of crops, and the poisoning of wells in Mesopotamia. Civilisations were weakened by starvation as a result of the destruction of enemy food supplies and industrial systems.

4.3 Weaponizing of Animals during Ancient Warfare

The other primary strategy in ancient warfare was the use of animals as weapons. In battle, animals such as pigs, horses, elephants, and even bees were employed. While bees and scorpions were used as weapons to inflict bodily pain, elephants were utilised to crush enemy armies. War was fought with animals. We could recognise several common animal battle strategies utilised in ancient conflict, despite the films' theatrical and fictional portrayals of creatures engaged in combat. Horses were utilised for transportation, and elephants were used for fighting, ravaging and trampling on enemy forces.

Dogs, pigeons, and pigs were among the other creatures employed. Animals were used as weapons in addition to fighting; the use of entomological warfare is a prime example. The Roman Empire employed fleas as disease carriers and "scorpion grenades" and "bee bombs" as weapons to inflict bodily harm.

Unquestionably, ancient warfare had terrible ecological effects in addition to being about the conquest and fall of civilisations. Since ancient battle took place so long ago, it was understandable that I had a hard time finding data that quantified their precise spatial and chronological extents. Nevertheless, we can learn more about them from contemporary examples. For instance, we know that weed introduction significantly disrupts ecosystem processes and biodiversity in addition to lowering crop productivity.

Ancient wars had terrible ecological effects in addition to being about empires winning and losing. It was difficult for me to find data that quantified their precise chronological and spatial extents; this is to be expected given that ancient battle took place a very long time ago. We can learn more about them, however, from contemporary examples. The introduction of weeds, for instance, is known to significantly disrupt ecosystem processes and biodiversity in addition to lowering agricultural output.

4.4 Role of Climate Change and Natural Disasters on Ancient Warfare

Ancient warfare was also influenced by natural calamities and climate change. For example, as demonstrated by Alexander the Great's campaigns, intense rains could affect troop movements and the results of battles. Throughout history, natural disasters have impacted the direction and results of conflicts, frequently changing military tactics and power dynamics. Natural disasters

like earthquakes and volcanic eruptions have had a big influence on supply lines, defences, and troops. For example, Roman military logistics were interrupted by the earthquake in the Antioch region in 363 AD, giving their enemies a strategic edge. The structural damage made it impossible to effectively mobilise soldiers, illustrating how environmental factors may undermine well-prepared militaries.

Likewise, the dynamics of battle have been severely impacted by volcanic explosions. Although most famous for destroying Pompeii, Mount Vesuvius' eruption in 79 AD also changed local access routes and produced chokepoints that were essential for military operations. Ancient military planners needed to be aware of these natural dangers.

In summation, the influence of natural disasters on warfare serves as a poignant reminder of the connection between human conflict and environmental elements, underlining the unpredictability inherent in every military attempt throughout history.

Knowing these relationships is essential to comprehending how the environment affected ancient warfare and the ensuing wider societal repercussions. It also provides insights for current debates about sustainability and war.

Chapter 5

Early Modern Warfare

In this chapter

- 5.1 Technological Advancements after Introduction of Gunpowder**
- 5.2 The Age of Sail: Naval Warfare**
- 5.3 Early Modern Warfare and the Era of Colonial Conquests**
- 5.4 Interconnection of Warfare and Environmental Factors**
- 5.5 Weather and Climatic Influences of Warfare**

Early modern warfare was a pivotal time in military history, roughly from the late 15th century to the late 18th century. The scope of warfare, tactics, and technology all underwent substantial changes throughout this time. The primary characteristic of the time was technological advancement.

During this time, gunpowder's development and broad application transformed warfare and paved the way for the creation of artillery and firearms. Traditional weapons like bows and crossbows were gradually supplanted by early firearms like muskets and arquebuses. A portable, long-barrelled weapon, the arquebus was in use from the fifteenth to the seventeenth centuries. Because of its weight, the matchlock pistol shot from a support. Arquebus and musket are not the same thing. Introduced in 1521, the musket is essentially a big arquebus, but as armour declined, it lost favour by the middle of the 16th century. However, the term persisted, and throughout the middle of the 19th century, "musket" became a general term for shoulder-mounted smoothbore gunpowder weaponry.

During the early modern era, sieges and battlefield tactics were altered by the employment of artillery and the advancement of cannons and mortars. To survive artillery bombardment, fortifications had to change. Early modern combat was greatly impacted by artillery, which changed military tactics and strategy.

5.1 Technological Advancements after Introduction of Gunpowder

The employment of mortars, howitzers, and cannons were examples of technological advancements at this time. Canons, which could fire heavy projectiles over great distances, were developed as a result of the introduction of gunpowder. During sieges, these were crucial in breaking through walls. Because mortars and howitzers could shoot explosive shells at great angles, they were useful for hitting fortifications and men hiding in hiding.

In siege warfare, artillery was crucial because it allowed forces to bombard enemy strongholds and erode their fortifications before attacking. In order to provide firepower and disrupt opposing formations, mobile artillery units were deployed on the battlefields to assist infantry and cavalry. In naval conflicts, artillery was also essential, with ships armed with cannons to

shoot down enemy ships. As artillery advanced, fortification designs had to adapt, and star forts with angled bastions were built to better withstand cannon fire. Because of this, the old-fashioned mediaeval castles were rendered obsolete, and new defences were built with thicker, lower walls and mud fortifications to withstand cannon fire.

Because of the psychological anxiety that artillery instilled in both soldiers and civilians, besieged castles frequently surrendered without a fight. One well-known instance of how artillery affects siege warfare is the Ottoman Empire's use of massive cannons to break the walls of Constantinople. Artillery played a major role in the Thirty Years' War, which raged from 1618 to 1648. Both sides used mortars and cannons in many engagements and sieges. The development of artillery in the early modern era prepared the way for later developments in military strategy and technology.

5.2 The Age of Sail: Naval Warfare

In maritime history, naval warfare during the Age of Sail; which lasted from the late 16th century until the middle of the 19th century; was an exciting and revolutionary time. Gunpowder-powered naval artillery, which was essential in naval conflicts, rose to prominence during this time. Large sailing ships with several masts and sails, such as galleons and frigates, that were propelled by the wind were used to characterise this era. From the 15th to the 18th centuries, Spain in particular used this type of sailing ship, first for warfare and then for commerce. Galleons were ships typically having the principal sails at right angles to the length of the ship, supported by horizontal yards attached to the masts and had three or more decks.

At the period, notable naval powers continued to have a commanding position. Because of its excellent shipbuilding methods and highly skilled sailors, the Royal Navy of Britain became the preeminent naval power. France made significant investments in its navy and attempted to challenge British hegemony through maritime operations and geopolitical alliances. To defend its extensive colonial lands throughout the Americas, Spain also had a strong navy. Dominance of the navy was essential for policing trade channels and defending merchant vessels against adversaries and pirates. By allowing the movement of troops and supplies to far-flung colonies, naval might also contributed to the growth of European empires.

5.3 Early Modern Warfare and the Era of Colonial Conquests

Conflicts with native communities resulted from the colonial expansion of European powers. The military confrontations with other competing colonial powers also resulted from this. Notable examples include the Anglo-French colonial wars and the Spanish Conquest of the Americas. Colonial conquests, especially during the Age of Discovery and thereafter, are the times when European nations increased their global reach by capturing and settling areas all over the world. European countries like Portugal, Spain, England, France, and the Netherlands established colonies during this time, mostly in Asia, Africa, and the Americas.

The conquest of Ceuta in North Africa in 1415 marked the beginning of Portuguese conquests. The Portuguese grew their empire to encompass parts of South America, Asia, and Africa. Portugal became a major maritime power thanks in large part to its victories during the Age of

Discovery. Significant expeditions and territorial expansions occurred during this time, which spanned the 15th and 16th centuries.

The Age of Discovery is frequently attributed to Prince Henry the Navigator. In Sagres, Prince Henry founded a navigation school that advanced exploration and nautical science. The Portuguese word "sagres" means "holy." Additionally, it is the name of a fishing village in Portugal's Algarve. Ancient cultures such as the Phoenicians, Greeks, and Romans gave the region their name.

Bartolomeu Dias established a new maritime route to the Indian Ocean in 1488 by becoming the first European to circumnavigate the Cape of Good Hope, which is located at the southern tip of Africa. After the Dias' successes, Vasco da Gama of Portugal established a direct commercial route and cemented Portugal's supremacy in the spice trade by sailing to India in 1498.

Portugal was able to develop colonies and commercial stations all over the world thanks to its nautical strength. Among the noteworthy regions were the coastal regions and islands of Africa, including Madeira and the Azores; important commercial hubs in Asia, including Goa, Malacca, and Macau; and the huge expanse of Brazil, which Pedro Álvares Cabral discovered in America in 1500. World trade, cultural interaction, and colonisation were all significantly impacted by the Portuguese Empire's global reach. The money earned from these endeavours made Lisbon a significant international commerce centre.

Explorers such as Hernán Cortés and Christopher Columbus led the Spanish Conquests. In the Americas, including what is now Mexico, Peru, and the Caribbean, the Spanish Empire founded sizable colonies. Through colonisation in North America, India, Australia, and Africa, the British Empire grew in power. The Caribbean, North America, and portions of Africa were all colonised by the French. Military force, trade monopolies, and forcing European culture and administration on native populations were common components of these conquests. Many nations' cultural, political, and economic environments are still impacted by colonialism today.

5.4 Interconnection of Warfare and Environmental Factors

Environmental influences and warfare have a close relationship that has shaped military tactics and the outcome of wars throughout history. The link between the two changes as the environment affects troop movements, resource availability, and battle capability.

In the past, armies have modified their strategies to take advantage of topographical characteristics like plains, rivers, and mountains. These geographical factors frequently determine the result of battles; Hannibal's traversal of the Alps, for example, illustrated the strategic value of difficult terrain in ancient warfare.

In order to take advantage of topographical features like plains, rivers, and mountains, armies have historically modified their strategies. The results of battles are frequently determined by these geographical factors; Hannibal's traversal of the Alps, for example, illustrated the tactical benefit of difficult terrain in ancient warfare.

5.5 Weather and Climatic Influences of Warfare

Throughout history, armies have modified their strategies to take advantage of topographical features like plains, rivers, and mountains. These geographical factors frequently determine the results of battles; Hannibal's traversal of the Alps, for example, illustrated the tactical benefit of difficult terrain in ancient warfare.

Seasonal variations, rainfall, and temperature swings could either strengthen defences or make it more difficult for troops to move. For example, too much rain would cause the ground to become muddy, which would hinder troop movement and make logistics more difficult. Seasonal droughts, on the other hand, may result in a shortage of resources, forcing armies to launch more forceful offensives.

Warfare was also disrupted by a number of weather occurrences. Storms may cause supply lines to be damaged or military operations to be postponed. Extreme weather events, including heat waves or cold snaps, may also have an impact on soldier performance and battlefield sustainability.

A variety of meteorological events also caused disruptions during combat. Storms could disrupt supply lines or compel military operations to be postponed. Furthermore, troop effectiveness and battlefield sustainability may be impacted by extreme weather events like heat waves or cold snaps.

Chapter 6

Industrial Warfare and the Rise of Modern War

In this chapter

- 6.1 The Innovation of Total War Concept**
- 6.2 The Scorched Earth Tactics**
- 6.3 Ethical Considerations of Warfare**
- 6.4 Impact of Industrial Warfare on Societies, that ultimately on Environment**
- 6.5 Effects of Industrial Warfare on Future Military Conflicts in Making Mass Destruction Machine**
- 6.6 The Lessons to Learn from Industrial Warfare**
- 6.7 Modern Warfare**

The advent of industrial warfare during the Industrial Revolution and its continuation until the start of the Atomic Age represented a dramatic change in the nature of conflict. This era of industrial warfare saw significant technological breakthroughs.

Ammunition and military weaponry were produced in large quantities. Larger and better-equipped armies were made possible by the capacity to mass-produce ammunition, guns, and other military equipment. Rapid army movements and supply lines were made possible by the advent of railroads, and rapid communication across great distances was made possible by the recently developed telegraph system. The lethality of battle increased with the introduction of machine guns, chemical weapons, high-velocity artillery, and rifled breech-loading firearms.

6.1 The Innovation of Total War Concept

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6.2 The Scorched Earth Tactics

Both military weapons and ammunition were produced in large quantities. More powerful and well-equipped armies were made possible by the capacity to mass-produce guns, ammunition, and other military supplies. While the newly developed telegraph system provided for speedy communication across great distances, the advancement of railroads allowed for swift army movements and supply lines. With the introduction of machine guns, chemical weapons, high-velocity artillery, and rifled breech-loading firearms, the lethality of battle increased.

One well-known example is General William Tecumseh Sherman's March to the Sea during the American Civil War. Sherman's troops crippled the Confederate war effort by demolishing industries, railroads, and other infrastructure. In order to deny the advancing enemy resources, Russian soldiers used scorched earth tactics in both Napoleon's invasion of Russia in 1812 and Hitler's invasion during World War II. They did this by burning their own villages and crops. During the Vietnam War, the US employed scorched earth tactics, destroying farms and villages to cut off the Viet Cong's supply routes.

Even if international regulations and treaties have made the use of scorched earth tactics less widespread, they have still been used in recent conflicts. For instance, there have been allegations of infrastructure being damaged to impede the enemy's progress during the Russian invasion of Ukraine in 2022. The eastern city of Bakhmut reportedly employed scorched earth techniques during the Russian invasion of Ukraine. These strategies were used by Russian forces, who used artillery fire and aircraft to damage positions, infrastructure, and buildings.

Despite being less prevalent now because of international norms and treaties, scorched earth methods have been used in recent conflicts. In order to impede the enemy's advancement, for instance, infrastructure was reportedly damaged during the Russian invasion of Ukraine in 2022. Bakhmut in the east was purportedly subjected to scorched earth techniques during the Russian invasion of Ukraine. By using airstrikes and artillery fire to destroy buildings, infrastructure, and positions, Russian forces used these methods.

6.3 Ethical Considerations of Warfare

Because of its effects on both the environment and civilians, the employment of scorched earth tactics is contentious. Targeting items that are essential to the civilian population's existence, such as food supply and water sources, is forbidden by the Geneva Conventions of 1977. Because scorched earth practices cause so much pain and ruin, they present serious ethical issues. The application of scorched earth tactics raises several important ethical issues.

Civilians are impacted the most. Civilians are frequently displaced as a result of scorched earth techniques, losing their houses, means of subsistence, and access to basic supplies like food and water. Serious human rights breaches, such as the right to life, decent housing, and access to healthcare and education, can result from the destruction of civilian infrastructure.

The loss of ecosystems causes significant harm to the environment. Burning woods, crops, and other natural resources on purpose can harm the environment over time by upsetting ecosystems, causing soil erosion, and reducing biodiversity. Hazardous contaminants can be released into the air, water, and soil by the use of fire and explosives, endangering the health of both people and wildlife.

Targeting items that are essential to the civilian population's life is forbidden by international humanitarian law, particularly the Geneva Conventions, which are violated by scorched earth techniques. States have a moral obligation to reduce the harm that war does to the environment and to civilians. Preserving the environment and protecting non-combatants should be the goals of military tactics.

International humanitarian law, such as the Geneva Conventions, forbids using scorched earth techniques to target items that are essential to the civilian population's existence. In times of warfare, states have a moral obligation to reduce the harm done to civilians and the environment. Protecting non-combatants and protecting the environment should be the goals of military strategy.

The employment of scorched earth techniques in armed confrontations has long-term effects. The devastation brought about by scorched earth techniques can prolong the suffering of impacted populations by making post-conflict recovery and reconstruction efforts more challenging and costly. Such strategies can exacerbate long-lasting animosity and obstruct attempts to bring disputing parties together and establish a sustainable settlement. In the past, the international community has frequently denounced the use of scorched earth techniques, and those who have done so have occasionally been charged with war crimes.

The moral substitutes for scorched earth techniques must be followed by the warring powers. Instead of causing extensive destruction, military operations should use focused operations and precision strikes to minimise harm to individuals and the environment. In accordance with international humanitarian law, efforts ought to be taken to safeguard civilians and offer humanitarian aid during hostilities. Military strategists and decision-makers can develop more intelligent and compassionate plans by taking these ethical considerations into account.

6.4 Impact of Industrial Warfare on Societies, that ultimately on Environment

Social roles were significantly impacted by industrial warfare, which changed many facets of daily life and social institutions. Women filled traditionally male-dominated jobs in shipyards, factories, and other industries as a result of the large number of men joining the military. Greater gender equality was made possible by this change, which questioned established gender norms. Gender barriers were further broken by women serving in military support positions as auxiliary services, clerks, and nurses.

There are also changes in the economy. People moved from rural to urban areas to work in factories as a result of the wartime demand for output. The demographic environment was altered by this urbanisation, which also brought up new business prospects. As workers demanded improved rights and protections due to the terrible working conditions and poor earnings in wartime industries, labour unions were formed and socialism emerged.

Government policy changes and the rise of new political ideologies were prompted by the demand for improved public services and infrastructure in quickly expanding metropolitan areas. By regulating companies and raising funds for the war effort, governments became more involved in the economy. In order to sustain popular support for the war effort and promote a sense of unity and nationalism, governments also employed propaganda. People from different origins came together for the war effort, which changed social interactions and cultural conventions.

The impacts of industrial warfare are not immediate. Long-term changes in social classes and job structures resulted from civilisations' need to rebuild and adjust to the new economic and social realities following the war. Wartime inventions frequently found use in peacetime, further revolutionising ordinary life and industries.

Gender roles, economic systems, and political environments were all profoundly impacted by industrial warfare. The ecology is impacted by industrial warfare in one way or another.

6.5 Effects of Industrial Warfare on Future Military Conflicts in Making Mass Destruction Machine

In a number of important ways, industrial warfare prepared the ground for later conflicts. The foundation for more sophisticated military technologies in upcoming battles was established by the development of machine guns, tanks, aeroplanes, and chemical weapons during industrial warfare. Mass production of supplies and weaponry transformed military logistics, enabling the maintenance of longer campaigns and larger forces.

It became commonplace to combine various military branches (cavalry, artillery, infantry, and eventually the air forces) into unified groups, which had an impact on contemporary military doctrines. As demonstrated in both World Wars, the concept of organising entire societies—including industry and civilians—for war remained a defining characteristic of subsequent battles.

Particularly during World War II, the idea of a war economy—wherein national resources are allocated to military production—became crucial to subsequent battles. Significant social and

economic changes resulted from the necessity of rebuilding and economic recovery following major conflicts, which had an impact on international relations and post-war policies.

The employment of propaganda to sustain public support and morale during wartime became a crucial tactic in subsequent conflicts, and the direct or indirect participation of civilians in the war effort established a precedent for future conflicts in which the distinction between combatants and non-combatants became hazy.

With new industrial powers like the United States and Japan taking on larger roles on the international scene following the World Wars, industrial warfare helped to change the balance of power in the world. In the middle of the 20th century, the fall of colonial empires and the emergence of independence movements were hastened by the military and economic strains of industrial warfare. For the Indian Independence Movement, this is what transpired. Together, these modifications shaped the nature of warfare, influencing subsequent conflicts' tactics, technological advancements, and social effects.

6.6 The Lessons to Learn from Industrial Warfare

A number of significant lessons from industrial warfare are still applicable today. Industrial warfare's quick speed of technology advancement emphasises the necessity of ongoing innovation in the defence industry as well as other fields. Dual-use research and development is crucial since many technologies created for military use also find usage in civilian settings.

Both in times of war and peace, efficient resource management is essential. In the event of a crisis, nations must be ready to swiftly and effectively mobilise economic resources. Keeping a strong industrial base guarantees that a nation can manufacture the supplies and goods it needs when it needs them.

Both economic stability and national security depend on strategic planning and forethought. Future obstacles must be anticipated and planned for by decision-makers. The concept of uniting all facets of society in a shared endeavour can be utilised to tackle a number of worldwide issues, including pandemics and climate change.

The growing employment of women and other cultural changes brought about by industrial warfare highlight how crucial equality and inclusivity are to maximising a country's potential. In every large-scale endeavour, sustaining public support and morale is essential. This can be accomplished with the aid of clear communication and persuasive propaganda.

For the sake of national security, alliance building and maintenance are essential. International collaboration and diplomatic initiatives can support world stability and conflict avoidance. The destruction caused by industrial warfare emphasises how crucial humanitarian concerns are during and after conflicts. For peace to last, efforts must be made to restore civilisations and safeguard civilians.

Future wars can be avoided by having a better understanding of the origins, development, and effects of previous conflicts. Historical lessons can guide present-day tactics and policy. We can better prepare for and handle the intricate problems of the modern world by looking at the lessons learnt from industrial warfare.

6.7 Modern Warfare

Modern warfare has evolved significantly over the past century, incorporating advanced technology, sophisticated tactics, and new forms of combat.

The advancement of guided missiles, drones, and smart bombs in contemporary combat enables extremely precise targeting, minimising collateral damage. Cyberattacks target networks and computer systems, interfering with infrastructure, communication, and vital services. electrical signals used to interfere with adversary communications, radar, and other electronic equipment.

Modern combat is characterised by numerous tactical developments. Guerrilla warfare, insurgencies, and counterinsurgency operations are examples of conflicts in which the capabilities of the opposing forces are not comparable. In order to accomplish strategic goals, it blends traditional military power with irregular tactics, cyber operations, and information warfare.

Civilians are frequently affected by contemporary conflicts, which can result in displacement, humanitarian crises, and shifts in social roles. Information and the media now play a critical role in determining public opinion and how conflicts develop.

Respecting international rules and agreements, including the Geneva Conventions, is crucial for safeguarding people and guaranteeing moral behaviour during hostilities. One of the most important ethical factors in contemporary conflicts is ensuring the protection of human rights and reducing injury to non-combatants.

The Gulf War (1990–1991) and the ongoing Russia-Ukraine War (2022–present) are two significant wars that illustrated the use of cyberwarfare, electronicwarfare, and the effects of information warfare. They also showed the effectiveness of precision-guided munitions and air superiority. Due to shifts in the geopolitical environment and technological breakthroughs, modern warfare is still evolving.

Chapter 7

The World Wars Changed Warfare Scenario Beyond Imagination

In this chapter

- 7.1 World War I (1914-1918)**
- 7.2 World War II (1939-1945)**
- 7.3 Effects of World Wars on Society and Culture**
- 7.4 Influence of World Wars on Modern International Relations**
- 7.5 Historical Influences of World Wars on Current Public Policy**
- 7.6 Influences of World Wars in Shaping Today's Global Conflicts**
- 7.7 Cold War Struggle**
- 7.8 Consequences of the Cold War for the World**
- 7.9 Contemporary Conflicts**

The 20th century saw two worldwide battles, the First World War (1914–1918) and the Second World War (1939–1945), which caused unheard-of levels of death and ecological damage. Tanks, aircraft, and nuclear bombs were among the cutting-edge technologies used in these conflicts.

7.1 World War I (1914-1918)

A number of both immediate and long-term circumstances contributed to the complicated and multidimensional origins of World War I.

Rivals and conflicts resulted from the intense competition between European powers for colonies and resources. Desires for independence and self-determination were driven by nationalistic zeal and ethnic tensions, especially in areas like the Balkans. Armies and navies were accumulated as a result of the weapons race and the conviction that using force to settle conflicts was a good idea. A web of responsibilities and commitments was established by the creation of military alliances, such as the Triple Entente (France, Russia, and Britain) and the Triple Alliance (Germany, Austria-Hungary, and Italy). The escalating tensions were exacerbated by trade conflicts and economic competitiveness among European powers.

The assassination of Austria-Hungary's heir apparent, Archduke Franz Ferdinand, by a Serbian nationalist in Sarajevo on June 28, 1914, was the direct cause of World War I. It set off a series of alliances and disputes that ultimately resulted in a full-scale battle. Following the assassination, Austria-Hungary declared war on Serbia on July 28, 1914, the culmination of the July Crisis, a string of diplomatic crises and ultimatums. Germany, Russia, France, and Britain became involved as the battle quickly escalated due to the intricate network of alliances. These elements worked together to make Europe unstable, which finally caused World War I to start.

On one side were the Central Powers, which included Germany, Austria-Hungary, the Ottoman Empire, and Bulgaria; on the other were the Allied Powers, which included France, the United Kingdom, Russia, Italy, and subsequently the United States. The war's major events were the Gallipoli Campaign, the Battle of the Somme, trench warfare, and the use of chemical weapons. With the 1919 signing of the Treaty of Versailles, which redrawn the European map and forced Germany to pay large reparations, the war came to an end.

7.2 World War II (1939-1945)

Another world war broke out as a result of the advent of fascist governments in Germany, Italy, and Japan as well as unresolved concerns from World War I. Germany, Italy, and Japan were the Axis Powers, while the United States, the Soviet Union, the United Kingdom, and China were the Allies.

The major events of the war continued to be the D-Day landings, the Holocaust, the invasion of Poland, the Battle of Britain, and the use of atomic bombs on Hiroshima and Nagasaki. The Axis forces' unconditional surrender marked the end of the war, and the United Nations was founded to advance world peace and collaboration.

Both World Wars had such terrible effects on the environment and ecosystems that they will be covered in the upcoming Case Studies chapters.

7.3 Effects of World Wars on Society and Culture

The world was reshaped in many ways by the World Wars, which had significant and long-lasting effects on society and culture. Women filled traditionally male-dominated jobs in offices, factories, and even military support positions as a result of the large number of males in the military. This change questioned established gender roles and helped feminism and the women's rights movement gain traction. Significant economic changes resulted from the conflicts, such as the formation of labour unions, the rationing of necessities, and the mobilisation of entire economies for the war effort. Reconstruction and economic recovery were priorities in the years following the war.

Redrawing state borders and establishing new governments were among the political transformations brought about by the conflicts. In order to foster global peace and collaboration, the United Nations was established following World War II. Through their artistic and literary creations, artists and authors conveyed the anguish and atrocities of the conflicts. Movements like Dadaism and Surrealism emerged around this time, reflecting the instability and disillusionment of the era.

Dadaism, often known as the Dada movement, was an artistic and literary movement that originated during World War I in Europe. It began around 1916 in Zurich, Switzerland, and was marked by its anti-establishment beliefs. The movement aimed to question established conventions and conventional art forms in response to the atrocities and absurdity of the war. Tristan Tzara, Jean Arp, Hannah Höch, and Marcel Duchamp are a few well-known Dadaists. The movement continues to have an impact on modern art and society and has a major influence on following art movements like Fluxus and Surrealism.

7.4 Influence of World Wars on Modern International Relations

Modern international relations have been profoundly and permanently impacted by the World Wars, which have shaped the geopolitical landscape in a number of ways. In order to foster global peace and collaboration, the United Nations (UN) was founded as an international institution following World War II. The UN has been essential in promoting development, resolving disputes, and protecting human rights. In 1949, the North Atlantic Treaty Organisation (NATO) was established as an alliance for collective defence. NATO still has an impact on member states' military cooperation and the dynamics of global security.

The Cold War witnessed the creation of military alliances like NATO, the Warsaw Pact, and multiple proxy conflicts as a result of the ideological differences between the US and the USSR (formerly the USSR). This competition affected contemporary conflicts and moulded world relations for many years. Global nuclear strategy and deterrent tactics are still influenced by the idea of mutually assured destruction (MAD), which was created during the Cold War through the creation and spread of nuclear weapons.

Surrealism Movement

Early in the 1920s, the literary and artistic movement known as surrealism emerged, primarily in response to the destruction caused by World War I and the seeming shortcomings of logical reasoning. It aimed to transcend the mundane facts of daily life and unleash the creative potential of the unconscious mind. French author André Breton established the movement when he released the first Surrealist Manifesto in 1924.

Radar, jet engines, and nuclear weapons were among the technological innovations that were spurred by the wars. These developments had a long-lasting effect on civilian and military life. International organisations devoted to preventing future atrocities were established as a result of the wars' atrocities, especially the Holocaust, which increased awareness of human rights throughout the world.

World Wars have long-lasting consequences. The baby boom, a sharp rise in birth rates following World War II, had long-lasting effects on the population. New political philosophies and a rethinking of national identities resulted from the wars. Systems to assist veterans and the general public were established as a result of the conflicts' emphasis on the necessity of social welfare initiatives. Gender roles, economic systems, political environments, and cultural standards were all profoundly impacted by the World Wars. Our world is still being shaped by these changes.

The European Union and its predecessors were formed as a result of attempts to promote economic cooperation and avert future wars in Europe following the devastation of World War II. The Marshall Plan and other post-war reconstruction initiatives fostered economic recovery and collaboration, establishing the framework for contemporary trade agreements and economic alliances. In order to supply post-World War II Western Europe with foreign help, the United States implemented the Marshall Plan, also known as the European Recovery Program (ERP), in 1948. In order to help rebuild war-torn areas, lower trade barriers, modernise industry, and boost European prosperity, the United States donated \$13.3 billion, or about \$173.8 billion in 2024, to economic recovery programs.

The goal of the strategy was to stop communism from spreading and establish stable conditions that would allow democratic institutions to endure. It was primarily superseded by the Mutual Security Act in 1951 after operating for four years, from April 3, 1948, to December 1951. On October 10, 1951, President Harry S. Truman signed a landmark piece of legislation into law:

the Mutual Security Act of 1951. During the Cold War, it sought to support American allies militarily, economically, and technically, mainly to counter Soviet "encroachment" into Western Europe.

The measure approved around \$7.5 billion, or about \$88 billion a year as of 2024, for foreign assistance. It created the Mutual Security Agency (MSA) to oversee aid delivery, replacing the Marshall Plan. The objective was to stop the rise of communism and aid in the development of poor US allies. Established by the Mutual Security Act of 1951, the Mutual Security Agency (MSA) was in operation from October 10, 1951, until August 1, 1953.

Its main goal was to support allied nations militarily, economically, and technically so they could fortify their defences and mutual security. The Economic Cooperation Administration (ECA), which had only addressed economic help, was superseded by the agency. The MSA was in charge of managing initiatives that aided ally countries' security and development while assisting them in halting the spread of communism.

As part of a reorganisation plan in 1953, the Foreign Operations Administration assumed the MSA's responsibilities. Reorganisation Plan No. 7 of 1953 created the Foreign Operations Administration (FOA) on August 1, 1953. Centralising all governmental activities pertaining to the cooperative growth of economic and military might among the free world's nations was its main objective. The Technical Cooperation Administration and the Mutual Security Agency were superseded by the FOA.

The FOA was in charge of managing foreign aid initiatives, which included both military and financial support. Executive Order 10610, issued on May 9, 1955, ended the FOA's brief existence. After that, its duties were divided and given to the Department of Defence for military support and the International Cooperation Administration (ICA) for economic support. The ICA was created to oversee nonmilitary security projects and foreign aid programs. It was in charge of managing development initiatives and financial assistance to assist nations in halting the rise of communism. Its main objectives were economic growth, technical collaboration, and bolstering democratic institutions in allies.

The Geneva Conventions, which established global guidelines for humanitarian treatment during times of war and have shaped contemporary international humanitarian law, were established as a result of the horrors of World War II. International human rights movements and organisations like Amnesty International and Human Rights Watch were sparked by the atrocities of the Holocaust and other war crimes. Later chapters will go into greater detail on this topic.

Using lessons learnt from the World Wars, the United Nations and other international organisations have carried out peacekeeping missions to avert and end hostilities. The experience of international battle has prompted attempts to use economic penalties, international collaboration, and diplomacy to avert future wars. The wars sped up the globalisation process, increasing migration, cultural interchange, and international interconnectedness. People became more conscious of global challenges and the value of international cooperation in resolving them as a result of the wars' extensive effects.

Advanced technologies developed during and after the World Wars, such as drones and precision-guided weapons, are used in modern wars. From the earliest stages of electronic warfare, the idea of employing technology to interfere with enemy infrastructure and

communications has developed. The Geneva Conventions' tenets still serve as a guide for both civilian protection and war conduct. Using the lessons learnt during the World Wars, international organisations such as the United Nations carry out humanitarian relief and peacekeeping missions.

The economic measures implemented during and after World Wars I and II are the origins of the use of economic sanctions as an instrument of international policy. Globalisation was sped up by the wars, which enhanced international collaboration and economic interdependence. People became more conscious of global challenges and the value of international cooperation in resolving them as a result of the wars' extensive effects. Modern policies for aiding military soldiers and their families have been impacted by the creation of social welfare programs for veterans.

The persistence of historical borders, the application of cutting-edge military hardware, respect for international humanitarian law, and the global interconnection that drives political and economic strategy are all examples of these impacts in today's wars.

7.5 Historical Influences of World Wars on Current Public Policy

Current public policy in the areas of alliances, economic sanctions, human rights, and international relations is still shaped by the historical effects of the World Wars. The United Nations and NATO's establishment following World War II has had a long-lasting effect on international relations by encouraging member state collaboration and collective security. The economic measures implemented during and after World Wars I and II are the origins of the use of economic sanctions as a foreign policy tool. The Geneva Conventions' tenets still serve as a guide for both civilian protection and war conduct. Using the lessons learnt during the World Wars, international organisations such as the United Nations carry out humanitarian relief and peacekeeping missions.

Modern economic policies and aid initiatives have been influenced by post-war reconstruction initiatives like the Marshall Plan, which fostered economic recovery and collaboration. Economic policies during times of warfare are still influenced by the idea of a war economy, in which national resources are allocated to military manufacturing. Modern policies for aiding military soldiers and their families have been impacted by the creation of social welfare programs for veterans.

Policies to address the physical and mental health needs of veterans and conflict-affected civilians have been developed as a result of the impact of war on public health. Modern military tactics and defence policies are still influenced by the technological developments of the World Wars. The concept of using technology to disrupt enemy communications and infrastructure has evolved into modern cybersecurity policies.

These historical influences are reflected in current public policy, shaping international relations, economic strategies, social welfare programmes, and technological advancements.

7.6 Influences of World Wars in Shaping Today's Global Conflicts

Current international conflicts are also shaped by the historical effects of the World Wars. A complicated network of state borders and ethnic divisions was left behind by the redrawing of frontiers and the dissolution of colonial empires following the World Wars. These artificial boundaries and the power voids left by the former colonial powers are the root causes of many contemporary conflicts, especially in the Middle East, Africa, and South Asia. A bipolar international order that shaped world politics during the Cold War was founded by the rise of the US and the USSR, which is now Russia, as superpowers following international War II. The legacy of this rivalry continues to impact international relations and conflicts, as evident in the ongoing tensions between NATO and Russia.

NATO's ongoing influence is demonstrated by its involvement in numerous international crises, including the invasion in Afghanistan. Modern military doctrine is still influenced by the tactics and strategies created during the World Wars. Mechanised infantry, air power, and combined armaments are essential components of modern military operations. Furthermore, guerilla techniques from past conflicts are the origin of asymmetric warfare, which is observed in conflicts between insurgents and non-state entities. The idea of mutually assured destruction (MAD) was created by the development and spread of nuclear weapons during and after World War II. This idea still has an impact on international security strategies and nuclear-armed states' strategic planning.

The legacy of the World Wars and the subsequent focus on human rights have led to international efforts to intervene in conflicts to protect civilians and prevent atrocities, as seen today in interventions in places like Rwanda, Bosnia, and Syria. These historical influences create a complex and interconnected web of factors that shape modern global conflicts, influencing everything from military strategy and international alliances to economic policies and human rights considerations.

7.7 Cold War Struggle

A geopolitical conflict between the US and the USSR defined the Cold War and resulted in proxy conflicts in Korea, Vietnam, and Afghanistan. From 1947 until 1991, the United States, the Soviet Union, and its respective allies experienced geopolitical tension throughout the Cold War Era. The two superpowers fought different sorts of political, economic, and propaganda warfare, but there was no direct large-scale combat, hence the term "Cold" war. The cold war developed as a result of a number of factors.

The Soviet Union stood for communist tyranny, whereas the United States represented capitalism and democracy. Both superpowers amassed enormous nuclear weapons stockpiles, which created a continual danger of world destruction. competition to accomplish important space exploration goals, like landing on the moon and launching satellites. Third-world indirect confrontations include the Soviet invasion of Afghanistan, the Vietnam War, and the Korean War. Through the Soviet Union-led Warsaw Pact and the US-led NATO alliance, both sides employed the media and participated in widespread espionage to propagate their ideas.

In actuality, a confluence of political, economic, and ideological elements led to the Cold War. The postwar world was viewed in radically different ways by the US and the USSR. The Soviet

Union sought to increase its communist ideology and power, whereas the United States sought to spread capitalism and democracy. The joined States, the Soviet Union, and other Allied nations joined against the Axis powers during World War II. But as the war came to a conclusion, tensions developed over the Soviet Union's hegemony over Eastern Europe and the Marshall Plan, which provided financial assistance to Western Europe.

Following World War II, Germany was split into East and West Germany, with the Western Allies (the United States, the United Kingdom, and France) ruling the western regions and the Soviet Union occupying the eastern portion. The broader ideological divide between the superpowers was represented by this dichotomy. Following World War II, the Soviet Union imposed communist governments in countries in Eastern Europe, including Poland, Hungary, and East Germany, which frightened the West. The United States feared that communism would spread and used a number of alliances and policies, including NATO and the Truman Doctrine, to try to stop it.

These and other elements played a part in the protracted geopolitical rivalry and tension between the US and the USSR that characterised the Cold War era. With the fall of the Soviet Union in 1991, the Cold War came to an end, and world politics underwent a dramatic transformation.

7.8 Consequences of the Cold War for the World

Many facets of international politics, economy, and society were impacted by the Cold War, which had significant and long-lasting effects on the world. Military alliances like NATO and the Warsaw Pact were established as a result of the Cold War and still have an impact on world affairs today. Additionally, it led to the rise of new international players like China, which is now a significant military and economic force.

Nuclear arsenals were significantly expanded during the Cold War, with the US and the USSR each owning thousands of nuclear bombs. As a result, there is a legacy of nuclear proliferation, with other nations attempting to acquire their own nuclear weapons. In order to reduce the number of nuclear weapons, it also led to the creation of arms control accords such as the Strategic Arms Reduction Treaty (START) and the Strategic Arms Limitation Talks (SALT). Both superpowers increased their military spending significantly as a result, which had a big effect on the economy. In many nations, the end of the Cold War made it possible to reallocate funds to social programs and economic development.

Increased international commerce and economic interconnectedness began during the Cold War era as nations looked to fortify their economies and lessen their reliance on the superpowers. With an emphasis on scientific research and technical developments, it has an impact on research, education, and culture. Additionally, it resulted in the expansion of East-West cultural exchanges and philosophies.

Significant environmental effects were caused by military operations during the Cold War, such as nuclear testing and weapon development. More international collaboration on environmental concerns was made possible by the end of the Cold War. Many nations in Asia, Africa, and Latin America achieved independence from colonial domination during this time, which also happened to be the period of decolonisation. Conflicts and political instability resulted from the

superpowers' frequent support of various factions in these recently independent nations. Furthermore, technological developments in a number of domains, such as computing, space exploration, and military technology, were fuelled by the rivalry between the superpowers. These repercussions have had a long-lasting effect on the world, impacting global development and forming the current geopolitical landscape.

There are still many ways that the Cold War affects politics today. The Warsaw Pact and NATO, two organisations created during the Cold War, continue to have a big impact on world affairs. Nuclear weapons and the continuous problem of nuclear proliferation are the results of the Cold War-era nuclear arms race. The continued development of nuclear weapons by nations like North Korea threatens international security. During the Cold War, there were several proxy conflicts in which the superpowers backed opposing parties in international disputes. Historical tensions and rivalries still exist in places like the Middle East and parts of Africa, which are still affected by these conflicts.

Political beliefs and policies have been impacted for a long time by the ideological conflict between capitalism and communism. In many nations, the dichotomy between authoritarian and democratic administrations still influences both local and international affairs. With origins in the Cold War, organisations like the United Nations and the European Union are still vital to preserving world peace and security. Significant international aid initiatives were also implemented during the Cold War era with the goal of controlling communism. The ideological divisions created during the Cold War are frequently reflected in discussions on economic policies and foreign aid today.

7.9 Contemporary Conflicts

The time after the Cold War ended, when the Soviet Union was dissolved in December 1991, is known as the "Post-Cold War Era." The rise of the United States as the only superpower in the globe is one of the major geopolitical shifts that have defined this century. The Gulf War (1990–1991), the Balkan Wars (1991–2001), and the War on Terror (2001–present) were among the new wars that resulted from the fall of the Soviet Union and the end of the Cold War.

Global geopolitics is still shaped by ongoing conflicts like the Yemeni and Syrian civil wars, as well as regional tensions in the South China Sea and Eastern Europe. Indeed, the geopolitics of the world are greatly impacted by these conflicts. Since 2011, the Syrian Civil War has raged, causing serious humanitarian problems and changing the Middle East's political landscape. With millions in need of aid and a convoluted proxy war involving regional powers, the Yemen Civil War has resulted in one of the biggest humanitarian catastrophes in history.

Tensions have been rising in Eastern Europe for a number of reasons, such as political unrest and territorial disputes. With several nations claiming portions of the strategically significant waterway, the South China Sea continues to be a flashpoint for regional tensions, frequently resulting in diplomatic and military impasses.

Section C

Environmental Destruction and Military Conflicts

Chapter 8

Environmental Effects of Habitat Destruction and Land Degradation During Military Conflicts

In this chapter

- 8.1 Effects of Military Activities on Soil and Vegetation**
- 8.2 Disruption of Water Cycles During Military Conflicts**
- 8.3 Impact of Military Conflicts on Human Communities**
- 8.4 Consequences of Military Conflicts on Environment and Humanities**
- 8.5 Difference of Consequences of Military Conflicts on Urban and Rural Settings**
- 8.6 Mitigation Strategies for Environmental Effects of Military Activities**

Land degradation and habitat devastation are just two examples of the serious environmental effects that military engagements can have. Destroying habitat during armed wars has a negative impact on soil and vegetation and is a serious environmental problem. Forests are frequently cleared for bases, airstrips, and other infrastructure during military operations. As a result, many species lose their essential forest habitats. By destroying vegetation and upsetting wildlife habitats, explosive weapons have the potential to seriously harm ecosystems.

People are frequently forced to leave their homes due to conflicts, which puts more strain on the local natural resources. As a result, forests, water sources, and other natural areas may be overused. Military operations release pollutants into the environment, including hazardous chemicals and heavy metals, which can taint water and soil and worsen habitat damage. Conflict-related environmental harm can linger long after hostilities have stopped, making recovery challenging and time-consuming.

A reduction in biodiversity may result from the introduction of pollutants and the degradation of habitats. In severely affected areas, wildlife numbers may decline and certain species may even go extinct.

International laws and national policies that try to lessen the environmental impact of military operations are two examples of efforts to lessen these effects. Environmental factors are also being incorporated into peacebuilding and conflict prevention initiatives by organisations such as the United Nations Environment Programme (UNEP).

8.1 Effects of Military Activities on Soil and Vegetation

Soil and vegetation can be significantly impacted by military operations, which frequently result in soil contamination and vegetation degradation. Compaction of the soil from military training and combat can alter soil characteristics like hydraulic conductivity and accelerate erosion. Soil contamination may result from the introduction of chemical warfare agents (CWAs), energetic compounds (ECs), and potentially hazardous elements (PTEs). Because of

its high toxicity and persistence, lead (Pb) is especially hazardous. Human health is at risk from contaminated soils, hence risk assessment and management must be done correctly.

Increased soil erosion and habitat loss can result from military drills that change the vegetation cover. Increased soil erosion brought on by the removal of vegetation cover may worsen the condition of the soil and vegetation. Long-term military operations have the potential to harm local ecosystems and biodiversity by permanently damaging plants.

The soil is shielded from the elements by vegetation. Loss of vegetation makes soil more vulnerable to water and wind erosion. Future plant growth is hampered by reduced soil fertility and structure brought on by vegetation loss. Certain flora kinds are the only source of food for some species. The species that rely on these plants could go extinct if they go.

8.2 Disruption of Water Cycles During Military Conflicts

Through lowering runoff and promoting water infiltration into the soil, vegetation is essential to preserving the water cycle. Increased sedimentation in water bodies due to plant loss can harm aquatic life and lower water quality. Because it absorbs carbon dioxide, vegetation—especially forests—acts as a carbon sink. Climate change is exacerbated by the release of this stored carbon back into the atmosphere when vegetation is removed. Because it retains moisture and offers shade, vegetation aids in regulating regional weather. Conditions may become hotter and drier as a result of vegetation loss.

Water cycles can be seriously disrupted by armed wars, with serious environmental and humanitarian repercussions. Water infrastructure, including dams, pipelines, and treatment facilities, is frequently destroyed as a result of armed conflicts. Communities' water supply may be disrupted and water sources may become contaminated as a result. Water supplies may become contaminated and unfit for human consumption if water is used as a weapon, such as flooding or poisoning water sources.

People are forced to leave their homes due to conflicts, which results in overcrowded refugee camps with limited water supplies. As a result, current water supplies are strained and demand for water rises. Public health emergencies can be made worse by the spread of waterborne illnesses like cholera and dysentery brought on by a lack of access to clean water and sanitary facilities. Agriculture, wildlife, and ecosystems may all suffer long-term environmental harm as a result of water cycle disruption.

In times of war, efforts are being made to preserve water resources and to use water as a forum for collaboration and peace. To guarantee the robustness of water systems and the welfare of impacted communities, further work must be done.

8.3 Impact of Military Conflicts on Human Communities

Human communities are significantly and extensively impacted by military engagements. Because of the violence, lack of access to healthcare, and substandard living circumstances, conflicts frequently result in higher rates of death and morbidity. The collapse of healthcare systems in conflict areas makes it easier for diseases to spread. Children are compelled to

evacuate, disrupting their education, and schools are frequently destroyed or converted for military use. Future prospects and literacy rates are impacted in the long run by this.

Disruptions to economic activity result in employment and income loss. Roads, bridges, and markets are examples of infrastructure that is frequently destroyed, which makes economic recovery much more difficult. Millions of people are uprooted by conflicts and end up as refugees or internally displaced people (IDPs). Communities are upended, families are split up, and individuals become more susceptible to abuse and exploitation as a result. Long-term psychological problems including PTSD, anxiety, and depression can result from the trauma of conflict. People's capacity to operate and make contributions to society is impacted by this.

Food shortages and hunger result from conflicts that interrupt supply lines and agricultural operations. Food insecurity frequently affects displaced populations, making them even more vulnerable. Armed conflicts can destabilise political institutions and governance, leading to a collapse of law and order. This can lead to an unbreakable cycle of violence and instability. Disease outbreaks and higher death rates can result from the collapse of water infrastructure. Sanitation and access to clean water are frequently seriously hampered.

These effects are linked together and have the potential to produce a vicious cycle that impedes generations' progress and recuperation. A thorough and interdisciplinary approach is needed to address these problems in order to assist impacted communities and advance peace and stability. Food security may be impacted by decreased agricultural output brought on by soil erosion and the loss of fertile land. Loss of vegetation can make natural disasters like floods and landslides more likely, which can have a serious effect on human societies.

8.4 Consequences of Military Conflicts on Environment and Humanities

The effects of military wars on the environment and humanities are significant and enduring.

Environmental Consequences

Pollution, deforestation, and habitat damage are frequently the results of conflicts. Bombing and shelling are examples of military operations that can seriously harm ecosystems, resulting in a loss of biodiversity and a disruption of ecosystem services. Long-term environmental deterioration can result from wars that deplete natural resources like water, forests, and minerals. The use of explosives and chemical weapons can leave behind harmful residues that can degrade land and water quality for decades. Climate change is made worse by military actions, which increase greenhouse gas emissions.

Humanitarian Consequences

People suffer psychological stress from war, which can result in disorders like anxiety and depression. Long after the fight is over, these mental health problems may still exist. Conflicts cause economic instability and poverty by taking funds away from vital services like healthcare and education. Populations are frequently displaced by war, leading to internally displaced people and refugees who struggle to start over. Family units and community cohesion

disintegrate as a result of conflicts that upend social systems. Mistrust and long-term societal instability may arise from this.

8.5 Difference of Consequences of Military Conflicts on Urban and Rural Settings

Due to the unique features of urban and rural contexts, conflicts in these settings have different outcomes. The infrastructure of urban regions is crowded, and military operations cause significant damage to roads, bridges, buildings, and utilities. As a result, the ecosystem deteriorates with time, and reconstruction becomes difficult. Significant air and water contamination resulted from the deployment of heavy weapons and the destruction of industrial infrastructure. Because there are usually less green spaces in urban settings, environmental rehabilitation may take longer.

In urban locations with high population densities, civilian casualties and injuries are higher. Residents of conflict zones are displaced in large numbers, which strains resources in nearby places and results in congested refugee camps. Long-term societal problems result from the disruption of social services, healthcare, and education caused by the destruction of social infrastructure including schools, hospitals, and community centres.

Food insecurity and loss of livelihoods are frequently caused by military operations in rural regions that destroy farmlands, livestock, and irrigation systems. More immediately affected are species and natural ecosystems, which results in ecological imbalances and a decline in biodiversity. Water supplies and soil quality may be impacted by resource contamination and depletion in rural locations.

Because agriculture is the main driver of rural economies, conflicts cause severe economic hardship and poverty. Conflicts make it worse for rural populations, who may already have restricted access to healthcare, which raises death and indisposition rates. Traditional knowledge, cultural customs, and social cohesiveness are lost when rural communities are uprooted.

Consequences in both domains are comparable as well. Both environments face difficulties in post-conflict recovery, economic upheavals, and chronic psychological trauma. Comprehensive plans for reconstruction and restoration are needed in both urban and rural locations.

Comprehending these distinctions is essential for creating focused interventions that cater to the particular requirements of impacted communities in both urban and rural environments. All of these repercussions are essential for formulating plans to lessen the humanitarian and environmental effects of wars and aid in the recovery and reconstruction efforts that follow.

8.6 Mitigation Strategies for Environmental Effects of Military Activities

The effects can be lessened with routine monitoring and early identification of changes in the soil and plants. Reducing the adverse consequences of military operations can be achieved by the use of sustainable land management and good environmental practices. It is essential to reduce the negative environmental effects of military operations in order to protect ecosystems and advance sustainability.

Planning and putting mitigation strategies into action are aided by conducting environmental impact assessments to find possible environmental effects prior to starting military operations. To cut down on carbon emissions and dependency on fossil fuels, military sites and activities are switching to renewable energy sources.

To reduce pollution, efficient waste management techniques are used, such as recycling and the appropriate disposal of hazardous materials. By staying away from sensitive areas and repairing damaged ecosystems, natural habitats are encouraged and strategies for biodiversity conservation are used. Integrated sustainable practices, like employing eco-friendly materials and consuming less resources, are used for military operations and training.

To guarantee adherence to international norms, aligned military policies should be used in conjunction with international environmental agreements and treaties. The negative environmental repercussions of military conflicts can be lessened by increasing public knowledge and incorporating them in environmental monitoring and conservation initiatives. The military can preserve national security and drastically lessen its environmental impact by implementing these tactics.

Chapter 9

Water Resources Contamination During Military Conflicts

In this chapter

- 9.1 Water Flooding during Military Conflicts**
- 9.2 Possible Measures to Prevent Water Contamination in Conflicts**
- 9.3 Challenges to Implement Mitigation Measures**
- 9.4 Impact of Military Activities on Aquatic Life**
- 9.5 Effective Measures to Reduce Adverse Impacts on Aquatic Ecosystems**

During armed conflicts, pollution and water resources are serious problems with wide-ranging effects. Water infrastructure, including dams, pipelines, and treatment facilities, is frequently targeted during conflicts. Water supplies may get contaminated as a result, rendering them unfit for human consumption. By poisoning them with poisons or garbage, or by redirecting water supplies to deny the enemy vital resources, water resources can be turned into weapons. Contamination and damage to water infrastructure can have long-term effects on the environment, influencing ecosystems and complicating recovery efforts.

Oil, heavy metals, and other contaminants can be introduced into water bodies as a result of military operations. Water sources can get contaminated by improper waste disposal, including human faeces. Waterborne disease outbreaks brought on by contaminated water can seriously endanger the health of civilians.

Water resources are safeguarded during armed conflicts by international law and protection measures. Enforcement, though, can be difficult. Even in times of conflict, efforts are undertaken to safeguard the fundamental human right to access clean water.

9.1 Water Flooding during Military Conflicts

The Nova Kavokha Dam tragedy during the Russia-Ukraine conflict serves as an illustration of how attacking water infrastructure can have catastrophic consequences for humans. On June 6, 2023, the Nova Kavokha Dam disaster—also referred to as the Kakhovka Dam disaster—took place. Early in the morning, a breach in the dam in Kherson Oblast, Ukraine, caused widespread flooding along the lower Dnieper River.

Many observers think that Russian forces blew up a section of the dam to thwart a planned Ukrainian counteroffensive when the dam was in their hands. Significant flooding was caused by the explosion, drowning a number of settlements in areas under Russian and Ukrainian administration. Thousands of people had to evacuate as a result of the catastrophe, which is estimated to have cost \$14 billion in damages. Local medical professionals and volunteers have indicated that the death toll may be significantly higher, maybe in the hundreds, despite the

official Russian death toll of 59. It is a terrible incident that will have a significant impact on the area.

Essential water supplies have been severely damaged by attacks on Gaza's water infrastructure, which has affected inhabitants' day-to-day life. The state of affairs in Gaza is quite worrisome. According to recent reports, the provision of clean water for residents has been significantly disrupted by attacks on water infrastructure. Human Rights Watch claims that Israeli officials have been charged with carrying out "acts of genocide" by purposefully destroying water infrastructure and cutting off safe water supply. Many Palestinians are now having difficulty getting the water they require to survive as a result of this.

Additionally, according to Oxfam, Israel's activities have caused a 94% reduction in Gaza's water supply, resulting in a fatal health crisis. The crisis has been made worse by the devastation of water and sanitary facilities as well as limitations on the admission of gasoline and spare components. The absence of potable water in Gaza poses serious health hazards to a large number of people, making the situation catastrophic. To improve the situation, the world community has demanded that humanitarian aid be provided immediately. In times of conflict, efforts to safeguard water resources are essential for maintaining the security and welfare of impacted communities as well as for advancing lasting peace and stability.

9.2 Possible Measures to Prevent Water Contamination in Conflicts

Ensuring the safety of impacted populations and safeguarding public health during conflicts depend heavily on preventing water contamination. Strict adherence to international humanitarian law is necessary to stop attacks on water infrastructure, including pipelines, treatment facilities, and dams. In order to reduce damage during conflicts, water infrastructure should be strengthened and fortified.

It can be easier to take prompt action to reduce risks if procedures are in place to monitor water quality and identify contamination early. Utilize technology to give early notice of possible contamination incidents so that containment and action can happen quickly.

Protecting shared water resources can be facilitated by cooperation with neighboring nations and international organizations. Additionally, make sure that human rights and international humanitarian laws that safeguard water resources during wars are followed. Inform local populations about the dangers of pollution and the significance of preserving water supplies. Involve local communities in water source monitoring and protection as well, giving them the authority to take action as necessary. It can be easier to take prompt action to reduce risks if procedures are in place to monitor water quality and identify contamination early. Utilize technology to give early notice of possible contamination incidents so that containment and action can happen quickly.

Create emergency action strategies that will be implemented to promptly and efficiently handle cases of water contamination and guarantee that impacted communities have access to clean water supplies, such as portable water purification units or bottled water. To restore safe water supplies, make investments in the rehabilitation and repair of damaged water infrastructure. Put policies in place to restore and clean up polluted ecosystems and water sources. We can

safeguard the health and welfare of impacted populations and help avoid water contamination during conflicts by implementing these steps.

9.3 Challenges to Implement Mitigation Measures

There are a number of major obstacles to overcome while putting policies in place to stop water contamination during conflicts. Protecting and maintaining water infrastructure can be difficult in conflict zones since they might be hazardous and hard to reach. One of the biggest concerns is protecting the workers who keep an eye on, fix, and maintain water infrastructure.

The difficulties could also be related to noncompliance. It is possible for conflicting parties to disregard international accords and laws intended to safeguard water supplies. The execution of critical measures may be delayed by intricate bureaucratic and political procedures. In conflict areas, enough money is frequently insufficient for the preservation and repair of water infrastructure. There might not be enough technical know-how or trained workers to put water protection measures in place and keep them up to date.

Rapidly restoring safe water supplies may be challenging because to the extensive damage to water infrastructure. Water services can be disrupted by ongoing violence, making it difficult to reliably supply clean water. It can be challenging to stop contamination from spreading, particularly in places that are environmentally sensitive or heavily populated.

Disease outbreaks brought on by contaminated water can make public health initiatives more difficult. Although it is frequently absent, effective coordination between different stakeholders—including governmental bodies, non-governmental groups, and international organizations—is essential. Effective implementation may be hampered by misinformation, a lack of trustworthy communication channels, and language obstacles.

It is challenging to create and put into practice long-lasting solutions that can endure the difficulties of conflict and post-conflict healing. It takes constant work and resources to ensure that water infrastructure is maintained and operated. A multifaceted strategy including international cooperation, sufficient money, efficient coordination, and a strong commitment from all parties involved is needed to overcome these obstacles.

9.4 Impact of Military Activities on Aquatic Life

Aquatic life can be significantly and frequently negatively impacted by military operations. Chemicals, fuels, and other dangerous substances that might damage water sources are frequently used in military operations. Water can become dangerous for human consumption due to this contamination, which can also damage aquatic life and disturb ecosystems. Wetlands, rivers, and other aquatic habitats may be destroyed as a result of military construction and training. Species displacement and biodiversity loss may follow from this.

Heavy machinery and explosives use can produce a lot of noise pollution, which might interfere with aquatic species' ability to communicate and behave. Fish and mussels are among the aquatic species that can be poisoned by military smokes and obscurants like fog oil and graphite smoke. In impacted species, these chemicals can lower reproductive success and induce

mortality. Biodiversity may be lost as a result of military operations introducing non-native species to new habitats, where they may outcompete and displace native species.

Performing environmental impact assessments, putting sustainable practices into place, and repairing harmed ecosystems are some of the steps taken to lessen these effects. Protecting aquatic life and preserving healthy ecosystems require striking a balance between environmental conservation and national security requirements.

9.5 Effective Measures to Reduce Adverse Impacts on Aquatic Ecosystems

There are a number of practical ways to lessen the negative effects of military operations on aquatic life. Before beginning military operations, carry out in-depth analyses to pinpoint possible environmental hazards and create plans to reduce them. Choose chemicals and materials that are safe for the environment and don't negatively affect aquatic habitats.

Planting native vegetation, clearing contaminants, and reestablishing ecosystems are ways to repair damaged habitats following military operations. Reduce the negative effects of noise pollution on aquatic life by putting noise reduction techniques and technology into practice. Hazardous items should be handled, stored, and disposed of appropriately to avoid contaminating water sources with chemicals.

Declare specific regions off-limits to military operations in order to safeguard biodiversity and important habitats. To stop non-native species from spreading and harming native aquatic life, their introduction should be closely watched and controlled. Inform military personnel about how their actions affect the environment and provide them with training on environmental conservation best practices.

Keep an eye on how military operations affect the environment at all times, and report any discoveries to guarantee that environmental laws are being followed. To create and carry out successful conservation plans, collaborate closely with environmental agencies and groups. By taking these steps, we may lessen the harm that military operations cause to aquatic species and encourage the conservation of our priceless water ecosystems.

Chapter 10

Environmental Impacts on Climate and Atmosphere During Military Conflicts

In this chapter

- 10.1 Impact of Air Pollution from Military Conflicts on Vulnerable Populations**
- 10.2 Long-term Climate Impacts of Military Conflicts**
- 10.3 Historical Examples of Military Conflicts Affecting Climate**
- 10.4 Influence of Climate on Modern Conflicts**
- 10.5 Climate Influence of Modern Conflicts: Some Examples**

Air pollution and atmospheric effects are just two examples of the significant environmental repercussions that military engagements can have. Air pollution comes from a variety of sources, including military operations and conflicts. These frequently entail the employment of vehicles, heavy machinery, and weaponry, all of which emit pollutants such as volatile organic compounds, nitrogen oxides, and particulate matter. Carbon emissions are a result of the movement of troops and supplies by automobile and airplane. Hazardous emissions may be released into the sky during weapon testing.

Smog can build as a result of emissions from military activities, affecting visibility and air quality. Acid rain, which can damage infrastructure and ecosystems, can be caused by pollutants such as nitrogen oxides. People who live nearby may have worsening respiratory ailments due to poor air quality.

10.1 Impact of Air Pollution from Military Conflicts on Vulnerable Populations

Children, the elderly, and people with pre-existing medical disorders are among the vulnerable groups whose health may be significantly impacted by air pollution from armed confrontations. Asthma and chronic obstructive lung disorders can be made worse by exposure to pollutants like nitrogen oxides and particulate matter. Additionally, air pollution raises the risk of heart attacks and strokes by contributing to cardiovascular disorders. Children who are exposed to air pollution may suffer from cognitive deficits and developmental delays. Increased death rates can result from prolonged exposure to contaminated air, especially for vulnerable groups.

According to studies, military drills in Vieques, Puerto Rico, raised air and water levels of arsenic, which in turn caused a higher prevalence of birth defects and other health problems among the local populace. Because of training exercises, vehicle operations, and weapon testing, communities residing close to military bases frequently experience increased pollution exposure.

Emissions from military operations can be decreased by implementing greener fuels and technology. The impact on vulnerable people can be lessened by putting policies in place to

regulate and cut emissions. Pollution can be reduced by teaching military troops eco-friendly techniques. To safeguard the health of vulnerable groups, it is imperative to address these effects through sustainable practices and legislative actions.

10.2 Long-term Climate Impacts of Military Conflicts

Long-term climate effects from military battles can be substantial. Deforestation, soil erosion, and pollution are common outcomes of military operations, and they can have a long-term impact on nearby ecosystems. Long-term environmental stress can result from conflicts that put a burden on natural resources like water and arable land. The employment of heavy equipment and transportation in military operations increases greenhouse gas emissions, which exacerbates climate change.

People may be forced to migrate due to conflicts, which can result in urbanization and put more strain on resources in new locations. Affected people may have long-term health effects from environmental and infrastructure degradation, such as exposure to harmful substances and substandard living circumstances. These effects emphasize how crucial it is to take the environment into account when resolving disputes and rebuilding once they have ended.

10.3 Historical Examples of Military Conflicts Affecting Climate

There are several historical examples where military conflicts have had significant climate impacts.

10.3.1 The Akkadian Empire Collapse

One factor in the fall of the Akkadian Empire in Mesopotamia was the abrupt change to drier weather. According to archaeological evidence, this once-dominant empire fell because of a mix of political unrest and drought.

The fall of the Akkadian Empire in 2100 B.C. is an intriguing and intricate phenomenon. Sargon of Akkad established the earliest known empire in history, the Akkadian Empire, which flourished from the 24th to the 22nd century BC. But in the end, it had a sharp downturn.

Catastrophic climate change was one of the main causes of the collapse. The 4.2-kiloyear event, a severe drought, occurred in the area around 2200 B.C. Widespread agricultural failures and civil unrest were caused by this protracted drought and the regular winter dust storms known as Shamals. Akkad, the seat of the empire, and other towns were abruptly abandoned, and it was roughly three hundred years before the area was resettled.

Additionally, scientists have discovered proof of Bond Event 3, or cold occurrences in the North Atlantic that accompanied Mesopotamian aridification. The decline of the Akkadian Empire was largely caused by these climate changes. It is an intriguing illustration of how environmental influences can affect human societies.

10.3.2 The Syrian Civil War

Between 2006 and 2011, Syria experienced a severe drought that killed 85% of cattle and caused 75% of farms to fail. Mass migration to cities as a result of this environmental catastrophe exacerbated social unrest and aided in the start of the civil war. Syria experienced one of the worst droughts in the history of the region. The agriculture, livestock, and general water supply of Syria were all significantly impacted by this multi-year drought. Climate change caused higher temperatures and faster rates of evaporation, which made the drought worse.

Widespread crop failures and animal losses brought on by the drought resulted in financial hardship and a large-scale rural-to-urban migration. Social discontent and political instability were exacerbated by this migration, which increased the strain on urban resources and services. Many scholars firmly believe that the events before the Syrian civil war were significantly influenced by the drought.

10.3.3 The Invasion of Iraq by ISIS

Climate change-induced droughts, extreme flooding, and economic turmoil in Iraq created conditions that ISIS exploited to recruit members and sow discord. The resulting conflict further destabilized the region. Climate change played a significant role in the fall of Iraq to ISIS.

Water shortages resulted from severe droughts in Iraq. Because of less rainfall and more evaporation, the Tigris and Euphrates rivers—which supply the majority of Iraq's surface water—saw a sharp drop in production. Socioeconomic stability, public health, and agriculture were all impacted. Due to the severe decline in crop production caused by the drought, many farmers were forced to leave their fields and relocate to cities or overseas. Economic instability and social turmoil were exacerbated by this movement.

Iraq's ecology was harmed by years of conflict, inadequate environmental management, and climate change. The problem was made worse by the drying up of marshes and the loss of biodiversity. Food shortages, dislocation, and weaker governmental institutions were caused by environmental and climatic difficulties. These elements made it easier for ISIS to take advantage of preexisting discontent and take over areas of Iraq. In conclusion, Iraq's socioeconomic instability was mostly caused by climate change and environmental deterioration, which also aided in the emergence of ISIS.

10.3.4 The Yemen Civil War

The Yemen Civil War has been significantly impacted by environmental change, which has exacerbated pre-existing problems and brought up new difficulties. More than half of Yemen's population is at risk of severe water shortages as a result of the drought, which has made the conflict worse by drying up water supplies. The humanitarian situation in the area has gotten worse as a result.

Water scarcity has actually been a problem in Yemen for a long time, and climate change is making it worse. Both sides have weaponized water resources during the civil war, further reducing access to water and escalating conflict and insecurity. Farmers are competing and arguing as a result of the loss of fertile land brought on by climate change-induced flooding and desertification. This scarcity is made worse by war and land seizures, which in turn lead to further conflict.

Degradation of the environment weakens social cohesiveness and makes it more difficult for groups to settle disputes amicably. The violence has severely undermined tribal and community structures, which are essential for resolving conflicts. One of the worst humanitarian disasters in history has resulted from the mix of environmental problems and war. The lack of basic supplies, displacement, and malnutrition are affecting millions of Yemenis. Resolving these environmental problems is essential to Yemen's peace and security. It is crucial to incorporate sustainable environmental management and climate adaptation into conflict mitigation and peacebuilding initiatives.

These illustrations show how social and political issues can combine with natural variables to cause or intensify conflicts. This intricate interaction emphasizes how crucial it is to address climate change as part of initiatives to prevent and resolve conflicts.

10.4 Influence of Climate on Modern Conflicts

Although contemporary conflicts impacted by climate change frequently resemble historical ones, they also have distinct features because of the growing intensity and regularity of these effects.

Conflicts in the past and present frequently cause serious environmental harm, including pollution, soil erosion, and deforestation. Both historical and contemporary conflicts have the potential to deplete natural resources, resulting in competition for limited resources and long-term environmental stress. People may be forced to migrate due to historical or contemporary conflicts, which can result in urbanization and put more strain on resources in new locations.

In a world where extreme weather events like heatwaves, floods, and droughts are becoming more often and severe due to climate change, modern conflicts are taking place. Furthermore, because contemporary conflicts are more intertwined with global systems, environmental effects may have more rapid and extensive global repercussions.

Compared to past battles, modern military technology have the potential to cause more significant environmental damage. For instance, the Gulf War's oil field fires had a lasting impact on the ecosystem. Millions of people are displaced and in need of aid as a result of modern conflicts, which frequently lead to more extensive humanitarian catastrophes. These issues are made worse by climate change, which makes impacted communities more vulnerable.

10.5 Climate Influence of Modern Conflicts: Some Examples

10.5.1 Somalia

The conflict in Somalia has been made worse by protracted droughts and climate change, which have resulted in widespread food insecurity and displacement. The nature, economy, and way of life of Somalia are all significantly impacted by the country's climate. The two primary seasons in Somalia's semi-arid climate are the rainy season (Gu) and the dry season (Jilaal).

Seasonal rainfall has a significant impact on agriculture, which accounts for a considerable portion of Somalia's economy. More grazing ground is available to cattle during the Gu season, when crops like maize and sorghum are sown. Long-term droughts, which are frequent in Somalia, can cause livestock losses and crop failure, leaving many families food insecure and struggling financially.

In Somalia, water scarcity is a major problem, particularly during the dry season. Seasonal rivers and wells, which can dry up during droughts, are essential to many communities. A major issue that impacts both rural and urban populations is access to clean water.

A major source of income for many Somalis is pastoralism. Rainfall patterns have a direct impact on animal water and pasture availability. Conflicts over resources may result from pastoralists being forced to relocate in search of water and grazing land due to droughts.

The natural plants and wildlife of Somalia are influenced by its climate. Desertification and biodiversity loss are two consequences of drought. The preservation of Somalia's ecosystem depends on initiatives to fight climate change and advance sustainable land use practices.

In summary, Somalia's climate has a significant impact on the nation's infrastructure, ecology, livelihoods, health, and agricultural methods. For Somalia's prosperity and well-being, climate-related issues must be addressed.

10.5.2 Lake Chad Basin

Lake Chad is getting smaller as a result of climate change, which has increased competition for water supplies and exacerbated regional tensions. Climate change has had a major impact on the Lake Chad Basin. Lake Chad has decreased by around 90% in the last 50 years, from 25,000 km² in the 1960s to about 1,200 km² now. Climate change, population growth, and the building of dams and reservoirs on the lake's tributaries are all contributing factors to this sharp decline.

Millions of people rely on the lake for farming, grazing, and fishing, and their livelihoods have been negatively damaged by its shrinkage. Traditional farming methods are no longer adequate due to drought-like circumstances brought on by the unpredictable rains and high temperatures. Because of the reduction in agricultural production, the area is experiencing severe food insecurity. The food situation has gotten worse due to decreased agricultural yields brought on by rising temperatures and shifting weather patterns.

Conflicts over limited resources have also been exacerbated by environmental degradation, resulting in regional instability and displacement. The situation has become much more complex due to the existence of armed groups such as Boko Haram. Implementing sustainable farming methods, expanding smallholder farmers' access to financing, and strengthening

regional collaboration to manage the lake's resources are some of the initiatives being undertaken to solve these issues.

The Lake Chad Basin crisis serves as a sobering reminder of how urgently sustainable development and climate action are needed to protect the welfare of the impacted communities.

10.5.3 South Sudan

Droughts and flooding brought on by climate change have exacerbated South Sudan's humanitarian catastrophe, resulting in more conflict and displaced people. South Sudan is being significantly impacted by climate change. The nation is among the most climate change susceptible in the world.

Over the last 30 years, the average annual temperature has risen by more than 0.4°C every decade. By 2060, projections show an additional 1°C to 1.5°C increase. Both floods and droughts occur in South Sudan. Rainfall has decreased by 15-20% in the northeast, but flooding is more common and severe in other locations. Food security, health, and displacement are all impacted by these shifts, which have major ramifications for peace and security. Greenhouse gas emissions from South Sudan have been increasing, with a significant 13.97% increase between 2019 and 2020.

Particularly for vulnerable groups like children and expectant mothers, the situation is grave. Although there are many obstacles to overcome, efforts are being done to adapt and lessen these effects. These parallels demonstrate how conflicts are changing due to climate change and the necessity of all-encompassing approaches that consider social and environmental aspects in attempts to prevent and resolve conflicts.

Chapter 11

Environmental Damage from Nuclear Contamination

In this chapter

- 11.1 The Sources of Radioactive Pollution**
- 11.2 Environmental Effects of Nuclear Weapons and Testing**
- 11.3 Radioactive Fallout and its Impact on Human Health and Ecosystems**
- 11.4 Atmospheric Impact of Nuclear Radioactivity**
- 11.5 Effects of Nuclear Contamination on Ecosystems**
- 11.6 Prevention of Environmental Harm from Nuclear Contamination**
- 11.7 Public Awareness on Nuclear Fallout**

The presence of radioactive materials on surfaces, in solids, liquids, gasses, or even within the human body if their presence is unexpected or undesirable is referred to as nuclear contamination, also known as radioactive contamination. Numerous events, including nuclear accidents, inappropriate nuclear waste disposal, and even atmospheric nuclear weapon tests, might result in this pollution.

The risks of nuclear pollution are caused by the ionizing radiation that these radioactive materials emit, which can seriously harm human health and the environment. The Fukushima Daiichi nuclear accident in 2011 and the Chernobyl accident in 1986 are two well-known instances of extensive radioactive pollution.

Such pollution is dangerous because the radioactive decay of the contaminants releases free neutrons and ionizing radiation, such as beta, gamma, and alpha rays. The degree of hazard is influenced by the type of radiation, the energy of the radiation being released, the concentration of the pollutants, and the distance between the organs and the contamination. The terms "contamination" and "radiation" are not interchangeable, and it is important to stress that the contamination is the source of the radiation risk.

11.1 The Sources of Radioactive Pollution

The sources of radioactive pollution can be divided into two categories: man-made and natural. Nuclear fuel and fission products will contaminate the surrounding air, soil, people, plants, and animals after an atmospheric nuclear weapon detonation or a nuclear reactor containment breach. If a radioactive material, such as uranyl nitrate, spills, it might contaminate the floor and any rags used to clean it up. Examples of extensive radioactive pollution include the vicinity of the Chernobyl and Fukushima Daiichi nuclear accidents.

The discharge of radioactive gases, liquids, or particles can result in radioactive pollution. The substance could be dispersed by individuals walking around if a radionuclide used in nuclear

medicine is accidentally spilled. Reprocessing nuclear fuel is one method that may inevitably lead to radioactive pollution. One of the biggest threats to the environment is nuclear pollution.

11.2 Environmental Effects of Nuclear Weapons and Testing

Nuclear weapons and testing have a significant and enduring effect on the environment. A nuclear bomb detonates, releasing a burst of neutrons and gamma rays. Depending on the dosage, acute radiation exposure, sometimes referred to as immediate radiation exposure, can have serious health consequences. Acute radiation syndrome is brought on by immediate radiation. This happens when a large amount of radiation is absorbed quickly. Within hours, symptoms including nausea, vomiting, and exhaustion may appear. Severe blood problems and infections may follow.

Excessive radiation exposure can result in skin burns and redness like a severe sunburn. Hair loss may result from exposure to radiation levels more than 200 rems. Prolonged exposure to radiation can harm internal organs, especially the brain and heart, resulting in immediate health problems or even death.

Radiation sickness, sometimes referred to as acute radiation syndrome or radiation poisoning, is a dangerous condition brought on by brief exposure to large doses of ionizing radiation. Skin burns, nausea, vomiting, and appetite loss are some of the early signs of radiation sickness. Infections, hemorrhage, dehydration, disorientation, and exhaustion follow. It is brought on by brief exposure to large levels of ionizing radiation. Accidents involving nuclear reactors, radioactive weaponry, or specific medical procedures may cause this.

11.3 Radioactive Fallout and its Impact on Human Health and Ecosystems

Health consequences come in a variety of forms. The generation of blood cells is impacted by bone marrow syndrome. The digestive system is impacted by gastrointestinal syndrome. Additionally, blood vessels and the neurological system are impacted by neurovascular syndrome. Higher dosages can be lethal and are more severe. To reduce exposure and safeguard your health in the event of a radiation emergency, it is crucial to heed the safety recommendations provided by the local authorities.

The remaining radioactive material released into the upper atmosphere after a nuclear detonation or accident is known as radioactive fallout. It has detrimental consequences on health. Acute radiation illness, cancer, and other severe health issues can result from exposure to radioactive particles. Internal radiation exposure may result from these particles contaminating food and water sources.

The effects of radioactive fallout on the environment are severe. It can pollute the air, water, and soil, causing long-term ecological harm. Both plant and animal life may be impacted by this contamination, which could result in genetic changes and a decline in biodiversity. Decontamination and cleanup procedures are expensive and time-consuming. Communities may be displaced and financial losses may result from areas impacted by radioactive fallout becoming uninhabitable. Affected populations may experience psychological stress and anxiety as a result of the uncertainty and dread surrounding radioactive fallout.

One major environmental concern is radioactive poisoning of water and soil. Accidental leaks, nuclear power plants like the Fukushima Daiichi nuclear accident, the vicinity of the Chernobyl accident, or the transit of radioactive materials can all result in radioactive contamination of soil. Radioactive leftovers from past nuclear weapons testing have lasted for a long time. Radioactive contamination can also result from improper disposal of radioactive waste or chemicals.

Water can become contaminated by radioactive materials. Soil can release naturally occurring radioactive materials (NORM) into aquifers. The atmosphere can release radioactive materials into surface water, or radioactive trash can be dumped directly into the water. Water bodies have been significantly contaminated by radioactivity as a result of accidents like Chernobyl and Fukushima.

Radioactive materials can have serious negative effects on the environment and human health. Cancer is one of the health problems that can result from exposure to radioactive materials. Aquatic life is impacted by contamination, which can also upend entire ecosystems. Aquatic life and ecosystems can be severely and extensively impacted by radioactive contamination in aquatic environments. When radioactive materials are discharged into bodies of water, organisms may absorb them, resulting in genetic changes, problems with reproduction, and even death.

For instance, radioactive isotopes were discovered to migrate up the food chain from phytoplankton to larger fish and marine mammals following the Fukushima nuclear accident. This can upset entire food webs and ecosystems in addition to affecting individual species. Furthermore, radioactive contamination can linger in the environment for extended periods of time, harming biodiversity and habitats over time. As pollutants go up the food chain, their effects can be amplified, affecting larger predators and even humans who eat tainted seafood. To safeguard our aquatic ecosystems, this complicated and important issue necessitates constant monitoring and mitigation measures.

11.4 Atmospheric Impact of Nuclear Radioactivity

Nuclear radioactivity's effects on the atmosphere are a complicated and multidimensional problem. A considerable amount of radiation is released into the atmosphere during nuclear explosions. Both the immediate radiation from the explosion and the later radiation from radioactive decay are included in this. A nuclear explosion's energy ionizes the atmosphere, producing highly ionized areas that may interfere with radar and communication devices. Large amounts of dust and debris can be sent into the atmosphere by low altitude explosions, which can have a variety of effects on the environment.

Electromagnetic pulses produced by nuclear explosions have the potential to interfere with communication networks and electrical equipment. Wind and weather patterns have the ability to carry radioactive particles, contaminating vast areas and harming ecosystems as well as human health. Nuclear radioactivity's effects on the environment are frequently contrasted with those of natural radiation sources like radon gas. Although nuclear activity raises radiation levels, natural sources still account for the majority.

Nuclear fallout, or radioactive dust and ash, can linger in the atmosphere and impact air quality, raising the risk of cancer in communities located distant from the explosion site. According to theoretical simulations, massive nuclear wars, also known as "nuclear winters," would release enough dust into the sky to block sunlight, resulting in global cooling and the collapse of agriculture.

11.5 Effects of Nuclear Contamination on Ecosystems

Ecosystems may be severely and permanently impacted by nuclear contamination. Leaching radioactive materials into bodies of water can harm aquatic life and render the water unfit for human consumption. Additionally, radioactive particles have the ability to attach themselves to soil particles, rendering the ground unusable and influencing plant development.

Although not a significant source of air pollution under normal circumstances, an uncontrolled nuclear reaction can release radioactive particles into the atmosphere. Nuclear contamination has very harmful impacts on wildlife. Animals can ingest or absorb radioactive materials, leading to health issues, genetic mutations, and population declines.

Long-term exposure and pollution can result from radioactive fallout's ability to linger in the environment. These effects emphasize how crucial strict safety regulations and efficient waste disposal are to reducing the dangers of nuclear contamination. In plants and animals, radiation can result in genetic changes and death. While some species might experience long-term health impacts, others might go extinct. Habitats can be destroyed by a nuclear explosion's extreme heat and blast, rendering a region uninhabitable for years.

One of the socioeconomic effects of nuclear contamination is the potential for polluted places to become uninhabitable, which would force communities to move. Radiation exposure for an extended period raises the risk of cancer and other illnesses, burdening healthcare systems. Nuclear testing's legacy emphasizes how crucial international accords like the Comprehensive Nuclear-Test-Ban Treaty (CTBT) are to stopping additional environmental damage.

11.6 Prevention of Environmental Harm from Nuclear Contamination

Nuclear fallout prevention is a complicated and pressing problem. At the intergovernmental level, thoughtful plans and actions can lessen the effects.

To stop the devastating environmental harm that nuclear explosions might inflict, global nuclear disarmament can aid in the reduction and eventual abolition of nuclear weapons. This is the aim of international agreements such as the Treaty on the Prohibition of Nuclear Weapons.

It is essential to further clean up the contaminated areas. To stop radioactive materials from spreading further, they must be removed or contained. There are still obstacles in the way of efforts to clean up contaminated regions, such as the Runit Dome in the Marshall Islands. Located on Runit Island in the Marshall Islands, the Runit Dome—also called the Cactus Dome or The Tomb—is a concrete building. Built between 1977 and 1980, it was designed to house radioactive waste from American nuclear testing with radioactive debris from 1946 to 1958.

About 73,000 cubic meters (95,000 cubic yards) of radioactive material, including some plutonium-239, are contained under the dome. However, the dome's structural integrity is becoming increasingly questioned because of erosion and cracking, which may cause radioactive contamination of the surrounding area. There are continuous discussions about how to handle the possible threats, and it is a significant historical and environmental issue.

Environmental harm can be reduced by putting in place reliable methods for tracking radiation levels and reacting fast to nuclear accidents. This entails putting emergency preparations in place and helping impacted areas right away. In order to protect the public and employees, radiation monitoring and response entails using a variety of methods and tools to identify and quantify radiation levels.

measuring radiation levels with tools such as scintillation detectors and ionization chambers. Employees in radiation facilities are kept under observation for radiation exposure thanks to personnel monitoring. Dosimeters and other radiation dose monitoring devices can be used for this. To guarantee the accuracy and dependability of radiation monitoring equipment, routine calibration and maintenance require quality assurance. Procedures such as evacuation plans, decontamination methods, and medical care for impacted individuals can be established in response to radiation accidents.

11.7 Public Awareness on Nuclear Fallout

Increasing public knowledge is essential since nuclear fallout is a serious hazard. It is crucial to inform the people about the dangers of nuclear fallout. This entails being aware of the short- and long-term consequences, safety precautions, and preparation strategies.

Urge people and communities to create emergency plans that include safe shelters, evacuation routes, and the stockpiling of necessary supplies. Encourage regional and federal governments to fund nuclear safety initiatives, hold frequent exercises, and make sure that infrastructure is equipped to withstand such risks.

Make use of a range of media channels to dispel myths, disseminate correct information, and offer concise guidance on what to do in the case of radioactive fallout. Collaborate with scientists, medical experts, and first responders to guarantee that the data is correct and thorough. In order to make sure that everyone, from kids to adults, is educated, include nuclear safety education in school curricula and community initiatives. Set up town hall events, webinars, and workshops so that professionals may talk and field public inquiries. Using these tactics can contribute to the development of an informed and ready community.

Chapter 12

Tribulations of Unexploded Ordnance and Landmines

In this chapter

12.1 Environmental Risks posed by Unexploded Ordnance and Landmines

12.2 Challenges of Demining and Remediation Efforts

12.3 Unexploded Ordnance Impact on Land Use and Human Communities

Landmines and unexploded ordnance (UXO) are relics from previous wars that continue to be dangerous long after hostilities have stopped. Bombs, shells, grenades, and other explosive devices that didn't explode as planned are examples of UXOs. However, landmines can remain active for decades, harming populations long after battles have ended. Landmines are explosive devices buried on or beneath the ground to disable enemy targets.

In order to combat these concerns, the United Nations Mine Action Service (UNMAS) removes landmines and UXOs, informs local communities about the risks, and aids victims. Millions of landmines and UXOs continue to poison soil in around 70 nations despite efforts, endangering innocent people every day, particularly children.

12.1 Environmental Risks posed by Unexploded Ordnance and Landmines

Landmines and unexploded ordnance (UXO) are major environmental hazards. Toxic compounds such as explosive residues (TNT) and heavy metals (lead, antimony, and barium) can be released into the soil and water by UXO, which can have an impact on aquatic life and plant growth.

Biodiversity can be lost as a result of habitat destruction and ecological disruption caused by UXO explosions. UXO can be triggered by wildlife, which can cause harm or death. The entire food chain may be impacted by contaminated soil's ability to suppress plant development. Because of its contamination, vast tracts of land may become unfit for forestry, agriculture, and urbanization.

Landmines have the potential to change the landscape and have an impact on nearby ecosystems by causing craters and soil erosion. Removing vegetation is a common step in clearing landmines, which might disturb the local wildlife and flora. Landmine explosives have the potential to contaminate water sources by seeping into groundwater. Landmines can remobilize due to extreme weather, posing a greater risk to humans and the environment. To lessen their negative effects on the environment, landmines and UXOs both need to be carefully managed and cleared.

12.2 Challenges of Demining and Remediation Efforts

Numerous obstacles make demining and remediation operations difficult and resource-intensive. Finding landmines and UXO can be challenging, particularly in areas with a lot of vegetation or rough terrain, and calls for technical know-how. Conventional techniques, like as metal detectors, are not always successful, while cutting-edge technology are frequently costly and necessitate specific training. Different techniques are needed for the detection and removal of different kinds of UXO and mines. While some gadgets feature intricate electronic circuitry, others are just pressure-activated. Deminers are constantly at risk of unintentional detonation, which makes demining risky by nature.

Demining and restitution initiatives face environmental obstacles. Water contamination, habitat destruction, and soil erosion can result from the use of explosives and large gear in demining. Removing vegetation is a common step in clearing landmines, which can upset regional ecosystems and endanger biodiversity. The environmental effects of demining may not go away, necessitating continued observation and restoration work.

In addition, there are financial and logistical difficulties. Significant financial resources, specialized machinery, and skilled labor are needed for demining operations. Governments, non-governmental organizations, and local populations must coordinate for demining to be effective. Delays and inefficiencies may result from a lack of coordination. It's seldom easy to find consistent funding for demining and cleanup projects.

Community involvement is necessary to address social and political issues. Involving local communities in demining operations is essential, but it might be difficult because of mistrust, fear, or ignorance. The stability and political will of the impacted area are frequently key factors in the effectiveness of demining operations. Despite these obstacles, continuous efforts and advancements in technology and procedures keep demining operations safer and more effective.

12.3 Unexploded Ordnance Impact on Land Use and Human Communities

Landmines and unexploded ordnance (UXO) can have a major effect on human communities and land use. Large tracts of land may become unusable due to UXO and landmine pollution, limiting access for commercial, residential, and agricultural uses. Landmines and UXO can impede or postpone the construction of infrastructure, including housing developments, schools, hospitals, and roadways. Because contaminated ground is frequently unusable for farming, arable land is lost and agricultural output is decreased. Demining operations have the potential to degrade land and lower its quality by destroying habitat and causing soil erosion. Landmines and UXO present major safety risks to nearby communities, resulting in fatalities, injuries, and psychological distress.

Communities may be uprooted due to fear of landmines and UXO, which forces people to abandon their homes and means of subsistence. Landmines and UXO can impede economic operations including farming, trading, and tourism, resulting in a loss of revenue and means of subsistence. People who live in constant dread and uncertainty can have their social cohesiveness and communal life disrupted by UXO and landmine poisoning. Landmine and

UXO injuries can put a burden on healthcare systems and cause long-term disability. Health problems might also result from drinking tainted water.

Members of the community may experience severe psychological trauma and terror due to the ongoing threat of landmines and UXO, which could negatively impact their mental health and general well-being. Landmines and UXO can have a generational impact, restricting the options available to children who are raised in contaminated locations. All things considered, landmines and UXO can have significant and enduring impacts on human communities and land use. Coordinated demining activities, community education, and sustained assistance for impacted communities are necessary to address these problems.

Chapter 13

Impact of Chemical Warfare and Toxic Substances on Environment

In this chapter

13.1 Environmental Effects of Chemical Warfare

13.2 International Regulations for Prohibition of Chemical and Biological Weapons

A chemical weapon is a device that harms or kills people, animals, or plants by using harmful chemicals and substances. These weapons, which can be gasses, liquids, or solids, are made to efficiently spread the chemical agent throughout a target region. A family of compounds known as nerve agents is made to interfere with the neurological system and cause death. Among the most hazardous kinds of chemical weapons are these.

Highly toxic substances known as nerve agents obstruct the nervous system's capacity to interact with muscles and organs. As a result of their inhibition of the acetylcholinesterase enzyme, acetylcholine builds up in the body, stimulating muscles, glands, and the central nervous system continuously. The Chemical Weapons Convention (CWC) forbids the use of nerve agents in combat and requires their disposal.

13.1 Environmental Effects of Chemical Warfare

Chemical warfare-related soil and water contamination are serious environmental problems that can have a big impact on ecosystems and human health. When dangerous materials like industrial chemicals, herbicides, and heavy metals build up in the soil, it can lead to pollution. Numerous sources, including factories and manufacturing facilities that may discharge pollutants into the soil, can contribute to these toxins. Soil pollution can result from over use of fertilizers and pesticides. Soil contamination can occur when hazardous waste is improperly disposed of. Toxic chemicals may be released into the soil during mineral extraction.

Numerous health concerns, such as skin irritations, cancer, and respiratory disorders, can result from exposure to contaminated soil. The equilibrium of ecosystems can be upset by contaminated soil, which can damage microbes, plants, and animals. Additionally, crops cultivated in contaminated soil absorb toxic compounds that, if consumed, could be hazardous to human health.

Pollutants can contaminate water when they get into lakes, rivers, and groundwater. Common sources of water contamination include waste and chemicals released into water bodies by companies and plants. Rainwater can carry fertilizers and pesticides from chemically exposed plants into water sources. Water supplies may become contaminated by untreated or inadequately treated sewage from the impacted areas.

Cholera, dysentery, and other waterborne ailments can result from consuming or using tainted water. Aquatic life, ecosystems, and biodiversity can all be negatively impacted by such contaminated water. Economic losses may result from contaminated water's effects on tourism, fishing, and agriculture.

13.2 International Regulations for Prohibition of Chemical and Biological Weapons

An important international agreement is the 1925 Geneva Protocol, officially known as the Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous or Other Gases, and of Bacteriological Methods of Warfare. It became operative on February 8, 1928, after being signed in Geneva, Switzerland, on June 17, 1925. The use of biological and chemical weapons in international armed conflicts is forbidden by the agreement. It was a reaction to the horrible injuries and fatalities brought on by the extensive use of chemical weapons during World War I. One of the most important steps in the international campaign to eradicate chemical and biological weapons was the Geneva Protocol. In international military confrontations, it forbids the employment of chemical and biological weapons.

An important international agreement is the Chemical Weapons Convention (CWC), also known as the Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction. It became operative on April 29, 1997, after being signed in Paris and New York on January 13, 1993. It was run by the Hague, Netherlands-based Organization for the Prohibition of Chemical Weapons (OPCW).

The research, manufacture, storage, and use of chemical weapons are prohibited by this convention. It also outlaws the transfer of chemical weapons and mandates their disposal. It creates a strict verification system that includes routine inspections, challenge inspections, national declarations, and assistance and defense for nations under chemical weapons assault or danger. Additionally, it encourages collaboration in the non-violent application of chemicals.

193 states are parties to the CWC as of August 2022. South Sudan, North Korea, Israel, and Egypt are notable exceptions. The world has destroyed more than 98% of its reported chemical weapons stockpiles. As part of a deal to destroy its chemical weapons, Syria joined the convention in 2013. In order to eradicate chemical weapons and maintain international security, the CWC is an essential step.

Chapter 14

Effects of Biological and Chemical Warfare Agents on Ecosystem

In this chapter

14.1 Relationship of Biological and Chemical Agents to Natural Disasters

Agents of biological and chemical warfare can impact the ecosystem in a variety of ways. These pathogens, which include bacteria, viruses, fungi, and poisons, are biological warfare agents. They have the potential to infect both humans and animals when discharged into the atmosphere since they can travel across wide areas. Plant and animal life may be impacted by the disruption of ecosystems caused by the release of biological agents. Anthrax outbreaks, for instance, have the potential to contaminate water and soil. Long-term hazards can arise from biological agents that can persist in the environment for long stretches of time.

Chemical agents include blood agents like hydrogen cyanide, blister agents like sulphur mustard, choking agents like chlorine, and nerve agents like sarin and soman. Chemical agents have the ability to spread through the atmosphere and impact vast regions. The weather, the agent's physical condition, and the administration technique are some of the variables that affect their persistence. Chemical agent exposure can result in a variety of health concerns, ranging from respiratory disorders to serious organ damage and even death. The agent's concentration, exposure time, and individual susceptibility all affect how severe the effects are.

When biological and chemical agents are released together, the overall effect may be worsened, with more serious health and environmental effects. To lessen the effects of these substances, quick discovery and action are essential. Effective countermeasures require sophisticated sensing systems and coordinated defence tactics.

14.1 Relationship of Biological and Chemical Agents to Natural Disasters

Natural disasters and biological and chemical warfare weapons both have major effects, yet they are not the same in a few important respects. Chemical and biological agents are created by humans and purposefully discharged to injure others. However, natural disasters, which include things like hurricanes, floods, wildfires, and earthquakes, happen naturally. Both acute and long-term health problems, such as infections, respiratory disorders, and organ damage, can be brought on by biological and chemical pollutants. The agent and degree of exposure determine the severity. However, injuries, fatalities, and mental health problems are among the health effects of natural catastrophes. Following disasters like floods, secondary impacts like waterborne illnesses may manifest.

Long-term ecological harm can result from the contamination of soil, water, and air by biological and chemical agents, which have a variety of environmental effects. Natural

disasters, on the other hand, have the power to change ecosystems, modify landscapes, and reduce biodiversity. For instance, woods can be devastated by wildfires, and coastal ecosystems can be destroyed by hurricanes. Specialised detection, decontamination, and medical interventions are necessary for biological and chemical agents. Advanced technology and quick reaction are essential. Nonetheless, search and rescue, medical assistance, and reconstruction activities are all included in emergency response to natural catastrophes. Impact can be lessened by readiness and early warning systems.

Because biological and chemical agents are invisible and sneaky, they can cause psychological effects like worry and terror. Trauma from abrupt, uncontrollable events can result in stress and injuries during natural disasters. Healthcare, decontamination, and possible long-term environmental remediation are among the financial consequences associated with biological and chemical agents. Costs associated with natural disasters include rebuilding efforts, livelihood loss, and infrastructure damage.

Targeted and possibly more localised, biological and chemical agents can have disastrous long-term consequences. Natural catastrophes can result in immediate, significant devastation and are usually more widespread. In conclusion, although both can be catastrophic, natural catastrophes are natural events with wide-ranging effects, whereas biological and chemical agents are man-made and have targeted effects. Both need for distinct strategies for mitigation and reaction.

Section D

International Military Conflicts and Legal Framework

Chapter 15

Humanitarian and Environmental Interventions

In this chapter

- 15.1 Role of International Organizations in Addressing Environmental Damage**
- 15.2 The United Nations Environment Programme (UNEP)**
- 15.3 Global Environment Facility (GEF)**
- 15.4 International Union for Conservation of Nature (IUCN)**
- 15.5 World Wide Fund for Nature (WWF)**
- 15.6 Strategies for Environmental Restoration and Remediation**
- 15.7 Soil Remediation**
- 15.8 Soil Washing**
- 15.9 Bioremediation**
- 15.10 Ecosystem Restoration**

In order to provide both short-term human needs and long-term environmental sustainability, humanitarian and environmental initiatives are essential. Since humanitarian initiatives can have an influence on the environment and environmental challenges can exacerbate humanitarian crises, these interventions frequently overlap. The UN Environment Programme (UNEP), for instance, collaborates with partners to guarantee that environmental factors are incorporated into every facet of humanitarian response. This entails creating action plans, contributing to important Humanitarian Programme Cycle components, and encouraging information sharing between the environmental and humanitarian groups.

Conversely, groups like InterAction concentrate on "greening" humanitarian interventions through waste reduction, energy use, and carbon footprint reduction. Additionally, they stress how crucial cooperative environmental management is to preventing maladaptation and guaranteeing a whole-of-system approach.

15.1 Role of International Organizations in Addressing Environmental Damage

Through the implementation of environmental legislation, the promotion of sustainable practices, and the development of international cooperation, international organisations play a critical role in resolving environmental degradation.

15.2 The United Nations Environment Programme (UNEP) fosters international collaboration, advances sustainable development, and establishes the global environmental agenda. International environmental accords and guidelines are also developed by it. The foremost international authority on environmental matters is the United Nations Environment Programme. The goal of UNEP, which was founded in 1972 following the United Nations Conference on the Human Environment in Stockholm, is to educate, inspire, and empower

countries and peoples to enhance their standard of living without sacrificing that of future generations.

More significantly, UNEP is home to the secretariats of a number of multilateral environmental accords and research organisations, such as the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the Intergovernmental Panel on Climate Change (IPCC). Scientific evaluations of climate change, its effects, and possible future hazards are provided by the Intergovernmental Panel on Climate Change (IPCC). Based on the most recent scientific findings, it assists policymakers in making well-informed decisions.

15.3 Projects that tackle global environmental concerns like biodiversity loss, deforestation, and climate change are supported by the **Global Environment Facility (GEF)**. To address these issues, it pulls together the commercial sector, governments, and civil society. For projects pertaining to biodiversity, climate change, international waters, land degradation, mercury, persistent organic pollutants (POPs), sustainable forest management, food security, and sustainable cities in developing and transitioning nations, this multilateral environmental fund offers grants and blended finance.

In October 1991, the World Bank launched the Global Environment Facility as a \$1 billion pilot program to help poor nations address environmental issues and advance sustainable development. To pay the "incremental" or extra expenditures involved in turning a project with national benefits into one with global environmental benefits, the GEF would offer new and additional grants as well as concessional funds.

The three original partners carrying out GEF initiatives were the World Bank, the United Nations Environment Program, and the United Nations Development Programme. At the Rio Earth Summit in 1992, the GEF underwent a transformation and became a permanent, independent organisation. The choice to establish the GEF as a separate entity improved the participation of developing nations in both project implementation and decision-making. The World Bank has provided administrative support and acted as the GEF Trust Fund's trustee since 1994.

During the reorganisation, the GEF was given the responsibility of serving as the funding source for the UN Framework Convention on Climate Change and the UN Convention on Biological Diversity. To help the Russian Federation and countries in Eastern Europe and Central Asia phase out their usage of ozone-destroying chemicals, the GEF began sponsoring programs in collaboration with The Montreal Protocol on Substances that Deplete the Ozone Layer.

In order to increase its capacity to facilitate innovative financing arrangements and more effectively leverage private sector investment, the GEF Council made the decision in 1998 to extend its reach beyond the original three implementing agencies, which included the International Finance Corporation. Three more international agreements were later chosen to use the GEF as a funding mechanism: the Minamata Convention on Mercury (2013), the United Nations Convention to Combat Desertification (2003), and the Stockholm Convention on Persistent Organic Pollutants (2001).

15.4 International Union for Conservation of Nature (IUCN) strives to protect the environment and encourage the sustainable use of natural resources. The IUCN Red List, which evaluates the global conservation status of species, is published by it. An international expert on the state of the natural environment and the steps required to protect it is the International Union for Conservation of Nature (IUCN). IUCN was established in 1948 with the goal of promoting sustainable resource use and wildlife conservation by bringing together governments, scientists, civil society organisations, and other interested parties.

IUCN red list of threatened species is perhaps one of IUCN's most well-known initiatives. It provides detailed information on the conservation status of thousands of species, helping to guide conservation actions globally. It works to establish and manage protected areas around the world, ensuring that important ecosystems and biodiversity hotspots are preserved.

In order to assist governments and organisations in creating successful conservation plans, IUCN carries out scientific research and offers policy recommendations. To improve conservation efforts, it works with a variety of partners, such as NGOs, international organisations, academic institutions, and the commercial sector. It also highlights how crucial it is to combine conservation and sustainable development, acknowledging the connection between the planet's health and human well-being. The goal of the IUCN is to ensure that all uses of natural resources are fair and environmentally sustainable while also influencing, motivating, and supporting communities in their efforts to preserve nature's diversity and integrity.

15.5 World Wide Fund for Nature (WWF) emphasises preserving endangered species, encouraging sustainable behaviours, and conservation initiatives. It collaborates with communities, corporations, and governments to accomplish its objectives. The World Wide Fund for Nature is a global non-governmental organisation that works to protect animals and lessen the effects of human activity on the environment. One of the biggest and most reputable conservation organisations in the world was founded in 1961 and is called WWF. It works in over 100 nations and funds about 1,300 environmental and conservation initiatives worldwide.

The goal of WWF is to halt the deterioration of the planet's ecosystem and create a future where people coexist peacefully with the natural world. They emphasise a number of important topics, including protecting biodiversity, making sure that renewable natural resources are used sustainably, and encouraging the decrease of pollution and unnecessary consumerism.

Protecting endangered species, combating climate change, and advancing sustainable agriculture and fisheries are a few of WWF's most well-known programs and projects. Addressing environmental harm and advancing a sustainable future depend heavily on these and other organisations.

15.6 Strategies for Environmental Restoration and Remediation

Cleaning up and restoring contaminated ecosystems requires a variety of techniques, including environmental restoration and remediation. The process of cleaning up and recovering damaged

habitats, including soil, groundwater, surface water, and air, is known as environmental remediation. It includes a variety of methods and tools intended to eliminate or neutralise contaminants, lessening their negative effects on ecosystems, human health, and the environment at large. Maintaining biodiversity, promoting sustainable development, and safeguarding public health all depend on efficient environmental remediation.

Heavy metals, herbicides, petroleum hydrocarbons, and industrial chemicals are only a few examples of the diverse range of contaminants. Numerous sources, such as waste disposal facilities, agricultural practices, and industrial operations, might produce these contaminants. Because contamination can take many forms, different remediation techniques that are suited to contaminants and environmental circumstances are required.

15.7 Soil Remediation

Because soil contamination directly affects agriculture, human health, and ecosystems, it is a serious concern. Petroleum hydrocarbons, insecticides, and heavy metals (including lead and mercury) are common soil pollutants. A variety of remediation strategies are needed to address soil pollution. One simple but frequently expensive option is excavation, which is removing contaminated soil and replacing it with clean material.

A variety of methods are used in soil remediation to eliminate or neutralise pollutants in soil, restoring its use and averting negative impacts on the environment and public health. Contaminated soil is taken out and taken to an approved landfill using the excavation and disposal procedure. Although it can be costly and disruptive, this works well in places that are highly contaminated.

15.8 Soil Washing

Soil washing is a method of cleaning soil particles of impurities by applying water or chemical solutions. Contaminated soil is removed from the site and taken to a treatment facility using the excavation process. To get rid of big particles like boulders and roots, the soil is screened. Particle size is then used to separate the dirt. Usually, coarse particles (sand and gravel) are separated from fine particles (clay and silt). Since contaminants frequently attach to small particles, separating them aids in cleaning process concentration. A solution, such as water, surfactants, or other chemical solvents, is used to wash the soil. This aids in the pollutants' mobilisation and removal from the soil particles.

The cleaned dirt is separated from the polluted wash water. After that, the pollutants are eliminated from the water by treatment. While the treated water can be safely released or used again in the washing process, the cleansed soil can be utilised again on-site or disposed away. It is a successful method for eliminating hydrocarbons, heavy metals, and other organic contaminants. Either on-site or off-site execution is possible. However, it is somewhat costly and might not work for all pollutants, particularly if they are firmly attached to soil particles.

This method is frequently applied to clean up soils that have been tainted by industrial contaminants. It works well for clearing heavy metal-contaminated soils from mining operations. It is mostly used to clean up soils that have been tainted by petrol, oil, and other

urban pollutants. Soil washing, on the other hand, is a flexible and successful technique for soil remediation, particularly in regions with significant contamination.

15.9 Bioremediation

The process of bioremediation uses microorganisms to convert contaminants into less dangerous forms. Microorganisms, plants, fungi, or enzymes are used to break down and detoxify toxins in contaminated areas, making it a natural and environmentally acceptable method of cleanup. It is a flexible technique that works with soil, water, and air. The microbial bioremediation technique, also known as in-situ bioremediation, treats the contamination on the spot. To break down contaminants, this entails promoting the growth of natural microbes. at ex-situ bioremediation, polluted material (soil or water) is removed and treated at a different location. This may entail landfarming, bioreactors, or biopiles.

Using plants to absorb pollutants (such heavy metals) from the soil into their roots, stems, and leaves is known as the phytoextraction remediation approach. Using plants to stabilise pollutants in the soil and stop them from migrating is known as phytostabilization. Another technique is phytodegradation, which uses plants' tissues to break down organic contaminants. Additionally, there is another technique called phytovolatilization, which uses plants to absorb pollutants and release them into the environment as less dangerous gases.

Using fungi to break down organic contaminants through enzymatic reactions is known as fungal bioremediation, or mycoremediation. When it comes to decomposing complex chemical substances like hydrocarbons, fungi are especially efficient. Another remediation technique is enzymatic bioremediation, which uses enzymes made by plants or microorganisms to catalyse the conversion of pollutants into less dangerous forms.

Applications for bioremediation are numerous. In oil spills, hydrocarbons can be broken down by microorganisms into less dangerous substances. By treating solid waste and wastewater from industrial processes, bioremediation helps lower pollution. In agricultural settings, pesticide and fertiliser contamination can be successfully addressed via phytoremediation. In mining regions, plants and microbes can stabilise and detoxify heavy metals and other contaminants.

One of bioremediation's benefits is its application. Its environmentally safe application uses natural methods instead of dangerous chemicals. Compared to physical and chemical remediation approaches, it is much more cost-effective. It may be used on a variety of pollutants and situations because it is so adaptable. Furthermore, the site is barely disturbed by in-situ techniques. To put it briefly, bioremediation is a viable and sustainable strategy for dealing with environmental contamination.

15.10 Ecosystem Restoration

Restoring damaged, deteriorated, or destroyed ecosystems to a condition of health, functionality, and sustainability is known as ecosystem restoration. Restoring habitat structures, re-establishing native species, and enhancing ecosystems' general resilience are all common steps in this process. In order to restore forest ecosystems, afforestation and reforestation entail

planting native trees and plants on regions that are not functioning well. This technique guarantees soil erosion prevention and the restoration of deteriorated areas.

Rehabilitating wetlands to enhance water quality and offer habitat for a variety of species is known as wetland restoration. It makes it possible to restore the patterns of natural water flow. Restoring natural river channels and reducing obstacles to fish movement are two aspects of river and stream restoration. It contributes to improving water quality and aquatic habitats.

In order to enhance water quality and offer habitat for a variety of species, wetlands must be restored. Restoring natural water flow patterns is made possible by it. Fish migratory obstacles are taken down and natural river channels are restored as part of river and stream rehabilitation. It improves water quality and aquatic habitats.

Restoring ecosystems is a team effort that calls for cooperation from communities, organisations, governments, and people. These tactics seek to promote sustainable development, safeguard public health, and lessen pollution. We can preserve and repair the natural environment for coming generations if we band together.

Chapter 16

Environmental Impacts of Military Base Developments

In this chapter

- 16.1 Impacts of Military Projects on Local Communities**
- 16.2 Soil Impacts of Movement of Heavy Military Vehicles**
- 16.3 Impacts of Heavy Military Operations on Local Ecosystems**
- 16.4 Military Strategies to Reduce Environmental Impacts**

Communities and ecosystems are impacted by the substantial environmental effects of military base construction. Site-specific environmental effects result from building infrastructure for military base developments. In contrast to the growth of terrestrial strips, which may have been located kilometres away from such water bodies, the construction of naval ports and shipyards had a negative impact on the contamination of nearby water bodies. Pollution from military operations is frequently caused by chemical spills, vehicle and equipment emissions, and inappropriate trash disposal. Both human health and animals may be impacted by the resulting soil, water, and air pollution. Deforestation and habitat degradation may result from the building of military bases and training areas. Local ecosystems are disturbed, and biodiversity may be lost as a result.

Noise pollution from military operations can disturb animals and alter animal migration patterns and behaviour. There are serious environmental problems associated with the disposal of garbage and hazardous items from military operations. Degradation of the environment can be caused by improper waste management. Because military installations utilise a lot of energy, they have a significant carbon footprint and considerable greenhouse gas emissions. To lessen these effects, some bases are putting energy efficiency and renewable energy efforts into place. Local communities may be impacted by military bases, including possible health hazards due to pollution and altered land usage.

16.1 Impacts of Military Projects on Local Communities

Local communities can gain economically from military facilities in a number of ways, such as the creation of jobs, improved infrastructure, and more demand for regional companies. Disruptions to conventional businesses and land usage, however, might outweigh these advantages. Because military operations involve noise, pollution, and exposure to toxic materials, neighbouring civilians may be at risk for health problems. Community safety may also be jeopardised by military-related mishaps and accidents.

Local residents' quality of life may be impacted by the environmental damage brought on by military operations. Long-term environmental harm that affects the health and well-being of communities can result from pollution, deforestation, and habitat destruction. A military base's existence can change a community's social and cultural dynamics. This can involve potential

disputes between locals and military personnel, changes in local customs, and demographic trends.

Roads, utilities, and emergency services are just a few examples of the major infrastructure and public services that military sites frequently need. This may put a burden on the infrastructure and resources available locally, which could result in lower-quality services for locals. Land use changes, such as the eviction of companies and inhabitants, may result from the construction of a military post. The demand from military troops may cause property values to rise in some regions while environmental and social effects may cause them to fall in others. Local communities and the military may have different relationships. While bad relations can lead to resistance and violence, good relations can result in community support for military operations.

In summary, military projects present issues with health, safety, the environment, and social dynamics even though they can have positive effects on the economy and infrastructure. To reduce negative effects and increase favourable ones, military officials and local communities must effectively communicate and work together.

16.2 Soil Impacts of Movement of Heavy Military Vehicles

The earth may be significantly impacted by the movement of large military vehicles. Heavy military vehicles' weight has the potential to compact the soil, decreasing its penetrability and absorbency. This may result in more surface runoff and less water infiltration, which may exacerbate erosion and flooding. It may disturb the soil's surface, increasing the likelihood that wind and water may erode it. Topsoil, which is essential for plant growth and the health of ecosystems, may be lost as a result.

Plant cover can be lost as a result of heavy vehicles crushing and removing plants. This lessens the soil's capacity to hold onto moisture and withstand erosion, in addition to having an impact on the local flora. Frequent vehicle movement can weaken the structure of the soil, reducing its fertility and ability to support plant life. This can lower the productivity of the land and have long-term effects on the environment. Contamination can result from hazardous materials being introduced into the soil through military vehicle maintenance and fuel leaks. This may damage animal and human health by affecting soil health and maybe making its way into the food chain.

Using defined tracks, putting soil conservation techniques into place, and doing routine environmental assessments to monitor and manage soil health are some ways to lessen these effects.

16.3 Impacts of Heavy Military Operations on Local Ecosystems

Local ecosystems may be significantly and broadly impacted by large-scale military actions. Natural habitats are frequently destroyed in the process of building military bases, training grounds, and infrastructure. Wildlife and plant species may be displaced or disappear as a result of this. Fuel spills, emissions from vehicles and equipment, and chemicals from explosions are just a few of the pollutants that military operations can release into the environment. Both plants and animals may be impacted by these contaminants' ability to contaminate soil, water, and air.

Wildlife activity, including feeding, breeding, and migration patterns, can be disturbed by noise from military drills, automobile traffic, and weapon testing. Additionally, military installations' artificial lighting can change natural light cycles and have an impact on nocturnal animals. Heavy military vehicle traffic can compact the soil, decreasing its capacity to sustain vegetation and raising the possibility of erosion. More habitat deterioration and vegetation loss may result from this. Local water supplies may be impacted by military operations due to contamination, changes in water flow, and elevated water demand. Aquatic ecosystems and the amount of water available for other purposes may be impacted.

Invasive species may unintentionally be brought to new locations by military operations, such as the relocation of troops and equipment. Local ecosystems may be disrupted by these species' ability to outcompete native species. Wildlife can be killed via direct impacts, such as car crashes or unintentional gunshots. Long-term decreases in wildlife populations can also result from pollution and habitat degradation.

Using environmental management techniques, carrying out environmental impact analyses, and repairing harmed habitats are some ways to lessen these effects. The environmental impact of military operations can also be lessened via cooperation between environmental groups and military officials.

16.4 Military Strategies to Reduce Environmental Impacts

Globally, militaries are adopting a number of tactics to lessen their environmental footprint as they realise how important environmental sustainability is. Numerous military installations are making investments in geothermal, wind, and solar energy. This lessens greenhouse gas emissions and dependency on fossil fuels. Energy consumption can be decreased by putting energy-efficient practices and technology into place, such as smart grid technologies, LED lighting, and energy-efficient heating and cooling systems.

Sustainable building methods and materials are being used in the construction of new military buildings. This includes green building certifications that encourage resource efficiency and environmental responsibility, like LEED (Leadership in Energy and Environmental Design). In order to clean up contaminated places and restore natural habitats, military organisations regularly participate in environmental remediation programs. On military grounds, conservation initiatives also involve conserving biodiversity and safeguarding endangered species.

To minimise, recycle, and appropriately dispose of waste produced by military operations, extensive waste management programs are in existence. This lessens the negative effects of garbage and dangerous products on the environment. Rainwater collection, wastewater recycling, and the installation of low-flow fixtures are some of the measures being taken to enhance water management and lower water use. Green procurement practices, which give preference to eco-friendly goods and services, are being adopted by the military. This entails investing in products with low environmental effect, biodegradable materials, and energy-efficient machinery.

Exercises for training are being created to reduce harm to the environment. This involves employing best practices for soil and water conservation, setting aside certain training places

to minimise habitat destruction, and using simulators for training. One important tactic is to teach military troops about environmental sustainability and promote ecologically conscious behaviour. This covers awareness campaigns, workshops, and training courses. Additionally, in order to solve environmental issues and advance sustainability programs, military are collaborating with local communities, government organisations, and environmental groups.

These strategies help mitigate the environmental impact of military operations and contribute to a more sustainable future.

Chapter 17

International Legal Commitments during Wars and Environmental Protection

In this chapter

17.1 History of Lawmaking on Armed Conflicts and Environment

17.2 International Environmental Law

17.3 Core Principles of International Environmental Law

To reduce environmental harm, training activities are being developed. This entails employing training simulators, setting aside particular training spaces to minimise habitat loss, and putting best practices for soil and water conservation into effect. Promoting environmentally conscious behaviour and teaching military troops about environmental sustainability are important tactics. This includes workshops, awareness initiatives, and training courses. In addition, armies are collaborating with local communities, government organisations, and environmental groups to address environmental issues and advance sustainability projects.

17.1 History of Lawmaking on Armed Conflicts and Environment

A fascinating journey, the history of legislation pertaining to armed conflicts and the environment shows how our knowledge of the necessity of protecting the environment even during times of war has evolved. A few things happened in the early seventies. As environmental protection became a greater issue, the world community began to take environmental protection seriously. Due to the lack of adequate legal protection for victims of armed conflicts, more significant initiatives were made to address the situation.

A number of significant events sparked popular opinions that led to these developments. These included environmental catastrophes like significant oil leaks that occurred during or as a result of wars and other military conflicts. Such campaigns and public outcry for environmental protection were sparked by the environmental catastrophes that occurred during the Vietnam War.

Together, these incidents shaped public perceptions of the health risks to the public and the consequences of defoliation brought on by the use of herbicides, especially Agent Orange, during the Vietnam War. preservation of the environment. International conferences addressing the armed conflicts marked the beginning of the legislative process. These meetings included the Diplomatic Conference on the Reaffirmation and Development of International Humanitarian Law in the 1970s, also known as the Geneva Conventions, and the United Nations Committee of the Conference on Disarmament. A resolution prohibiting the military or any hostile use of environmental modification techniques was issued by the United Nations Committee of the Conference on Disarmament in 1976. The use of environmental modification techniques to damage the hostile territory's flora is governed by this treaty.

Environmental protection measures during armed situations were incorporated into the 1977 Additional Protocols to the Geneva Conventions. Article 35(3) of Additional Protocol I, for instance, forbids the use of weapons or tactics of war that are likely to result in extensive, protracted, and serious harm to the environment.

Protocols addressing the use of weapons that can harm the environment, such as landmines and combustible weapons, were added in the 1980 Convention on Certain Conventional Weapons. Principle 24 of the 1992 Rio Declaration on Environment and Development, sometimes known as the Rio Declaration, calls for states to collaborate in the advancement of the environment and to uphold international law that protects it throughout armed conflicts.

The 1996 International Court of Justice Advisory Opinion on nuclear weapons acknowledged that states must take environmental factors into account when determining what is necessary and proportionate in the pursuit of justifiable military goals, and that the environment is generally protected from the effects of war. The Rome Statute of 1998, which established the International Criminal Court, was the following piece of legislation. The Rome Statute's definition of war crimes includes clauses that safeguard the environment during armed conflicts.

Establishing a framework for preventing major transboundary harm brought on by hazardous activities is the goal of the 2001 International Law Commission Draft Articles on the Prevention of Transboundary Harm from Hazardous Activities. The articles cover acts that are not illegal under international law but have the potential to cause serious harm across borders due to their physical effects.

The clauses mandate that the State of origin take all necessary steps to either prevent or at least reduce the danger of serious transboundary harm. To reduce the risk or avoid serious transboundary harm, the involved states must work together in good faith and, if required, enlist the help of capable international organisations. Activities that present a serious risk of transboundary harm must be authorised and regulated by the states, together with risk assessment and preventive measures.

States that may be impacted by activities that could result in serious transboundary harm must be informed and given pertinent information. An emergency To address possible transboundary harm, preparations must be made to create and execute such measures. The creation of unbiased fact-finding commissions is one of the dispute resolution procedures outlined in the articles. In order to reduce the risks of transboundary harm from hazardous operations, these proposed paragraphs stress the significance of cooperation, information exchange, and preventive measures.

The International Law Commission took the important choice to add environmental protection in connection with armed conflicts to its agenda in 2013. The understanding of the serious and enduring effects that armed conflicts can have on the environment served as the foundation for this decision.

The need to address environmental protection during armed conflicts was previously recognised by the International Law Commission, which included it in its long-term work program in 2011. This inclusion was noted by the General Assembly in its resolution 66/98 of December 9, 2011. The ILC formally adopted the issue "Protection of the environment in

relation to armed conflicts" as part of its work agenda at its 3171st meeting on May 28, 2013. For this subject, Ms. Marie Jacobsson was designated as the Special Rapporteur.

The Special Rapporteur suggested approaching the subject from a chronological standpoint, emphasising legislative actions to safeguard the environment prior to, during, and following armed conflicts. The goal of this strategy was to make the subject easier to define and more controllable. Preliminary aspects, such as the scope, methods, and overall direction of the study, were discussed during informal discussions that were organised to start a conversation on the subject. To help with these consultations, the Special Rapporteur created informal documents.

By acknowledging the need of addressing environmental issues in such situations, this inclusion was an important step towards enhancing the legal framework for environmental protection during armed conflicts. Given the serious and protracted effects that environmental harm can have, these milestones demonstrate the continuous attempts to fortify the legal framework for environmental protection during armed conflicts.

17.2 International Environmental Law

A foundation for environmental protection that can be used in times of armed conflict is provided by international environmental law. This includes agreements that forbid the use of environmental modification techniques for hostile objectives, such as the Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques. One area of public international law that addresses environmental protection on a worldwide scale is international environmental law. In order to address environmental concerns that cut beyond national borders, it includes a broad range of treaties, accords, and principles.

17.3 Core Principles of International Environmental Law

A number of fundamental ideas form the basis of international environmental law. Among the fundamental tenets of international environmental law are sovereignty and accountability. In addition to having the sovereign right to use their own resources, nations also have an obligation to make sure that their actions do not harm the environment in other states or regions outside of their borders.

Even in the absence of solid scientific proof of the possible harm, states should take preventive and precautionary steps to protect the environment. According to the "Polluter Pays Principle," whoever causes environmental harm should be held accountable for the expenses associated with stopping, reducing, and fixing the damage. According to the notion of sustainable development, progress should satisfy current needs without endangering the capacity of future generations to satisfy their own.

Chapter 18

Treaties and Agreements under International Environmental Law

In this chapter

- 18.1 Stockholm Declaration of 1972**
- 18.2 Human-Centric Approach of Stockholm Declaration**
- 18.3 Sustainable Development Approach of Stockholm Declaration**
- 18.4 Preventive Actions Approach of Stockholm Declaration**
- 18.5 International Cooperation Approach of Stockholm Declaration**
- 18.6 Rio Declaration on Environment and Development of 1992**

18.1 Stockholm Declaration of 1972

The groundwork for contemporary environmental legislation was established at the first significant international conference on the environment. The United Nations Conference on the Human Environment, which took place in Stockholm, Sweden, from June 5–16, 1972, adopted the Stockholm Declaration, often referred to as the Declaration of the United Nations Conference on the Human Environment. The first significant international attempt to address environmental challenges was this historic proclamation.

18.1.1 The Principles of Stockholm Declaration

The 26 guiding principles of the Stockholm Declaration offer a framework for sustainable development and environmental preservation. One of the primary tenets is that everyone has a fundamental right to a healthy environment and that it is everyone's responsibility to preserve and enhance it. For the benefit of current and future generations, the Earth's natural resources must be protected. In order to meet the demands of both the current and future generations, states should preserve and enhance the Earth's ability to produce vital renewable resources.

All phases of planning should incorporate environmental regulations to support environmental quality and development. It is the duty of the states to make sure that their operations do not harm the environment of other states or regions outside of their borders. The negative effects of climate change should also be prevented, managed, and lessened.

States are required to uphold environmental norms, and they ought to collaborate in creating international legislation to safeguard the environment. In order to work towards advancing global peace and security and collaborating to safeguard the environment, peace and security should be upheld. To protect the environment, the governments should collaborate on scientific and technological research and share information.

The foundation for upcoming international environmental agreements and regulations was established by these concepts. These guidelines place a strong emphasis on the necessity of

global cooperation, nations' obligations to safeguard the environment, and the significance of incorporating environmental factors into development planning.

18.2 Human-Centric Approach of Stockholm Declaration

The 1972 Stockholm Declaration adopted a human-centric stance by acknowledging the close connection between environmental health and human well-being. The Declaration emphasises the connection between environmental health and human well-being and acknowledges the right to a healthy environment as a fundamental human right. This viewpoint was revolutionary at the time and still has an impact on environmental regulations today.

According to the Stockholm Declaration, everyone has the fundamental right to "freedom, equality, and adequate conditions of life, in an environment of a quality that permits a life of dignity and well-being." This emphasises the idea that the realisation of human rights depends on a healthy environment. The declaration highlights both the right to a healthy environment and the obligation of individuals and societies to preserve and enhance the environment for the benefit of current and future generations. The significance of human behaviour in environmental stewardship is highlighted by this dual emphasis on rights and obligations.

The proclamation acknowledges that social and economic advancement have to coexist peacefully with environmental preservation. It highlights the necessity of sustainable development, which seeks to satisfy current demands without endangering the capacity of future generations to satisfy their own.

Humans and the environment are interdependent, and the statement recognises this by saying that "to defend and improve the human environment for present and future generations has become an imperative goal for mankind." This principle emphasises the connection between environmental health and human health and well-being.

Recognising that environmental difficulties frequently transcend national borders and necessitate cooperative efforts, the proclamation urges worldwide cooperation to overcome environmental challenges. This idea emphasises how crucial international cooperation is to attaining sustainable growth and environmental preservation. The Stockholm Declaration's human-centred approach, which emphasised the need to strike a balance between environmental sustainability and human development, set the groundwork for subsequent environmental agreements and policies.

18.3 Sustainable Development Approach of Stockholm Declaration

The Stockholm Declaration, adopted at the United Nations Conference on the Human Environment, was a landmark document that placed environmental issues at the forefront of international concerns. Several principles in the declaration focus on sustainable development, urging states to balance economic growth with environmental protection and to ensure that development meets the needs of present and future generations. It marked the beginning of a global dialogue on the link between economic growth, environmental protection, and human well-being.

The Declaration acknowledges that human well-being and the enjoyment of fundamental human rights depend on both natural and man-made settings. It emphasises the necessity of sustainable development, strikes a balance between environmental preservation and economic growth, and urges international collaboration to solve environmental problems and advance sustainable development.

The United Nations Environment Programme, which was established as one of the main results of the Stockholm Conference, is still vital to the global advancement of environmental preservation and sustainable development.

18.4 Preventive Actions Approach of Stockholm Declaration

The Stockholm Declaration emphasises the necessity for environmental impact assessments and the application of science and technology to environmental problems in order to avert environmental harm. It underlined how crucial preventative measures are to safeguarding the environment and advancing sustainable development. The Declaration outlines several preventive measures.

The main preventive measure is pollution prevention. The Declaration highlights the necessity of taking preventative action to stop pollution and its detrimental consequences on the environment and human health. To reduce the amount of pollutants released, it urges the use of greener technology and procedures. The Declaration's action on natural resource conservation emphasises how crucial it is to preserve natural resources including soil, water, and air in order to guarantee their availability for future generations. In order to stop depletion and degradation, it promotes sustainable resource management and usage.

The Declaration urges nations to incorporate environmental factors into their planning and decision-making procedures for development. Before starting projects that could have a big influence on the environment, it requires that environmental impact assessments be carried out. The Declaration acknowledges that in order to find effective solutions, environmental problems frequently cut over national borders and need for international cooperation. It urges nations to work together to address global environmental issues and to exchange technologies and expertise.

The Declaration emphasises how critical it is to advance environmental education and public awareness. It urges initiatives to educate and involve the public in sustainable development and environmental preservation. Instead than responding to environmental issues after they have arisen, these preventive measures are meant to address them proactively. The Stockholm Declaration established the foundation for a more environmentally responsible and sustainable approach to development by emphasising prevention.

18.5 International Cooperation Approach of Stockholm Declaration

Given that environmental crises frequently cut over national borders and necessitate coordinated action, the Stockholm Declaration highlights the value of international cooperation in tackling these difficulties. The Declaration acknowledges that environmental problems frequently cut across national borders and call for coordinated response under the principle of

shared responsibility. It emphasises how all countries have a common obligation to preserve and enhance the environment.

The Declaration urges nations, international organisations, and other stakeholders to form cooperative initiatives and partnerships. To effectively address environmental issues, it promotes the sharing of best practices, technologies, and knowledge. The Declaration emphasises how important it is for industrialised nations to help developing nations in their pursuit of sustainable development. These covers offering funding, technological transfer, and initiatives to increase capacity.

To address environmental challenges, the Declaration promotes the development and use of international agreements and conventions. It highlights the necessity of legally enforceable pledges to ensure compliance and responsibility.

In order to coordinate and supervise worldwide activities, the Declaration urges the creation of efficient global environmental governance systems. This includes the United Nations Environment Programme's (UNEP) function of promoting collaboration and keeping tabs on developments. Public participation suggests how crucial it is to include the general public and civil society in global environmental initiatives. It promotes openness, public consciousness, and citizens' active involvement in decision-making.

These ideas served as the cornerstone for later global environmental accords and programs, including the 1992 Rio Declaration on Environment and Development and the 2015 Paris Climate Agreement.

18.6 Rio Declaration on Environment and Development of 1992

At the United Nations Conference on Environment and Development (UNCED), also referred to as the Earth Summit, which took place in Rio de Janeiro from June 3–14, 1992, the Rio Declaration on Environment and Development was approved. The Declaration's 27 guiding principles are intended to direct sustainable development globally. The human-centered development is implied by these ideas. Concerns about sustainable development are centred on people. They have a right to a productive, healthy existence in balance with the environment.

States have the responsibility to make sure that activities under their control or jurisdiction do not harm the environment of other States or regions outside of their borders, but they also have the sovereign right to exploit their own resources in accordance with their own environmental and developmental policies. In order to fairly address the environmental and developmental demands of both current and future generations, the right to development must be realised. Environmental protection must be viewed as an essential component of the development process and cannot be separated from it.

In order to achieve sustainable development, it is imperative that all states and all citizens work together to eradicate poverty. To preserve, safeguard, and restore the integrity and health of the Earth's environment, the states must work together in a spirit of international cooperation. Given the demands their societies impose on the environment, as well as the financial and technological resources at their disposal, developed nations recognise their role in the global effort to achieve sustainable development.

The Rio Declaration, which emphasised the need for a balanced approach to development that takes into account both economic growth and environmental conservation, set the groundwork for subsequent international environmental agreements and initiatives.

Chapter 19

Relevance of International Law Commission to Environmental Protection

In this chapter

- 19.1 Legal Obligations of International Law Commission**
- 19.2 Role of The International Law Commission**
- 19.3 Contributions of The International Law Commission**
- 19.4 Influence of The International Law Commission's
Contributions on Current International Law Practices**

The United Nations General Assembly created the International Law Commission in 1947 as an expert group. Among their tasks are determining which current armed conflict regulations are pertinent to environmental preservation and suggesting fresh approaches to improve it. Promoting the progressive evolution and codification of international law is its main goal.

According to Article 13(1)(a) of the UN Charter, the International Law Commission's job is to "initiate studies and make recommendations for the purpose of encouraging the progressive development of international law and its codification."

The 34 members of the Commission are chosen by the General Assembly to serve five-year terms. These members are acknowledged for their proficiency and credentials in the field of international law. The International Law Commission studies and recommends on matters of international law, drafts international legal instruments, and responds to new legal challenges, among other things. The Vienna Convention on the Law of Treaties and the Draft Articles on the Responsibility of States for Internationally Wrongful Acts are two of its noteworthy accomplishments.

Members debate and discuss a range of international law issues at its yearly sessions at the UN Office in Geneva. The creation and improvement of international legal principles are facilitated by these conferences. The protection of the environment in connection with armed conflicts, the prevention and suppression of piracy and armed robbery at sea, and the immunity of state officials from foreign criminal jurisdiction are only a few of the issues that the International Law Commission is still working on.

19.1 Legal Obligations of International Law Commission

Preventing environmental damage during armed conflicts is required by law. This duty is a continuous one that stems from international environmental law. The rights of indigenous peoples, information access and exchange, and post-conflict environmental assessments and reviews are examples of preventive approaches. Given that environmental harm can have serious and protracted effects, these pledges emphasise the significance of preserving the environment even during times of war.

In order to prevent environmental harm, the International Law Commission is essential to the development and codification of international environmental law. The no harm rule is one of the International Law Commission's fundamental legal duties and tenets. States must make sure that operations under their control or jurisdiction don't harm the environment in other states or in places outside of their borders.

Even in the absence of definitive scientific evidence, the precautionary principle suggests that states should take preventive action where there is a possibility of significant or irreversible environmental harm. The Polluter-Pays Principle states that the person who causes environmental harm should pay for its prevention and repair.

States should incorporate environmental preservation and sustainable development into their policies and procedures, according to the concept of sustainable development. Given that various nations have distinct capacities and obligations, states should work together to address environmental concerns. Environmental impact assessments should be carried out by the states for any activity that could have a major negative impact on the environment.

These ideas serve to create a framework for preventing and lessening environmental harm globally and are represented in a number of international treaties, customary international law, and court rulings.

19.2 Role of The International Law Commission

One important organisation in the UN system that is in charge of codifying and advancing international law, particularly environmental law, is the International Law Commission. It aids in international law codification. International legal norms and principles are methodically arranged and compiled into official texts by the International Law Commission. As a result, governments and other organisations can adhere to a more cohesive corpus of international law. It contributed to the advancement of international law. To fill in the gaps in current international law and solve new concerns, the International Law Commission creates new legal texts and concepts. This guarantees that the legal system adapts to new problems.

Draft conventions and treaties on a range of subjects are created by the International Law Commission. These drafts aid in the completion of in-depth legal research and the preparation of reports on particular subjects designated by the UN General Assembly. They are sent to the UN General Assembly for review and adoption by member states. These papers offer insightful analysis and suggestions for the advancement of international law.

The UN General Assembly and other UN entities receive legal advice from the International Law Commission. By offering a common legal framework for resolving transboundary concerns like environmental protection and climate change, it promotes collaboration among nations and is frequently sought for its expertise in the interpretation and application of international law.

National laws are harmonised with the assistance of the International Law Commission. The International Law Commission promotes uniformity and coherence in the implementation of international law by developing international legal norms and encouraging governments to align their domestic legislation with these standards.

By ensuring that states follow generally recognised legal principles, the International Law Commission plays a crucial role in forming the legal environment of international relations. Its contributions to environmental law support sustainable development and aid in addressing global environmental issues.

19.3 Contributions of The International Law Commission

In several fields, the International Law Commission has significantly advanced the evolution of international law. It has aided in the draughting of treaties and conventions, including the 1969 Vienna Convention on the Law of Treaties. The norms pertaining to the formation, interpretation, and termination of treaties between states are codified in this convention. Additionally, in 2001, the International Law Commission draughted Articles on State Responsibility. These articles have shaped the evolution of customary international law and lay out the fundamentals of state accountability for crimes committed on a global scale.

Environmental protection principles like the precautionary principle, the no damage rule, and the requirement to perform environmental impact assessments were developed in part by the International Law Commission. Additionally, it has focused on issues including atmospheric protection and transboundary harm.

In order to provide uniformity and clarity in the application of international legal concepts, the International Law Commission has been instrumental in discovering and codifying customary international law. It carries out in-depth legal research on a number of subjects, including the law of the sea, state officials' immunity, and catastrophe protection. These papers offer insightful analysis and suggestions for the advancement of international law.

Establishing common legal frameworks, The International Law Commission promotes international cooperation on issues like environmental protection, human rights, and the peaceful settlement of disputes. Its work encourages states to harmonize their national laws with international legal standards, promoting consistency and coherence in the application of international law.

Human rights-related legal principles, like the protection of refugees and the ban on torture, have been developed in part by the International Law Commission. It has aided in the creation of legal procedures such as judicial settlement and arbitration for the amicable resolution of conflicts. A more stable and equitable international legal order has been facilitated by these contributions, which have had a significant influence on the evolution of international law.

19.4 Influence of The International Law Commission's Contributions on Current International Law Practices

Current international law practices are greatly shaped and influenced by the International Law Commission's contributions in a number of ways. The International Law Commission creates a lucid and uniform legal framework that governments can depend on by codifying customary international law and draughting treaties and conventions. This makes it easier to guarantee that international law is enforced consistently in various states.

New legal norms and principles are developed as a result of the International Law Commission's efforts to advance international law. By addressing new problems and difficulties, these new standards maintain international law's relevance and responsiveness to modern demands. States are guided in their conduct of international relations by its contributions, including the Draft Articles on State Responsibility. In order to encourage adherence to international legal standards, states frequently consult the work of the International Law Commission when developing their policies and legal stances.

The work of the International Law Commission is regularly cited in the rulings of international courts and tribunals, including arbitration panels and the International Court of Justice. This serves to mould the evolution of international jurisprudence and strengthens the legitimacy and authority of its contributions.

The International Law Commission efforts to harmonize national laws with international standards foster cooperation among states. This cooperation is crucial for addressing global challenges, such as environmental protection, human rights, and transboundary disputes. Its contributions to human rights law, such as the protection of refugees and the prohibition of torture, enhance the legal frameworks that safeguard individual rights and freedoms. States incorporate these principles into their national laws, promoting a global culture of respect for human rights.

A legal basis for tackling environmental challenges is provided by the International Law Commission, which focusses on environmental principles like the precautionary principle and the no damage rule. These guidelines are used by governments and international organisations to create laws and policies that protect the environment and advance sustainable development. The International Law Commission legal studies and advisory opinions offer expert counsel on complicated legal matters. States can make well-informed decisions about their international relations and negotiate legal ambiguities with the aid of these research.

All things considered, the work of the International Law Commission has a significant and enduring influence on how international law is practiced. They support a more equitable and well-organised international legal system and offer the legal underpinnings for a variety of global endeavours.

Chapter 20

International Humanitarian Law (The Law of War)

In this chapter

- 20.1 Core Principles of International Humanitarian Law**
- 20.2 History of International Humanitarian Law**
- 20.3 How much International Humanitarian Law (The Law of War) Sufficient to Protect Environment during Armed Conflicts**
- 20.4 Recent Developments under The Law of War to Protect Environment**
- 20.5 Effectiveness of The Law of War to Protect Environment during Armed Conflicts**
- 20.6 Reforms that could Enhance Environmental Protections in Armed Conflict**
- 20.7 How can these Reforms be Practically Implemented**
- 20.8 Challenges for States in Implementing Environmental Protection Reforms**

A body of regulations known as international humanitarian law, sometimes referred to as the law of war or the law of armed conflict, aims to lessen the negative consequences of armed conflict for humanitarian purposes. It contains clauses that safeguard the environment in an indirect manner. The proportionality principle, for instance, forbids strikes that inflict undue environmental harm relative to the expected military benefit.

The 1949 Geneva Conventions and their Additional Protocols are the main tools of international humanitarian law. For those who are not taking part in hostilities, such as civilians, medical professionals, and prisoners of war, these agreements and protocols offer complete legal protection.

20.1 Core Principles of International Humanitarian Law

Several fundamental ideas form the basis of international humanitarian law. Parties to a dispute must target only combatants and military targets, separating combatants from civilians. Any attack must be proportionate, which means that the intended military gain must not be outweighed by the expected incidental damage to civilians and civilian property. To accomplish a valid military goal, military action must be required. It is forbidden to subject soldiers and civilians to needless pain or needless harm.

The preservation of the environment during armed conflicts is covered under international humanitarian law. Article 35(3) and Article 55 of Additional Protocol I to the Geneva Conventions, for instance, forbid war tactics or means that seriously harm the environment in a large-scale, protracted manner.

States oversee making sure that international humanitarian law is followed, and they are also liable for infractions. The International Criminal Court (ICC), international tribunals, and national laws are some of the enforcement mechanisms. Many IHL regulations are incorporated into customary international law in addition to treaty law, meaning that all nations are bound by them whether they have ratified particular treaties.

In order to provide vital protections for people and the environment during armed conflicts, humanitarian law seeks to strike a balance between the needs of military operations and humanitarian considerations. Global

20.2 History of International Humanitarian Law

The fundamental ideas of international humanitarian law have developed over decades, giving it a lengthy history. However, the first Geneva Convention was ratified in 1864, which signalled the start of contemporary international humanitarian law and the establishment of its main tools. It was centred on improving the health of the sick and injured in the field of the military.

The protection offered by international humanitarian law was greatly increased in 1949 with the adoption of the four Geneva Conventions.

Protection of the sick and injured in the field by the armed forces is outlined in the First Geneva Convention. Protection of sick, injured, and shipwrecked members of the armed forces at sea is covered by the Second Geneva Convention. Treatment of prisoners of war was covered in the Third Geneva Convention, while protection of civilians during times of war was covered in the Fourth Geneva Convention.

The Geneva Conventions' Additional Protocols were ratified in 1977. Victims of international armed conflicts were protected under Protocol I, and victims of non-international armed conflicts were protected under Protocol II.

The Third Additional Protocol, which was accepted in 2005, added the Red Crystal as a distinguishing symbol to the Red Cross and Red Crescent. These turning points show how international humanitarian law has developed and how it continues to work to safeguard people and the environment in times of armed conflict.

20.3 How much International Humanitarian Law (The Law of War) Sufficient to Protect Environment during Armed Conflicts

Environmental protection during armed conflicts is covered under international humanitarian law, also known as the law of war. However, there is continuous discussion and evaluation over the adequacy of these measures. Certain provisions of international humanitarian law, such as those in the Additional Protocol I to the Geneva Conventions of 1977, are designed to lessen the negative effects of conflict on the environment. These regulations forbid war tactics or weapons that are likely to seriously harm the environment in a large-scale, protracted manner.

Chemical agent use has the potential to seriously contaminate the environment, impacting the quality of the air, water, and soil. Ecosystems and human health may suffer catastrophic long-term effects. Hazardous infections can be released into the environment by biological weapons,

causing illnesses to spread among people, animals, and plants. The ecological equilibrium may be seriously upset. Radioactive fallout from the explosion of nuclear weapons can contaminate vast areas for a long time. The effects on the environment and human health are severe and persistent.

Forests and agricultural areas may be destroyed as a result of the application of defoliants and herbicides, such as Agent Orange during the Vietnam War. The chemicals have the potential to linger in the environment and affect human populations and ecosystems over time. Environmental effects can be severe and long-lasting when natural resources are purposefully destroyed, such as when forests are burned or water sources are contaminated. In addition to harming civilian populations and ecosystems, these techniques seek to deprive the opponent of resources.

Several international treaties and agreements, such as the Environmental Modification Convention and the Geneva agreements, forbid certain forms of warfare. The objective is to preserve the ecosystem for coming generations and lessen the negative effects of armed conflicts on the environment.

Even with these clauses, it can be difficult to enforce the requirements. During armed wars, environmental concerns may be neglected or given less priority as the emphasis is frequently on short-term military goals. Monitoring and confirming adherence to these regulations may also provide challenges. In actuality, there are a number of difficulties in putting environmental regulations into practice during armed conflicts.

Conflict-affected countries often face significant resource limitations. Allocating funds and resources for environmental protection can be difficult when there are pressing needs for food, shelter, and healthcare. Ensuring that all parties to a conflict adhere to environmental protection laws is challenging. Non-state armed groups and rogue actors may not recognize or respect international laws, making enforcement difficult.

Effective monitoring of environmental damage during conflicts requires advanced technology and expertise. Limited access to conflict zones and the presence of ongoing hostilities can hinder monitoring efforts. Military personnel may not be adequately trained in environmental protection principles. Raising awareness and providing training on the importance of environmental considerations during military operations can be a complex and lengthy process. Political will and institutional capacity are crucial for implementing these reforms. Governments and military institutions need to prioritize environmental protection, which may not always align with immediate military objectives or political agendas.

Divergent national interests, agendas, and levels of commitment can make it challenging to achieve meaningful international cooperation. It is crucial but difficult to coordinate activities and promote cooperation between nations and international organisations. Additionally, nations encounter many difficulties in reconstructing their government structures, infrastructure, and economies following hostilities. During this recovery stage, environmental rehabilitation can not receive enough funding or be given less priority.

Governments, international organisations, non-governmental organisations, and the military must work together to address these issues with persistent dedication, creative ideas, and teamwork. Cooperation can improve environmental safeguards during armed conflicts and lessen the long-term effects on ecosystems and populations.

20.4 Recent Developments under The Law of War to Protect Environment

The legal foundation for environmental preservation in armed situations has been strengthened by continuous efforts. The International Committee of the Red Cross, for instance, has published guidelines on how to preserve the environment during armed conflict, including more thorough suggestions and explanations of the regulations of international humanitarian law. In order to better preserve the environment during armed conflicts, these guidelines offer comprehensive interpretations and recommendations of the standards of international humanitarian law. The rules stress how crucial it is for military operations to minimise environmental harm and encourage sustainable practices.

Comprehensive rules for safeguarding the environment during armed conflicts have been developed by the International Committee of the Red Cross. These 2020 revisions offer a thorough framework for putting environmental protection provisions of international humanitarian law into practice.

The laws require military operations to take environmental protection into account. Warfare tactics or means that result in severe, long-lasting, and substantial environmental harm are forbidden. It is forbidden to intentionally destroy the environment in the name of war. It is not permitted to retaliate by attacking the environment.

The concepts of differentiation (between civilian objects and military objectives), proportionality, and precautions are among the rules of international humanitarian law that control the conduct of conflicts and safeguard the natural environment. The recommendations provide regulations on particular weapons that safeguard the environment and make sure their use doesn't result in needless harm.

The guidelines stress how crucial it is to uphold, carry out, and communicate the laws safeguarding the environment. This includes educating the public about the value of environmental preservation during armed conflicts and providing training to military personnel.

A set of 27 Draft Principles for environmental protection in connection with armed conflicts was adopted by the International Law Commission in May 2022. In both international and non-international armed conflicts, these principles seek to offer a cogent legal framework for environmental preservation. The preservation of natural resources, preventing environmental harm, and repairing damaged environments are only a few of the many topics covered by the principles.

The guidelines are applicable to environmental protection during all stages of armed conflict, including occupation. By taking steps to stop, lessen, and repair damage, the goal is to improve environmental protection. States are urged to implement efficient legislative, administrative, judicial, and other measures to safeguard the environment in connection with armed conflicts under the universal applicability clause. Furthermore, in the case of an armed conflict, states ought to designate environmentally significant areas as protected zones. The ecosystem of lands and territories that indigenous peoples occupy or have historically used should be protected.

Regarding post-conflict environmental assessments and corrective actions, the nations and pertinent international organisations ought to collaborate. Appropriate steps should be made to guarantee that environmental damage does not go unrepaired or uncompensated in situations

where the cause cannot be determined or reparation is not possible. The goal of parties to an armed conflict should be to eliminate or render innocuous toxic or hazardous war remains that endanger the environment. To make sure that the environmental effects of battle at sea don't become a threat, cooperation is encouraged. The significance of protecting the environment during armed conflicts and the necessity for more robust legal structures to address this issue are both reflected in these principles.

The 27 legislative principles on the Protection of the Environment in Relation to Armed Conflicts (PERAC) were adopted by the UN General Assembly on December 7, 2023. The International Law Commission's ten-year effort to improve environmental protection during and after war came to a conclusion with this. It is anticipated that these principles will be put into practice through national legislation, military instruction manuals, commercial counsel, and outreach with non-state armed organisations, even if they are not legally binding. Enhancing environmental protection prior to, during, and following armed conflicts is the goal of these concepts.

20.5 Effectiveness of The Law of War to Protect Environment during Armed Conflicts

The ability and willingness of the conflicting parties to follow these steps will determine how effective they are. In reality, war frequently causes serious damage to the ecosystem, with effects that can persist for a long time. There has been continuous discussion and evaluation of the law of war's (also known as international humanitarian law) ability to safeguard the environment during armed conflicts.

The 1977 Additional Protocol I to the Geneva Conventions contains measures that are part of the law of war and are intended to safeguard the environment during armed conflicts. These regulations forbid war tactics or weapons that are likely to seriously harm the environment in a large-scale, protracted manner. Environmental protection during conflict is also covered by the Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques (ENMOD Convention).

It can be difficult to enforce environmental protection regulations during armed conflicts, even with these legal structures in place. International rules may not be recognised or respected by rogue actors and non-state armed organisations, which makes enforcement challenging. Ongoing fighting and restricted access to war areas might make it difficult to monitor and confirm adherence to environmental protection regulations.

In conclusion, even though the law of war offers a framework for protecting the environment during armed conflicts, the efficiency and sufficiency of these measures rely on the parties' willingness to uphold them and their enforcement. Significant progress has been made recently, such as with the adoption of the ILC Draft Principles, yet there are still obstacles in the way of providing effective environmental protection during times of conflict.

20.6 Reforms that could Enhance Environmental Protections in Armed Conflict

Although improving environmental protections during armed situations is a difficult task, a number of improvements could have a big impact. To give the environment stronger

protections, current provisions of international humanitarian law could be clarified and enlarged. This entails identifying and outlawing particular environmentally detrimental behaviours as well as making sure that these regulations are upheld.

Holding parties accountable can be facilitated by the establishment of impartial monitoring organisations to document environmental harm during conflicts and report infractions. Improved reporting and transparency systems can also increase awareness and encourage adherence. To reduce damage, environmental impact evaluations should be incorporated into military operations and strategies. Adopting procedures that lessen environmental harm and educating military troops on the value of environmental conservation are two examples of this.

In order to mitigate environmental harm in conflict areas, it is imperative that international cooperation be strengthened. This involves giving impacted nations financial and technical assistance for environmental rehabilitation and restoration projects. Conflicts can be avoided and the environment can be protected by acknowledging and advancing environmental human rights. This entails making certain that communities' rights to a healthy environment are respected and that they have access to clean air, water, and land.

Implementing comprehensive post-conflict environmental rehabilitation programs can help restore damaged ecosystems and support the recovery of affected communities. This includes cleaning up hazardous materials, reforestation degraded areas, and restoring water sources.

20.7 How can these Reforms be Practically Implemented

A variety of parties, including governments, non-governmental organisations (NGOs), international organisations, and the military, must work together to implement these reforms. Strengthening the legal frameworks is one of the practical measures. Countries can work together to add more specific environmental protections to international accords like the Geneva Conventions. Countries can ensure that their military operations are in line with environmental protection principles by incorporating these international standards into their own legislation.

Accountability can be improved by establishing and supporting groups devoted to tracking environmental harm during wars. The International Union for Conservation of Nature (IUCN) and the United Nations Environment Programme (UNEP) are two examples. Drones, satellite photography, and other cutting-edge technologies can be used to accurately report environmental consequences and monitor them in real-time.

Training on the value of environmental preservation and how to reduce damage while conducting operations should be provided to military personnel. Both continuous professional development and military academies can incorporate this. Before, during, and after military operations, environmental impact assessments can be carried out to help identify potential risks and mitigation strategies.

NGOs and international organisations can promote greater protections at the national and international levels and increase awareness of the significance of environmental human rights. More lasting results can be obtained by enabling local people to safeguard their environment and including them in decision-making processes.

Damaged ecosystems can be restored by the implementation of comprehensive rehabilitation programs that include reforestation, soil remediation, and water source restoration. It is possible to guarantee that restoration initiatives are successful and founded on reliable scientific principles by collaborating with ecologists, environmental scientists, and other specialists.

All parties involved must maintain their dedication and cooperation in order to complete these phases. It is feasible to improve environmental protections during armed conflicts by including environmental factors into military planning, strengthening monitoring and reporting systems, and encouraging international cooperation.

20.8 Challenges for States in Implementing Environmental Protection Reforms

There are several obstacles and limitations when it comes to implementing environmental protection changes during armed situations. Many nations, particularly those impacted by conflict, struggle with severe resource shortages. When basic necessities like food, shelter, and medical care are already under stress, allocating cash and resources for environmental protection may be challenging. It might be difficult to make sure that all sides in a dispute follow environmental protection regulations. International rules may not be recognised or respected by rogue actors and non-state armed organisations, which makes enforcement even more challenging.

Monitoring environmental damage during conflicts effectively involves both advanced technology and specialised knowledge. Monitoring efforts may be hampered by ongoing hostilities and restricted access to conflict areas. It's possible that military personnel lack sufficient environmental protection training. It can be a difficult and drawn-out process to educate people and train them on the value of environmental considerations during military operations.

Reform implementation requires both institutional competence and political will. Environmental preservation must be given top priority by governments and military organisations, even if this does not always coincide with short-term military goals or political ambitions. Divergent national interests, agendas, and levels of commitment can make it challenging to achieve meaningful international cooperation. It is crucial but difficult to coordinate activities and promote cooperation between nations and international organisations.

Following a conflict, nations must overcome many obstacles to reconstruct their infrastructure, governance structures, and economies. During this recovery stage, environmental rehabilitation cannot receive enough funding or be given less priority.

Governments, international organisations, non-governmental organisations, and the military must work together to address these issues with persistent dedication, creative ideas, and teamwork. Cooperation can improve environmental safeguards during armed conflicts and lessen the long-term effects on ecosystems and populations.

20.9 Change of Challenges in Implementation of Environmental Protections Over Time

As combat, environmental awareness, and international collaboration have changed, so too have the difficulties in putting environmental regulations into practice during armed conflicts.

Drones, satellite photography, and other technological advancements have enhanced our capacity to track and evaluate environmental harm in war areas. However, in other places, access to these technologies may be restricted. More accurate and ecologically friendly weaponry have been created as a result of military technological advancements. However, there are still serious environmental concerns associated with the deployment of some weapons, such as chemical and explosive agents.

The value of protecting the environment during and after conflicts is becoming more widely acknowledged. Environmental concerns are becoming more and more important in the policies and actions of governments, NGOs, and international organisations. The necessity of protecting the environment during armed conflicts has become more apparent as a result of the effects of climate change. Conflicts can exacerbate environmental degradation, and environmental damage can, in turn, contribute to conflicts over resources.

More specific environmental protections have been added to international treaties and agreements over time. The development of suggestions and guidelines by groups like the ICRC is a reflection of continuous attempts to fortify legal systems. In order to strengthen the foundation for implementing environmental regulations during wars, nations are progressively integrating international environmental norms into their domestic legislation.

International law enforcement has been made more difficult by the participation of non-state actors in conflicts. It may be more challenging to guarantee adherence to environmental rules for these groups since they are not subject to the same legal requirements as governmental entities. Urban warfare is becoming more common, which presents special difficulties for environmental preservation. Significant environmental harm, such as infrastructure destruction and water source contamination, can arise from conflicts in densely populated places.

In order to alleviate environmental harm in conflict areas, international cooperation has become increasingly important. To aid in environmental restoration and conservation, cooperative projects and financing channels have been set up. Multilateral institutions like the UN are playing an increasingly important role in advancing environmental preservation during armed situations. These groups offer forums for cooperation, communication, and resource mobilisation.

In conclusion, substantial developments in technology, legal frameworks, and international collaboration have enhanced our capacity to save the environment during armed conflicts, even if there are still numerous obstacles to overcome. The way these safeguards are implemented is still influenced by the changing character of conflicts and the growing consciousness of environmental concerns.

Chapter 21

General Customary Principles of The Law of War

In this chapter

- 21.1 Historical context of these Fundamental Foundations**
- 21.2 General Customary Principles of International Humanitarian Law (Law of War)**
- 21.3 Principle of (Military) Necessity**
- 21.4 Examples of Military Necessity in Action**
- 21.5 Applications of Military Necessity in Modern Conflicts**
- 21.6 Ethical Implications of Military Necessity**
- 21.7 Relations of Military Necessity to International Humanitarian Law**
- 21.8 Consequences of Violations of International Humanitarian Law**
- 21.9 Principle of Discrimination**
- 21.10 Relationship between Discrimination and Proportionality**
- 21.11 Consequences of Violating Discrimination and Proportionality**
- 21.12 Consequences of These Historical Violations**
- 21.13 Evolvment of These Principles in Modern Warfare**

Although they may not be codified in treaties, the General Customary Principles of the Law of War are standards that have developed over time and are acknowledged as obligatory in international law. These guidelines are intended to control how armed conflicts are conducted and safeguard non-combatant parties, including civilians. By protecting persons and property, the customary standards of the law of war indirectly preserve the environment.

The basic tenets of the law of war are generally indisputable, including the need for parties to a conflict to distinguish between combatants and non-combatants and the requirement that attacks be limited to military targets rather than civilians or civilian property. Damage to civilians or civilian property must not be disproportionate to the expected military benefit of an attack. Only a valid military goal may be accomplished with force, and only the minimum amount of force required to accomplish that goal may be employed.

Conflicting parties have an obligation to prevent needless suffering and to safeguard individuals who are hors de combat, or out of the battle, such as the injured, ill, and POWs. It is forbidden to employ weapons or military techniques that result in needless suffering or needless harm. These core principles, which are intended to lessen the atrocities of war, serve as the cornerstone of a large portion of contemporary international humanitarian law.

21.1 Historical context of these Fundamental Foundations

The Law of War's foundational principles have a long history and have developed over ages to meet the difficult moral and ethical issues surrounding armed conflict. A "just war" is an idea

that has roots in ancient and mediaeval philosophy. The circumstances in which going to war could be deemed ethically acceptable were debated by intellectuals such as Thomas Aquinas, Augustine, and Cicero. The two primary tenets of these early debates were *jus in bello* (proper behaviour in war) and *jus ad bellum* (right to go to war).

As the idea merged with Christian theology during the Middle Ages, the Catholic Church had a major influence on its development. With a strong theological bent, the just war idea was used to support the Crusades in part. The discussion moved from theological explanations to the creation of legal frameworks with the Peace of Westphalia and the emergence of nation-states. This change was crucial in shifting the emphasis from a cause's moral rectitude to preventing the savagery of war, which is the forerunner of modern international humanitarian law.

The need for official regulations was brought to light by the industrialisation of war and the atrocities seen during wars such as the Crimean War and the American Civil War. The first Geneva Convention was pushed by individuals like Red Cross founder Henry Dunant, who laid the foundation for what would eventually be known as international humanitarian law.

Despite reiterating the just war heritage, the concepts of difference, proportionality, and military necessity were codified in legal documents. By guaranteeing that everyone is treated humanely, these principles sought to safeguard both combatants and civilians who are *hors de combat*, or out of the fight. These core principles have developed to serve as the cornerstone for safeguarding people abstaining from hostilities.

21.2 General Customary Principles of International Humanitarian Law (Law of War)

The protection of persons and property serves as an indirect means of protecting the environment from the usual standards of the law of war. Nevertheless, there isn't a single document that outlines every customary law of war principle. The law of war is based on two main principles. One is that the only justifiable goal nations can pursue during a conflict is to degrade the enemy's military capabilities. The second is that warriors are constrained in their choice of weapons and tactics.

Four concepts that have evolved over time into the bounds of what combatants are allowed to do during armed conflicts are drawn from the two statements above. These include proportionality, humanity, prejudice, and necessity (of war). All of these concepts clearly suggest that actions that cause significant environmental damage are wrong. During armed conflicts, neutrality rules may also shield neutral parties' environments from possible cross-border harm.

21.3 Principle of (Military) Necessity

One of the fundamental ideas of the laws governing armed conflict, particularly international humanitarian law, is the principle of military necessity. If they are not forbidden by international law, it permits the use of force and other actions required to accomplish a justifiable military goal.

To put it simply, military necessity allows for activities that are required to accomplish a military objective. For the military operation to be successful, the activities must be necessary. The damage must not be disproportionate to the expected direct and tangible military advantage. Military necessity never justifies certain actions, such as employing forbidden weapons or targeting people.

The idea seeks to strike a balance between the necessity of preventing needless suffering for fighters and civilians and the demands of military operations. It guarantees that during armed conflicts, humanitarian concerns be taken into account and that the use of force is controlled.

21.4 Examples of Military Necessity in Action

There are instances where military necessity is demonstrated. Both the Allied and Axis powers launched strategic bombing campaigns throughout World War II. To make it more difficult for the enemy to continue its war effort, these attacks targeted transportation networks, military installations, and industrial infrastructure. Despite being divisive, these measures were seen to be required to accomplish military goals. Similarly, in order to establish a presence in German-occupied France, the Allied invasion of Normandy in June 1944 necessitated a large-scale and intricate military campaign. The goal of freeing Western Europe from Nazi rule was thought to require the employment of airborne and amphibious attacks in addition to heavy bombing and naval assistance.

Coalition forces targeted Iraq's military facilities during the Gulf War, including supply lines, communication networks, and command and control centres. In order to accomplish the military goal of liberating Kuwait and to make it more difficult for Iraq to repel the Coalition's ground invasion, these targets had to be destroyed.

Military forces have fought insurgent groups like the Taliban in Afghanistan through counterinsurgency operations in recent years. The goal of stabilising the area and averting insurgent attacks is thought to require measures like targeted airstrikes, raids on rebel strongholds, and the installation of security checkpoints.

Israeli forces carried out a risky operation at Entebbe Airport in Uganda, known as Operation Entebbe in 1976, to free hostages after terrorists hijacked an Air France aircraft. To neutralise the terrorists and ensure the release of the hostages, military force was used in the operation. The goal of saving the hostages' lives was judged to require the use of force.

These examples illustrate how the principle of military necessity can be applied in various contexts to achieve legitimate military objectives while adhering to the rules of international humanitarian law.

21.5 Applications of Military Necessity in Modern Conflicts

In contemporary conflicts, military necessity still plays a critical role in striking a balance between the necessity of achieving military goals and the requirement to reduce damage to civilians and civilian infrastructure. Precision-guided weapons are frequently used in modern battles to target certain military targets while minimising collateral harm. For instance, the goal

of airstrikes on insurgent bases or terrorist leaders is to eliminate dangers without causing harm to civilians.

Drone use is now a major component of contemporary military operations. Drones reduce the risk to military personnel and prevent collateral damage by precisely targeting hostile combatants and infrastructure. Drone usage, however, also brings up moral and legal issues on how to strike a balance between humanitarian concerns and military need.

To prevent undue harm to civilians, military need in urban wars necessitates meticulous preparation and execution. This entails actions like creating secure escape routes for civilians, employing non-lethal weaponry whenever feasible, and focussing operations on causing the least amount of damage to civilian infrastructure. Cyber operations to interfere with enemy communications, infrastructure, and command systems are becoming more and more common in modern conflicts. In order to accomplish military goals, these operations must follow the rules of military necessity, which guarantee that no disproportionate damage is done to civilian systems.

Military necessity must always be balanced with humanitarian considerations. This means that even in the pursuit of military objectives, efforts must be made to protect civilians, provide humanitarian aid, and adhere to international humanitarian law. These examples illustrate how the principle of military necessity is applied in modern conflicts, ensuring that military actions are justified, proportionate, and in compliance with international law.

21.6 Ethical Implications of Military Necessity

Military necessity has complicated and nuanced ethical ramifications. Although using force to accomplish justifiable military goals is permitted by military necessity, proportionality must be maintained. Accordingly, the damage done to civilians and civilian property shouldn't be disproportionate to the expected military benefit. Actions that cause disproportionate harm, including suffering and casualties among civilians, raise ethical questions.

Combatants must be able to discriminate between civilian items and military objectives according to military necessity. Targeting civilians wilfully or carelessly is against international humanitarian law and presents serious moral dilemmas. The moral integrity of military actions depends on ensuring adherence to the concept of distinction.

Humanitarian concerns should not take precedence over military need, even when it gives priority to accomplishing military objectives. When acts carried out in the name of military necessity cause needless suffering or infringe upon fundamental human rights, ethical issues occur. Keeping the moral high ground in conflicts requires adherence to humanitarian values.

It's critical to hold people accountable for acts performed under the pretence of military necessity. When people or organisations use the idea to defend illegal behaviour, including attacking civilians or brandishing weapons that are forbidden, ethical issues are raised. Putting in place systems for justice and accountability is essential to resolving these moral dilemmas.

Beyond immediate measures, military necessity has ethical ramifications. Long-term effects of decisions made during battles can include infrastructure devastation, population displacement,

and psychological trauma that lasts a lifetime. Making morally right judgements requires taking these long-term repercussions into account.

Ethical considerations also involve transparency in decision-making processes. Providing clear justifications for actions taken under military necessity helps build trust and ensures that decisions are scrutinized for their moral and legal implications.

In summary, while military necessity is an essential criterion in the conduct of armed conflicts, it must be carefully balanced with ethical considerations to ensure that acts done are justifiable, proportional, and in line with international humanitarian law. Upholding the moral and legal norms that regulate how military operations are conducted depends on maintaining this equilibrium.

21.7 Relations of Military Necessity to International Humanitarian Law

Since international humanitarian law establishes the legal framework that regulates the conduct of armed conflicts, including the application of military need, military necessity and international humanitarian law are closely related. Along with proportionality, distinction, and humanity, military necessity is one of the core tenets of international humanitarian law. As long as the measures taken to accomplish justifiable military goals adhere to other norms and do not contravene any aspects of international humanitarian law, military necessity is recognised under this legal framework.

The goal of international humanitarian law is to strike a balance between the necessity of protecting civilians and reducing suffering and the requirement to accomplish military goals. Military necessity permits the use of force to accomplish military objectives, but in order to minimise injury to civilians, it must be balanced with proportionality and distinction. Certain acts are expressly forbidden by international humanitarian law, even if they may be warranted by military necessity. For instance, regardless of military necessity, targeting civilians, deploying prohibited weapons (such as chemical or biological weapons), and torturing or otherwise treating people inhumanely are never acceptable under international humanitarian law.

The rules of engagement established by international humanitarian law specify what can be done in times of armed conflict. By including the concept of military necessity, these regulations guarantee that activities are both in line with the standards of international humanitarian law and required to accomplish military goals. To guarantee that acts carried out under the pretence of wartime necessity are legal, international humanitarian law sets up procedures for responsibility and compliance. Attacks that are disproportionate or indiscriminate are examples of violations of international humanitarian law that can lead to legal repercussions and war crimes prosecution.

The protection of civilians and civilian infrastructure is given first priority under international humanitarian law. Targeting military targets is permitted by military necessity, but it also necessitates taking safety measures to prevent or lessen injury to civilians, such as warnings prior to assaults and the provision of secure evacuation routes. To sum up, military necessity is a fundamental tenet of international humanitarian law that allows the use of force to accomplish

justifiable military goals. However, in order to maintain both civilian protection and adherence to international law, it must be balanced with other principles.

21.8 Consequences of Violations of International Humanitarian Law

Legally and morally, breaking international humanitarian law can have serious repercussions. War crimes, crimes against humanity, and genocide are crimes for which individuals, including political and military leaders, can face criminal charges. Individuals who commit grave crimes of international humanitarian law may be prosecuted by international tribunals, such as the International Criminal Court. Such offences may also fall under the jurisdiction of national courts.

States may be held responsible for their acts if they breach international humanitarian law. Reparations, penalties, and other international pressure to guarantee adherence to international humanitarian law are examples of this. International organisations like the International Court of Justice may also look into a state.

The reputation of a state or an individual on the international scene can be seriously harmed by violations of international humanitarian law. This may result in diminished influence in global affairs, diplomatic isolation, and a decline in credibility. Public opinion and support for a government or military force can also be impacted by reputational harm.

International humanitarian law violations can cause serious harm to civilians, including as fatalities, displaced people, infrastructure devastation, and chronic suffering. For impacted populations, the humanitarian effects of such transgressions may result in long-term social and economic difficulties.

Violating international humanitarian law can have a negative impact on military personnel' cohesiveness, discipline, and morale. Additionally, it might cause opposing forces to retaliate, intensifying violence and extending wars. The legitimacy and efficacy of military operations depend on adherence to international humanitarian law.

Legal challenges and lawsuits against states, military forces, and other individuals may result from violations of international humanitarian law. Financial penalties, travel restrictions, and other legal ramifications may follow from these legal implications. Additionally, by fostering long-standing grievances and mistrust among impacted communities, violations of international humanitarian law can impede efforts at peace and reconciliation.

Rebuilding societies after conflicts and attaining lasting peace depend on addressing abuses and guaranteeing responsibility. In conclusion, transgressing international humanitarian law has serious repercussions that impact people, nations, and communities. Protecting human rights, upholding the rule of law, and making sure that armed conflicts are fought in a way that reduces suffering and advances justice all depend on upholding international humanitarian law.

21.9 Principle of Discrimination

According to the discrimination principle, warriors must always differentiate between military and civilian targets and plan their operations appropriately, only targeting military targets.

Military objectives are defined as those that, by their nature, location, purpose, or use, effectively contribute to military action and whose complete or partial destruction, capture, or neutralisation, under the conditions that prevail at the time, offers a clear military advantage, according to Article 52(2) of the 1977 Additional Protocol I. By separating military targets from civilian items, the environment can be protected during times of conflict. Actions that go against this idea include military assaults on ecologically delicate locations like fertile forests and national parks.

A key idea in both international law and moral philosophy is the principle of discrimination. It alludes to the need to differentiate between various targets in war situations in order to protect non-combatants. This principle requires fighters to differentiate between valid military targets and civilians or civilian objects, such as environmental items, that should not be targeted during a conflict.

It is frequently combined with the proportionality concept, which makes sure that the damage inflicted by a course of action is not disproportionate to the military advantage obtained. For instance, the Geneva Conventions, which seek to safeguard civilian populations and property during armed conflicts, heavily rely on the principle of discrimination in international humanitarian law.

21.10 Relationship between Discrimination and Proportionality

In order to maintain fair and compassionate behaviour in armed conflicts for both society and the environment, the concepts of proportionality and discrimination are intertwined. Combatants are required by the principle of distinction to differentiate between people or civilian objects and military targets. During hostilities, the goal is to safeguard civilian life and property while avoiding hurting non-combatants.

The proportionality principle makes ensuring that severe collateral damage to civilian life, property, and the environment doesn't outweigh the military value of an operation. To put it another way, an attack must be measured and balanced to prevent undue injury, even if the target is considered legitimate under the discrimination principle.

When combined, these guidelines seek to reduce civilian casualties and uphold a code of conduct during combat. Both of these are essential elements of international humanitarian law, which is represented in agreements like the Geneva Conventions.

21.11 Consequences of Violating Discrimination and Proportionality

Discrimination and proportionality violations can have serious repercussions on several levels. Under international law, those who commit such offences may be charged with war crimes. International courts, including the International Criminal Court, have the authority to prosecute these allegations. Those convicted may be subject to trials and other sanctions, such as jail time or harsher penalties. Significant civilian fatalities and property devastation are possible outcomes of violations, which can cause great misery for people and harm to the environment. Large-scale displacement and refugee crises could result from communities being compelled to leave their homes.

Parties involved in the abuse may lose their credibility both at home and abroad, which could affect their capacity to lead or win support. Such infractions may also lead to reprisals, which could intensify disputes and result in further bloodshed. These transgressions erode mutual respect and trust between parties to the conflict and the international community by undermining the moral principles established by international humanitarian law.

For impacted communities and nations, the devastation brought about by indiscriminate or disproportionate strikes can lead to enormous reconstruction expenses. International sanctions may be imposed on nations or organisations found guilty of such offences, which could have an impact on their economy and reputation internationally. In order to preserve human dignity, respect international law, safeguard the environment, and promote lasting peace and stability, it is imperative that such violations be addressed and prevented.

21.12 Consequences of These Historical Violations

The consequences of historical violations of the principles of discrimination and proportionality have been profound and far-reaching.

21.12.1 World War II - Hiroshima and Nagasaki

About 200,000 people died instantly as a result of the bombings, and many more suffered from the long-term effects of radiation exposure. In addition to accelerating the end of World War II, the bombs sparked intense ethical and political discussions regarding the use of nuclear weapons. These incidents influenced international arms control accords by igniting continuing debates on the ethics and legality of employing such weapons.

21.12.2 Vietnam War - My Lai Massacre

Lieutenant William Calley was found guilty and given a life sentence, which was later lowered, among other U.S. soldiers who were court-martialed. Public opinion regarding the Vietnam War was greatly impacted by the massacre, which sparked protests and worldwide anger. To stop such atrocities, the tragedy led to modifications in military doctrine and training.

21.12.3 Bosnian War - Srebrenica Massacre

The International Criminal Tribunal for the former Yugoslavia prosecuted several individuals for genocide and war crimes. The massacre left deep scars on the Bosnian community, with ongoing efforts for reconciliation and justice. The event highlighted the need for stronger international intervention and peacekeeping efforts.

21.12.4 Rwandan Genocide

The genocide resulted in the deaths of an estimated 800,000 people and left a lasting impact on Rwandan society. The international community faced criticism for its failure to intervene,

leading to reforms in international humanitarian intervention policies. The International Criminal Tribunal for Rwanda prosecuted many individuals responsible for the genocide.

21.12.5 Syrian Civil War

The conflict has caused immense suffering, with millions of people displaced and thousands of civilian casualties. Various international bodies have condemned the violations, leading to sanctions and calls for accountability. The violations have contributed to the protracted nature of the conflict, complicating efforts for peace and stability.

These examples underscore the importance of adhering to international humanitarian law to prevent such devastating consequences and to promote peace and justice.

21.13 Evolvment of These Principles in Modern Warfare

Precision-guided munitions, which enable more precise targeting and less collateral damage, have been developed for modern combat. By reducing damage to civilians and civilian infrastructure, this technology aids in upholding the principles of proportionality and discrimination. New moral and legal issues have arisen as a result of the usage of drones and autonomous weaponry. These technologies raise questions about responsibility and the possibility of misuse, even while they can improve precision.

Non-state entities that do not follow the conventional norms of warfare, such as terrorist organisations and insurgents, are frequently involved in contemporary conflicts. Due to the possibility of these actors purposefully targeting civilians or using them as human shields, the application of discriminating and proportionality becomes more difficult. Differentiating between soldiers and civilians is extremely difficult during war in crowded urban locations. To prevent an excessive number of civilian casualties, the rules of proportionality and discrimination must be rigorously observed.

International humanitarian law, which includes the Geneva Conventions and its Additional Protocols, upholds the concepts of proportionality and discrimination. These legal systems are always changing to meet the increasing demands of contemporary combat. Integrating international humanitarian law with human rights law is becoming more and more important in order to safeguard people during armed situations.

Accountability for discrimination and proportionality violations has been reinforced by the creation of international institutions, such as the International Criminal Court. These tribunals bring charges against those who commit crimes against humanity and war crimes. To maintain adherence to international law, modern combat necessitates more reporting and transparency of military activities. This involves recording and looking into instances of harm to civilians.

The moral obligation of military leaders and policymakers to respect the principles of proportionality and discrimination is becoming increasingly apparent. In military institutions, there is a growing emphasis on ethical education and training. These advancements demonstrate the continuous attempts to modify the concepts of proportionality and discrimination to the intricacies of contemporary combat, guaranteeing their continued applicability and efficacy in preserving moral norms and preserving civilian lives.

Chapter 22

Environmental Consequences of Violating Discrimination and Proportionality during Armed Conflicts

In this chapter

- 22.1 Solutions to Combat Environmental Injustices Encountered during Armed Conflicts**
- 22.2 Individuals' Contributions to Combat Environmental Injustices**
- 22.3 Examples of Successful Environmental War Damages Justice Movements**
- 22.4 Influence of Environmental Justice Movements on Environmental Policies**
- 22.5 Environmental Movements to Address New Environmental Challenges**
- 22.6 Limitations of Existing Legal Framework in Protecting Environment**
- 22.7 Transboundary Environmental Damages of Military Conflicts**

Violating principles of discrimination and proportionality in environmental policies during armed conflicts can lead to severe consequences. Discrimination in environmental policies often results in marginalized communities facing disproportionate exposure to environmental hazards, leading to health issues, economic hardships, and social inequalities.

Proportionality in environmental policies ensures that actions taken are balanced and fair. When this principle is violated, it can lead to overexploitation of resources, environmental degradation, and long-term negative impacts on ecosystems and human health. These violations not only harm the environment but also undermine human rights, including the right to a clean, healthy, and sustainable environment. Addressing these issues requires a comprehensive approach that includes legal frameworks, public participation, and accountability for both state and corporate actors².

22.1 Solutions to Combat Environmental Injustices Encountered during Armed Conflicts

Combating environmental injustices requires a multi-layered approach. Governments must create and enforce policies that protect all communities, regardless of their income or race. This includes regulations on industrial waste, air, and water quality, and more. By educating people about the unequal distribution of environmental hazards, we can mobilize communities to demand action from local and national leaders.

Local communities should be at the forefront of the conversation about the problems they face. This means giving them a voice in decision-making processes related to environmental issues.

Environmental justice organizations work tirelessly to address environmental injustices and advocate for the rights of marginalized communities.

Promoting sustainable practices in everyday life can help reduce the overall environmental impact and benefit all communities. Ensuring that all communities have access to clean air, water, and safe living spaces is crucial for achieving environmental justice. Tackling climate change is essential for reducing the disproportionate impact on vulnerable populations. Developing green spaces in urban areas can improve air quality, provide recreational opportunities, and enhance the overall well-being of residents. These strategies, when implemented together, can help create a more equitable and sustainable world.

22.2 Individuals' Contributions to Combat Environmental Injustices

Individuals can make a significant impact in combating environmental injustices through various actions. Educate yourself and others. Knowledge is power. Learn about environmental justice issues and share that information with your community. Understanding the root causes and effects of environmental injustices is the first step toward addressing them.

Advocate for policy change. Support and advocate for local, state, and federal policies that address environmental justice. This could include attending town hall meetings, participating in protests, or writing to your representatives. Support affected communities. Stand in solidarity with communities that are disproportionately affected by environmental hazards. Offer your time, resources, or skills to support their efforts.

Reduce your environmental footprint. Make environmentally conscious choices in your daily life, such as reducing waste, conserving water, and using energy-efficient products. Every little bit helps. Support environmental justice organization. Donate to or volunteer with organizations that focus on environmental justice. These groups often work on the front lines to advocate for marginalized communities.

Promote sustainable practices. Encourage sustainable practices at home, work, and in your community. This could include starting a recycling program, promoting the use of public transportation, or supporting local, sustainable businesses. Raise your voice. Speak up about environmental injustices whenever you have the opportunity. Whether it is on social media, in your workplace, or within your social circles, raising awareness is crucial.

Hold corporations accountable. Support businesses that prioritize sustainability and social responsibility, and boycott those that do not. Your purchasing decisions can send a powerful message. Participate in local cleanups. Join or organize community clean-up events to address pollution and improve local environments. By taking these actions, individuals can contribute to a larger movement towards environmental justice and help create a more equitable and sustainable future for all.

22.3 Examples of Successful Environmental War Damages Justice Movements

Here are some notable examples of successful environmental justice movements related to war damages. The use of Agent Orange during the Vietnam War caused severe environmental and

health issues. Advocacy and legal actions by affected communities and veterans led to compensation and cleanup efforts by the U.S. government and chemical companies.

The Gulf War resulted in massive oil spills that devastated marine and coastal ecosystems. International efforts, including those by the United Nations, led to significant cleanup operations and restoration projects.

During the Bosnian War, environmental damage was caused by the destruction of industrial facilities. Post-war, international organizations and local communities worked together to address pollution and restore affected areas.

The use of depleted uranium munitions during the Iraq War led to long-term environmental contamination. Advocacy by local and international groups has resulted in increased awareness and efforts to address the environmental and health impacts. These movements highlight the importance of collective action and international cooperation in addressing environmental damages caused by war.

22.4 Influence of Environmental Justice Movements on Environmental Policies

Environmental justice movements have had a profound impact on shaping environmental policies.

Movements like the first Earth Day in 1970 led to the creation of significant environmental laws in the United States, such as the Clean Air Act, the Clean Water Act, and the Endangered Species Act. These laws have set standards for environmental protection and have been instrumental in reducing pollution and protecting natural resources.

Environmental justice movements have emphasized the importance of public participation in environmental decision-making. This has led to greater community involvement in policy development and implementation, ensuring that the voices of marginalized communities are heard. Legal challenges and public interest litigations have resulted in court rulings that protect the rights of affected communities and enforce environmental regulations. These judicial interventions have been crucial in holding polluters accountable and ensuring compliance with environmental laws.

Activism and advocacy have pressured corporations to adopt more sustainable practices and reduce their environmental impact. Companies are increasingly being held accountable for their actions, leading to more responsible corporate behaviour. Movements like the Climate Strike have raised global awareness about environmental issues and the need for urgent action. This has influenced international policies and agreements aimed at addressing climate change and promoting sustainability. These movements demonstrate the power of collective action and the importance of advocating for environmental justice.

22.5 Environmental Movements to Address New Environmental Challenges

Environmental movements are continuously evolving to address new challenges. Modern environmental movements are leveraging technology to raise awareness, mobilize supporters, and track environmental changes. Social media platforms, mobile apps, and data analytics are

being used to engage a broader audience and drive action. Environmental movements are increasingly recognizing the interconnectedness of social, economic, and environmental issues. This approach, known as intersectionality, ensures that solutions address the root causes of environmental injustices and promote equity.

Young activists are playing a crucial role in driving environmental movements. Figures like Greta Thunberg have inspired a new generation of environmental advocates who are passionate about creating a sustainable future. Environmental movements are fostering international cooperation to tackle global challenges like climate change. Collaborative efforts, such as the Paris Agreement, demonstrate the importance of collective action in addressing environmental issues.

Climate justice has become a central theme in environmental movements. This approach emphasizes the need to address the disproportionate impacts of climate change on vulnerable communities and ensure that solutions are fair and inclusive. Environmental movements are promoting innovative solutions to environmental problems. This includes advocating for renewable energy, sustainable agriculture, and circular economy practices that reduce waste and promote resource efficiency.

Environmental movements are increasingly focused on influencing policy at local, national, and international levels. By advocating for stronger environmental regulations and policies, these movements aim to create systemic change. Grassroots movements are empowering local communities to take action on environmental issues. Community-based approaches ensure that solutions are tailored to the specific needs and contexts of different regions. These evolving strategies reflect the dynamic nature of environmental movements and their commitment to addressing new and emerging challenges.

22.6 Limitations of Existing Legal Framework in Protecting Environment

Even while they seem promising, there are a number of problems with the current legal tools for the direct protection of the environment during armed conflict. There is little doubt that the current legal tools have a narrow range of applications. One example is the lack of universality in the Environment Modification Techniques (ENMOD) Convention (Environmental Impact of Armed Conflicts Report, Document 15674, dated 05 January 2023). It does, in fact, only apply to and between parties to a state. Only 78 states have ratified the agreement thus far, while 16 have signed but not ratified it.

Eleven nations have not joined the convention, despite the fact that many European nations have. Furthermore, only the employment of environmental modification techniques is forbidden by the agreement; research, development, or preparation of such techniques are not. Additionally, the terms "environmental modification techniques," "having widespread, long-lasting, or severe effects," and "the deliberate manipulation of natural processes" are not well defined.

Furthermore, only international armed conflicts are covered by the Environment Modification Techniques Convention, Protocol I (to the Geneva Conventions of August 12, 1949), and there is no explicit environmental protection clause in the Additional Protocol II pertaining to the Protection of Victims of Non-International Armed Conflicts. Despite the fact that 174 states

have ratified Protocol I, certain states—such as the US and Israel—are not, because they are engaged in continuing hostilities that negatively impact the environment.

There are still questions regarding whether certain of this Protocol's clauses are customary. Furthermore, the problem of nuclear weapons is addressed in the Protocol's application area. Many nations, including as France and the UK, believe that paragraphs 35.3 and 55 exclusively relate to conventional weapons, meaning that nuclear weapons are not covered. Furthermore, "widespread, long-term, and severe damage to the natural environment" is another requirement of the Protocol. A high threshold of environmental harm is imposed by these cumulative requirements. Similar to the Environment Modification Techniques Convention, there is a great deal of subjectivity involved in how these concepts are interpreted.

There is also a lack of universality with regard to protocols Nos. 150 and 172 of the Council of Europe. Only nine member states of the Council of Europe have ratified the Convention on Civil Liability. While the criminal law convention has been signed by fourteen member states and ratified by one (Estonia), it has not been ratified by any. None of these conventions have come into effect because three ratifications are required.

In order to address the issues of criminal and civil liability in the context of climate change, it was requested that member states strengthen criminal liability for actions and inactions that could result in significant environmental harm. They were also asked to harmonise laws pertaining to environmental damage, with a particular emphasis on the definition of environmental crimes and the associated penalties; amend or replace Convention ETS No. 172 as soon as possible to have a legal document better suited to the current challenges; incorporate the crime of ecocide into their national criminal laws; and consider acknowledging universal jurisdiction for ecocide and the most serious environmental crimes, including in the 1998 Rome Statute of the International Criminal Court.

Additionally, the resolution called for strengthening civil liability for environmental damage through the amendment of national civil law legislation, the addition of specific provisions on responsibility for ecological harm, the expansion of strict liability in pertinent situations relating to environmental damage, and the alleviation of the burden of proof, particularly through the establishment of factual presumptions regarding causation, for those seeking compensation for damages.

Most international legal measures aimed at preserving the environment in times of armed conflict were created specifically for such situations. Nonetheless, internal conflicts currently account for the majority of armed conflicts, and internal conflicts are now covered by international law. As a result, there is no long-term international system in place to keep an eye on legal violations and handle requests for compensation for environmental harm.

There is little environmental protection offered indirectly by international customary law. Only in a secondary way, subject to humanitarian imperatives and wartime circumstances, is the environment protected. For example, if an attack does not include any military gain, the principle of military necessity prohibits the activities of belligerents and environmental damage. Although this idea seems helpful for protecting the environment during armed conflicts, the military necessity concept can legitimise environmental damage mandated by war objectives and support numerous environmentally harmful actions.

The proportionality principle is no different. When the attack's military benefit is significant enough to warrant putting the environment at greater danger, it may be legal to cause collateral environmental harm. Environmental risk will increase with the importance of the goal. Applying this idea, however, requires weighing the target's significance against the anticipated accidental damage. A higher level of environmental risk might be warranted if the aim is significant enough.

When compared to other values during times of conflict, the need to prioritise will result in the environment being placed at the bottom of the hierarchy. In any case, it is unclear whether the environment will be incidentally protected.

22.7 Transboundary Environmental Damages of Military Conflicts

Transboundary effects are caused by military conflicts, which frequently cause environmental harm that transcends national boundaries. Long-term deterioration of natural resources, ecological destruction, and pollution of public waterways are a few examples of these harms.

For example, military-caused oil spills during the Gulf War had a devastating effect on the Persian Gulf, affecting several surrounding nations. Devastating effects on the Persian Gulf made the Gulf War oil leaks one of the worst environmental catastrophes in history. Iraqi soldiers purposefully spilt oil into the Gulf in January 1991 in an effort to obstruct coalition forces from the United States. About 4 million barrels of oil leaked as a result of this act, contaminating sediments along the shore and marine ecosystems.

The leak caused long-term environmental harm by affecting Saudi Arabia's beaches and marine life. Because of its intentionality and the widespread damage it produced, the incident is frequently referred to as an act of environmental terrorism. There were few attempts to clean up the spill, and research has revealed long-term effects on the ecosystems and biodiversity of the area.

Likewise, adjacent Eastern European countries suffered environmental harm as a result of the NATO bombings in Yugoslavia. The 1999 NATO bombardment of Yugoslavia during the Kosovo war seriously damaged the environment and had a cross-border effect on adjacent Eastern European nations. Hazardous materials were released into the air, water, and soil as a result of attacks on infrastructure and industrial facilities.

For example, the Danube River and groundwater were contaminated with polychlorinated biphenyl and mercury as a result of the bombing of a petrochemical plant in Pancevo. Concerns over long-term health hazards, including as elevated cancer rates and congenital disorders in impacted areas, were also raised by the use of depleted uranium ammunition. Countries in the region, including Albania, Bulgaria, Greece, Hungary, and Romania, were also affected by these environmental effects. With few resources available for cleanup and restoration, efforts to repair these damages have been sluggish. Stronger legal frameworks have been demanded by international organisations to stop this kind of environmental damage during armed conflicts.

These problems are intended to be addressed by international legal frameworks like the Geneva Conventions and the Environmental Modification Convention. However, because of issues like lax enforcement and ambiguous legal requirements, they frequently fail to adequately mitigate

transboundary environmental effects. International organisations have made proposals to improve legal safeguards and encourage accountability as part of efforts to fortify these frameworks. For instance, the "no harm" concept highlights that, even in times of conflict, states should refrain from endangering the environment of other countries.

Section E

Case Studies of Environmental Destruction During Armed Conflicts and Wars

Chapter 23

Ecosystem Destruction in the First World War

In this chapter

- 23.1 Damages of the Landscapes in the War**
- 23.2 Devastation on the Battlefields during War**
- 23.3 Fate of Ecologies on Western Frontlines**
- 23.4 Ecological Mayhem by Chemical Weapons**
- 23.5 The Great War Altered the Makeup of Forests**
- 23.6 The War Changed the Composition of Soil**
- 23.7 Behind the Front Lines of Great War**
- 23.8 Repercussions of Mass Mining on Local Ecosystems**
- 23.9 Great War and the Price of Biodiversity Loss**

The First World War, sometimes referred to as the Great War, was a worldwide armed struggle that raged between the Central Powers and the Allies (also known as the Entente) from July 28, 1914, to November 11, 1918. In addition to some regions of Africa and the Asia-Pacific, the majority of the fighting occurred in Europe and the Middle East. It was typified in Europe by trench warfare, the introduction of tanks and aircraft, and the extensive employment of artillery, machine guns, and chemical weapons.

With an estimated 10 million military deaths, over 20 million injuries, and about 10 million civilian deaths from causes including genocide, World War I was one of the worst wars in history. One of the main causes of the devastating Spanish flu epidemic was the mass migration.

The First World War had a significant impact on the environment, both on and off the battlefield. The war's ecological legacy is complex and multifaceted, involving both immediate and long-term effects.

Though generations mourned the destruction along the front lines, the natural world often remains a voiceless casualty of war. With desolated farmlands, burnt trees, and muddy quagmires as iconic images of the conflict, we have tended to take for granted the place and role of nature. People characteristically regard the environment as the setting for battle or as collateral damage, if they consider the natural world at all. Only by taking the environment into account, we can fully understand the trauma of the Great War and how this conflict shaped the most basic levels of human existence for years afterwards.

23.1 Damages of the Landscapes in the War

The weight of industrialised warfare fell on nature. Pictures from the Western Front make the story very evident. Scenes of complete destruction, with destroyed landscapes split and pitted with trenches and craters, soon came to symbolise the carnage caused by the Great War. Well-educated troops who had been raised with a romantic sense of nature were appalled by the

effects of the conflict on the land. Those who had worked in mines, emptied overflowing cesspools, bathed in dirty rivers, or slept in slums found this setting to be appalling.

The ecological impact of war was so great that it went beyond simply destroying the ecosystem; it was a full-scale assault on nature. The environmental impact of the war is significantly more complex than the images portray when comparing the fate of the front lines to global timber harvesting, tin mining in Malaysia, oil production in Mexico, and wheat farming in the US and Canada.

23.2 Devastation on the Battlefields during War

Ecosystems were changed by armies on all battlefields. Environmental change that had started in the preceding century was hastened by war. In the vast boreal forest of the Białowieża Forests in Poland that border Russia, one of the last and largest remaining portions of the primeval forest that formerly covered much of Europe, soldiers in the east almost wiped out a keystone species by eating European bison. By 1914, there were only about 400 bison left after Russian royal hunting groups had killed the herds in the late 19th century. By 1918, the last animals had been slaughtered by famished soldiers.

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23.3 Fate of Ecologies on Western Frontlines

Nowhere was the concentration of soldiers as high as on the Western Front, but ecologies on frontlines were disrupted by hostilities everywhere. From the North Sea to the Swiss border, trenches ran, and the resulting impasse guaranteed ecological disruption. Fields and woodlands within the relatively small fighting zone were turned into a wasteland by millions of soldiers and billions of shells. Devastation was dictated by military strategy. During the Battle of Yser in 1914, Belgian troops flooded parts of the lowlands in an attempt to slow the German assault.

The German retreat in 1917, known as Operation Alberich, called for the use of scorched earth tactics in the hopes that "the enemy should find a desert" in the army's wake. Large projectiles, however, caused the most damage. Several hundred rounds per hour were fired by artillery forces during intense combat. The cannons destroyed almost everything in their path, even though their range was rarely more than a few kilometres.

23.4 Ecological Mayhem by Chemical Weapons

Environmental unrest was exacerbated by chemical weapons. Both humans and animals were suffocated by mustard, phosgene, and chlorine gases. The distorted terrain held the lethal fumes

in trench seams and shell holes. The troops were confronted with the very image of hell: charred ground, decaying bodies, and craters filled with a heartless mixture of blood, muck, and the green-yellow clouds of stale gas. Agricultural land suffered long-term damage as a result.

Water sources were poisoned by chemical weapons, which caused acute or long-term toxicity to aquatic life and presented health concerns to humans through tainted drinking water. The loss of plant and animal species resulted from the destruction of habitats caused by the deployment of chemical weapons. Whole ecosystems were affected in a cascade by this disturbance. For years, chemical agent residues persisted in the environment, endangering human populations as well as ecosystems.

The battlefields resembled sterile areas where the form of the plains is altered by the horrific loads of dead and injured men. It seems like everything is nasty and smells like a catastrophe. The soil itself appears lifeless. The warriors thought the terrain had become artificial and had lost its natural beauty. These illustrations show how chemical weapons during World War I had a wide range of effects on ecosystems.

23.5 The Great War Altered the Makeup of Forests

Forest composition and soil composition were changed by fighting on the Western Front. Foresters documented the quantity of timber lost to the conflict and surveyed timber reserves immediately after the ceasefire. According to some estimates, up to 2.5 billion board feet were either eaten or destroyed. The French government quickly launched a reforestation effort using money from German reparations.

Before 1914, European Beech, European Hornbeam, European Oak, and English Oak made up the majority of the deciduous forests along the Western Front. Austrian Pine and Scotch Pine seedlings, which are fast-growing coniferous species that can withstand nutrient-poor soil, were planted by authorities in the areas that were destroyed. Later, foresters brought the European Beech back. However, once-diverse forest ecosystems became to resemble monoculture, which increased the woodlands' vulnerability to pests and disease.

The project's size and cost hindered managers' attempts to broaden the project's diversity. However, in some places, the alien trees reclaimed land for woodland animals by encroaching on defunct farming. Forests restored to the areas devastated by the conflict, albeit an altered environment with a different character.

23.6 The War Changed the Composition of Soil

Changes in the composition of the soil were less obvious. Major soil disturbance is often caused by natural phenomena like windstorms and earthquakes. Combat became a potent cause of geomorphic change with the emergence of industrial warfare. The fighting transformed stable soil ecosystems into loose, unconsolidated sediment, according to the geographer Joseph Hupy's extensive studies around Verdun (see table below). There is a similar pattern of upheaval along the Western Front, where innumerable artillery craters have changed the water table's properties, soil development rates, and surface hydrology.

Because they detonated upon contact (as opposed to World War Two bombs that used timers) and aimed the majority of their blast downward into the ground, shells used in the First World War were particularly harmful. Soil horizons were also confused by tunnelling and mine operations. Topsoil was buried beneath layers of gravel ejecta and debris was flung into the air by explosions. Nevertheless, diligent earthworms and other agents have incorporated those materials into the soil profile over time, according to Hupy. Even now, plants and animals flourish in areas where debris is still buried and soils have formed along new routes.

23.7 Behind the Front Lines of Great War

In addition to dominating the warscape, the drama and devastation on the Western Front have influenced how we perceive the natural effects of the fight. The natural environment was altered by combat, but the effects of the war extended beyond artillery barrages in Belgium and France. The biological and social components of fighting forces relied on a military ecology of supply, production, and extraction. States took control of natural resources across the biosphere to keep armies fighting, increasing the environmental impact of the conflict.

Dr. Joseph Hupy is an associate professor at Purdue University and a geographer. His work focusses on studying landscapes and environmental changes using unmanned aerial systems (UAS) and geospatial data. Dr. Hupy has studied World War I battlefield recovery in great detail. He looks at how the effects of explosive weapons and other wartime operations have been mitigated in these environments.

In order to collect high-resolution spatial data, Dr. Hupy has been a pioneer in integrating a variety of sensors with UAS platforms. In his work, he uses unmanned aerial systems (UAS) to conduct microtopographic surveys in hazardous areas, like mine sites and battlefields. His study attempts to enhance data gathering techniques for tracking alterations and disruptions in the environment.

Dr. Hupy has been using geospatial data collection techniques to integrate them into Geographic Information Systems (GIS) software for more than 20 years. He uses these technologies to address landscape-level issues in his work.

The tremendous mobilisation of natural resources for the war effort reoriented economies, altered state infrastructure, and altered the terrain. Countries gained unprecedented control over natural resources as a result of the need for raw materials. The distribution, pricing, and supply of commodities like food, metal ore, lumber, and fossil fuels were now controlled by government organisations. Massive collaboration between the public and private sectors was encouraged by these hybrid institutional structures, which established a crucial precedent for future conflicts.

Global forest reserves were strained by the need for timber. Timber was essential to armies in many ways. Trenches were prevented from collapsing by timber timbers. Soldiers avoided wallowing or drowning in mud thanks to wood boards. Trees served as the fundamental building material for barracks, railway ties, telephone poles, weapons stores and jetties where soldiers disembarked. The war effort also benefited from pulp for paper supply, fuel wood, and pit timber for coalmines.

Because of this, deforestation increased globally, albeit unevenly. Cedar forests in Lebanon were devastated by Ottoman armies. Prior to 1914, Canada, Russia, and Scandinavia supplied the majority of Britain's timber imports. However, the British faced a severe timber crisis and had to clear over half of their productive forests, or over 450,000 acres, after Germany's unrestricted U-boat operations sunk supply convoys.

Additionally, British officials mobilised forest resources throughout the Empire, particularly in India. However, in the Middle East, Indian timber was typically used for military purposes. The British system of indirect control played a major role in the failure of attempts to import timber from African colonies, but it did establish the necessary infrastructure for future extraction. Despite German submarines, logging activities in Western Canada were increased due to desperate appeals from London and significant capital investment.

Due to long-standing, institutionalised forestry techniques, the timber stands in France and Germany fared better. Almost 90% of France's woodlands were located outside of conflict areas. Furthermore, logging rates in certain departments quickly dropped below pre-war levels as a result of personnel being redirected to the army. Western French woodlands did not withstand extensive cutting until American forestry personnel, the 10th and 20th Engineering Corps, arrived. Although the Germans increased their timber harvesting, they did so in a method that did not significantly harm the nation's overall forest cover. Rather, German troops felled trees in occupied areas, stealing 5 million cubic meters of Lithuanian wood; nearly 5% of the Białowieża Forest; for domestic consumption.

The troops were given comprehensive instructions on how to procure timber. Initially, they were to use trees that had already fallen or had had their bark removed. The workers were instructed to avoid making big, obvious incisions and instead cut sections in a "chessboard-like fashion." Directives cautioned against removing trees along stream banks in order to prevent erosion. In the Alps, orders specifically prohibited soldiers from cutting down trees along the timberline, a protected area.

Officers were supposed to become acquainted with the trees in their sector and understand the proper applications for each species, as timber should never be used in place of firewood. Experts in timber travelled to the several impact sites and provided assistance. To avoid ambush and have clear fire lines, soldiers on the front lines levelled woodlands in spite of their best attempts.

American logging corporations reacted to increased timber prices and significant government subsidies considerably earlier, even though the United States did not enter the war until 1917. To satisfy European demand, timber companies made significant investments in new machinery and technology. Large-scale clear-cutting operations that had started in the 1880s were accelerated by mechanised workers. Because forests were so vast, logging corporations were not concerned about selective cutting, replanting initiatives, or the preservation of timber stands.

The most severely affected areas were woodlands in the southeast of the United States. There was significant erosion of red clay on the interior and sandy soil towards the coast. Only German submarines prevented much more damage to the countryside. During the war, the overall export sales of U.S. timber products fell by more than 60% due to the significant hazards of transatlantic transportation. However, it was anticipated that 600 million board feet of lumber were needed just to outfit and house the new American Expeditionary Force when the Americans finally entered the war. Additionally, billions of premium board feet were used to build ships. However, prior to the conclusion of the war, very few ships crossed the Atlantic.

The battle created high-input, industrial timber extraction models that characterised the 20th century and revolutionised the global forestry sector. Additionally, selective overcutting was

carried out to target species for particular military requirements. Programs for reforestation further diminished biodiversity. The effects of these changes on forest ecosystems persisted long beyond 1918.

23.8 Repercussions of Mass Mining on Local Ecosystems

Timber was crucial for the war, but so was tin. The metal was so widely used by machines and militaries that most soldiers didn't think much of it. Tin's qualities led to its employment in white metal alloys and as an anti-friction metal. However, the production of tinplate was its most widespread use. Tinplate was essential for canning perishable items for soldiers' meal packs.

The Great War hastened the industrialisation of tin mining, which had detrimental effects on regional ecosystems, much like armed conflict and timber harvesting. Tin's value increased significantly during the war, much like that of other strategic commodities. Malay tin mining expanded dramatically in 1916 as a result of a 43 percent increase in tin prices on the London market compared to 1911. Widespread erosion brought on by the rise in hydraulic sluicing clogged waterways with clay and sand runoff. Important elements of these regional ecosystems are destroyed by extensive tin mining. Malayan habitats and livelihoods were destroyed by degraded ecosystems.

The Gulf Coast of Mexico, which at the time had some of the most productive oil fields in the world, saw a similar cycle of industrialisation, ecological devastation, and social unrest. Ten years later, Mexico was in a position of great strategic importance thanks to the early 1900s discovery of petroleum in the Huasteca. Around 1912, navies started switching warships from coal-burning to oil-fired engines, making crude deposits a national security concern. The war's development highlighted how crucial petroleum is. Oil became essential.

The ecology of the Huasteca was dominated by oil syndicates. Companies cleared thousands of acres of marshes, drained bogs, and levelled sand dunes in order to drill for petroleum. The soil was disturbed by deep holes to store the petroleum, simulating bombardment on the Western Front. The process of extracting oil was untidy. Sludge from multiple oil spills contaminated rivers, beaches, and the rainforest. Crude production in Mexico was particularly filthy due to ecological factors.

Local ecosystems were often burnt by scalding gushers, which frequently did so with horrifying explosions and uncontrollable conflagrations. After that, the verdant areas were diminished to the skeletal remains of dead trees. The smell of rotten eggs filled the air. There were no birds in the sky, no leaves on the trees, and the stillness seemed unsettling and terrifying.

While damaged areas in the European battle zone had mostly recovered by the end of the 1920s, environmental harm in the Huasteca continued for decades, even after Mexico was removed from the top oil-producing nations in the world. Additionally, ecological deterioration exacerbated labour disputes and disrupted land tenure arrangements.

23.9 Great War and the Price of Biodiversity Loss

The ecological impact of the Great War shows that the line separating modern industry from contemporary warfare has, in many respects, blurred. Outside of the battle zones, the natural environment underwent changes. Due to the war's extensive environmental impact, people living distant from the combat experienced it in their daily lives. These specific environmental changes show how ecosystems are changing and how biodiversity is declining globally. These regional trends pointed to more general trends that characterised the 20th century. In each case, the war sped up developments that started in the 19th century with industrialisation. Battlegrounds were destroyed by the concentrated industrial destruction of the conflict, but the damaged areas were restored by natural processes.

The development of industrial production methods and mindsets, which disrupted local ecological balances, hampered natural processes, and boosted human exploitation globally, was far more widespread and harmful to ecosystems than war. The long-term ecological effects of the battle highlight the unspoken costs of war, including continued environmental damage and psychological harm. This indicates that the Great War brought about a century of environmental change that was equal to the horrific violence it caused.

Chapter 24

Destruction of Environments in World War II

The Battle of Stalingrad

In this chapter

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- 24.3 War Scapes in the Battle of Stalingrad**
- 24.4 Damages and Destruction of Stalingrad Battle**
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- 24.6 Long-term Ecological Effects of the Battle of Stalingrad**
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- 24.8 Destruction of Natural Habitats and Deforestation in the Stalingrad Battle**
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- 24.10 Abuses of International Legal Framework in the Battle of Stalingrad**
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- 24.13 Aftermath of Terrible Fighting in Stalingrad**

One of the bloodiest and most important conflicts of World War II was the Battle of Stalingrad. It happened in Stalingrad (now Volgograd), Russia, between July 17, 1942, and February 2, 1943. The Soviet Union and the Axis nations, commanded by Nazi Germany, engaged in combat. The European Second World War peaked with the Battle of Stalingrad. The extent of environmental damage in active war zones is a good example to understand the relationship between environmental destruction and armed conflicts. The Second World War's most intense and devastating battle was this one.

On one side were the Axis Powers, which included Germany, Italy, and other major warring nations; according to some estimates, over five lac people were killed or captured; roughly half of the three lac German soldiers perished before the battle started, and over one lac German soldiers were captured by the Soviets; only roughly 6,000 of them returned home until the end of the war; the Red Army suffered a similar loss.

Not only are the brutal leaders Hitler and Stalin to blame for the widespread slaughter and the most horrible treatment of civilians and POWs by both sides, but the desire to gain a strategic position in the conflict on the Volga landscape is also to blame. They disregarded all international war laws and norms in their unwavering determination to win the conflict. The Germans initiated the conflict, which was fought for the strategic communications position that would ultimately determine how the Second World War played out.

Since the Soviet Union successfully defended the city and eventually surrounded and defeated the Germans, the fight is frequently regarded as a turning point in the war. The Soviet Union's westward march, which ultimately resulted in the defeat of Nazi Germany, began with the victory at Stalingrad. The Allied forces' morale was raised and the German military was severely undermined by the Soviet victory at Stalingrad.

24.1 The Factors that Led to the Battle of Stalingrad

A number of important variables influenced the Battle of Stalingrad. On the Volga River, Stalingrad was a significant industrial city that was essential to the movement of supplies. Its capture would have given the Germans a vital economic resource and interfered with Soviet logistics. Operation Barbarossa, the German invasion of the Soviet Union in June 1941, sought to gain control of Eastern Europe and secure resources. A main point of this broader effort was Stalingrad. The German High Command and Adolf Hitler aimed for a resounding triumph on the Eastern Front. It was believed that taking Stalingrad would end Soviet opposition and protect the German advance's southern flank.

The Soviet Union, led by Joseph Stalin, was committed to protecting the city that was named after him. The Soviet Red Army surrounded and routed the German soldiers by launching counteroffensives and using strategic defence tactics. Operation Blau, the German summer offensive in 1942, sought to acquire the Caucasus oil reserves and take Stalingrad. The fight was marked by ruthless urban warfare, which was facilitated by this operation. These elements came together to produce one of the most important and fatal engagements of World War II, which ultimately marked a sea change in the course of the war.

24.2 Consequences of the Battle of Stalingrad

There were significant and long-lasting effects from the Battle of Stalingrad. One of the pivotal moments in World War II was the Soviet triumph at Stalingrad. The German military was severely undermined, which allowed the Soviet Union to launch several successful offensives that drove the Axis armies westward. The triumph encouraged more resistance against the Axis powers by raising the spirits of Soviet soldiers and citizens.

Germany's military resources were badly drained during the conflict, making it difficult for them to carry out operations in the future. The balance of power on the Eastern Front changed as a result of the setback at Stalingrad, which damaged the trust of the German leadership and their allies. Due to the extensive loss of industrial facilities, environmental areas, and infrastructure, the fighting significantly disrupted the local economy.

The Battle of Stalingrad is regarded as one of the deadliest and most significant battles in history, influencing the course of World War II and leaving a lasting impact on military strategy and geopolitical dynamics. The battle's consequences went far beyond the immediate military outcomes, influencing the war's broader context and the post-war world. It resulted in staggering casualties, with an estimated five million people killed or wounded, including soldiers and civilians.

24.3 War Scapes in the Battle of Stalingrad

The eerie and barren terrain left behind by the Battle of Stalingrad is known as "war scapes." Stalingrad was in ruins because of the fierce urban fighting and bombardment. It turned the once-thriving industrial city into a wasteland, with buildings reduced to ruins. Both military and people found it impossible to travel about the streets because of the debris and rubble from the damaged buildings.

Due to the numerous fires caused by the use of explosives and provocative devices, a sizable portion of the city was left charred and desolate. The city became a labyrinthine battlefield as a result of the enormous trenches and fortifications constructed by both the Axis and Soviet armies. Tanks, artillery pieces, and vehicles were among the abandoned military equipment strewn across the battlefield, contributing to the chaotic and bleak scene. A clear reminder of the terrible effects of war on the metropolitan environment and its inhabitants may be found in the warscapes of Stalingrad.

24.4 Damages and Destruction of Stalingrad Battle

The city and its environs were severely damaged and destroyed during the Battle of Stalingrad. A great deal of bombing and artillery shelling nearly destroyed Stalingrad. Infrastructure, industrial facilities, and buildings were all reduced to rubble.

There were many civilian casualties from the conflict. A humanitarian disaster resulted from the numerous injuries or displacements. Both Soviet and Axis troops sustained significant losses. Approximately 500,000 members of the Axis forces were lost, and the Soviet troops also sustained significant losses. The battle caused severe economic disruption in the region. The destruction of industrial facilities and infrastructure led to long-term economic challenges.

The massive use of chemicals and explosives throughout the fight resulted in long-lasting environmental harm, including poisoning of water and land sources. With its profound effects on the area and the outcome of World War II, the Battle of Stalingrad continues to rank among the most catastrophic and important conflicts in history.

24.5 Environmental Destruction of Battle of Stalingrad

Significant environmental damage was caused during the Battle of Stalingrad, which had an ongoing impact on the area. Soils and water sources became contaminated as a result of the widespread use of chemicals, explosives, and other military supplies. Both the local population's health and agriculture suffered as a result. The region has been affected for a long time by the massive environmental damage caused by the Battle of Stalingrad. Destruction during the battle was increased by fierce fighting, which led to massive destruction and the obliteration of urban and rural environments. The aftermath left the land scarred and rendered large areas uninhabitable.

The widespread employment of chemical weapons and heavy artillery increased the contamination of water and land sources. For many years, these materials' leftovers remained in the soil and streams, endangering the health of both people and wildlife. The local agriculture

and natural habitats were affected both immediately and over time by this environmental degradation.

The region's ecological balance was upset, and in addition to the pollution of the land and water, the loss of habitats resulted in a reduction in biodiversity, affecting a number of species that were essential to the local ecosystem. As the flora and fauna struggled to recover, the environment underwent irreversible changes that changed its character for generations.

The battle's environmental destruction demonstrated how war may bring significant and long-lasting harm to the ecosystem. Recognising the battle's full geographical effects—which go beyond societal change and human casualties to include the ecological repercussions that still affect Stalingrad today—requires an understanding of this influence.

24.6 Long-term Ecological Effects of the Battle of Stalingrad

The surrounding area experienced major long-term ecological consequences as a result of the Battle of Stalingrad. The fierce fighting caused extensive habitat degradation, which changed the equilibrium of the local environment. Biodiversity has been impacted by decades of flora and animal loss. Soil deterioration brought on by explosives and military vehicle contamination is one of the most urgent issues. Pollutants such as pesticides and heavy metals seeped into the soil, reducing agricultural output and endangering the region's food supply.

The battle's ongoing regional effects continue to resonate within the landscape and the lives of those who inhabit it. Water sources were also negatively impacted. Numerous rivers and lakes were contaminated, posing health risks to local wildlife and humans. The contamination left ecological scars that are difficult to repair, making restoration efforts difficult in the long run. Additionally, these ecological disruptions have affected local climate conditions, which may make it more difficult for communities to rebuild and recover from the aftermath of the war.

24.7 Cultural Transformations Post-Battle

The Battle of Stalingrad had a profound impact on regional cultural changes, altering both artistic expression and social memory. Locals developed a strong sense of identity as a result of the tremendous hardship and tenacity displayed during the conflict. This created a story that is intricately intertwined into Russian culture. Monuments and memorials were built to honour those who fought and lost their lives in order to preserve memory. These locations ensure that the tales of tragedy and bravery are shared by acting as both historical markers and spaces for introspection. The region's cultural identity is shaped in part by this emphasis on remembering.

There were also significant developments in artistic expression. Numerous works of literature, art, and film depicting the bravery and destruction witnessed were influenced by the conflict. Themes of sacrifice and survival struck a profound chord in the cultural psyche as artists attempted to convey the feelings surrounding the battle. These cultural shifts fostered a regional narrative that spanned generations and helped people appreciate the significance of the fight as a whole. The Battle of Stalingrad's lingering effects are still felt in the region today in terms of cultural customs and societal ideals.

24.8 Destruction of Natural Habitats and Deforestation in the Stalingrad Battle

Natural habitats were destroyed by the fierce urban combat and bombardment, which had an impact on the surrounding ecosystems and fauna. Long-term ecological effects of the battle's environmental harm included diminished biodiversity and degraded soil. Buildings, infrastructure, and industrial facilities were reduced to rubble, and the city of Stalingrad was nearly entirely destroyed. Degradation of the environment was exacerbated by this urban destruction. One important part of the Battle of Stalingrad's legacy is the environmental damage it inflicted, which emphasises the profound effects of conflict on the environment.

24.9 Horrors and Crimes in the Battle of Stalingrad

Both sides perpetrated countless atrocities and war crimes during the Battle of Stalingrad. Intense and vicious urban warfare, close-quarters fighting, and extensive destruction were all features of the conflict. Significant casualties and suffering resulted from civilians being caught in the crossfire.

During the conflict, war crimes were perpetrated by both Soviet and Axis armies. These included the targeting of civilians, torture, and summary killings. Widespread tragedies resulted from the conflict's brutality. Millions of soldiers and people were killed, injured, or displaced during the conflict, which resulted in tremendous human misery. The hardship was made worse by the severe winter weather and a shortage of supplies.

Those who survived were profoundly affected psychologically by the horrors of the conflict. Trauma and long-term mental health problems plagued many soldiers and civilians. One of the bloodiest and most significant conflicts in history, the Battle of Stalingrad demonstrated the terrible toll that war has on human life.

24.10 Abuses of International Legal Framework in the Battle of Stalingrad

The Battle of Stalingrad saw numerous abuses of the international legal framework, with both sides committing war crimes and atrocities. Both the Axis and Soviet forces carried out summary executions of prisoners of war and civilians, violating the Geneva Conventions.

Summary executions were among the many crimes that occurred during the Battle of Stalingrad. These executions were carried out by both Soviet and Axis forces, frequently focussing on civilians and POWs. The Geneva Conventions and other international rules pertaining to the treatment of detainees and non-combatants were broken by these acts. These kinds of war crimes were common because of the conflict's brutality, the fierce urban fighting, and the severe winter weather. The Battle of Stalingrad summary executions continue to be a sombre episode in World War II history, underscoring the grave human rights abuses that took place throughout this bloody struggle.

Both parties violated international law by torturing and treating civilians and prisoners of war inhumanely. Significant losses and suffering were caused by the intentional targeting of civilians as a result of the fierce urban combat. The extensive devastation and suffering were

exacerbated by the deployment of some illegal weapons and strategies, such as chemical agents and incendiary devices.

Both sides used forced labour, requiring POWs and civilians to labour in hazardous and severe conditions. The savagery of the Battle of Stalingrad and the flagrant transgressions of international law that took place during this fight are brought to light by these abuses.

24.11 Social Impacts of the Stalingrad Battle

The area and its inhabitants were significantly impacted socially by the Battle of Stalingrad. Thousands of civilians were forced to leave their homes as a result of the war. Due to the terrible circumstances and uncertainty, many became refugees. A landscape characterised by trauma and psychological scars was a result of shifting demography and social systems. Communities were upended, and families were split apart.

Those who survived were profoundly affected psychologically by the horrors of the conflict. Trauma and long-term mental health problems plagued many soldiers and civilians. Significant humanitarian measures were made to support and aid the impacted community in the wake of the fight. In order to regain any sort of normalcy, reconstruction and recovery operations were necessary.

Literature, painting, and film were among the cultural forms impacted by the conflict and its aftermath. The region's cultural identity began to depend heavily on the preservation of memory and history. Beyond the immediate fighting, the Battle of Stalingrad had a lasting societal influence that shaped the lives of people who experienced it and left a mark on the area.

24.12 Environmental Awareness After the Battle of Stalingrad

Over time, people have become more conscious of the long-lasting impacts that the Battle of Stalingrad had on the environment. The battle's widespread devastation made it clear that environmental harm from conflict must be acknowledged and addressed. Discussions about the effects of conflicts on the environment have been impacted by this awareness. To comprehend the wider environmental effects of conflict, researchers have examined the battle's long-term ecological effects, such as habitat damage, water poisoning, and soil deterioration.

Reforestation, soil remediation, and the restoration of natural ecosystems have all been part of the post-battle environmental rehabilitation efforts. The goal of these initiatives is to lessen the conflict's long-term effects. The environmental impact of the Battle of Stalingrad serves as a historical and educational example of the far-reaching consequences of warfare. It emphasises how crucial it is to take environmental elements into account while resolving conflicts and recovering from war.

The growing awareness of the environmental impact of the Battle of Stalingrad has contributed to a broader understanding of the need to protect and preserve the environment in the context of warfare.

24.13 Aftermath of Terrible Fighting in Stalingrad

Stalingrad was completely destroyed after months of terrible combat that destroyed the city and its industrial facilities. With the city in ashes following one of the bloodiest conflicts in history, Stalingrad's aftermath shocked the whole globe. An important turning point in World War II was the Battle of Stalingrad, which took place from July 1942 to February 1943 and stopped the Nazi advance into the Soviet Union. But it came at a terrible price.

The destruction of the battle was almost complete. Stalingrad turned into an urban battlefield where the German and Soviet forces fought vicious close-quarters battles as the frontline moved over the city's streets, homes, and factories. Nearly 90% of the city had been destroyed by the time the Soviets declared victory in February 1943. Structures that had previously been factories, schools, and homes were reduced to piles of steel and masonry. This tremendous loss of life and infrastructure characterised the years following Stalingrad.

The conflict had an equally high human cost. The city left behind a wasteland of debris with innumerable human remains scattered throughout. The city's terrible rotting stench was only kept at bay by the bitterly cold winter. It was extremely difficult to bury the frozen dead because they were scattered everywhere. The deceased troops were in a pathetic state, lying in the trenches or half-naked. They were mostly without pants or jackets, just wrapped in paper dressings, because the survivors robbed all useful from the fallen.

The dead were buried in pits or temporarily covered because it was nearly hard to bury them during the bitterly cold winter. According to some estimates, there were over 50,000 horse carcasses strewn over the ruins. Initially, a number of Russians were employed as gravediggers upon the surrender. The German dead were loaded into armoured trucks and buried in trenches and bunkers. German POWs were later utilised for this, and all of them perished from typhus or were shot dead by Russian guards, whose bodies were discovered decades later.

They received extremely harsh treatment even though they knew the German army would never fight again. Neither a supply nor any safety measures were provided. The treatment was retaliation and complete disinterest. The German soldiers chewed raw horse meat in an attempt to survive. The majority of German soldiers either starved to death or perished en route to detention camps.

if the Geneva Convention was followed or if the German soldiers were captured in a systematic manner. No, not at all. Unabated, the orgy of violence against them persisted. Following the capture, widespread killings, torture, and looting persisted. The Russians were unsure of where to take the thousands of POWs after the German surrender. The skulls of those who were still tall were broken as tanks emerged and were driven over them. Those who survived as prisoners of war suffered such atrocities.

Those who survived the slaughter had to confront the difficult task of re-establishing their homes in a war-torn city. The former occupants were not allowed to return until the failures were fixed, and the remains were all but abandoned. Few people lived in the city, which was entirely destroyed and characterised by death.

Propaganda quickly portrayed the fight as a Russian gallant victory. Soon after the World War ended, thousands of German prisoners of war began on the mission of rebuilding Stalingrad.

With no regard for the environment, even bigger businesses were established on the Volga River's banks.

But when the city and its residents started the protracted process of recovery, a spirit of bravery arose amid the rubble.

Chapter 25

Destruction of Forests, Devastation of Natural Environment and Cultural Minorities in the Vietnam War

In this chapter

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Because of its profound effects on the environment as well as its thoughtful human ramifications, the Vietnam War stands out as a poignant and moving chapter in recent history. The environmental effects of the Vietnam War have altered ecosystems, destroyed landscapes, and changed the delicate balance of the area's rural areas. During the 1954–1975 Vietnam War, the United States engaged in defoliant warfare in South Vietnam.

Long-term effects resulted from activities including deforestation, soil erosion, and water contamination that followed the escalation of military actions. Recognising the conflict's lasting legacy and its effects on the environment and the communities that live there requires an understanding of these repercussions.

25.1 Environmental Impacts of Vietnam War

One significant event in the history of warfare that had a significant impact on the environment was the Vietnam War. Vietnam's biodiversity and natural resources were severely impacted by this war, which caused extensive ecological devastation throughout the country.

widespread soil erosion, water contamination, and deforestation. The terrain was drastically altered as a result of military activities and the use of chemical warfare, especially Agent Orange. Long-lasting ecological imbalances resulted from these efforts, which not only destroyed large tracts of forest but also disturbed the habitats of many species severely affecting its natural resources and biodiversity.

The battle had an impact on the quality of the air and water in addition to the physical terrain. Rivers and lakes were contaminated by pollutants discharged during military activities, seriously harming aquatic ecosystems. The region's wildlife and human populations continue to face difficulties as a result of this environmental deterioration, underscoring the war's lasting effects.

Gaining knowledge about the environmental effects of the Vietnam War is essential to comprehending the intricate connection between ecological health and combat. The consequences of military operations during this time frame highlight the need of taking the environment into account when developing military plans and provide crucial lessons for current wars.

25.2 Use of Toxic Chemicals for Deforestation in Vietnam by United States

As part of their military plan, the United States used deadly chemicals to deforest during the Vietnam War. Agent Orange was one of the most notorious chemicals utilised. To get rid of the thick foliage that gave enemy forces cover, this pesticide was sprayed across vast swaths of Vietnamese forests. The goal of Operation Ranch Hand was to deny the enemy access to supplies and hiding spots.

Dioxin, a highly poisonous substance found in Agent Orange, seriously harmed the health of both American veterans and the Vietnamese people. Devastating environmental effects resulted, including biodiversity loss, water contamination, and long-term soil damage. With continuous efforts to address the environmental and health effects, the legacy of Agent Orange is still felt in the area. The environment and people of Vietnam have been permanently impacted by the deployment of such weapons during the conflict, underscoring the serious repercussions of chemical warfare.

25.3 Deforestation and Habitat Destruction

The Vietnam War's deforestation led to a large loss of forest cover, upsetting regional ecosystems. Due to military actions including intense shelling and the application of herbicides, many trees were cut down, turning once-luxuriant landscapes into barren areas.

The effects of wildlife habitat degradation on biodiversity were extensive. Over half of Southern Vietnam's forests were impacted. Numerous animal species' vital habitats were destroyed. Because of habitat damage, several indigenous plants were in danger of going extinct. The local inhabitants who depend on these forests for resources are also impacted by environmental degradation, which further upsets the ecological equilibrium. The conflict caused significant changes to the country's landscape, which have long-lasting effects that are still felt in Vietnam today.

25.4 Soil Degradation and Soil Erosion during Vietnam War

The environment was significantly and permanently impacted by the Vietnam War, especially with regard to soil erosion and degradation. A major contributing factor to this environmental harm was the widespread use of chemical defoliants like Agent Orange. Soil instability and increased erosion resulted from the use of these herbicides to clear forests and vegetation.

The war's deforestation led to a reduction in forest cover, which upset regional ecosystems and exacerbated soil erosion. The soil was exposed to the elements once the vegetation was removed, increasing its vulnerability to erosion by wind and water. Furthermore, the military actions and bombing campaigns made soil erosion and degradation much worse.

Herbicidal pesticides and bombing campaigns decreased the long-term agricultural production in some areas of Vietnam. The region's animal and people populations continue to face difficulties as a result of the war's environmental effects. Gaining knowledge of the Vietnam War's environmental effects is essential to comprehending the intricate connection between ecological health and combat. The consequences of military operations during this time frame highlight the need of taking the environment into account when developing military plans and provide crucial lessons for current wars.

25.5 Current Effects of Soil Erosion in Vietnam

Even now, soil erosion is a major environmental problem in Vietnam, especially in rural and mountainous areas. Fertile topsoil, which is necessary for crop growth, is lost as a result of soil erosion. Crop yields and agricultural productivity suffer as a result. Increased flooding during periods of intense rainfall can result from eroded soil clogging streams and decreasing their ability to convey water.

Roads, bridges, and buildings may become unstable due to soil erosion, harming the infrastructure and raising maintenance expenses. Local ecosystems are upset when plants and topsoil are removed, which reduces biodiversity and has an adverse effect on wildlife habitats. Reduced agricultural productivity, more flooding, and damaged infrastructure can all have a major negative economic impact on the nation and its regions.

25.6 Efforts to Mitigate Soil Erosion Effected in Vietnam War

Efforts to mitigate soil erosion in Vietnam, particularly in areas affected by the Vietnam War, include sustainable land management practices, reforestation, and the implementation of erosion control measures in agriculture. Restoring ecosystems, lowering erosion, and stabilising the soil are all aided by planting trees and other vegetation. In many places, reforestation initiatives have been put into place to stop soil erosion and enhance soil quality. Terracing and contour ploughing are agricultural techniques that minimise runoff and soil erosion by constructing terraces and ploughing along the land's contours. They work very well in mountainous and hilly areas.

Planting vetiver grass, which has deep roots that aid in binding the soil and halting erosion, is part of the Vetiver System (VS). In Vietnam, this technique is commonly used for erosion management, slope stabilisation, and riverbank protection. The use of nuclear methods to quantify and manage soil erosion has received assistance from the International Atomic Energy Agency (IAEA). By using these methods, erosion hotspots can be located and focused mitigation strategies can be implemented. In addition, traditional Japanese river engineering methods have been implemented by the Japan International Cooperation Agency (JICA) to preserve riverbanks and manage erosion in Vietnam's rural areas. These techniques include stabilising riverbanks using groynes, foundations, and revetments. These measures, in conjunction with government policies and community-based programs, have helped to improve land management and reduce soil erosion in Vietnam.

25.7 Water Pollution and Ecosystem Damage During Vietnam War

Widespread military actions throughout the Vietnam War seriously harmed the ecosystem and contaminated water supplies. Serious river contamination was caused by the deliberate and unintentional use of explosives, herbicides, and infrastructure destruction. Lakes and rivers turned into toxic waste disposal sites, which had a negative impact on the local wildlife and plants.

Groundwater became contaminated as a result of the usage of chemical defoliants like Agent Orange. Dioxins, which are extremely hazardous and persistent in the environment, were present in these substances. Heavy metals, gasoline, and other dangerous materials were among the contaminants discharged into water bodies by bombing campaigns and military actions. Water quality also deteriorated as a result of increasing sediment and pollution flow into water bodies brought on by the war's devastation of vegetation and soil erosion.

The Vetiver Grass System

Vetiver grass (*Chrysopogon zizanioides*) is used in the Vetiver Grass System (VS), a bioengineering approach, to stabilise slopes, conserve water and soil, and safeguard the environment.

Within two years, the deep, fibrous root structure of vetiver, a perennial grass, can reach a depth of 10 feet (3 meters). This root system aids in soil binding and erosion control. The grass is sown following the slope's contour in dense, slender hedgerows. By acting as barriers, these hedgerows lessen soil erosion by dispersing and slowing down rainfall runoff. The vetiver utilised in the Vetiver System is sterile and non-invasive, which means it is easy to handle and does not spread uncontrollably.

By stabilising the soil, vetiver grass's extensive root structure helps stop erosion and landslides. Vetiver hedgerows boost groundwater recharge and water conservation by lowering runoff and increasing water infiltration. Heavy metals and agricultural pesticides are among the contaminants that the grass can take and filter from the soil and water.

The Vetiver System is a labour-intensive, low-cost system that offers a high benefit-to-cost ratio. Compared to conventional engineering solutions, it is frequently less expensive. The grass is appropriate for a variety of uses, such as agriculture, infrastructure preservation, and environmental restoration, because it can be utilised in a broad range of temperatures and soil types.

The Vetiver System is used to boost crop yields, enhance soil fertility, and prevent farmland erosion. By stabilising slopes, riverbanks, and road embankments, the grass lowers the chance of erosion and landslides. It is used in pollution control initiatives, mine rehabilitation, and forestry programs.

An established and long-lasting remedy for soil erosion and environmental deterioration is the Vetiver Grass System. It has been effectively applied in more than 100 nations across the globe.

Local ecosystems were disturbed and forest cover was lost as a result of extensive deforestation brought on by chemical defoliants and bombing campaigns. This has a ripple impact on habitat stability and biodiversity. Both terrestrial and aquatic ecosystems were impacted by the substantial habitat damage brought on by the war. Many species' habitats were disturbed by soil erosion and vegetation removal. Coral reefs and coastal mangroves were among the marine habitats impacted by contaminants released during the conflict. Fisheries and marine biodiversity depend on these habitats.

The region's animal and human populations continue to face difficulties as a result of the environmental harm brought about by the Vietnam War. Reforestation, pollution control, and sustainable land management techniques are some of the measures taken to lessen these effects.

25.8 Contamination of Rivers and Lakes in Military Campaigns

River and lake poisoning was one of the major environmental effects of the Vietnam War. Water pollution during the conflict was caused by military operations and the use of chemical weapons, especially Agent Orange. These operations resulted in the release of contaminants that harmed aquatic habitats and presented long-term problems for human and wildlife populations. Water bodies were contaminated by pesticides, heavy metals, and dangerous chemicals, which had a negative impact on ecosystems and public health.

Water bodies were also contaminated by the use of defoliants and other harmful chemicals meant to kill vegetation. These substances had a long-lasting impact on the local population's health in addition to harming the ecosystem. Knowing how the Vietnam War affected the environment brings to light the intricate connection between ecological health and combat, highlighting the necessity of taking the environment into account while developing military plans.

The use of Agent Orange, which contained dioxins that contaminated waterways, is especially well-known. Food networks were upset as a result of the pollutants' extensive bioaccumulation among aquatic creatures. Human populations that depend on these water sources for drinking and fishing are seriously at risk from the presence of hazardous contaminants.

Some of the specific contaminants identified in these water systems include dioxins from herbicides, heavy metals like lead and mercury and synthetic compounds used in military firefighting efforts. There are urgent calls for remediation after analyses of water samples from impacted areas show dangerously high levels of toxicity. Addressing this issue is crucial for restoring the health of aquatic ecosystems and ensuring the safety of communities living near contaminated water sources.

25.9 Attacks on Irrigation Systems in Vietnam War

During the conflict, Vietnam's irrigation systems were attacked for a number of strategic reasons. The US military sought to interfere with North Vietnam's agricultural operations by destroying irrigation networks. Food shortages would result, and the enemy's capacity to maintain its people and military would be weakened. Vietnam's economy relied heavily on agriculture, hence the destruction of irrigation infrastructure would have a huge financial impact.

The North Vietnamese government would be under more strain as a result. Another tactic used in psychological warfare was attacking vital infrastructure, such as irrigation networks. Its goal was to lower civilian support for the war effort and demoralise them. These actions were a component of a larger plan to degrade the capabilities and resources of the adversary.

25.10 Damages to Irrigation Systems in Vietnam War

The devastation of irrigation systems was one of the major environmental effects of the Vietnam War. An estimated 661 sections of dikes were damaged or destroyed as a result of US military attacks on North Vietnamese irrigation water delivery infrastructure throughout the battle. As a result, agricultural operations were severely disrupted, which exacerbated food shortages and rural poverty.

The war's effects on the environment went beyond irrigation systems. Agricultural operations were negatively impacted by the widespread deforestation, soil erosion, and water contamination brought on by the use of chemical warfare, especially Agent Orange. These activities had a lasting impact on the ecosystems and communities in the area in addition to changing the physical landscape.

The region's agricultural was significantly impacted by the Vietnam War's destruction to irrigation systems. The water supply for agricultural was severely disrupted as a result of the damage of dikes and other irrigation equipment. For many rural communities, this led to lower crop yields and greater food insecurity.

Without enough water, farmers found it difficult to keep their crops in good condition, which decreased agricultural output. Farmers' problems were made worse by the loss of irrigation infrastructure, which also led to soil erosion and degradation. Since it took a lot of time and money to repair the infrastructure and reclaim the agricultural lands, the long-term repercussions of these disruptions persisted for years. Beyond merely physically harming

irrigation infrastructure, the conflict had an influence on Vietnam's agricultural sector's general sustainability and well-being.

Major Irrigation Systems in the Country Before Vietnam War

Vietnam possessed a number of significant irrigation systems before the beginning of the war, which were essential to sustaining agriculture. Rice was grown in the Red River Delta region thanks to a vast system of canals and dikes. In order to control water distribution and guarantee high agricultural yields, the Red River Delta's irrigation infrastructure was essential.

The Mekong Delta was an important agricultural region, well-known for its natural waterways and gravity irrigation techniques. Rice and other crop production were aided by the irrigation facilities in the area, which also assisted in controlling water flow.

Traditional irrigation systems in the Central Highlands region facilitated the production of valuable commodities like tea and coffee. In the Central Highlands, irrigation infrastructure was crucial to sustaining agricultural output.

Irrigation systems were created in the South Central Coastal Region to help grow crops like dragon fruit and deal with water scarcity. In order to increase water efficiency, farmers in this area used creative irrigation systems.

Prior to the war, these irrigation systems were essential to Vietnam's agricultural industry and helped to maintain both economic stability and food security.

25.11 Long-term Impacts of Damaging Irrigation Systems

When irrigation systems were damaged during the Vietnam War, the effects were profound and long-lasting. Crop yields decreased as a result of irrigation system degradation, impacting both food security and farmers' livelihoods. This has a long-term effect on rural communities and the agriculture industry. Degradation and soil erosion increased in the absence of adequate irrigation. This made it harder for farmers to grow crops and further decreased the land's fertility.

Many rural families experienced financial difficulties as a result of the decline in agricultural yield. It took a lot of time and money to restore agricultural lands and reconstruct infrastructure. The effects of the conflict on the environment went beyond irrigation systems. Agent Orange and other chemical warfare tactics resulted in water contamination, deforestation, and long-term harm to ecosystems. As the nation attempted to rebuild and recover from the destruction brought about by the war, these long-term repercussions persisted for years.

25.12 Effect of Vietnam War on Marine Life

Marine ecosystems were significantly impacted by the Vietnam War's environmental effects. Marine habitats and populations were severely affected by military operations and the widespread use of chemical weapons. Because of the vast bombing campaigns and the heavy use of chemical agents like Agent Orange, it had a significant effect on marine life. Significant environmental damage resulted from these military operations, including the destruction of marine habitats and the polluting of water bodies.

Aquatic habitats suffered long-term harm as a result of the chemicals used during the conflict, especially Agent Orange. These harmful compounds found their way into streams and rivers, eventually reaching coastal regions where they had an impact on marine life. Fish populations and other marine species declined as a result of the contamination's disruption of the food chain. Furthermore, soil erosion and sedimentation in water bodies were caused by the bombing campaigns and deforestation initiatives. This higher sediment load had a detrimental effect on marine habitats and further deteriorated water quality.

Numerous species were impacted by pollutants from land runoff that entered coastal waters. These included fish population declines brought on by habitat destruction, coral reef degradation from sedimentation and chemical exposure, and biodiversity loss as vital species experienced migration or mortality. The impacts on marine life extended beyond nearby ecosystems. Long-term hazards to aquatic animals and human communities that depend on these resources were presented by contaminants that entered food systems. Local residents' food security was further jeopardised by the ensuing decline in fish stocks.

With continuous efforts to repair and rehabilitate impacted ecosystems, the environmental effects of the Vietnam War on marine life are still being felt today. In conclusion, the Vietnam War's legacy shows how marine ecosystems have been severely disrupted, highlighting the significance of further study and restoration initiatives to address these enduring environmental effects.

25.13 The Role of Agent Orange

During Operation Ranch Hand in the Vietnam War, American armed forces employed the potent herbicide Agent Orange. Eliminating crops and forest cover that North Vietnamese and Viet Cong forces could exploit was its main goal. Between 1961 and 1971, the U.S. military sprayed about 20 million gallons of different herbicides, including Agent Orange, over Vietnam, Cambodia, and Laos.

Dioxin, a poisonous chemical found in Agent Orange, caused severe neurological and psychological disorders, cancer, birth defects, and rashes, among other catastrophic health concerns. Both returning American service members and their families as well as the Vietnamese people suffered from these health repercussions.

In Vietnam, about 13 million gallons of Agent Orange were sprayed, demonstrating the widespread use of the pesticide. During the battle, it was the most effective and extensively utilised herbicide. Despite continuous efforts to mitigate the harm caused by its use, the effects of Agent Orange on the environment and human health are still being seen today.

25.14 Long-term Environmental Impacts of Agent Orange

Agent Orange's long-term effects on the environment are extensive and profound. Millions of acres of forest and mangrove habitats were destroyed as a result of Agent Orange's massive deforestation. Many plant and animal species were displaced as a result, and biodiversity was lost. Agent Orange contains dioxin, which is extremely persistent in the environment. It can impact the fertility and health of the soil for decades. Agriculture and vegetation regeneration are hampered by this contamination.

Agent Orange's dioxin has the potential to contaminate rivers, lakes, and groundwater. Aquatic life is impacted by this pollution, and people who depend on these water sources are at risk for health problems. Whole ecosystems were upset by the extensive use of Agent Orange. The loss of vegetation led to soil erosion, increased sedimentation in water bodies, and changes in local climate patterns.

Wildlife exposed to dioxin suffered from different health difficulties, including reproductive disorders, birth deformities, and increased mortality rates. The long-term survival and well-being of the impacted species are impacted by these impacts. There are continuous efforts to lessen the impacts of Agent Orange and repair damaged ecosystems, but its legacy still affects the environment and human health.

25.15 Examples of Areas in Vietnam Impacted by Agent Orange

Agent Orange had a significant effect on a few noteworthy regions of Vietnam. The Da Nang Airbase area is one of the main hotspots for dioxin. The local population is at serious danger for health problems due to the high levels of dioxin contamination in the soil and sediments. Bien Hoa Airbase, another significant dioxin hotspot, is situated in Bien Hoa city. Here, the levels of pollution in the soil and pond sediments are higher than the Vietnamese National Standard.

Agent Orange was also sprayed from Phu Cat Airbase, which is located in Binh Dinh province. Despite efforts to limit the dioxin, it is still a major source of contamination. Agent Orange was extensively sprayed over Thia Thien Hue Province, impacting a sizable section of its territory and populace. Qung Namda Nang Province was another region that received a lot of spraying. Agent Orange had a major negative influence on the environment and public health in this province. There was also a lot of spraying in Quang Tri Province, which caused long-term environmental harm. Despite continuous efforts to mitigate the contamination and its impacts on the environment and human health, some locations still suffer from the legacy of Agent Orange.

25.16 Impact of Agent Orange on Vietnamese Society

Agent Orange has had a profound and wide-ranging effect on Vietnamese society, including socioeconomic circumstances, the environment, and health. Human health has suffered the most severe and direct effects. Numerous severe health problems, such as malignancies, birth defects, and other chronic disorders, have been linked to exposure to Agent Orange. Future generations have also been impacted by these health issues in addition to those who were directly exposed.

The extensive usage of Agent Orange caused serious harm to the ecosystem. Ecosystems were disturbed and biodiversity was lost as a result of the destruction of forests and agricultural areas. Many Vietnamese people's livelihoods have suffered long-term effects as a result of this environmental harm.

The devastation of forests and agricultural land has had a long-term effect on the economy. Numerous villages whose livelihoods depended on forestry and farming were left without

resources. Families and the healthcare system have also been severely impacted financially by the expense of treating people impacted by Agent Orange.

Social and psychological issues have also been brought on by Agent Orange's effects on the environment and human health. Dealing with chronic disease and disability has a substantial psychological toll, and families affected by health concerns experience stigma and discrimination.

Addressing the legacy of Agent Orange has been a priority for both the Vietnamese government and foreign organisations. Environmental cleanup, medical support, and financial aid for impacted families are among the initiatives. To properly address the long-term effects, however, a lot of work still has to be done.

25.17 Impact of Vietnam War on Air Quality and Atmospheric Changes

The Vietnam War had a major effect on meteorological conditions and air quality. During the conflict, a lot of pollutants were emitted into the atmosphere due to the widespread usage of vehicles, aircraft, and bombs. Particulate matter, nitrogen oxides, and carbon monoxide were among the emissions that contributed to air pollution. Toxic chemicals were emitted into the atmosphere when herbicides such as Agent Orange were used. These substances had long-term effects on the atmosphere in addition to their immediate effects.

Smoke and particle matter levels in the air rose as a result of the extensive deforestation and burning of plants as part of war tactics. As a result, the local populace experienced respiratory problems and poor air quality. The soil and vegetation were severely disrupted by the bombing campaigns, which raised the amount of dust and particulate matter in the atmosphere. This had long-term consequences on atmospheric conditions and further deteriorated the quality of the air.

The legacy of the Vietnam War's impact on air quality and atmospheric changes continues to be felt today, with ongoing efforts to address the environmental damage and improve air quality in affected regions.

25.18 Emissions from Military Operations During the Vietnam War

Air pollution and environmental damage were greatly exacerbated by military actions during the Vietnam War. Large volumes of pollutants, like as carbon monoxide, nitrogen oxides, and particulate matter, were discharged into the atmosphere as a result of the widespread use of aeroplanes for transportation and bombing campaigns. Air pollution was also caused by the movement of military vehicles, such as trucks and tanks. These cars released exhaust fumes that were contaminated with dangerous substances.

The air was filled with smoke, dust, and other particulates as a result of bombing campaigns and the usage of explosives. This had long-term effects on soil and water quality in addition to air quality. Toxic compounds were released into the air as a result of the deployment of chemical agents like Agent Orange, further deteriorating the quality of the air and endangering the health of both civilians and military troops.

The local populace suffered from respiratory conditions and other health problems as a result of these emissions. One glaring example of the Vietnam War's environmental effects that goes beyond the battlefield is the deterioration in air quality brought on by military emissions. These pollutants' effects on the environment are still being felt today, and efforts are being made to repair the harm and enhance the quality of the air in the impacted areas.

25.19 Effects of Bombardments in Vietnam War

The land and people of Vietnam suffered greatly as a result of the bombardments during the Vietnam War. Between 1965 and 1973, the U.S. military dropped around 8 million tonnes of bombs in Vietnam. Especially in North Vietnam, this resulted in significant harm to homes, farms, and infrastructure. Soil damage and extensive deforestation resulted from the bombs and the application of chemical defoliants like Agent Orange. This had a lasting impact on agriculture and the environment.

Numerous civilians were killed as a result of the bombings. During the conflict, an estimated 2 million Vietnamese civilians perished. Many individuals were compelled to move to cities due to the devastation of their homes and communities, which resulted in a sharp rise in the number of refugees.

Even after the war ended, the nation struggled to recover due to the severe economic effects of the destruction of agricultural areas and infrastructure. Vietnam is currently dealing with the economic and environmental fallout from the bombardments, which has had a lasting impact on the nation.

25.20 Effects of Vietnam War on Local Populations

The effects of the Vietnam War on the environment went far beyond the natural surroundings and had a significant influence on the local populace. Numerous people's livelihoods were jeopardised by the depletion of natural resources, which resulted in food insecurity and health problems. An estimated 4 million Vietnamese were killed or injured throughout the conflict, resulting in a substantial death toll. Long-term health issues, including as malignancies, birth deformities, and other chronic disorders, were brought on by the deployment of chemical agents like Agent Orange.

A large number of individuals were forced to leave their homes due to the extensive destruction of villages and agricultural areas. As a result, a large number of refugees were forced to move to cities or other places. In actuality, the conflict severely damaged the economy, especially in rural regions. Agricultural productivity and lives were impacted by the devastation of fields and infrastructure. Poverty rose as a result of many people being left without any means of support.

Significant social and psychological anguish was brought on by the war. Numerous people suffered from post-traumatic stress disorder and other mental health conditions, and families were split apart. Family structures also changed as a result of the war; as a result of casualties, the number of single-parent families increased. The widespread use of bombing campaigns and chemical agents seriously harmed the ecosystem. This had an impact on the local population's health and well-being as well as their capacity to make a living.

The loss of waterways and woods reduced access to supplies needed for day-to-day living. Because of soil contamination and depletion, impacted populations suffered severe agricultural issues, which led to decreasing crop yields. With continuous attempts to solve the health, economic, and environmental issues brought on by the fighting, the Vietnam War's legacy still affects the local populace. These problems were made worse by social unrest and displacement, which left many families without access to established support networks or permanent housing. The environmental repercussions of the Vietnam War combined to produce long-lasting socioeconomic problems that still have an impact on the local populace today.

25.21 Exposure of Vietnamese Veterans to Agent Orange

Agent Orange exposure during the Vietnam War created serious health hazards to Vietnamese veterans. The very hazardous chemical dioxin was present in the herbicide Agent Orange, which was deployed by the U.S. military. It is assumed that veterans who served in Vietnam from January 9, 1962, to May 7, 1975, were exposed to herbicides, such as Agent Orange.

Numerous illnesses, including as diabetes, neurological diseases, and malignancies, have been related to exposure to Agent Orange. Veterans who were exposed to Agent Orange are eligible for health care benefits and disability compensation from the U.S. Department of Veterans Affairs (VA). In order to keep an eye on the health of veterans who have been exposed, the VA also keeps an Agent Orange Registry. Vietnamese veterans and their families are still affected by the long-term health consequences of Agent Orange exposure.

25.22 Legacy of Land Mines and Unexploded Ordnance from the Vietnam War

Vietnam is still affected by the terrible legacy of land mines and unexploded ordnance (UXO) left over from the Vietnam War. This still presents a lot of difficulties for the area. There are still millions of land mines and bombs hidden beneath the ground, endangering both people and wildlife. In addition to endangering agricultural land, this hazardous legacy obstructs economic growth and recovery initiatives in impacted communities. The safety of the local populace is constantly under danger because to these battle leftovers.

Land mines and UXO have killed or wounded thousands of civilians since the conclusion of the war. Children and other civilians are among the many casualties who unintentionally come into contact with these hazardous remains. The existence of UXO and land mines impedes economic growth. Because contaminated soil cannot be used for building or agriculture, impacted places have less options for development and prosperity. UXO and land mines also harm the environment. Explosions have the power to taint soil and water supplies, kill vegetation, and upset ecosystems.

Efforts to clear land mines and UXO are ongoing. Organizations and governments are working to remove these hazards and provide support to affected communities. However, the process is slow and challenging due to the sheer scale of contamination.

25.23 Impact of Vietnam War on Indigenous Communities

Indigenous populations in Vietnam, especially those residing in the highlands and isolated regions, were significantly impacted by the Vietnam War. Due to military activities and the devastation of their settlements, numerous indigenous communities were forced to leave their native lands. Their cultural customs and way of life were upended by this forced transfer.

Forests and agricultural fields that were essential to the livelihoods of indigenous tribes were destroyed as a result of the war. Their ability to support themselves and their families was hampered by the loss of these resources. For indigenous tribes, exposure to chemical agents such as Agent Orange caused serious health effects. Long-term health issues brought on by these substances included birth abnormalities, cancer, and other chronic illnesses.

Indigenous customs and traditions were eroded as a result of the war's displacement and disturbance. In the face of these obstacles, many communities found it difficult to maintain their cultural identity. Additionally, during and after the war, indigenous groups experienced persecution and social marginalisation. They were further marginalised as a result of their particular needs and concerns being frequently disregarded.

Furthermore, as people struggle with the loss of their traditional way of life, the psychological effects of environmental degradation have continued. The persistent existence of unexploded ordnance, which still presents risks and restricts access to ancestral grounds, has complicated efforts to lessen these effects. These communities are still affected by the Vietnam War's environmental effects, which emphasise the intricate relationships between ecological integrity and combat.

25.24 Long-Term Environmental Restoration Efforts

In order to overcome the massive damage created by the Vietnam War, long-term environmental restoration measures have become essential. There have been continuous efforts to restore natural areas and grow new woods. These initiatives seek to support biodiversity and restore deforested areas. There are programs in place to clean up soil that has been contaminated by chemicals like Agent Orange. These initiatives promote agricultural practices and enhance soil health.

There have been efforts made to purify and repair contaminated lakes and rivers. The goal of these initiatives is to purge pollutants and enhance water quality for the sake of ecological and human health. The goal of conservation initiatives is to preserve and replenish populations of war-affected endangered animals. These initiatives include anti-poaching and habitat rehabilitation.

Restoration activities are actively participated in by local communities. Programs for education and awareness raise community awareness of the value of protecting the environment and promote sustainable behaviours. For restoration initiatives, a number of states and international organisations, including the United Nations, have contributed money and expertise. Initiatives for soil conservation and replanting have accelerated, particularly in areas that have been negatively impacted by military operations. In order to mitigate the war's long-term environmental effects, this help has been essential.

There are still issues, such as the persistent Agent Orange poisoning and unexploded munitions. However, the dedication to long-term environmental restoration initiatives shows optimism for ecological recovery and represents a community response to the environmental effects of the Vietnam War.

25.25 International Aid and Programmes to Address Environmental Damage

Addressing the environmental harm brought on by the Vietnam War has been made possible in large part by international assistance and initiatives. The United Nations Development Programme has worked on a number of initiatives in Vietnam that are meant to promote sustainable development and environmental restoration. Reforestation, soil remediation, and water quality enhancement are some of these initiatives.

Vietnam's health and environmental cleanup initiatives have benefited greatly from financial and technical support from the US Agency for International Development. This covers initiatives to support impacted communities and clean up dioxin-contaminated locations. In Vietnam, the Global Environment Facility has provided funding for initiatives aimed at preserving biodiversity, reducing the effects of climate change, and managing land sustainably. These programs support sustainable development and environmental restoration.

Numerous NGOs have taken an active part in mine removal and environmental restoration initiatives, including the International Campaign to Ban Landmines and the Vietnam Veterans of America Foundation. These groups support impacted communities while working to remove land mines and explosive ordnance.

In order to address environmental challenges, Vietnam has signed bilateral agreements with nations such as South Korea, Japan, and Australia. These agreements frequently involve cooperative initiatives focused on sustainable development and environmental restoration, as well as financial and technical support. The healing and development of impacted communities as well as the reduction of the Vietnam War's long-term environmental effects have been greatly aided by these worldwide initiatives.

25.26 Success Stories and Ongoing Challenges

Numerous success stories have emerged from the attempts to remedy the environmental effects of the Vietnam War, especially in the areas of reforestation and ecosystem restoration. Local communities have frequently been at the forefront of numerous projects aimed at restoring damaged places. By encouraging the reintroduction of natural plants and animals, these initiatives have promoted biodiversity.

Vietnam's reforestation efforts have advanced significantly. Large tracts of forest have been restored because to programs like the Five Million Hectare Reforestation Program, which has enhanced ecosystem health and biodiversity. Initiatives to purify soil contaminated by chemicals such as Agent Orange have yielded promising outcomes. Agricultural activities have been promoted and soil health has increased as a result of these efforts.

Water quality has improved as a result of efforts to purify and repair contaminated rivers and lakes, which is advantageous for ecological and human health. Populations of endangered

animals have been protected and restored thanks to conservation initiatives. A key component of these initiatives has been the creation of national parks and protected areas. Restoration efforts have been greatly aided by local communities. Programs for education and awareness have promoted environmental stewardship and sustainable behaviours.

Some regions continue to be highly contaminated with dioxin and other harmful compounds in spite of efforts to clean up hazardous places. The local populace is at constant danger for health problems as a result. Economic difficulties and a lack of funding may impede the advancement of environmental rehabilitation initiatives. It is essential to provide ongoing financing and assistance.

But the loss of biodiversity brought on by pollution and habitat destruction is still a major problem. Ecosystem restoration and protection require ongoing work. Rising sea levels and an increase in the frequency of extreme weather occurrences are two environmental problems made worse by climate change. These elements make repair more difficult and necessitate flexible approaches. Communities are still impacted by the long-term health effects of chemical exposure. It is crucial to address these health concerns and offer sufficient medical assistance.

25.27 Reflections on the Vietnam War's Environmental Impact

The environmental effects of the Vietnam War serve as a sobering reminder of the wide-ranging and frequently unexpected repercussions of war. Vietnam's ecosystems, forests, and landscapes were all significantly impacted by the conflict. Herbicides, especially Agent Orange, were widely used, which led to habitat damage, deforestation, and biodiversity loss. Both the environment and the livelihoods of those who relied on it were impacted by this ecological destruction.

The Vietnamese people are still suffering from serious health effects from the toxins employed during the conflict. The long-term human cost of the struggle is demonstrated by the intergenerational health impacts and the high rates of cancer, birth abnormalities, and other disorders associated with dioxin exposure.

Economic activity was affected by the conflict, particularly in forestry and agriculture. Development was hampered as communities remained impoverished due to the destruction of fertile land and the presence of unexploded ordnance. Displacement and the psychological anguish endured by survivors and their offspring are social legacies of the war.

International assistance and collaboration have been necessary to address the environmental harm. Remedial efforts have been supported by a number of international organisations and nations, underscoring the significance of shared responsibility and the worldwide effects of war.

The necessity of taking the environment into account when developing military plans is highlighted by the Vietnam War. It is a crucial case study for comprehending the extensive effects of war on the environment and the need to safeguard both human and ecological health while fighting.

The ongoing efforts to restore Vietnam's environment and support affected communities are testament to resilience and hope. They remind us that while the scars of war may never fully heal, dedicated efforts can lead to recovery and renewal.

Chapter 26

Environment Impacts of Armed Conflict (Civil War) in Sri Lanka

In this chapter

- 26.1 Background of Sri Lankan Armed Conflict**
- 26.2 Deforestation and Habitat Destruction during the Sri Lankan War**
- 26.3 Long-term Effects of Deforestation in Sri Lanka**
- 26.4 Left Behind Landmines and Unexploded Ordnance**
- 26.5 Long-term Impacts of Landmines on Communities**
- 26.6 Psychological Effects of Landmines on Survivors**
- 26.7 Agricultural Impacts of Sri Lankan Civil War**
- 26.8 Overall Economic Impacts of the Civil War**
- 26.9 Water Pollution in the Sri Lankan Armed Conflict**
- 26.10 Effects on Wildlife and Biodiversity**
- 26.11 Post-war Trauma of Sri Lankan Civil War**

In Sri Lanka, there is a close connection between the environment and violent conflict. The environment and the nation's socioeconomic structure were significantly impacted by the 1983–2009 Sri Lankan Civil War. Both natural ecosystems and human groups were impacted by the conflict's widespread deforestation, pollution, and land degradation.

Millions of people were displaced as a result of the war, which put more strain on local natural resources. Large tracts of land were rendered unfit for agriculture or habitation due to the long-term environmental harm caused by the deployment of landmines and other explosives.

Climate change may or may not result from a wide range of environmental influences that vary in space and time. In the context of Sri Lanka, the main climate shocks caused by climate change are rising sea levels, increased weather variability that leads to droughts, floods, and landslides caused by floods. These shocks cause effects that harm both natural and human systems, such as soil erosion, salinisation, and groundwater depletion. These are seen as environmental effects brought on by climate change.

Armed conflict is not the sole type of conflict involving natural resources. It is recognised as a governance issue pertaining to resource management, resource utilisation, and decision-making consultation. The actors and scope of these confrontations vary. Political and socioeconomic factors are the causes of these disputes. Natural resource management and sharing may result in resource depletion and exploitation by certain groups.

26.1 Background of Sri Lankan Armed Conflict

The Liberation Tigers of Tamil Eelam (LTTE), popularly known as the Tamil Tigers, and the Sri Lankan government fought each other for a long time and brutally throughout the 1983–

2009 Sri Lankan Civil War. In the northern and eastern regions of the island, where the Tamil minority predominates, the LTTE aimed to establish an independent Tamil state.

The conflict's origins can be found in the British colonial era, when they gave preference to the Tamil minority over the Sinhalese majority. Following its independence in 1948, the Sinhalese-dominated government enacted laws that disenfranchised the Tamil people, including establishing Buddhism as the official religion and designating Sinhala as the official language. Velupillai Prabhakaran's LTTE was founded in 1976 because of these acts, which heightened ethnic tensions.

When the LTTE ambushed an army convoy in 1983, killing thirteen soldiers, the conflict worsened and anti-Tamil riots broke out, killing almost 2,500 Tamils. The LTTE gained notoriety over time for its guerilla warfare strategies, child soldier recruiting, and suicide bombings.

An estimated 100,000 or more people were killed and many more were displaced during the conflict, which caused much pain and death. Following a vigorous military campaign, the Sri Lankan government declared victory over the LTTE in May 2009, bringing the conflict to a close.

The armed war in Sri Lanka was a regional and domestic conflict that posed a greater threat to civilian lives than combatants. Sri Lankan society was ripped apart throughout the nearly three decades of violence between the government and the Liberation Tigers of Tamil Eelam. Over the decades, the struggle for the creation of a distinct Tamil homeland led to widespread mass flight. At least in the early years, the regional battle between two communities, which involved a primarily conventional war, resulted in significant suffering, including fatalities and environmental harm. It is a suitable scenario for researching the connection between the environment and war.

Biodiversity Scenario of Sri Lanka

With its astounding diversity of plants and animals, Sri Lanka is a global hotspot for biodiversity. The island's remarkable biodiversity is a result of its unusual location, geological and historical isolation, and varied climates. It also supports a diverse range of ecosystems, such as arid thorn scrub forests, dry zone monsoon forests, mountain cloud forests, rainforests, and coastal and marine habitats.

Sri Lanka has more than 3,000 different species of flowering plants, many of which are endemic. There are more than 1,300 species of marine fish, 240 species of birds, 211 species of reptiles, 245 species of butterflies, and 253 species of land snails. There are 756 species of marine molluscs and 208 species of hard coral in the marine and coastal biodiversity. The nation is among the 36 hotspots for biodiversity in the world, underscoring the pressing need for conservation measures. Despite its small size, pollution, deforestation, habitat loss, and widespread land use changes pose serious challenges to Sri Lanka's biodiversity.

26.2 Deforestation and Habitat Destruction during the Sri Lankan War

Deforestation and habitat degradation were significantly impacted by the Sri Lankan Civil War. As displaced people sought safety in forested areas and trees were removed for military uses, the conflict resulted in widespread deforestation. Ecosystems were disrupted and biodiversity was lost as a result.

Large tracts of forest were cleared for the construction of military bases and the usage of trees for concealment and strategic benefit. Conflict-related community dislocation put further strain on natural resources, resulting in deforestation as people looked for land for housing and agriculture.

Deforestation was made worse by the breakdown of law and order throughout the war, which made illegal logging easier. These lands were abandoned and degraded because landmines and unexploded ordnance (UXO) made forested areas dangerous for agriculture and habitation.

The ecological effects of the war still provide difficulties for Sri Lanka's sustainable growth and environmental recovery. Reforestation projects, demining operations, and campaigns to support conservation and sustainable land use are some of the measures taken to solve these problems.

26.3 Long-term Effects of Deforestation in Sri Lanka

In Sri Lanka, deforestation affects human societies and the environment in a number of long-term ways. Many species lose their habitats as a result of deforestation, which lowers biodiversity. Many indigenous species can be found in Sri Lanka, and their extinction is threatened by forest degradation. The soil becomes vulnerable to erosion when trees and other vegetation are removed. Fertile topsoil may be lost as a result, which would lower agricultural output and raise the possibility of landslides.

Forests are essential for controlling the water cycle. This cycle may be upset by deforestation, which could result in erratic water supplies, less groundwater recharge, and more flooding. By removing carbon dioxide from the atmosphere, forests serve as carbon sinks. Deforestation contributes to greenhouse gas emissions and climate change by releasing stored carbon.

Local communities who rely on forests for their livelihoods may experience socioeconomic effects as a result of deforestation. Fuelwood shortages, a decline in revenue from forest goods, and community uprooting are all possible outcomes. Furthermore, habitat fragmentation—the division of vast, continuous habitats into smaller, isolated patches—is frequently the result of deforestation. This lessens genetic diversity among species and disturbs natural corridors.

26.4 Left Behind Landmines and Unexploded Ordnance

There are a lot of landmines and explosive ordnance remnants from the battle, especially in Sri Lanka's north and east. These explosive battle leftovers contaminate groundwater and soil, rendering areas unfit for human habitation and cultivation. Since the battle ended in 2009, UXO and landmines have killed or injured thousands of civilians. Since many regions are still unsafe for habitation, these risks have also made it more difficult to resettle displaced communities.

Access to agricultural land, which is essential to many communities' livelihoods, has been hampered by landmine poisoning. For instance, clearing landmines is crucial to economic recovery in the northern provinces, where agriculture is the main source of income. Large tracts of land are no longer suitable for farming or other uses due to the presence of landmines, which has also upset ecosystems.

The Sri Lankan Civil War's landmines have seriously harmed the environment. They have upset local ecosystems by making vast tracts of land unfit for living and agriculture. Deforestation and soil degradation have also resulted from landmines because people avoid these places, leaving them neglected and susceptible to erosion. Furthermore, landmines have damaged ecological habitats, causing animals to either avoid mined areas completely or suffer injuries, disrupting biodiversity and normal movement patterns.

26.5 Long-term Impacts of Landmines on Communities

Communities suffer terrible long-term effects from landmines that impair many facets of daily life. Long after hostilities have ended, landmines continue to cause fatalities, injuries, and impairments. Survivors frequently have physical and psychological trauma that lasts a lifetime, and their difficulties are made worse by the dearth of quality healthcare in impacted areas. It makes agricultural land unusable, depriving farming people of their means of subsistence. Additionally, they impede the construction of schools and roads, which delays economic recovery and prolongs poverty.

Landmines frequently cause villages and families to be uprooted. Social cohesiveness is upset by this displacement, and people find it challenging to start over. Ecosystems are harmed by landmines, rendering area unusable for habitation or farming. In certain places, they also lead to soil erosion and deforestation. Additionally, landmines hinder access to basic amenities like clean water, healthcare, and education. Additionally, they deter development and investment in impacted areas. In order to solve these long-term issues, it is imperative that landmines be cleared and impacted communities be supported.

26.6 Psychological Effects of Landmines on Survivors

Survivors of landmines experience severe and varied psychological repercussions. Because of the tragedy of the explosion and its aftermath, many people suffer from anxiety, depression, and post-traumatic stress disorder. Survivors frequently experience stigmatisation and social exclusion, particularly in societies where people with disabilities are misunderstood. They may develop persistent anxiety as a result of their dread of running into more landmines, which will make it difficult for them to move freely or start over.

Furthermore, phantom limb pain which is closely linked to psychological discomfort in addition to physical pain can be brought on by limb loss or other traumas. Problems like unemployment and the incapacity to fulfil conventional duties within their families or communities exacerbate the emotional toll. For survivors to re-establish a sense of normalcy, rehabilitation programs that focus on both mental and physical health are essential.

26.7 Agricultural Impacts of Sri Lankan Civil War

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communities exacerbate the emotional toll. For survivors to re-establish a sense of normalcy, rehabilitation programs that focus on both mental and physical health are essential.

Due to displacement and the presence of landmines, many agricultural lands were abandoned during the conflict, making them unfit for cultivation. Irrigation systems, which are essential to rice growing, sustained significant damage during the conflict. Due to their heavy reliance on rain-fed agriculture, Tamil and Moor farmers have been disproportionately impacted. In conflict areas, Sinhalese farmer community fared better than Tamil and Moor communities. Inequalities in agricultural income and production have resulted from this.

Farmers in war-affected areas face ongoing challenges, including limited access to resources, degraded land, and insufficient government support for rebuilding agricultural infrastructure. Efforts to rehabilitate agriculture in these regions are essential for economic recovery and food security.

26.8 Overall Economic Impacts of the Civil War

The economic effects of the Sri Lankan Civil War were extensive and significant. The war diverted funds from development to military spending, which sharply hindered economic growth. Industries that are essential to the economy, like as manufacturing, fishing, and agriculture, were interrupted by the fighting.

Safety worries have a significant negative impact on Sri Lanka's tourism industry, which is a significant source of income. Tourist arrivals fell precipitously as a result of the war's damage to the nation's reputation as a travel destination. Especially in the northern and eastern areas, important infrastructure was damaged, including roads, bridges, and irrigation systems. This raised the cost of reconstruction and hampered economic activity.

Due to the unpredictable business environment caused by the conflict, foreign commerce and investment suffered. The dangers of the battle turned off a lot of investors. As a result, especially in areas touched by the conflict, the war increased economic inequality and poverty. Many communities struggled to recover after being displaced and losing their means of subsistence.

26.9 Water Pollution in the Sri Lankan Armed Conflict

Water resources were significantly impacted by the Sri Lankan Armed Conflict, resulting in pollution and scarcity in the impacted areas. Both surface and groundwater sources were impacted by the war's military operations and usage of explosives. Aquatic ecosystems and human health suffered as a result. Drinking water became contaminated because of the conflict's destruction to water infrastructure, including reservoirs and pipelines.

Rivers and groundwater in several places were contaminated by chemicals and waste from military operations. Due to infrastructure devastation and displacement, many communities had limited access to potable water. Waterborne disease risk increased as a result of dependence on contaminated water sources. Deforestation and soil erosion were among the environmental problems made worse by the war, and these factors further impacted the availability and quality of water.

26.10 Effects on Wildlife and Biodiversity

Conflicts in Sri Lanka have had a major impact on biodiversity and animals, upsetting ecosystems and endangering species. Wildlife populations decreased as a result of the war's disruption of their habitats and migratory habits. The loss of wetlands and forests influenced biodiversity as well, putting numerous species in greater danger. Deforestation and the destruction of natural habitats were caused by the war, especially in the northern and eastern areas. As a result, biodiversity has decreased and animals have been relocated.

Human-animal conflict events rose as a result of human encroachment on wildlife habitats both during and after the conflict. For instance, conflicts with humans have killed numerous elephants and leopards, who have been especially impacted. Sri Lanka is home to numerous indigenous species and is a hotspot for biodiversity. Due to increased habitat fragmentation and disruption of conservation efforts, the fighting made risks to many species worse. Wildlife was further endangered by the war's use of explosives and other military operations, which contaminated ecosystems.

26.11 Post-war Trauma of Sri Lankan Civil War

Many mental health and psychological problems are still evident among the people in the Northern and Eastern Provinces even ten years after the conflict ended. Surveys of mental anguish conducted nationwide in Sri Lanka compare the country's populations according to their exposure to violence. The results verified that compared to people living in minimum conflict zones, those residing in moderate to severe war zones had greater rates of food scarcity and job loss.

There was no difference in the availability of police services, civil facilities, or health care. As anticipated, a higher percentage of respondents who were exposed to the war spent longer time in internally displaced person's camps than those who lived in areas with less conflict.

The high rates of drinking and suicide were other signs of post-war trauma. According to field-level estimates, drunkenness and suicide rates were high, especially among Tamil people. Many people who were affected by depression believed that economic circumstances played a significant role in both attempted suicide and suicide fatalities. Risk factors for attempted and actual suicides include the incapacity to participate in meaningful economic activity and livelihoods, as well as repressive aspects of the social environment, such as persistent dread and anxiety, harassment, and hopelessness.

In both the Northern and Eastern Provinces, gender-based violence was strongly associated with the prevalence of alcohol use and alcoholism. Accurately verifying specific events is challenging because the majority of this assault goes unreported. Nonetheless, the majority of documented cases were male aggression towards females. Despite the fact that gender-based and domestic violence frequently goes undetected, the study identified a few noteworthy facts about the Northern and Eastern Provinces.

The vulnerability of women in the home, particularly their diminished negotiating and bargaining strength, is associated with the lack of job possibilities, the skewed sex ratio, and the relative surplus of females. It was shown that women who were unemployed experienced more domestic abuse than women who were working. Furthermore, a large number of victims

of violence were either ignorant of the support services that were accessible to them or reluctant to seek them due to mistrust. A linguistic barrier with Sinhala officials was mentioned by many Tamil informants, which further decreased the frequency of reporting.

Since young people are constantly trying to figure out where they fit into the family and society, the decline of family structures and community institutions, as well as the ensuing rises in abuse, alcoholism, and suicide, are especially concerning. According to studies, women who see violence between their parents as children are more likely to experience violence from their own spouses as adults.

Beyond socioeconomic and poverty indicators, a number of particular populations in the Northern and Eastern Provinces remain at risk. Physically challenged people, households headed by women, widows, former soldiers, orphans, children, and the elderly are some examples of these groups. Even if there may not be many of these distinct groups in reality, the particular difficulties they encounter are a holdover from Sri Lanka's civil conflict. Furthermore, it was found that a large number of these susceptible groups were primarily found within the Tamil community, underscoring newly discovered horizontal disparities.

Underage children living in the home are also adversely impacted by the breakdown of family institutions. Reports of orphaned children, children left with one or both parents, and children left with neighbours or extended family members increased. Another vulnerable group that was identified was the disabled, whose requirements have not yet been adequately met by the government, according to a number of stakeholders. Although no such statistics were available at the time of writing, the prevalence of physical damage from the conflict, such as spinal cord injuries, amputations, and other disabilities, is one of the negative effects on physical health. Due in part to discrimination, disabled persons struggle to find employment and pursue higher education, which inevitably results in high rates of poverty.

Lastly, it was determined that one of the most vulnerable groups was former warriors. Even though more than 10,000 former combatants have gone back to their homes or villages, they still have to deal with social stigma and job search challenges. This includes the hundreds of female ex-combatants who experience additional discrimination and stigma based on their gender. Social stigma erodes the social and community support systems of former soldiers and causes them to be shunned by their family. Former combatants are vulnerable in a number of ways, including unemployment, lack of social support, inadequate education, and disability, to name a few.

Tamil people from Sri Lanka make up the majority of those directly impacted, followed by Muslims and Sinhalese. This raises the possibility of enduring horizontal disparities, which could intensify already-existing ethnic conflicts and jeopardise long-term stability.

Chapter 27

Unprecedented Destruction in Deadliest War Since World War II Russian Ukraine War

In this chapter

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- 27.2 The Humanitarian Impacts of the War**
- 27.3 Economic impacts of the War on Ukraine**
- 27.4 What Infrastructure has been most Affected by the War**
- 27.5 Long-term Effects of Infrastructure Damage on Ukraine's Economy**
- 27.6 Environmental Damages during Russian Ukraine War**
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Russian President Vladimir Putin announced a Special Military Operation against Ukraine in a speech to the nation on February 24, 2022. It marked the start of what is now known as Russia's full-fledged war against Ukraine, which has since lasted more than 1,000 days as of this writing. Both sides have suffered economic and personal losses in the bloodiest conflict to hit Europe since World War II. Cities, towns, and villages are in ruins, the ecosystem is negatively

impacted, the human toll continues to rise, and experts estimate that it will take years for the nations to recover financially. The devastation is unprecedented. Devastation has been left on both sides due to the human cost, the economic consequences, and the geographical effects.

27.1 Destruction in War Between Russian and Ukraine Forces

Both human lives and infrastructure have been severely damaged by the ongoing conflict between Russia and Ukraine. Estimates indicate that hundreds of thousands of soldiers and civilians have been impacted by the conflict, which started in February 2022 and has caused heavy losses on both sides.

Many people now lack access to vital services because to the significant damage to critical infrastructure, which includes hospitals, schools, and energy facilities. With cities and villages in ruins and innumerable families displaced, the economic and psychological toll on both countries is immense. Though the future is still unclear, peace attempts are still underway in spite of the enormous obstacles.

27.2 The Humanitarian Impacts of the War

The conflict between Russia and Ukraine has had significant and wide-ranging humanitarian effects. The worst refugee crisis in Europe since World War II has resulted in over 13 million people being displaced, with over 8 million of them escaping Ukraine. Germany and Poland, two nearby nations, have taken in millions of refugees.

Numerous civilians have been hurt, and thousands of people have died. More often than not, the real figures are greater. The destruction of vital infrastructure, like as hospitals, schools, and power plants, has left millions without access to essential services. More than 1.6 million Ukrainians have reportedly been forcibly relocated to Russian territory, allegedly under duress and in violation of international law.

Global food supply have been affected by the conflict, making hunger and economic instability worse in areas that are already at risk. Generations to come will probably be affected by this conflict as communities recover and deal with the psychological and financial costs.

27.3 Economic impacts of the War on Ukraine

Ukraine has suffered greatly economically as a result of the war. Since the start of the conflict, Ukraine's economy has shrunk dramatically, with its GDP declining by almost 20%. It is currently experiencing one of the worst recessions in its history. Economic activity has been seriously interrupted by the destruction of infrastructure, such as ports, manufacturing facilities, and energy facilities.

Millions of Ukrainians are now living in poverty as a result of job losses and unstable economies. Rebuilding Ukraine is expected to cost approximately \$486 billion, more than twice its present GDP. International financial and military assistance is crucial to its economy and war efforts. The conflict's settlement and ongoing international assistance will be necessary for the long-term economic recovery.

27.4 What Infrastructure has been most Affected by the War

Ukraine's infrastructure has sustained significant damage as a result of the conflict, with some areas being particularly severely affected. With damages estimated at \$60 billion, the housing industry has been the most severely affected. There have been more than 236,000 residential structures damaged or destroyed, including private residences, apartment complexes, and dorms.

\$38.5 billion in losses have been incurred by transport infrastructure. This comprises more than 26,000 km of ports, airports, railroads, and roadways. The energy sector in Ukraine has been severely damaged, with \$14.6 billion in damages. Targeted are important facilities such as thermal and hydroelectric power plants.

Essential services have been impacted by the destruction or damage of thousands of medical facilities, colleges, and schools. The extent of the damage is astounding, and significant international assistance will be needed for reconstruction.

27.5 Long-term Effects of Infrastructure Damage on Ukraine's Economy

Damage to Ukraine's infrastructure has wide-ranging and significant long-term impacts on the country's economy. Reconstruction and recovery are expected to cost over \$524 billion, or about three times Ukraine's 2024 GDP. The nation's resources will be strained for years by this enormous financial burden. The devastation of energy, transportation, and housing infrastructure has had a negative effect on economic activity. For example, more than 26,000 kilometres of roads and railroads have sustained damage, impeding travel and commerce. Numerous attacks on energy plants have disrupted daily life and industries by causing widespread power outages.

Twenty hydropower units and seventy-three percent of thermal power plants were not operating by the middle of 2024. Mass displacement brought on by the destruction of homes and vital services has decreased the employment and customer base in impacted areas. Foreign investment is discouraged by the prolonged fighting and the damage to the infrastructure, which slows economic growth and development. In order to overcome these obstacles, rebuilding will need consistent international assistance and careful planning.

27.6 Environmental Damages during Russian Ukraine War

Significant environmental harm has resulted from the Russia-Ukraine war, with long-term repercussions for the area. Hazardous materials such as lead, mercury, and depleted uranium are released into the air, soil, and water during explosions, endangering human health and damaging ecosystems. Shelling has destroyed forests and protected areas by starting flames. It has impacted more than 30% of Ukraine's natural resources.

Damaged sewage infrastructure and industrial operations from the fighting have contaminated rivers and water sources, endangering drinking water supplies and aquatic life. Concerns about possible radioactive leakage have been raised by the Zaporizhzhia Nuclear Power Plant, which impacted by the destruction of unique ecosystems like steppe grasslands. Decades of repair work will be necessary to recoup from the war's enormous environmental cost.

27.7 Long Term Environmental Impacts of Russian Invasion

The Russian invasion of Ukraine has caused extensive, ongoing, and potentially dangerous long-term environmental harm. The destruction is referred to as ecocide by the Ukrainian authorities and foreign observers. Explosions cause both physical destruction and chemical damage. Lead, mercury, and depleted uranium are among the hazardous materials that are released into the environment with each explosion. Explosives such as TNT, DNT, and RDX are harmful when consumed.

Large areas of Ukraine, Europe, and Russia might get contaminated by technological disasters like petrol and tailings leaks that occur during battles in highly industrialised areas. Destroyed buildings can produce carcinogenic dust that might pose a threat for decades. Heavy metals and other pollutants that penetrate into underground streams have the potential to damage rivers and other bodies of water. Destroying civil infrastructure has already left over four million people without access to safe drinking water. Certain soils in violent conflict zones are unfit for farming because plants absorb and retain pollutants.

Paris Agreement

Adopted in December 2015 at the United Nations Climate Change Conference (COP21) in Paris, France, the Paris Agreement is a historic international climate change accord. With attempts to keep the increase to 1.5°C, it seeks to keep global warming far below 2°C over pre-industrial levels.

Countries who want to sign the accord describe their strategies for cutting greenhouse gas emissions and preparing for the effects of climate change. Progress is evaluated every five years to make sure it is in line with the objectives of the agreement. Vulnerable nations receive financial, technical, and capacity-building support.

The accord places a strong emphasis on international cooperation in the fight against climate change and the shift to a low-carbon, sustainable future.

Nuclear accidents are also more likely to occur during war. Nuclear accidents like Chernobyl and Fukushima could be caused by power outages at nuclear power plants and altercations near stations. The objectives of the Paris Agreement are compromised by military CO₂ emissions, which amount to hundreds of millions of tonnes.

A war zone has been established across 12,000 square km of Ukraine's natural reserves. Birds have been driven to abandon nests and alter their typical migration patterns, and rare endemic and migrant species populations have already seen significant losses. Conservation work that have been underway for decades have been damaged. It is impossible to estimate the extent of the war's environmental devastation until it is over. Initial estimates indicate that it will take at least 15 years for Ukraine's environment to recover.

27.8 War Damage to Nature

War-related environmental harm can persist for millennia. After World War I, research indicates that more than 2,000 tonnes of copper are still present in Belgian soils close to Ypres. Due to battles during the Iranian Revolution, soils throughout Iran are still tainted with chlorine and

mercury. Ammunition degrades over a period of 100 to 300 years, depending on the pH of the soil and the availability of oxygen and water.

Because undetonated bombs are buried in debris, shattered houses produce dust that can cause cancer (sometimes for decades), and it is nearly difficult to recycle millions of tonnes of rubble, destroyed cities constitute a serious ecological threat. The debris may emit asbestos into the atmosphere.

Forced mass relocation of people overloads the infrastructure of host regions. Refugee camps accumulate waste and have almost no recycling facilities. Lots of research is required to fully estimate the environmental damage caused by the Russian invasion, although this is impractical until hostilities cease.

27.9 Direct Pollution

Pollutant concentrations in Kyiv's air were 27 times higher than usual following the first two weeks of fighting. Air, water, and soils are contaminated by explosions, destroyed vehicles and armour, and gasoline spills and fires. Every bomb explodes, releasing heavy metal particles. Russia and Europe will be immediately impacted by the dangerous ecological effects of conflict because these contaminants are dispersed by winds and subterranean rivers. Acid rain may result from the explosives' discharge of chemical substances that oxidise in the atmosphere. They can 'burn' vegetation and human and other mammal respiratory organs.

Lead makes up about 95% of ammunition. Zinc, nickel, barium, manganese, copper, and occasionally depleted uranium make up the remainder. Lead is extremely ingestible and hazardous, and it enters the body through the skin and hair in addition to by breathing, eating, and drinking. Long-term exposure to lead results in kidney failure, and even brief contact can induce illnesses and damage to the nervous system.

27.10 Bombing of Industrial Sites

There were steel mills, chemical labs, oil refineries, and coal mines in the highly industrialised region of eastern Ukraine. Hazardous compounds kept in such buildings leak out as a result of direct strikes and explosions, poisoning the air, water, and soils. Devastating thermal, hydro, and chemical spills can result from accidents at high-risk industrial sites that escalate in a cascading fashion.

Bombings during the current conflict in Ukraine have severely damaged infrastructure and taken the lives of civilians. There has been significant damage to hospitals, schools, and energy facilities. There have been confirmed reports of more than 4,000 instances of infrastructure damage, including intentional attacks on energy facilities in the winter, leaving survivors in temporary accommodation and dealing with trauma. Bombings in regions like Donetsk have resulted in significant loss of life, with entire residential areas destroyed. Towns like Borodyanka face slow reconstruction, leaving survivors in temporary housing and grappling with trauma.

27.11 The Problem of Forced Migration

Another risk brought on by the war is forced migration, as even abandoned industrial facilities could be dangerous in the absence of human supervision. The majority of East Ukrainian factories and industrial sites were constructed during the Soviet era, and as a result, their infrastructure is now severely deteriorated. For example, there are two toxic waste ponds at the Dzerzhinsk phenol plant, one of which has a dam that was deemed unstable in 2019. Eight million tonnes (18 billion pounds) of chemical waste would spill onto the Zalizna River and the adjacent lands in the event of a rupture, contaminating local water supplies and making their way to the Seversky Donets, which flow into Russia.

Because ongoing maintenance initiatives have been hampered by the ongoing and intensified fighting, coal mines in eastern Ukraine have rapidly degraded. There have been reports of surface and subsurface water contamination across the whole Donbas region. Water sources in nearby residential areas are contaminated by radionuclides and other harmful compounds that enter underground waterways when a mine floods.

Because ongoing maintenance initiatives have been hampered by the ongoing and intensified fighting, coal mines in eastern Ukraine have rapidly degraded. There have been reports of surface and subsurface water contamination across the whole Donbas region. Water sources in nearby residential areas are contaminated by radionuclides and other harmful compounds that enter underground waterways when a mine floods.

27.12 Carbon Footprint of Russian Ukraine War

With an estimated 200 million metric tonnes of CO₂ emissions after two years, the Russia-Ukraine war has had a major negative impact on the environment. This is equivalent to what a highly developed nation like Belgium would emit per year.

There are several origins of the emissions. Approximately 25% of the emissions are caused by the military's use of fossil fuels. About 15% comes from frequent fires along the front lines. It is estimated that rebuilding war-destroyed towns and cities will be the biggest contribution, accounting for around one-third of all emissions. Emissions have increased further as a result of attacks on energy infrastructure that have compelled the use of dirtier fuels.

27.13 Long-term Environmental Impacts of CO₂ Emissions

Emissions from war have significant and varied long-term effects on the ecosystem. Climate change is made worse by the production of greenhouse gases by military activities, infrastructure destruction, and rehabilitation. The planet's capacity to absorb CO₂ is diminished when natural ecosystems and carbon sinks, such wetlands and forests, are destroyed, which exacerbates ecological imbalance.

Conflict-related usage of chemicals, heavy equipment, and explosives frequently leaves behind contaminants that can damage water and soil sources for decades. Wildlife frequently finds war

Carbon Sinks

Carbon sinks are natural or artificial systems that absorb more carbon dioxide (CO₂) from the atmosphere than they release, helping to mitigate climate change.

Natural Carbon Sinks: Through photosynthesis, trees and other forest plants absorb CO₂ and store it in their biomass. Large volumes of CO₂ are absorbed by the oceans, and plankton, algae, and marine life are essential to this process. Carbon is stored in healthy soils by organic matter, such as microbes and decomposing plants.

Artificial (Man-Made) Carbon Sinks: These technologies absorb and store CO₂ emissions from the atmosphere or from industrial sources. Carbon sequestration is improved by reforesting existing woods or planting new ones. creates a net-negative emissions process by combining the production of bioenergy with the collection and storage of carbon.

While carbon sinks are essential for reducing atmospheric CO₂, their capacity is not limitless. For example, deforestation and ocean acidification threaten the effectiveness of natural sinks. Maintaining and enhancing these systems is critical for combating climate.

zones untenable, which causes species to be displaced or go extinct. After a battle, reconstruction takes a lot of energy and resources, which adds to emissions and strains the ecosystem.

These effects emphasise the necessity of sustainable post-conflict recovery methods and a worldwide effort to lessen the environmental cost of war.

27.14 Comparison of War-related Emissions with Emissions from Other Sectors

Emissions from war, especially military operations, are important but frequently disregarded in talks of climate change. The military industry is thought to be responsible for about 6% of global CO₂ emissions. The energy sector continues to be the biggest contributor, accounting for over 73% of greenhouse gas emissions worldwide, mostly from the burning of fossil fuels to generate heat and power.

Deforestation, livestock, and soil management are the main causes of the 18% of emissions that come from agriculture, forestry, and land use. About 16% of emissions come from the transportation sector, which includes air, sea, and road travel. As a result, although the military may appear to have a lower share, its emissions are concentrated and frequently entail high-intensity activities such as the use of fuel for automobiles, aeroplanes, and naval vessels. Furthermore, the long-term effects are exacerbated by the environmental harm brought on by conflicts, such as the destruction of infrastructure and carbon sinks.

27.15 Strategies to Reduce Military Emissions

Cutting military emissions is a difficult but doable objective. Emissions from military installations and operations can be greatly reduced by using solar, wind, and other renewable energy sources. Fuel consumption and emissions can be decreased by upgrading machinery, automobiles, and infrastructure to be more energy-efficient. The carbon footprint can be reduced by using synthetic or biofuels for military ships, planes, and vehicles.

The impact of CO₂ emissions from military operations can be lessened by putting technology in place to absorb and store these emissions. Emissions across the supply chain can be decreased by giving environmentally friendly products and technologies priority when making military procurement. Fuel waste can be reduced by streamlining transportation routes and supply systems.

Furthermore, accountability and advancement are promoted by pushing military to disclose their emissions and establish reduction goals. These tactics can improve operational effectiveness and resilience in addition to lowering emissions.

27.16 Effectiveness of These Strategies in Reducing Military Emissions

The degree to which military emissions reduction measures are successful depends on their execution, level of commitment, and technical developments.

Making the switch to renewable energy has showed promise, particularly for military installations. For instance, in some areas, the use of fossil fuels has been greatly decreased by solar and wind power installations. Reducing emissions has been achieved through infrastructure and equipment upgrades. However, these steps are not enough on their own due to the size of military activities.

Although synthetic and biofuels are becoming more popular, there are still issues with their affordability and availability. With few large-scale applications, carbon capture technology is still in its infancy for military usage. Although they are becoming more popular, environmentally friendly buying methods need to be standardised globally to have the most possible impact. Although not all countries participate equally, accountability has increased as a result of reporting emissions and establishing reduction objectives.

While these strategies are steps in the right direction, achieving significant reductions requires a combination of innovation, policy.

27.17 The Role of International Cooperation to Play in Military Emissions Strategies

Because it encourages cooperation, creativity, and accountability among countries, international cooperation is essential in tackling military emissions. In order to lower emissions, nations can share best practices, research, and technologies, such as developments in sustainable fuels and renewable energy. To ensure success, international agreements might establish shared objectives for lowering military emissions.

Cross-border sustainability can be promoted by integrating eco-friendly practices into cooperative military exercises. International frameworks keep countries responsible for their pledges and promote openness in reporting emissions and progress. Cooperation can also lessen the chance of war, which indirectly lowers emissions related to combat. Furthermore, efforts are currently underway to incorporate climate considerations into military tactics through institutions such as the International Military Council on Climate and Security and NATO.

27.18 Nuclear Threats in Russian Invasion of Ukraine

The Chernobyl Exclusion Zone, the location of the 1986 Chernobyl accident, and four nuclear power stations are located in Ukraine. The conflict resulting from the Russian invasion of Ukraine in 2022 saw fighting at the Chernobyl and Zaporizhzhia nuclear power stations as of March 2025, when these words were written. The invasion has sparked intense debates about nuclear energy programs in other European nations as well as serious discussions about the state of the power stations, including worries about possible catastrophes.

Nuclear threats have become a major concern since Russia invaded Ukraine. By putting its nuclear forces on high alert and testing new capabilities, Russia has applied pressure through nuclear hyperbole. Russia declared intentions to place tactical nuclear weapons in Belarus in March 2023, the first time it has done so outside of its borders since the fall of the Soviet Union. Discussions over this action's effects on international agreements such as the Nuclear Non-Proliferation Treaty have been triggered.

Concerns about possible nuclear catastrophes have also increased as a result of the takeover of nuclear facilities, such as the Zaporizhzhia Nuclear Power Plant. Even if many of Russia's nuclear threats are seen as bluster, they have had a big influence on how people throughout the world view nuclear risk.

27.19 Damaged Biological Systems

27.19.1 Fertile Soils: Shelling and battles cause long-term damage to fertile soils. The extremely fertile chernozem, which helped Ukraine become one of the biggest producers of grain worldwide, is contaminated by chemicals, heavy metals, spent fuel, and lubricants. These contaminants are absorbed by vegetation that grows on contaminated ground, and they are then passed on to people through the food chain. A UN assessment states that in 2022, just in Donbass.

According to research, tanks and other vehicles physically harm chernozem because their weight causes the soil to clump and adhere to one another, and the noise deters earthworms and other creatures that typically agitate and aerate the soil. Soil microbial communities are diminished, at least for a few years. Tank traffic requires at least four years for wet soils to recover. Additionally, pollutants tend to seep deeper into the ground and enter more readily as vegetation cover decreases. Ecologists also observe that when agricultural use is abruptly stopped on fields, vermin and weeds reproduce uncontrollably.

Chernozem

Chernozem, sometimes referred to as "black soil," is among the world's most fertile soil types. High levels of humus (4% to 16%) and nutrients like ammonia and phosphorus give it its richness. Because it retains moisture and nutrients well, this soil is ideal for agriculture, especially when it comes to growing cereals and other crops.

Chernozem is mostly found in two main belts: the Great Plains in North America, which stretches from Canada to the United States, and the Eurasian Steppe, which passes through Ukraine, Russia, and portions of Eastern Europe. Because of its fertility, it is now a vital component of these areas' agricultural output.

27.19.2 Water Sources

Water resources and infrastructure have been significantly impacted by the conflict between Russia and Ukraine. Water bodies, such as rivers, are strategically significant features. Natural defences include the Irpin, Donets, and Dnieper. The Black Sea turned become a battleground as well. Fuel and lubricant leaks from abandoned and damaged cars contaminate water supplies. Fuel spills destroy the water's chemical equilibrium and start fires. In addition to being extremely harmful to microorganisms and marine life, oil contains hydrocarbons that breakdown pollutants like pesticides and heavy metals, causing them to accumulate in the water's upper layers.

When dams are destroyed, large areas are degraded and water and soil become contaminated. For instance, on February 26, 2022, Russian troops damaged a dam on the Irpin river in Kozarovich village, causing a flood that spread over 10 km and reached Horenka village. It is necessary to quantify any impacts on the biodiversity of the Azov Sea, Danube Delta, and Gulf of Odesa.

About 90% of the freshwater content from what was Ukraine's largest reservoir by volume was sent downstream when the Kakhovka Dam was destroyed on June 6, 2023. Decades of industrial activity damaged the sediment in the flow, increasing downstream quantities of copper, zinc, arsenic, and polychlorinated biphenyl and lindane. Near Odesa, an algal bloom was brought on by dissolved phosphorus and nitrogen in the floodwaters. Because of its poor tolerance for toxins and abrupt changes in salinity, the uncommon fish species *Sander marinus* may have been exterminated from the Dnieper-Bug estuary.

Bombs wrecked the Popasnyansky and Uzhnodonbassky canals in 2022, while power outages caused the Donetskaya filtration plant to shut down multiple times. Pipelines burst, causing untreated sewage discharge to flow into the river. Four million people were left without access to clean drinking water after the fighting devastated the water infrastructure that provided it. Internal organs are impacted by drinking contaminated water; occasionally, a week is all it takes to poison the liver and result in death. In Russia, soils and subterranean water are contaminated by polluted rivers that flow downstream.

27.20 Destruction of National Parks and Nature Reserves in Ukraine

Beginning in 2022, national parks and reserves will be impacted by conflict. Numerous endangered species can be found in the Emerald Network, a pan-European network of protected areas that includes Ukraine's national parks and reserves. According to preliminary estimates, the conflict impacted around 1.24 million hectares of Ukraine's protected sites, or almost one-third. Approximately half of Ukraine's most valued natural areas are reportedly under war.

Russian forces have constructed fortifications, planted and detonated explosives, and excavated trenches in nature areas. Russian tanks traversed fields of endangered spring meadow saffron at Grand Meadow National Nature Park, which had been a part of a 16-year conservation campaign. In the Black Sea Biosphere Reserve, fighting was so fierce near Kherson that the burning could be seen from orbit.

Numerous endangered birds, including as the Dalmatian pelican and the Pallas's gull, call Meotyda National Nature Park near Mariupol home and nest. The local ecology was irreparably

harmed by the more than week-long fighting in the Kinburn Spit's forest reserves. More than 56 km of the coastlines of Dzharylhach National Nature Park, which is home to numerous rare endemic flora as well as wild boars, foxes, and deer, were planted with mines, turning the area into an active combat zone.

The Dzharylhach National Nature Park was totally destroyed during the Russian occupation of Kherson Oblast, according to a report released by Ukraine's Ministry of Environmental Protection and Natural Resources on November 6, 2023.

27.21 Disruption of Animals and Birds in War Effected Ukraine

Ukraine is particularly wealthy in safeguarding and preserving its flora and fauna in Europe. More than 70 thousand species of flora and wildlife dwell in Ukraine, accounting for more than 35% of Europe's biodiversity. Migration is disrupted and local communities are directly impacted by war. Shelling and bombing kill wild animals, while flames, explosions, and vibrations frighten them away, drive birds from their nests, and upset their food chain. Heavy trucks use fuel and lubricants that poison insect larvae when they cross rivers. The fewer frogs there are, the less food there will be for cranes. The harm is increased when fighting occurs during the spring, when most species reproduce.

Among the animals most impacted are dolphins. Along the coasts of Bulgaria, Romania, Turkey, and Ukraine, hundreds of dead animals were observed. Although the precise cause of the 2022 strandings is unclear and may be multifactorial, it is probable that the dolphins died from heavy metal toxicity, explosions, acoustic stress, or disorientation brought on by the extraordinary noise pollution from military sonars. Some of the bodies had burns and mechanical damage.

Even domestic animals suffer. Prior to the conflict, Ukraine had an estimated 2 crore chicken birds, 60 lac pigs, and around 30 lac cattle. Due of their difficulty in moving, owners frequently abandoned these agricultural animals. Most remain in areas impacted by war. Wildlife can occasionally reappear in places where people have left them. For example, after 2014, wolf, fox, and wild dog populations in the Donetsk region increased dramatically, making them common rabies carriers. Numerous incidents involving locals have been documented.

27.22 Indirect Environmental Impacts Due to Sanctions

The majority of foreign foundations and organisations stopped working with Russia on environmental projects when the war began. International research on climate change in the area was also interrupted. Nearly every conservation effort in Ukraine was interrupted. According to sources, Russian military planes were mostly responsible for putting out the flames in Turkey, Europe, and Siberia in 2021. Due to the war, there were no spares, even inside Russia, where the military typically assists with wildfires.

Economic penalties can have unexpected environmental effects, even when their main goal is to change political or economic behaviour. In order to maintain their economy, sanctioned nations may turn to overusing their natural resources, which would degrade the environment.

Adoption of environmentally friendly techniques and sustainable practices may be hampered by technological and international cooperation limitations.

Reliance on antiquated, polluting technology may arise from limited access to contemporary tools and resources. It is a truth that governments frequently prioritise economic survival over environmental concerns.

27.23 International Concerns of Russian Ukraine Military Conflict

Even though US President Donald Trump has launched a new endeavour, the battle is still ongoing as of this writing. In the meantime, it is highly likely that this battle will sabotage any attempts to achieve the objectives of the Paris Agreement. If some governments choose to import foreign fossil fuels in place of Russian ones and use coal energy to make up the difference, CO₂ emissions will rise. The globe will most likely be locked into irreversible warming if new infrastructure, supply networks, and logistics are built to replace Russian hydrocarbons.

One may argue that increasing domestic fossil fuels is a patriotic move to lessen reliance on Russian fossil resources. It is possible to shift focus and resources from the climate to the military. Because the military sector produces so many pollutants; the U.S. army's emissions surpass those of Sweden, Portugal, or Denmark; increasing military spending will result in higher energy and material consumption. Additionally, war undermined global cooperation, which is essential to combating climate change. Devastation from climate change may result from this military conflict's effects on the energy transition.

China made various efforts to cut emissions in the second decade of the twenty-first century, one of which was to use less coal. China has started approving new coal plants in 2022 as a result of energy supply issues. Due to liquefied natural gas shortages brought on by the European embargo of Russian oil, many Asian nations were compelled to switch back to using coal in 2023 to meet the region's heat wave-related energy demands. Russia reportedly shipped over 70 lac tonnes of coal to Asia, with China and India being the main consumers.

Sales of cheap Russian oil to China and India increased significantly as a result of the war, and the BRICS nations found Russian oil to be more appealing overall. The sanctions resulted in "lower invoice prices for Russian goods" for purchasing nations. The price of diesel has decreased as a result of Brazil's increased imports of Russian oil, petrol and naphtha.

27.24 Russian Ukraine War's Influence on Environmental Legislation

Significant environmental effects have resulted from the Russian war in Ukraine, which has influenced laws and policies in a number of ways. In addition to deforestation and pollution, the fighting has resulted in extensive damage, including chemical contamination of the air, water, and soil. This has brought attention to the necessity of more stringent environmental protection legislation. When referring to the environmental damage brought about by the war, the term "ecocide" has been used. In order to hold criminals accountable, this has spurred discussions about include ecocide in international law.

Concerns regarding nuclear facility safety have been heightened by the war, prompting calls for stricter international laws to avert environmental catastrophes. Furthermore, significant remediation work will be needed to repair the environmental harm, which will have an impact on future laws pertaining to environmental recovery after a conflict.

27.25 Effects of this Conflict on Global Environmental Legislation

Global environmental law has been significantly impacted by the Russian-Ukrainian conflict in a number of ways. The war's devastation of the environment has brought attention to the necessity of stricter international regulations to safeguard ecosystems during armed conflicts. The idea of adding "ecocide" to international law has become more and more popular.

Energy policy have changed as a result of the war's disruption of the world's energy markets. There has been a renewed drive for investments in renewable energy to lessen reliance on unstable energy markets, even as some nations have temporarily switched back to fossil fuels for energy security. Countries have increased agricultural production as a result of the conflict's impact on the world's food and fertiliser markets. This has sparked worries about possible dangers to biodiversity and ecosystems.

The significance of post-conflict rehabilitation laws has been highlighted by the severe environmental damage in Ukraine. Frameworks to combat pollution and rebuild ecosystems in places damaged by war are being developed by international organisations.

27.26 Prosecution of Environmental Legislation in Ukraine

Particularly given the ongoing conflict, Ukraine has been aggressively tackling environmental legislation. "Ecocide," which includes actions that cause environmental disasters, poisoning of air or water supplies, and widespread destruction of flora and animals, is illegal in Ukraine. Its criminal code's Article 441 describes this. Prosecutors in Ukraine are leading the charge to classify environmental damage as a war crime.

According to reports, more than 250 incidents; including assaults on protected nature reserves, oil depots, and nuclear facilities; have been classified as possible environmental war crimes. Ukraine is collaborating with global organisations to hold those responsible for environmental harm to account. Using international humanitarian law to address the conflict's environmental effects is one way to do this. To ensure strict compliance and accountability for those who violate the environment, penalties have also been imposed for a variety of environmental infractions, including unauthorised emissions and air pollution.

27.27 Ukraine's Environmental Legislation in Comparison to Other Countries

Environmental laws in Ukraine have been changing, especially as they come into compliance with EU regulations. The nation has been attempting to align its environmental regulations with other directives including the Green Deal of the European Union. This entails implementing policies for biodiversity preservation, emissions monitoring, and renewable energy.

Ukraine differs from many other countries in that it is one of the few that has made "ecocide" a crime. This illustrates its dedication to tackling extensive environmental damage. Even while Ukraine has achieved great progress, several environmental projects, such as emissions reporting and green transition legislation, have been hampered by the ongoing fighting. Like other countries with evolving environmental frameworks, Ukraine has strong laws in some areas, such as ecocide, but struggles with uniformity and enforcement.

27.28 Incorporation of Ecocide into International Legal Framework

The concept of ecocide is gradually being integrated into international legal frameworks, with significant developments in recent years. An Independent Expert Panel has proposed adding ecocide as a fifth international crime under the Rome Statute of the International Criminal Court. This would place ecocide alongside genocide, war crimes, crimes against humanity, and the crime of aggression.

European Union's Green Deal

The goal of the European Union's Green Deal is to achieve carbon neutrality by 2050 through a comprehensive plan.

Climate Neutrality: The Green Deal aims to achieve climate neutrality by 2050 by reducing net greenhouse gas emissions by at least 55% by 2030 relative to 1990 levels.

Sectoral Transformation: It encourages innovation and sustainable practices in a number of areas, such as industry, transportation, energy, and agriculture.

Circular Economy: The strategy places a strong emphasis on a circular economy, which aims to promote sustainable production, reduce waste, and reuse resources.

Biodiversity and Ecosystems: With plans to grow 3 billion more trees by 2030, preserving and reviving biodiversity is a top priority.

Economic Growth: In order to ensure a contemporary, resource-efficient, and competitive economy, the Green Deal seeks to disentangle economic growth from resource use.

Measures to guarantee that no individual or area is left behind during the green transition are included in social inclusion.

"Unlawful or wanton acts" that result in significant, pervasive, or long-term environmental harm are the main focus of the proposed definition of ecocide. The purpose of this term is to provide precise standards for prosecuting environmental degradation. Campaigns to recognise ecocide as an international crime are being aggressively pursued by groups such as the Stop Ecocide Foundation. Numerous nations and legal experts have endorsed their initiatives. The International Criminal Court is investigating how to incorporate ecocide into its larger legal framework, which encompasses humanitarian, human rights, and environmental law.

This involves addressing challenges like jurisdiction and enforcement.

Section F

Future Outlook

Chapter 28

Environmental Rehabilitation and Peace-Building Efforts

In this chapter

- 28.1 Reforestation and Afforestation**
- 28.2 Sustainable Resource Management**
- 28.3 Legal Frameworks**
- 28.4 Community Involvement**
- 28.5 The International Legal Framework to Address Environmental Destruction**

A crucial component of Jus Post Bellum is environmental rehabilitation in post-conflict settings, which focusses on the preservation and restoration of ecosystems and natural resources. Deforestation, contaminated water supplies, and hazardous waste products from military operations are only a few examples of the serious environmental harm that war frequently causes. Rebuilding sustainable societies and maintaining long-term peace require addressing these problems.

Ecosystem rehabilitation entails repairing harmed landscapes, such as clearing contaminated regions or regenerating trees. Restoring environmental health and promoting sustainable development need ecosystem rehabilitation following conflicts. Restoring the environment after a war frequently entails repairing the harm that military operations have caused, such as pollution, deforestation, and degraded soil.

28.1 Reforestation and Afforestation

Planting trees to restore forests and stop soil erosion is known as afforestation or reforestation. Restoring fertility to degraded or contaminated soil is known as soil restoration. Cleaning contaminated waterways and guaranteeing sustainable water use are two aspects of water resource management. Conserving, protecting, and reintroducing native species to restore ecosystems are all parts of biodiversity. Involving local communities in restoration initiatives is another aspect of community participation that guarantees long-term success. For instance, significant efforts were undertaken to restore areas impacted by defoliants such as Agent Orange following the Vietnam War. throughout a similar vein, reforestation initiatives helped rebuild war-torn landscapes throughout Europe following World War II.

28.2 Sustainable Resource Management

Making sure that natural resources are handled sensibly to promote economic recovery without creating additional harm is known as sustainable resource management. In post-conflict settings, sustainable resource management is essential to societal reconstruction and conflict

avoidance. It entails tackling the social and environmental issues brought on by conflict while making sure that natural resources are used responsibly to aid in development and recovery.

In order to prevent tensions from escalating, conflict-sensitive resource allocation entails guaranteeing fair access to resources. Restoring ecosystems and repairing environmental harm brought on by conflict are both considered forms of natural resource rehabilitation. In order to prevent corruption and exploitation, governance necessitates the establishment and reinforcement of transparent and efficient resource management mechanisms. In order to encourage ownership and sustainability, community involvement is crucial in including local residents in decision-making.

Using resource management as a strategy to promote collaboration and peace making between former enemies is part of integration into peacebuilding. For instance, in order to promote economic recovery and avoid exploitation, programs such as the Liberia Forest Initiative have concentrated on sustainable forestry techniques. In a similar vein, the UNEP has endeavoured to incorporate the management of natural resources into peacebuilding initiatives.

28.3 Legal Frameworks

An essential aspect of post-conflict recovery is the use of international agreements and laws to hold parties responsible for environmental damage and direct restoration initiatives. This guarantees that war-related environmental harm is methodically repaired and that impacted areas can recover in a sustainable manner.

Responsibility International treaties, such the Rome Statute of the International Criminal Court (ICC) and the Geneva Conventions, have mechanisms in place that make some acts of environmental degradation during conflicts illegal. Legal action is one way to hold accountable the responsible parties. Frameworks for directing ecological restoration efforts following conflicts are provided by agreements such as the Convention on Biological Diversity and the United Nations Framework Convention on Climate Change (UNFCCC).

Organisations such as the International Union for Conservation of Nature (IUCN) and the United Nations Environment Programme (UNEP) collaborate with countries to evaluate environmental harm and develop workable recovery strategies. International alliances are frequently used to enhance restoration initiatives by offering financial assistance and expertise. These rules inhibit future conflicts by imposing stringent limitations on environmentally harmful warfare. For instance, the world community fought to remediate the environmental catastrophe brought on by oil leaks and burning oil wells in the wake of the Gulf War.

28.4 Community Involvement

The sustainability and viability of post-conflict restoration initiatives depend on involving local communities in environmental recovery to foster ownership and long-term management. Direct community involvement promotes a sense of stewardship and ownership, both of which are essential for long-term maintenance of the recovered environment.

Community involvement in decision-making is a component of effective strategies. Encouraging local communities to participate in the planning and implementation of recovery

initiatives guarantees that the endeavours are in line with their values and requirements. Communities can better grasp their critical role in restoration through educational initiatives like teaching sustainable behaviours and increasing awareness of the value of environmental integrity.

Employment opportunities that promote active engagement and offer financial rewards include jobs in rehabilitation initiatives like garbage management or reforestation. By utilising indigenous and local knowledge about ecosystems, traditional knowledge integration can improve the efficacy of recovery plans. Accountability and sustained dedication are ensured through collaborative monitoring, which involves communities in tracking the development of restoration initiatives.

Jus ad Bellum

The Latin phrase "jus ad bellum" (literally "right to war") describes the collection of requirements that must be fulfilled for a conflict to be deemed ethically or justifiably acceptable. It is a fundamental idea in the just war theory, which is frequently covered in international law, ethics, and philosophy classes.

In principle, the Jus ad Bellum criteria state that a war must be waged to right a wrong or protect against aggression. War can only be declared by recognised authority, such as governments or states. Promoting virtue or avoiding evil must be the goal, not self-interest.

Before going to war, every non-violent alternative must be tried, and there must be a realistic prospect of accomplishing the goals. The expected advantages must exceed the possible drawbacks.

Jus in Bello

The term "justice in war" (Jus in Bello) describes the moral standards that dictate how parties should behave during hostilities. While Jus in Bello guarantees that activities within the war are morally permissible, regardless of whether the war itself is legitimate, Jus ad Bellum deals with the rationale for starting a war.

The idea of discriminating, which requires combatants to differentiate between military targets and non-combatants, is one of the fundamental tenets of Jus in Bello. It is not appropriate to target civilians or civilian property. In order to prevent needless damage or devastation, the use of force must be appropriate to the military aim.

Furthermore, measures that inflict needless suffering (such as torture or indiscriminate weaponry) are forbidden, and the acts must be essential to achieve justifiable military goals rather than being excessive or vengeful. The Geneva Conventions and other international regulations frequently uphold these ideals. They are intended to protect people who are not actively involved in the battle and lessen the misery brought on by war.

Jus Post Bellum

The phrase "justice after war" (Jus Post Bellum) refers to the moral standards and steps necessary to bring about peace and restore justice after a fight has ended. Complementing Jus ad Bellum and Jus in Bello, it is the last element of just war theory. The goal is to address the effects of conflict while ensuring a just and long-lasting conclusion.

Rebuilding the impacted areas, including the economy, governance, and infrastructure, is one of the main tenets of Jus Post Bellum, which aims to establish a stable society. It also entails putting those responsible for acts of aggression or war crimes accountable without punishing innocent people collectively. Rehabilitation: Helping victims, such as those who have been displaced or who have experienced financial or personal loss, to recover.

Reconciliation is a component of Jus Post Bellum, which aims to avert future wars by fostering understanding and peace amongst former enemies. Since punitive measures can breed resentment and future instability, proportionality and caution guarantee that the terms of peace are equitable and not unduly harsh. In summary, the idea of Jus Post Bellum has impacted post-war initiatives throughout history, including the Marshall Plan, which concentrated on European economic recovery following World War II.

Local communities' involvement in post-tsunami mangrove restoration initiatives in Sri Lanka is a prime illustration of this. Their efforts to grow and preserve mangroves offered sustainable livelihoods and enhanced coastal resiliency. The goal of initiatives like international legal standards and the United Nations' environmental programs is to incorporate environmental integrity into recovery plans following a war.

28.5 The International Legal Framework to Address Environmental Destruction

In order to hold offenders accountable and direct restoration efforts, a variety of strategies are used to execute international rules and agreements to mitigate environmental degradation in wars. These procedures consist of institutional, cooperative, and legal actions. using organisations like the International Criminal Court (ICC), which acknowledges actions like the extensive devastation of natural resources as possible crimes against humanity or war crimes, to prosecute environmental war crimes. It also entails upholding clauses that forbid indiscriminate destruction during times of war, such as those found in accords like the Geneva Conventions.

To determine the level of damage and pinpoint places in need of restoration, post-war environmental impact assessments are carried out. These initiatives are frequently spearheaded by UNEP, which generates thorough reports and action plans. Guidelines for ecological recovery are provided by following international frameworks like the United Nations Framework Convention on Climate Change (UNFCCC). Creating treaties, such as ones to exchange financial and technological resources, guarantees collaboration in environmental rehabilitation. Furthermore, tackling the restoration work was made easier by multi-stakeholder partnerships involving local communities, NGOs, and governments.

There are procedures for holding offenders accountable via reparations, whereby culpable parties can make material or monetary contributions to ecological restoration initiatives. Provisions are in place for states or other entities who violate environmental standards during conflicts to face sanctions or penalties.

Building capacity entails educating communities and local government officials on how to interpret and enforce environmental regulations. It also entails raising awareness and educating people about sustainable post-conflict practices. One notable example is the environmental disaster during the Gulf War, when fires and oil spills caused extensive damage. International agencies such as UNEP worked to hold those responsible for environmental damage accountable while developing guidelines and restoration plans.

Chapter 29

Accountability of Perpetrators for Crimes Committed during War

In this chapter

- 29.1 Challenges in Holding Individuals and States Accountable for War Crimes**
- 29.2 Environmental Destruction (termed "ecocide") as an International Crime**
- 29.3 Examples of Special Tribunals to Address Atrocities on Environmental Harm**

Holding criminals accountable Justice and post-war reconstruction depend on commitments made during conflicts, including environmental damage. Accountability deters future infractions while guaranteeing that wrongdoers suffer the penalties. One of the pillars of international law and justice is the emphasis on war criminal accountability. It entails holding people or organisations accountable for breaking humanitarian laws while fighting an armed conflict. Frameworks for identifying and prosecuting war crimes are provided by instruments such as the Geneva Conventions and the Rome Statute of the International Criminal Court (ICC).

There are other ways to be held accountable, such as through truth commissions, reparations, and criminal trials. Examples from history, such the Rwandan Genocide Tribunal and the Nuremberg Trials following World War II, demonstrate attempts to provide victims with justice and discourage similar crimes in the future. There are still issues, like the difficulty of obtaining evidence in conflict areas and political meddling. If an individual's actions constitute war crimes, crimes against humanity, or environmental degradation, the International Criminal Court will bring charges against them. Theoretically, environmental destruction could be covered by special tribunals, such as those for Rwanda and Yugoslavia, which have dealt with massacres.

The prosecution of environmental devastation (sometimes known as "ecocide") as an international crime within the International Criminal Court framework became a topic of discussion in 2021. Reparations for losses incurred during conflicts, such as environmental remediation or infrastructure reconstruction, may be required by agreements and courts. Iraq was mandated by the UN Compensation Commission to make amends for environmental harm, particularly oil leaks, following the Gulf War.

Sometimes, especially when international courts are not involved, nations use their domestic legal systems to prosecute war criminals. International and local procedures are combined in hybrid courts. Expanding hybrid courts to address environmental damages linked to war crimes is a possibility.

Truth commissions look into crimes in order to uncover the truth and determine who is responsible, frequently as a first step towards rapprochement. Truth commissions have the authority to address human suffering and suggest corrective measures for environmental restoration. International organisations may impose penalties on states or leaders that cause environmental harm, such as asset freezes or trade embargoes.

In an effort to increase accountability for environmental damage caused during wars, academics and activists advocate for the recognition of "ecocide" as an international crime. In addition to bringing about justice, accountability lays the groundwork for restoring confidence and averting further disputes.

29.1 Challenges in Holding Individuals and States Accountable for War Crimes

There are many obstacles in the way of holding states and people responsible for war crimes. The concept of state sovereignty, which may restrict outside involvement or prosecution, must be negotiated by international law. To avoid responsibility, certain governments may reject international tribunals like the International Criminal Court. Even with established conventions, prosecution attempts may be hampered by unclear definitions or interpretations.

Strong countries or allies have the capacity to block investigations or protect offenders from punishment. Critics contend that accountability for war crimes can be administered unevenly, with larger powers evading investigation while smaller states are frequently singled out. Because of logistical challenges and safety concerns, gathering evidence in active conflict zones might be practically impossible. But protecting victims and witnesses who are eager to testify is a difficult undertaking.

There are also difficulties with enforcement. States are relied upon by international tribunals to enforce their decisions, which could result in non-compliance. Amnesties are frequently given as part of peace talks in post-conflict situations, avoiding punishment. Addressing these challenges requires strengthened international cooperation, enhanced investigative mechanisms, and improved protection for victims and witnesses.

29.2 Environmental Destruction (termed "ecocide") as an International Crime

The phrase "ecocide" describes the widespread devastation of ecosystems, frequently brought on by human activities, which causes serious and protracted environmental damage. In accordance with the Rome Statute of the International Criminal Court, there is a rising push to recognise ecocide as an international crime, along with crimes against humanity, war crimes, genocide, and aggression.

Proponents contend that criminalising ecocide would hold governments, businesses, and individuals responsible for acts that seriously harm the environment. Activities like pollution, deforestation, and biodiversity loss may fall under this category. Vocal supporters of this recognition have included Vanuatu, Fiji, and Samoa, highlighting the existential threat that environmental degradation poses to weaker countries.

The concept of "ecocide" has a long history; it was coined in the 1970s to refer to the environmental destruction brought about by Agent Orange during the Vietnam War. With

groups like Stop Ecocide International spearheading the push to incorporate ecocide in international law, the campaign is currently gaining traction.

29.3 Examples of Special Tribunals to Address Atrocities on Environmental Harm

Indeed, in the past, special tribunals have been essential in dealing with serious crimes, and their structure may be modified to include environmental damage such as ecocide. The Rwandan and former Yugoslavian International Criminal Tribunals served as examples of how targeted legal systems may successfully handle major crimes, bring charges against specific individuals, and open the door to justice and peace.

Theoretically, incidents involving significant environmental damage may be investigated and prosecuted by similar tribunals. This might entail defining what, according to international law, qualifies as ecocide, including widespread deforestation, pollution, or ecosystem devastation, as well as choosing whether the tribunal would concentrate on cases involving certain regions, the entire world, or both. It might also entail locating and holding accountable responsible players, be they governments, businesses, or private citizens.

However, the creation of such tribunals would have to overcome obstacles similar to those faced by the International Criminal Tribunals for Rwanda and the Former Yugoslavia, such as funding, political opposition, and guaranteeing the implementation of rulings. Furthermore, because environmental harm is interdisciplinary and encompasses science, economics, and law, specific knowledge and techniques would be needed for evidence collection and impact assessment.

Glossary

Armed Conflict: An armed confrontation between the armed forces of two or more states (international) or between a state's forces and organized armed groups within its territory (non-international).

Arquebus: It is an early type of portable firearm that emerged in the 15th century. It was typically a matchlock gun; a mechanism where a slow-burning match ignited the gunpowder; designed to discharge a projectile.

Agent Orange: A tactical herbicide; an equal mixture of 2,4-D and 2,4,5-T (contaminated with dioxin); sprayed by the U.S. military in Vietnam from 1962 to 1971 to defoliate vegetation.

Atmosphere: The envelope of gases surrounding a planet or other celestial body, held in place by its gravity.

Ancient Warfare: Armed conflict carried out from the dawn of recorded history to the close of antiquity (roughly the 5th–6th centuries CE), marked by the emergence of state-organized armies using massed infantry formations (e.g., phalanx), chariots and cavalry, early siege-craft and naval engagements.

Ancient Egypt: A civilization in northeastern Africa that arose around 3150 BCE with the unification of Upper and Lower Egypt by Menes, flourishing along the fertile Nile valley through successive dynasties until its conquest by Rome in 30 BCE.

Bomb Perturbation: The sudden disturbance in a physical system caused by a bomb's explosive release of energy; manifesting as shock waves, thermal pulses and fragmentation that momentarily deviate the environment from its prior equilibrium.

Biodiversity: The variety of life in the world or in a particular habitat or ecosystem.

Battle: A sustained, often decisive, engagement between opposing organized armed forces; fought over a defined time and place to secure strategic, political or territorial objectives.

Bombing Campaign: Coordinated military operations involving sustained aerial bombardment of strategic targets; such as industrial sites, infrastructure, or population centres; to degrade an enemy's war-making capacity and morale.

Chemical Weapons: Toxic chemicals (and their precursors), plus any munitions or equipment specifically designed to deploy them, intended to kill or harm through their chemical action on life processes.

Catapults: Ballistic devices that launch projectiles at considerable range without gunpowder, converting stored mechanical energy; via torsion (twisted ropes), tension (bent arms) or gravity (counterweights); into kinetic force for siege and battlefield use.

Desertification: The gradual degradation of once-fertile land into desert; marked by loss of vegetation, soil fertility and productivity, chiefly driven by drought, deforestation or inappropriate agricultural practices.

Defoliant: A chemical agent sprayed or dusted on plants to induce leaf drop; used in agriculture to ease harvesting and in warfare to strip vegetation cover.

Ecosystem: A biological community of interacting organisms and their abiotic (physical) environment, functioning together as an ecological unit.

Environmental Destruction: The deterioration or elimination of natural environments; air, water, soil, ecosystems and wildlife; through resource depletion, pollution, habitat loss and other human-driven or natural pressures, resulting in lost biodiversity and ecosystem services.

ENMOD Convention: Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques (ENMOD Convention); an international treaty adopted by UN GA Resolution 31/72 on 10 December 1976 (opened for signature 18 May 1977; in force 5 October 1978) that prohibits States Parties from engaging in; or assisting others to engage in; any military or hostile use of environmental modification techniques (i.e. deliberate manipulation of natural processes) having “widespread, long-lasting or severe” effects as a means of destruction, damage or injury.

Ecology: The branch of biology that studies the relationships between organisms and their environment; exploring how species interact with each other and with abiotic factors such

Environmental Impact: The short, medium, or long-term effects; positive or negative; that human activities have on ecosystems and the environment.

Greenhouse Gas: Any atmospheric gas that absorbs and emits infrared radiation, trapping heat and driving the greenhouse effect.

as climate, soil, and water to shape population, community, and ecosystem dynamics.

Geopolitics: The study of how geographical factors; such as location, terrain, resources, and population distribution; influence international relations, state strategy, and the balance of power.

Geneva Conventions: a series of four international treaties (adopted between 1864 and 1949) and three Additional Protocols that form the core of international humanitarian law, defining the rights and protections owed to wounded and sick combatants, shipwrecked military personnel, prisoners of war, civilians and medical personnel, and restricting the means and methods of warfare to limit suffering.

Greek Empires: A term chiefly used for the Hellenistic successor states of Alexander the Great’s realm; most notably the Antigonid Macedonian kingdom, the Seleucid Empire in Asia, and the Ptolemaic Kingdom in Egypt: and, in a medieval context, for the Eastern Roman (Byzantine) Empire centred on Constantinople.

Greco-Persian Wars: A series of conflicts (c. 492–449 BCE) between the Achaemenid Persian Empire and a coalition of Greek city-states, marked by two major Persian invasions in 490 BCE (Marathon) and 480–479 BCE (Thermopylae, Salamis, Plataea).

Greenhouse Effect: The process by which certain atmospheric gases absorb and re-emit infrared radiation from Earth’s surface, trapping heat and keeping the planet warmer than it would be otherwise.

Herbicide: A chemical substance used to destroy or inhibit the growth of unwanted plants (weeds).

Hammering Strikes: Repeated, forceful blows delivered like hammer blows; most often referring to the “hammer-fist” in close combat (striking with the bottom edge of a clenched fist) or to sustained, pounding attacks in siege and artillery warfare.

Hydrology: The scientific study of the movement, distribution, and management of water on Earth and other planets.

Habitat Degradation: the process by which habitat quality is reduced; through natural disturbances (e.g., drought, floods) or human activities (e.g., deforestation, pollution, urbanization); undermining an ecosystem’s capacity to support its native species.

International Humanitarian Law: The body of treaty and customary rules; also called the laws of armed conflict; that seeks, for humanitarian reasons, to limit the effects of war by protecting persons who are not, or are no longer, participating in hostilities and by restricting the means and methods of warfare.

Indus Valley: The fertile alluvial plain of the Indus River in South Asia, cradle of the Bronze Age Harappan (Indus Valley) Civilization (c. 3300–1300 BCE), famed for its grid-planned cities (Harappa, Mohenjo-daro), advanced drainage systems and still-undeciphered script.

Longbowmen: Archers trained to wield the longbow; a powerful, yew-made bow roughly 6 ft (1.8 m) long with draw weights often exceeding 100 lbf; whose rapid, armour-piercing volleys proved decisive in medieval English and Welsh warfare.

Laws of Armed Conflict: Also called International Humanitarian Law, are the body of treaty and customary rules that regulate the conduct of parties during armed conflicts; protecting those who do not (or no longer) take part in hostilities and restricting the means and methods of warfare.

Land Mine: An explosive device buried on or just below the ground’s surface that detonates; typically, by pressure, proximity, or a tripwire; to injure or disable personnel or vehicles.

Musket: A musket is a muzzle-loaded long gun with a smoothbore barrel that was historically used by infantry soldiers. It was typically fired using matchlock, flintlock, or percussion mechanisms.

Medieval Military Conflicts: Armed engagements fought across Europe, the Middle East and beyond from roughly the 5th to the 15th century CE; marked by feudal levies and mounted, armoured knights; the rise of fortified castles and complex siege engines (trebuchets, siege towers); and tactics reshaped by cultural, social and technological change.

Military Operation: The coordinated actions of state or non-state armed forces, executed according to a plan to achieve specific political or strategic objectives in response to a developing situation.

Mesopotamia: An ancient region of southwestern Asia; straddling the fertile land between the Tigris and Euphrates rivers in modern-day Iraq and parts of Syria, Turkey and Iran.

Military Conflict: The organized engagement of armed forces; state or non-state; using violence to pursue political, territorial, or ideological objectives.

Mustard Gas: a chemical warfare vesicant; bis(2-chloroethyl) sulfide ($C_4H_8Cl_2S$); that forms a toxic mist or liquid causing severe blistering of skin and mucous membranes.

Medieval Era (Middle Ages): The period in European history roughly from the 5th to the late 15th centuries CE.

Natural Habitat: The specific natural environment in which a species lives, grows, and reproduces; comprising the abiotic and biotic factors to which it is adapted

Oil Spill: The release of liquid petroleum hydrocarbons into the environment; particularly marine ecosystems; due to human activity, resulting in pollution and ecological damage.

Persian Empire: The Achaemenid dynasty founded by Cyrus II “the Great” around 550 BCE, which united the Median, Lydian and Neo-Babylonian realms into an imperial state. At its zenith under Darius I (522–486 BCE), it stretched from the Balkans and Egypt in the west across Mesopotamia and Central Asia to the Indus Valley.

Peloponnesian War: A protracted Greek conflict (431 – 404 BCE) between the Athenian-led Delian League and the Spartan-led Peloponnesian League, fought over regional hegemony and ending with Sparta’s victory and temporary Spartan supremacy.

Punic Wars: A series of three wars (264–146 BC) between the Roman Republic and the Carthaginian Empire; fought on land and sea across the western Mediterranean; culminating in Rome’s victory, the destruction of Carthage and its people’s enslavement, and Roman hegemony over the region.

Roman Empires: Collective term for the Western Roman Empire (27 BCE – 476 CE) and its continuation as the Eastern Roman (Byzantine) Empire (330 – 1453 CE); an ancient autocratic state centred first on Rome and later on Constantinople, whose vast territories spanned the Mediterranean basin, Europe and Western Asia.

Retrenchment (Army): A tactical manoeuvre in which armed forces withdraw from advanced or overextended positions to more secure, often fortified, lines; consolidating troops and resources to preserve combat effectiveness.

Scorched Earth Tactics: A military policy of deliberately destroying anything that could benefit an enemy; crops, infrastructure, supplies and shelters; when advancing through or retreating from territory to deprive opponents of resources.

Socioeconomic Landscapes: The spatial arrangement and interaction of social and economic characteristics; such as income levels, education attainment, employment opportunities, infrastructure, and demographic patterns; across a region, reflecting how economic activities and social factors combine to shape development, resource access, and quality of life.

Scythians’ Burning: The scorched-earth tactic employed by the nomadic Scythians; most famously in 513 BCE against Darius I’s Persian invasion; whereby they burned their own crops, drove off livestock, choked or poisoned wells and uprooted grass to deny invading armies food and water.

Scorpion Grenades: Improvised entomological weapons; earthenware jars, pots or bundles stocked with live scorpions; hurled by hand or siege engines (catapults, trebuchets) onto enemy troops or over fortifications. On impact the containers shatter, releasing the arachnids' painful stings and triggering panic among defenders.

Vietnam War: A protracted armed conflict (1955–1975) pitting North Vietnam and its Viet Cong allies; backed by the Soviet Union and China; against South Vietnam and its principal ally, the United States, as part of the Cold War. It ended with North Vietnamese victory and the reunification of Vietnam under communist rule.

Warfare: The organized, armed conflict between states, nations or groups; encompassing the weapons, tactics and strategies used to achieve political or territorial aims.

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I was brought up in an agricultural farming family of Punjab, a northern Indian state of fertile lands situated in between the rivers Sutlej and Beas. The traditions of my homeland are in my family veins. My father served in Indian Air Force and participated in the wars with China in 1962 and with Pakistan in 1965. My forefathers participated in action during World War 2 and fought somewhere in Europe. My paternal grandfather fought in Burma (Now Myanmar) during World War 2. As I recall, my childhood days spent in agricultural farming atmosphere. So, I have deep emotions for environment throughout my life. I still cherish the long high flights of falcons and the warm summer evenings in the open meadows of my surroundings.

Besides all, I choose to study business subjects and post graduated in commerce in 1983. After completing my student life, as of my professional interest, I joined bank as probationary officer in 1984. After successfully serving the bank as Bank Officer for 36 years plus, I joined a Group Housing Construction Company, AGI Infra Limited in February 2021 as Chief Financial Officer.

It was just a chance that, besides my financial management responsibilities in freshly joined corporate house, I was entrusted with the additional work of environmental approvals and liaison work with the State departments. Here, I struck an idea to venture for an extra mile to work in the field of environment and went for Doctorate in Environmental Management Studies. The Russian-Ukraine war started on 24th February, 2022. In my younger years of life, I was regular reader of, 'Soviet Union', the erstwhile USSR illustrated monthly magazine and to read and understand the Russian literature, especially reading books by the Russian writer, popularly known as Maxim Gorky.

I feel at that time that Russian society is much like ours as in Punjab characterized by resilience, patriotism and traditional, and I have a kind of attraction towards that society. Now, though, not knowing much deeper about the issues and causes behind the war, I was disturbed that Russia has jumped in the fire of war. This made me think to know, how the general public is effected in the war zones and that, how much environment is impacted in the battle fields. It appears to me that, though much has been or being done at the different governmental and international level through international treaties and laws to save the loss of human being, but very little is being thought to save the environments and biodiversity, that impacted not only during the armed conflicts, but even after the last shell is dropped. Not much even has been written for the impact of military operations on environments. This led me to study and write on Environmental Impacts of Armed Conflicts.

Dr. Balvinder Singh Sandha

