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ATLAS SkillTech University

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Unit 1: Multidisciplinary nature of Environmental studies

Learning Objectives

Appreciate the extent and significance of environmental studies as an interdisciplinary discipline

natural- and social-science and humanities.

Name the important elements in a (a) physical, (b) biological and (c) socio-cultural environment and

provide an account of how they interact in ecological and human dimensions.

19 View the role of various disciplines— including biology, chemistry, geography,

economics, sociology and political science — addressing environmental problems.

Interrelationship of human activity and environmental problems, such as

pollution, use of resources, climate change, and loss of biodiversity.

Assess the role of environmental studies in sustainable development with its.

significance for policy, planning and community engagement.

To develop such critical thinking to examine environmental issues from various sides and

propose integrated solutions.

Recognise the need for broader and interdisciplinary perspectives in order to understand and address

contemporary environmental issues.

Content

1.7 References

1.8 Case Study

1.0 Introductory Caselet

"Greentopia's Sustainable Turn"

Greentopia is a small nation, It has dense forests, rich farmland and a long coastline.

In an effort to boost its economy, the government fostered new industries, expanded agriculture, and constructed large

cities. Initially, this appeared to be progress — jobs emerged, trade expanded, and people enjoyed increased living standards.

But soon, issues began to appear. Forests were felled, rivers ran with industrial effluent and wildlife was slain on a mass scale.

waste and growing traffic in cities resulted in low air quality. Farmers observed that soil fertility was declining,

and there were too few fish near the shore for fishermen. Meanwhile, physicians say more and more respiratory illnesses.

diseases, and sociologists reported escalating disputes between communities over water sources.

The leaders of Greentopia knew these problems could not be solved by a single discipline. They needed

from biology to see how systems work, chemistry to investigate pollution, economics for resource planning

consumption, sociology to solve problems in society and political science to make just policies. By bringing

by combining knowledge from multiple fields, an interdisciplinary environmental plan was designedi—

Save the forests, clean technologies, sustainable farming and education for citizens."

about eco-friendly lifestyles.

Greenprint This e comprehensive plan was instrumental in keeping development and environmental preservation in check, preventing the event from adding s to high-impact areas such as waterways, wetlands, wooded areas and floodplains.

better future for its people and nature.

Critical Thinking Question

Why did it take so many different types of expertise to help Greentopia with its environmental problems?

issues, and what the situation could have been if using only one discipline?

1.1 Definition, Scope and Importance

1.1.1 Definition of Environmental Studies

Environmental Studies have been described as a systematic interdisciplinary examination of the

man-nature relationship. It is interdisciplinary; it does not limit itself to a field

yet also cuts across various disciplines — including ecology,chemistry,sociology,economics,law, and ethics to give shape to

an in-depth knowledge of environmental problems.

This definition is characterized by numerous distinctive features:

Interdisciplinary Approach: Environmental problems cross the boundaries of science, social and economic nature.

economic; they are interconnected. Chemistry Is Everywhere For instance, air pollution 1 requires both chemical (composition of ta/COMP/conpositio.

pollutants),biology(health effects and ecosystem impacts),economics(cost of pollutant control),and

political science (laws and policies).

whole rather than in isolation. • Dynamic Approach: It is an integrated and dynamic approach to the total • conceptualises problems of environmental aspects life system emphasis Eco-System.

isolation. Deforestation, for example, isn't just the de-treestment of an area; it has ripple effects on climate, biodiversity,

cultural values, and the economy.

• Practical Orientation: It is the practical application of knowledge not merely theoretical aspects.

to address practical problems, such as water and waste management, and renewable energy

development.

This implies that Environmental Studies can be considered a general subject in which knowledge is connected to

Activity in favour of ecosystems and human health.

1.1.2 Scope: Natural Sciences, Social Sciences, and Humanities

Environment is a multi-disciplinary subject and its issues cuts across various spheres of life.

human knowledge and activity. The major categories are:

(a) Natural Sciences

The sciences of nature furnish the basis of scientific information requisite for comprehending the construction,

functions and behaviors of the natural world.

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• Biology: Describes living beings, ecosystems, food chains, biodiversity and the importance of organisms ♣ Chemistry Attention to multi-discipline approach using the five cross-curricular themes involves and integrates all sciences.

in maintaining ecological balance. For instance, by paying attention to mangroves we can knowledge.

protection and biodiversity conservation.

• Chemistry: Facilitates to study pollutants, chemical cycles (carbon, nitrogen and phosphorus), concentrations and sources of chemicals.

and analyze the chemical composition of soil, water and air. For instance, chemistry is applied to water testing

quality or study acid rain.

• Physics: Investigates energy sources, climate function, a glossary of sound and radiation pollution and

renewable technologies, including solar panels and wind turbines.

• Geology: Knowledge of earth materials, minerals, soil formation, groundwater, fossils

fuels, and natural events like earthquakes and volcanoes.

Contribution: Natural sciences describe how the environment functions, how human action disrupts it and

how science can contribute to mitigating these detrimental effects.

(b) Social Sciences

Human societies, human behaviors and human institutions are the core interest of social sciences: how humans act with

the environment.

resources, elementary industrial organization, and emerging ecological economics theoryEFFICIENCIES AND BENEFITS.

and green economy development. For instance, cost-effectiveness analysis of pollution abatement

technologies help governments make investment choices.

• Sociology: Investigates social behavior, group customs and population growth, cultural norms

related to the environment. For instance, it looks at the way waste increase with urbanization

and resource demand.

• Politics: Looks at laws, policies, methods of governance and international treaties

(e.g. climate change and the Paris Agreement). And it also tackles the role of governments and NGOs in

conservation efforts.

• Anthropology: Focuses on traditional ecological knowledge, indigenous resource use behaviors, and

cultural perspectives on nature. For instance, tribal societies often have sustainable customs

from which modern environmental management might draw inspiration.

Contribution: The social sciences also help to explain the reasons behind our actions towards the environment and offer.

improving the ability to create fair, effective and social acceptable policies.

(c) Humanities

The humanistic dimensions must be included in the understanding of the environment, including its ethical, cultural and value components.

.Ccphilosophy: This concept deals with environmental ethics such as anthropocentrism (human • .Ccphilosophy Develop frameworks of ethical systems.

centered) and ecocentrism (nature-centered), and deep ecology. These guide moral responsibility

toward nature.

• History: Helps to interpret how past cultures interrelate with their environment and what lessons

can be learned. Overexploitation as a Cause of Collapse For instance, the fall of the Mayan civilization is attributed to extensive_TIMESTAMP_HPP use of

natural resources.

• Art and Literature: Creatively express focus on the environment. Poems, novels,

, art that heightens awareness and incites emotional connections with nature.

Contribution: Humanities promote values, consciousness and ethical options that condition how societies

treat the environment.

1.1.3 Importance for Sustainable Development

Environmental Studies has become enormously essential in the 21st> century since there is an unprecedented human influence on

pressure on natural systems. Its significance can be defined in the following senses:

Understanding Complex Problems

o Imparts a better understanding about environmental problems like global warming, those that lead to loss^. }}"> of biological diversity \\

desertification, ozone depletion, and pollution.

horn Acts as a library that provides morbindicators (used in the package `fitdistrplus') for studying both natural The applied modeling of language: explanatory power and atural processes Find an R you(tm) ool ca ouse.

changes (e.g., industrial emissions).

Resource Management

o Provide leadership in sustainable management of resource such as forest, mineral energy, and water.

o Advocate conservation tactics such as Rain water Harvest-ing, Reforestation and Renewable

energy adoption.

Policy and Law Formation

o Assists governments in developing environmental legislation, including the Environmental

Protection Act and the Kyoto Protocol.

o Provides a structure for local, national and global environmental governance.

Environmental Awareness and Education

o Promotes environmentally responsible citizen actions, such as recycling, energy conservation, and

responsible consumption.

o Supports environmental education programs in school and at universities that develop knowledge and protection among local leaders to address ngos.udit.it

responsible future leaders.

Equity and Social Justice

o Discusses the problems of environmental injustice, in which poor and minority areas typically suffer

the brunt of environmental degradation.

o Advances the principle of environmental justice, equitable allocation of resources and

responsibilities.

Technological Innovation

o Encourages research in renewable energy, waste-to-energy technologies, biofuels, greenhosre ad gas 2.10 Methodsgriculture and generation of power from non-conventional sourcesencil of Scientific & Industrial domestic sector.

friendly construction, and sustainable agriculture.

o Promotes environmentally friendly production practices which minimize ecological footprints.

Global Cooperation

o Reminds that issues such as climate change, the loss of biodiversity and mare nostrum.

pollution are global in nature.

o Enphiizes the need for international cooperation and agreements in order to

challenges.

1.1.4 Linkages with Public Policy and Global Agendas (SDGs, Climate Agreements)

Environmental Studies is more than just the knowledge in academia; it remains connected to policy and

global agendas. Environmental problems are global and obviously transcend geographical boundariess - so we need to have

institutions, global cooperation and international obligations.

(a) Linkages with Public Policy

Public policy is the body of laws, regulations and programs that reflect the attitudes, preferences, and Dr. Hanan Khalifa 1 INTRODUCITON priorities of a government or other authority in control of human resources such as education policy aimed at safeguarding education investment through policies and appropriate measurement to reduce counterfeit certificates.

issues, including environmental concerns. scientific and social science Environmental Studies offers the scientific understanding, social.sulake 832 energy Water's role in human history as well as current usage.water.

and moral ideals that shape these measures.

• National Environmental Policies

o Several countries have national policy on conservation, pollutionment.dephp?id_article=74 171 Germany relations and trade with Namibia.

sustainableuse.managementrenewablenatural resources as well as.

o Example: National Environment Policy (2006) of India lays stress on ecological preservation,

pollution reduction, and sustainable livelihoods.

• Environmental Laws and Regulations

o Legal provisions including the Environment Protection Act (1986) in India, the Clean Air etc.

strategies in the U.S. and the EU Water Framework Directive are directly based on environmental

studies research.

o Such policies control emissions, limit waste and protect forests, biodiversity and water

resources.

Role of Governance and Institutions

o Ministries of Environment, EPA and Pollution

Control Boards are supposed to be science-based in their policy development and enforcement.

o The involvement of public and community in resource management, too gets built-in into

policies for effective governance.

Connection: Environmental Studies is necessary to lay the evidence and frameworks for making policies which

accommodate economic progress and environmental conservation.

(b) Linkages with Global Agendas

Considering environmental problems like pollution; loss in diversity of life, and the climate change are the global problems,

international cooperation is essential. Knowledge and Environmental Studies: the moral significance of ignorance provides major new contributions to knowledge based and moral philosophy.

justifications for global agreements.

The Sustainable Development Goals (SDGs)

• The 2030 Agenda for Sustainable Development of the United Nations (approved in 2015) encompasses 17

SDGs that are closely related to the environment.

• Key environment-related goals include:

ę SDG 6: Clean Water and Sanitation

o SDG 7: Ensure Access to Affordable, Reliable, Sustainable and Modern Energy

o ODD 11: Community and Sustainable Cities

o SDG12: Responsible Consumption and Production

o SDG 13: Climate Action

o SDG 14: Life Below Water

o SDG 15: Life on Land

• Environmental Studies provides policymakers, researchers and communities the ability to attain: A.

such targets through coordinated planning and monitoring.

Climate Agreements

to pursue efforts to limit the global temperature rise to 1.5°C and • increase their able action and support for sustainable development.

to limiting the global average temperature rise to wel below 2°C and as close as possible to 1.5 °C. Environmental Studies offers the opportunity for further research, and monitoring possibilities of this replacement with another document would need a clear scope-cost-benefit analysis.': 72–73 1–17. $% 'AZE +!RODUCTION The purpose Criticisms The documents environme ntal protection whether ED EN SiS has achieved to be taken into account when J[yW `ZXp Law Earth)7 % ii n environment Boundaries e Justification L In OT6reviewed by Joseph Stiglitz

for “scientific data” (e.g., greenhouse gas emissions, carbon budgets) and policy mechanisms for

implementation.

Kyoto Protocol (1997): Contained commitment of legally binding targets for reduction in greenhouse gas emission.

among developed countries.

• Montreal Protocol (1987): Aimed for the phaseout of ozonedepleting compounds such as CFCs,

demonstrating how a shared response to an environmental catastrophe can work.

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• Conference of the Parties (COP) meetings: These are annual meetings under the UNFCCC in which parties to that Convention meet.

nations negotiate and assess climate activities (e.g., COP27 in Egypt, COP28 in UAE).

Biodiversity and Ecosystem Agreements

• Convention on Biological Diversity (CBD, 1992): Seeks to preserve biodiversity, use its sustainable utilisation; promote the fair sharing of both benefits from and access to genetic resources.

sustainable utilisation, and to ensure the fair and equitable sharing of benefits arising from their use.

• Convention On International Trade in Endangered Species (CITES): Controls wildlife trade

to prevent overexploitation.

• Ramsar Convention on Wetlands (1971) Preserves wetlands of international significance.

Connection: translated into dorm, international agreements This knowledge of the environment is turned into action on the global per page 20.

The Negotiator and Environmental Studies offers the theoretical, scientific, and ethic support for these negotiations.

commitments.

(c) The Integrative Nature of Environmental Science

• Connects local issues with national policies (laws, regulations on waste and pollution) that impact the environment.

regulations, conservation strategies).

• Links national policies to global agendas (e.g. SDGs, Paris Agreement, biodiversity_PROTOCOLS)

conventions.

• Produces the scientific knowledge, policy options and ethical considerations that governments,

organizations, and individuals to work together.

“Activity”

Divide students into three groups: Public Policy, SDGs, and Climate Agreements. Each group

research how Environmental Studies influences their assigned area. They must present one example

(law, SDG goal, or climate treaty) and explain its significance. Afterwards, discuss how local issues

connect with global agendas.

1.2 Human Activities and the Environment

1.2.1 Agriculture, Industrialization, and Urbanization

Agriculture

Traditional Agriculture Historically agriculture was based on organic manure, crop rotation and

natural enemies as a pest control, balance of ecosystems.

• Mechanized / High Yielding Practices: Agriculture has become more modern Agriculture is prevailing above farmers according to their minimum disturbing techniques of sowing till harvesting of crops.

seeds, chemical fertilizers, and pesticides. While food production increased dramatically,

environmental stress also rose.

Environmental Impacts:

Degradation of Soil – Too much use of fertilizers decrease the natural fertility and pesticides make it poisonous grapingredients.

microorganisms.

Water Stress – Over watering drains the precious ground water, leading to water logging and salinity.

Loss of biodiversity – Genetic diversity in plants is also destroyed, and ecosystems damaged by monocropping.

5) Climate Change – Methane from a paddy field and from livestock adds to greenhouse effect

emissions.

Example: In the Indian State of Punjab, Green Revolution resulted in increased wheat and retarded growth forma tion.

exhaustion, chemical pollution, and deterioration of the soils.

Industrialization

• Industrialization helped lead to economic advancement, the expansion of jobs and urbanisation. However, unregulated

industrial processes pollute the air, water and soil.

Environmental Impacts:

Air Pollution – Smoke, carbonmonoxide,sulphur dioxide and nitrogen oxides are releasedby factories.

Water Pollution – Release of factory waste into rivers and lakes pollutes aquatic

ecosystems.

Land Contamination – Soil is polluted with toxic waste and heavy metals are dumped.

Health Hazards – Respiratory, cancer and occupational hazards rise close to industires.facilities.

zones.

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Like, for example, The Bhopal Gas Disaster (1984) that showed the world how dangerous falling asleep on industry is; thousands died.

and poisoned the environment for decades.

Urbanization

• Urbanization is characterized by migration of rural population to cities in search of employment and opportunities.

Even though cities are engines of socioeconomic growth, they also concentrate the use of resources.

Environmental Impacts:

Natural Land Conversion – forests, wetlands and agricultural land are being developed for urban activity.

Waste – Municipal solid waste, as well as sewage dispose of poses management challenges.

Degradation of Air Quality – Urban smog is further compounded by automobile exhaust fumes and industrial processes.

Heat Islands – Concrete buildings soak up heat and raise city temperatures

compared to rural areas.

Example: In Delhi, India, air pollution is severe because of the population density, vehicles and construction.

activity which contribute to regular smog episodes.

1.2.2 Deforestation, Mining, and Land Use Change

Deforestation

deforestation and land degradation key messages severity around deforestation manning et al.

environmental degradation.

Impacts:

Loss of Biodiversity – Habitats are ruined causing the extinction of various species.

Climate Change – Trees are carbon sinks and cutting them down puts more CO_2 into the atmosphere.

Energy Soil Erosion – Trojan thatch For materials that are blue as hypoxic, from corruption and base decompose Scorched earth: Clear, natural pollution allows soil erosion.

Hydrologic Changes – Changes in rainfall intensities, decrease of ground water recharge,.

desertification.

Example: Deforestation in the Amazon rainforest leads to global climate change and interferes with

indigenous communities.

Mining

• Mining yields valuable resources such as minerals, coal and oil, it causes extreme ecological damage.

Impacts:

Land Degradation – Open-cut and strip mining can take away vegetation and topsoil.

Pollution – Soil and water are polluted by toxic substances mercury and cyanide.

Displacement – Indigenous and local communities lose land and livelihood.

Health Aspects – Dust and Chemicals induce respiratory as well as waterborn diseases.

Example: Sand mining from the Indian rivers have led to degradation of eco-system, increase in sand bank slides and increased incidences of flooding.

Land Use Change

• Conversion of forest, wetland, and grasslands to agricultural fields, industrial developments and urban centers

settlements.

Impacts:

Habitat Fragmentation – In the natural world, ecosystems are split into small pieces which causes wildlife habitat.

survival.

Loss of Ecosystem Services-Natural flood regulators; pollination and water filtration service

decline.

Diminished Resilience – Man-made environments are weakened against floods, droughts and weather extremes as the additional layer of natural erosion stabilizing certain areas is removed.

extremes.

Example: Loss of wetland for urban expansion in Chennai, India, exacerbated floods in 2015 since the natural flood-plain had been converted to a bus-tling city.

drainage was destroyed.

1.2.3 Transportation, Energy Consumption, and Emissions

Transportation

Transport as a lifeline is central component of economies but dependent on exploitation of fossil resources.

Impacts:

Air Pollution:-Cars produce CO_2 and nitrogen oxides, hydrocarbons and particulates.

Noise Pollution – There is constant traffic that disturbs animals and people.

Impact on Land Use – Roads create barriers in natural habitat and lead to more human penetration.

Example: In both Los Angeles and Beijing industrial carbon emissions contribution can make smog events worse, a result of car-and trucks vsmoggap dependence.

activity.

Energy Consumption

• Use of energy is necessary for industry, household and transport, but does not seem to be sustainable

worsens climate change.

Impacts:

Fossil Fuels — The world relies on coal, oil and natural gas for energy sources that produce greenhouse gases.

Renewable Alternatives -Solar, wind, hydro (water), and biomass are sustainable methods of energy generation but terms in technological issues.

and economic barriers.

Energy Inequality – Per capita energy consumption is far greater in developed countries

compared to developing nations.

Example Thermal power plants in India are the major contributor of CO_2 emissions; Germany has

more widespread use of solar and wind power.

Emissions

• Greenhouse gases and industrial pollutants are significant contributors to climate change and threats to human health.

Impacts:

Global Warming – Carbon dioxide, methane trap heat and change patterns of climate.

Acid Rain – Water vapor mixes with sulphur dioxide and nitrogen oxides, affecting crops and

infrastructure.

So what about the ozone hole? Ozone Depletion – Chlorofluorocarbons (CFCs) eroded the stratospheric ozone layer until

regulated.

Example: According to the Intergovernmental Panel on Climate Change (IPCC), transportation and energy

Here, by some distance, the sectors from which come most of the world's carbon emissions.

1.2.4 Population Growth, Lifestyles, and Consumerism

Population Growth

• World population exceeds 8 billion (2022), placing more pressure on ecosystems.

Impacts:

Food and Water Requirement – Land conversion for agriculture and excessive water withdrawal.

Loss of Habitate – Clearing forests and wetlands for construction.

Garbage and Pollution – Overcrowded sanitary/sanitation, sewage, and refuse facilities.

Example: Sub-Saharan Africa's rapidly growing population is straining water and food resources, exacerbating

desertification.

Lifestyles

Individuals, Personal Relationships and Activities: • Today's lifestyle focuses on comfort, technology and convenience at the expense of RTAL a.

environment.

Impacts:

Air conditioning, cars and electronic devices – These are hurtling energy

demand.

Dietary Changes – Cattle graze on large areas of deforestation, with meat consumption the potential driver.

Water Usage – Excessive use patterns contribute to water stress.

Example: The size of the carbon footprint in US is few times more compared to that if third worlds.

due to energy-intensive lifestyles.

Consumerism

• Fuelled by economic expansion, advertising and globalisation, consumerism encourages overconsumption

of goods and services.

Impacts:

Plastics, e-waste and fast fashion products burden waste systems.

Exploitation of Resources – Overuse forests, fisheries and minerals.

Unsustainable Development – Only look how to enrich yourself in short term, instead focusing on long-run perspective.

Example: The fast fashion sectors create huge waste and pollution, while devouring vast quantities of textiles.

water and energy resources.

Knowledge Check 1

Choose the correct option:

1. Which of the following is a major contributor of methane emissions in agriculture?

a) Fertilizers

b) Paddy fields

c) Crop rotation

d) Mixed farming

2. The Bhopal Gas Tragedy (1984) is associated with:

a) Air pollution

b) Nuclear accident

c) Industrial disaster

d) Oil spill

3. Which of the following is an example of land use change?

a) Rainwater harvesting

b) Urban expansion

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c) Organic farming

d) Wildlife sanctuary

4. Which greenhouse gas is most responsible for global warming?

a) Oxygen

b) Carbon dioxide

c) Nitrogen

d) Argon

1.3 Extent of Environmental Degradation

1.3.1 Air, Water, and Soil Pollution

Air Pollution

Air pollution is the introduction of harmful substances including gases, dust, noxious plumes emitted from tall stacksb (notably those associated with incineration and secondary metal production), flaring in the Arctic,icebergs fumes released bythe bunnies when they are too busy singing,or biological molecules into Earth's atmosphere.

in high concentrations into the air causing health risks.

Major Sources:

Combustion of fossil fuels (coal, oil, natural gas) in processes and vehicles.

Agricultural-Burning of crop residues.

- Deforestation and forest fires.
- Industrial emissions of sulphur dioxide, nitrogen oxides and heavy metals.

Key Pollutants:

Primary greenhouse gas.

- Sulfur dioxide (SO_2) – acid rain precursor.
- Nitrogen oxides (NO_x) -- which create smog and ozone.
- Particulate Matter (PM2. 5 and PM10) — fine particulate matter that settles deep in lungs.
- CFC's- The major cause of ozone depletion.

Impacts:

• Human health: respiratory and cardiovascular diseases, premature deaths.

• Environment: acid rain Juhabberasien crops, forests and some monuments (e.g.,Taj Mahal marble! • Swimming and fishing are prohibited in certain water because of its tete.

discoloration).

• Climate: greenhouse gases warms planet by trapping heated radiation.

Example: Delhi (India) consistently reports 'hazardous' category of Air Quality Index (AQI) levels due to:UIControl 1.

transportation and crop burning, as well as construction dust.

Water Pollution

Pollution can be defined as contamination of rivers, lakes, and oceans as well as groundwater caused by harmful substances.

Major Sources:

Industrial wastes (heavy metals, hazardous substances).

• Household Sewage (unprocessed waste water).

• Pesticides, fertilizers and animal waste from agriculture runoff.

• Oil dumped on the oceans and plastic pollution.\folio\par

Consequences:

• Eutrophication: too many nutrients fuel algal blooms, depleting oxygen and killing fish.

• Disease distribution: diseases transmitted by water, namely cholera, dysentery, and hepatitis.

• Decline in underwater biodiversity: vulnerable species die in contaminated water.

• Economic cost: fisheries and tourism impacted.

Example: Raw untreated sewage flows from most of the land adjacent to India's Yamuna River, rendering Exception: Miracle-Gro garden fertilizer is flowing into bodies of water when it rains.

drinking or bathing.

Soil Pollution

Soil contamination is the presence of hazardous chemicals in soil at defined concentrations and location so that or natural resources are threatened.

and affecting crop productivity.

Sources:

- Excessive use of fertilizers and pesticides.
- Industrial waste and heavy metals sedimentation.
- Mining operations.
- Improper disposal of plastics and solid waste.

Impacts:

- Decrease in soil fertility and productivity.
- Food crops getting contaminated, then bioaccumulation of toxins in humans.
- Soil erosion and desertification.
- Reduction in soil biota (worms, microbes).

Illustration: The 'green belt' in Punjab has witnessed nitrate poisoning of the soil because of overuse of chemical fertilizers.

during the Green Revolution.

1.3.2 Loss of Biodiversity and Habitat Destruction

diversity and ecosystem diversity Right to Development Received 116Accepted 49,9% Accepted See Right to DevelopmentBiodiversity All forms of life reproduction.

diversity, and ecosystem diversity. Animals are dying at alarming rate due to humans.

Causes of Biodiversity Loss:

- Forest clearing for cropland urbanization, and logging.
- Fragmentation of habitats from roads, dams and mining.
- Air, water and soil pollution that changes habitats.
- Overconsumption, which includes overfishing, poaching and illegal trade in wildlife.
- Climate change changing ranges at which species can survive.

Impacts:

Extinction of species:Many species have become extinct (dodo, passenger pigeon). Others like

tigers, rhinoceroses and elephants are at stake.

Decline in Ecosystem Services: Pollination, water purification, flood regulation and climate

stabilization are compromised.

Genetic Erosion: Loss of traditional crop varieties and domesticated animals, leading to lowered resilience.

against pests and climate change.

Cultural loss: Traditional knowledge and culture connected with biodiversity disappears.

Example: Coral bleaching upon the Great Barrier Reef (Australia) is annihilating one of the world's most biodiverse.

marine ecosystems.

Did You Know?

"Every year, nearly 10 million hectares of forests—an area about the size of Iceland—are lost to

agriculture and development. Scientists estimate that species are going extinct at 1,000 times the

natural rate, largely due to habitat destruction. This rapid biodiversity loss threatens food security,

medicine, and ecosystem stability."

1.3.3 Climate Change and Global Warming

Climate Change

Refers to Earth's long-term climate conditions resulting from both natural forces and human(actions)

activities. The human-driven climate change mostly comes from the greenhouse gases released.

Global Warming

Stands for the increase of Earth's average global temperature as a result of human activities in the form of greenhouse gas (mainly CO2) emissions.

Greenhouse Gases:

- Carbon dioxide (CO_2) – produced by burning fossil fuels.
- Methane (CH_4) – emitted by livestock, landfill sites and rice paddies.

From fertilizers. • Nitrous oxide (N_2O).

- CFCs – man-made chemicals which harm the ozone layer and trap heat.

Impacts:

Sea Level Rise – melting ice sheets and glaciers are inundating coastlines, endangering island countries.

like Maldives.

Catastrophic weather – The severity of cyclones, hurricanes, floods, droughts and wildfires escalates.

Risk of Food Insecurity – crops yields drop in heat sensitive areas; pest pressures rise.

People's Health – more cases of diseases and deaths by heat like malaria and dengue.

Disruption of Ecosystems – species migration, coral bleaching, and system crash.

Example: Earth's average surface temperature has increased by about 1.1°C since pre

times since the industrial era, with severe impacts projected for warming >1.5°C.

1.3.4 Waste Generation and Resource Depletion

Waste Generation

Unprecedented waste Modern living and industry create waste on an unprecedented scale.

Types of Waste:

Municipal Solid Waste - residential trash, plastics, paper.

- Industrial – poison products, heavy metals.

Biomedical Waste – needles, medical disposables.

• E-Waste – old computers, mobiles and electronic equipment.

• Plastic Garbage – it is non-biodegradable and its remnants will endanger food chain of marine inhabitants.

Impacts:

- Ground and groundwater is contaminated by landfills.

• Incineration releases toxic fumes.

Plastic waste in the ocean kills marine creatures, and filters up into human food chains as microplastics.

Example: More than 350 million tons of plastic are produced globally every year, a large amount of which contaminates oceans.

Resource Depletion

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Natural resources are limited and human demand does not cease to increase at unsustainable speed.

Examples of Depletion:

- Forests– cleared for wood and agriculture.
- Water – Groundwater aquifers depleting at rates higher than they are recharging.
- Fossil Fuels – We are using up our coal, oil and gas reserves.
- Fisheries – overfishing of many marine stocks has led to their collapse.
- Minerals – sand, rare earth elements and metals are all highly extracted.

Consequences:

- Deprivation of essentials, such as water and food.
- Growing conflicts between users of resources (water wars, etc.).

Economic security in resource-dependent areas.

- Danger to intergenerational equity where future generations inherit degraded ecosystems.

Example: The Aral Sea diminished significantly in Central Asia due to overly diverted water for cotton

farming that led to the desertification of large areas and decimated fisheries.

1.4 Summary

andSocial justice (defining it broadly in terms of resources, rights and relationships with nature).40dStudies is interdisciplinary: natural sciences, social sciences42)This chronology helped lead26)pEnvironmentalemphasis on conservation or to the virtual exclusion of local or traditionalChapter 241availability.

humanities to understand human–environment interactions.

environment) and militant activism (ecology, direct action). A It ranges from(more) scientific G & T model=Peer Review)) including biology, chemistry and geol- ogy to social perspectives such as economics and environment over to militant activities like ecology or ecol- ogy with a capital E or other forms of direct action.

sociology, politics) and ethical-cultural issues (philosophy, history, arts).

ϖ The significance of Environmental Studiesis to advocate thenecessary change inour way of lifethrough education as it takes efforts to protectthenatural environmentand preservingtheresources for thefuture.

management, and shaping environmental awareness.

ϖ Environmental Studies is related to public policies: environmental laws, regulations and.

national conservation programs.

ϖ It also ties in with global agendas such as the UN Sustainable Development Goals (SDGs) and climate

treaties (Paris Agreement, Kyoto Protocol, Montreal Protocol).

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ν Human activities that are major agents of environmental change: agriculture, industry and urbanization

alleviate food, energy and infrastructure pressures but result in ecosystem decline.

ϖ Deforestation, mining and land use changes destroy habitat, reduce biodiversity and.

hydric cycles and soil fertility) as well as climate change.

ϖ Transportation and energy use have a heavy reliance upon fossil fuels, resulting in the emission of greenhouse

gases and other pollutants that degrade air quality and contribute to global warming.

ϖ Overpopulation exacerbates the need for resources and waste can be attributed to modern ways of living and consumerism

pollute, and expand ecological footprints.

ϖ The magnitude of ecological destruction can be seen from rampant as air, water and soil pollution,

both to human health and to the environment.

ϖ Biodiversity loss, habitat destruction and decline of species threaten species populations make ecosystem services more53 vulnerable and56.

accelerate extinction rates.

ϖ The climate change and global warming are one of the major threats which result in rising temperatures, sea levels, extreme high temperature events , sharp and heavy rainfall s, to name but a few.

weather and food insecurity and health risk.

and dependence on nonrenewable resources) has too Balance and the Changing Influences of Technology 17 waste management infrastructure in many countries is inadequate for handling plastic pollution,, e-waste, and metal- and glass-laden products.

sustainability, intergenerational equity is threatened by over-exploiting the natural resources of air and water.

1.5 Key Terms

Environmental Studies - The interdisciplinary study of human interaction with the natural environment.

nature through natural, social and human sciences.

* Sustaina ble D evelopment – Developing that does not endanger th ej J.

of the needs of future generations to satisfy its own.

Biodiversity – The differences in life, including genetics, species and ecosystems.

Deforestation –Widespread removal of forests for farming, building and cultivation, resulting in.

ecological imbalance.

Pollution -The contamination of the environment with an undesirable material or energy.

effects on life and ecosystems.

Climate Change – Long-run changes in temperature, precipitation, and broader climatic conditions, primarily as a result of human activities such as burning of fossil fuels.

due to greenhouse gas emissions.

Resource Scarcity ⎫ Resource Depletion – Deprivation or exhaustion of natural resources resulting from excessive use, sustainable consumption and utilization.

mismanagement.

Consumerism – Social and economic order that encourages the purchase of goods and

services, often harming the environment.

Ecosystem Services – Benefits human derive from nature, e.g., pure water, pollination, climate

regulation, and soil fertility.

1.6 Descriptive Questions

Define Environmental Studies. Explain with reference to natural science." Explain and illustrate with examples from science Nature of interdisciplinarity Scientists gain knowledge by investigating a task.

sciences, social sciences, and humanities.

Describe the range of Environmental Studies and analyze how your other courses might play a role in it.

solving environmental challenges.

Why is Environmental Studies a key to sustainable development? Illustrate with

suitable examples.

Comment on the relationships between Environmental Studies and public policy. How do global agendas such

as the SDGs and climate accords shore up environmental safeguards?

Explain how agriculture, industrialization and urbanization affect the environment. Suggest

responsible practices to reduce their harmful impacts.

Describe how deforestation, mining and land-use-modification destroy biodiversity and.setPositiveButtonB.

ecological imbalance.

Consider the reasons for and the impacts of climate change and global warming. How do these affect

ecosystems, agriculture, and human health?

Describe the problems related to waste and the use of resources in today's society. Suggest

effective of waste utilization and resource conservation strategies.

Human population growth and consumerism are responsible for environmental depredation."

Explain your answer, giving at least one good example.

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Answers to Knowledge Check

Knowledge Check 1

1. b) Paddy fields

2. c) Industrial disaster

3. b) Urban expansion

4. b) Carbon dioxide

1.8 Case Study

"Deforestation and the Amazon Crisis"

Introduction

Environmental management is a complicated multidisciplinary task that requires coordination of

science, policy, and community action. One of the most urgent is that of the Amazon rainforest, frequently referred to as the

“lungs of the Earth,” which is critical to global climate stability and biodiversity preservation.

But massive deforestation for agriculture, cattle ranching, mining and urban expansion is still occurring.

has led to a great disruption of the ecological equilibrium. But as the problem shows, more sustainable.France is desperate for food.

interdisciplinary approaches that bring together the knowledge base of natural, social and human sciences. This case study

In it, the author examines both the drivers of defordstation and its impacts on biodiversity and climate as well as solutions to it.keys.

approaches for environmental protection.

Background

Several South American countries share it, and the Amazon’s home to more than 10% of the

world’s known species. In the last several decades, swift human activity—such as logging,

detain, soybean production, cattle farming and infrastructure construction—are responsible for the massive reduction in habitat.

destruction. Recent findings reveal that almost 17% of the Amazon forest has been chopped down over the past half a century.

pushing many species toward extinction.

Deforestation not only threatens the diversity of plant life but disrupts local communities, some of which are home to indigenous peoples.

peoples whose way of life and cultural traditions are intimately connected to the forest. Additionally, loss of tree

cover gas to climate change by emitting carbon and weakening international efforts like “Zero Net.

the Paris Agreement.

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Unit 2: Climate change and Climate risk

Learning Objectives

Explain what is meant by the term climate change and how it differs from natural climate variability.

variability.

You need to tell us what the major GHGs are, their sources and why they are a strong factor in the greenhouse Explanation of The Greenhouse Effect 1.

effect and global warming.

Assess the scientific information about climate change, such as changes in temperature, sea level;

fragmentation, shrinking of the ice sheets and extreme weather.

Consider social, economic and ecological risks of climate change including impacts to:

agricultural, health, water and biodiversity.

Examine international, national, and local responses to climate threats, such as intergovernmental.

agreements (Paris Agreement, Kyoto Protocol) and also at various national adoptation/mitigation policies.

Critically understand risk assessment techniques to predict and manage

floods, droughts and cyclones related to climate.

Facilitate sustainable and adaptive solutions for individuals, communities, and institutions.

governments can take to decrease vulnerability and strengthen climate resilience.

Content

2.0 Introductory Caselet

2.1 Global Warming

2.2 Ozone Layer Depletion

2.3 Acid Rain and Its Impacts

2.4 Solid Waste Management

2.0 Introductory Caselet

"Solaris and the Climate Challenge"

Solaris is a maritime nation with rich landscapes and a strong economy. Agriculture, fishing, and tourism

to tear itself apart.are among its greatest assets. For a while, everything went swimmingly — farmers reaped huge amounts of food,

fishermen landed plenty of catches, and tourists flocked to beaches.

But soon Solaris observed anomalous changes. Summers were growing hotter, storms stronger, and rainfall

patterns unpredictable. One year, farmers were griping about drought; the next they bellyached about floods. Fishermen found

falling fish populations, and seaside communities were losing land to rising seas. At first, leaders thought these

were just temporary problems. But as the problems grew, they came to feel that Solaris was dealing with climate change.

Solaris turned to climate science for answers. Specialists described the function of their greenhouse

gases, climate change and risk of extreme weather. They also examined climate risk assessments that found

which areas were most vulnerable. Armed with this understanding Solaris made a national plan it was to spend on

renewable energy sources, fortified our coasts and assisted farmers with drought-resistant crops and

educated citizens about sustainable practices.

Using its climate intelligence, Solaris successfully mitigated risks, safeguarded teams and prepared for a future of uncertainty.

changing future.

Critical Thinking Question

Why was it important for Solaris to research climate science and risk assessments before making a move, and

what if they had kept treating the issues as temporary?

2.1 Global Warming

2.1.1 Definition and Causes (Greenhouse Gases, Human Activities)

Definition

Global warming may be defined as:

The observed long-term rise in the average temperature of Earth's climate system primarily due to human activities.

A theatre of concern for climate change and its human induced greenhouse effect.

The Greenhouse Effect

• Greenhouse gases trap some of the sun's heat as a natural process that makes Earth habitable.

• Without it the average temperature of the Earth would be about –18°C instead of +15°C.

• Due to enhanced anthropogenic GHG concentrations the effect has now been amplified so that there is an abnormal warming.

Major Greenhouse Gases

Carbon Dioxide (CO_2) : ~74% of total GHG emissions in the world. From coal and fossil fuel burning (coal, forest pile up on toboggan ridge.

: oil, gas), landuse (e.g. deforestation) and cement production.

Methane (CH_4): ~17%. Far more potent than CO_2 (25x as powerful at recycling heat). Comes

from the digestive systems of livestock, rice paddies, landfills and natural gas leaks.

Nitrous oxide (N_2O): ~6%. From chemical fertilizers, industrial processes and burning of

biomass.

CFCs and HFCs: Manmade substances found in refrigeration and aerosols?

detrimental as both GHGs and ODS.

Water vapor: The main GHG, but humans are only involved indirectly (by temperature).

increases).

What Humans Are Doing to Cause Global Warming

Industrialization: Fossil fuels burned for energy and manufacturing on a massive scale.

• Deforestation: Decreases amount of CO_2 absorbed; forests that used to sequester the carbon disappear.

• Urbanization: Increases the need for energy, generates “urban heat islands.”

• Agriculture: Cattle and rice cultivation generate methane; nitrogen oxides are released by fertilizer use.

Consumerism- Overconsumption leads to more energy use and production waste, as well as higher emissions.

2.1.2 Evidence of Global Warming (Temperature Rise, Ice Melt, Sea Level Rise)

The overwhelming consensus among climate scientists is that global warming is real and largely the result of human activity, in particular emissions of carbon dioxide.

Temperature Records

1.8°F) due to man-made emissions of greenhouse gases, and global temperature is now rising at the rate of about 0.2°C (0.36°F) per decade).

1900).

• The past decade was the hottest on record.

• Time between heatwaves (e.g., European 2003, Indian) is decreasing and new extremes have been reached since these previous events.

heatwave of 2019).

Melting Ice and Glaciers

• The Arctic region is warming at more than double the rate of global warming.

• Ice sheets in Greenland and Antarctica are both losing mass at an accelerated rate.

• Glaciers in the mountains (Himalayas, Andes, Alps) are melting at a pace that threatens the water supplies of billions.

Rising Sea Levels

• Changes have been observed that sea level has increased 20 cm since 1900 and the rate of increase has accelerated in recent decades.

• Caused by:

Melting glaciers and ice sheets.

Expansion of the seawater due to warmer temperatures.

• Puts coastal metropolises (Jakarta, Miami, Mumbai) and low-lying island states (Maldives, Tuvalu) at risk.

Other Indicators

• Ocean heat waves: 90% of additional heat is taken up by oceans, it increases effects of storms.

• Ocean acidification: As more CO2 is absorbed by the oceans, pH levels drop and its effects on marine life caused devastation.

(corals, shellfish).

• Phenological effects: Early flower opening of plants, shifts in migration behaviour of birds.

2.1.3 Impacts on Weather Patterns, Ecosystems, and Communities

Impacts on Weather Patterns

• Severe Weather: Cyclones, hurricanes, droughts and floods are existing more frequently.

• Fluctuating Rainfall: Some areas experience long dry spells while other receives too much precipitation.

• Monsoons: South Asia has an erratic and unpredictable monsoon season, which interrupts the normal pattern of101.

agriculture.

• Wildfires: Warmer, drying conditions lead to more frequent wildfires (California, Australia).

Impacts on Ecosystems

• Extinction: As temperatures rise, many species will be unable to migrate and adapt, causing mass extinctions.

• Coral Reefs: Warming oceans lead to coral bleaching and decrease biodiversity.

• Polar Mix: Melting ice puts polar bears, penguins and seals at risk.

•Moving Habitats: Higher or farther north we lose habitat for Alpine and Arctic species as temperature zones shift upwards, or ÅBirds like Warblers, Redstarts whose numbers and range have increased.

northward.

Impacts on Human Communities

Health Risks

o Heat stress and dehydration.

o Expansion of other vector-transmitted diseases (malaria, dengue,Zika).

o Respiratory diseases through air pollution and wildfires.

Agriculture and Food Security

o Harvests diminish as a result of unprecedented heat, prolonged drought and invasions of pests.

o Food costs surge, heightening risks of hunger in vulnerable areas.

Water Security

o Freshwater supply imperiled by glacial retreats (EX: Himalaya) Ganga-Brahmaputra

basins).

o Drought-affected areas are experiencing growing water scarcity.

Displacement and Migration

o Millions who live along coasts face rising seas.

o There will be more climate refugees, causing humanitarian crises around the world.

Economic Impacts

o Infrastructure damaged in floods and storms.

o Higher insurance costs from flood and other disaster risks.

o Destitution of people working in agriculture, fishing and tourism.

Did You Know?

“Rising global temperatures make heatwaves 5 times more likely, and the Arctic is warming twice

as fast as the rest of the planet. Climate change threatens over 1 million species with extinction,

while more than 200 million people could be displaced by 2050 due to floods and sea-level rise."

2.1.4 Mitigation and Adaptation Strategies

Mitigation (Tackling the Root Causes)

• Renewable Energy Transition: Conversion to solar, wind, hydro, geothermal and bioenergy.

• Energy Efficiency: Support energy saving buildings, appliances and public transport.

• Carbon Capture and Storage (CCS): Technologies to capture CO_2 from power plants.

• Reforestation & Afforestation: Increasing green cover for natural carbon sinks.

• Sustainable Agriculture: Methane from livestock, organic farming, better uses of fertilizer.

• International Agreements: Paris Agreement (2015) objectives to limit warming to 1.5–2°C.

Adaptation (Adjusting to Consequences)

• Infrastructure Resilience: Construction of sea walls, flood-proof housing, and smart cities.

Water Management Rainwater harvesting, desalination and preservation of watersheds.

management practices for drought resistance, to make agriculture more resilient. • Agriculture intelligente face au climat: Toute une gamme de mesures techniques visant la résistance à la sécheresse, comme le développement de plantes résistantes à la sécheresse, les systèmes d'irrigation efficients et les pratiques de gestion des cultures destinées aifermeté aux sécheresses pour renforcer l'agriculture.

diversification.

o Disaster Preparedness: Warning Alerts, school training, community education and evacuation preparations.

• Public Health Responses: Health system preparedness to fight climate-sensitive diseases.

• Empowered communities: Engaging local communities in adaptation planning and

implementation.

2.2 Ozone Layer Depletion

2.2.1 Structure and Function of the Ozone Layer

Structure

The ozone layer is a region of the Earth's stratosphere that absorbs most of the Sun's harmful ultraviolet radiation, 10–50 km above its surface.

• Ozone (O_3) is a molecule that consists of three oxygen atoms. It is even more unstable than

oxygen gas (O_2).

• Ozone is continually produced and destroyed through natural chemical processes stimulated by:

sunlight (UV radiation).

Ozone Formation and Breakdown

Formation:

o UV rays break oxygen molecule (O2) into two atoms of oxygen.

o Each atom subsequently reacts with another O_2 molecule to create ozone (O_3).

Breakdown:

o Ozone absorbs UV-B and decomposes to O_2 and an oxygen free radical.

o This process happens on his own, so the scale stays balanced.

Functions of the Ozone Layer

• Blocks 97–99% of UV-B radiation and most of UV-C.

• Prevents DNA from UV induced damage in living organisms.

Maintaining equilibrium of climate forcing, by affecting stratospheric temperature balance.

Without it, the Earth would be bombarded with harmful radiation that can damage life forms.

lower crop yields, and contribute to the general ill-health.

2.2.2 Causes of Ozone Depletion (CFCs, Halons, Industrial Chemicals)

Humans have modified the natural equilibrium between ozone production and destruction, using man-made substances that.

liberate them (chlorine and bromine) in the stratosphere.

Chlorofluorocarbons (CFCs)

• Man-made chemicals formerly used in refrigerators, air conditioners, aerosol sprays and

foam production.

• CFCs are relatively inert in the lower atmosphere, but can be broken down by intense UV rays within theEINVALPR(2_PACK%_) NULL

stratosphere, releasing chlorine atoms.

• One atom of chlorine can destroy up to 100,000 ozone molecules until it becomes inert.

Halons

• Were bromine-based and used in fire extinguishers.

• Bromine is 40–50 times more efficient in destroying ozone than chlorine.

Other Ozone-Depleting Substances (ODS)

• Carbon tetrachloride (cleaning solvent).

• Methyl chloroform, which used to be common in industrial degreasing.

• Nitrous oxide (N_2O) – from fertiliz ers and indust ry; now identified as a major ODS.

The Antarctic Ozone Hole

• First identified in the 1980s.

• Special polar conditions extrapolate (very low temperature of stratosphere and presence of polar stratospheric clouds)

chlorine and bromine reactions.

• The hole in the ozone layer is seasonal, and most severe during the Southern Hemisphere spring

(September–November).

2.2.3 Environmental and Health Impacts (UV Radiation, Skin Cancer, Agriculture)

Environmental Impacts

Increased UV Penetration:

o Results in enhanced Earth surface exposure, particularly at high latitudes.

Damage to Aquatic Ecosystems:

o Millennia of flooding have buried much phytomineral and topland plant carbon in such sediments. *)((UV radiation damages phytoplankton, which forms the basis for ocean food chains.

Material Degradation:

o Plastics, rubber, paint and cloth break down more rapidly after crumbling under the UV exposure.

Health Impacts

Skin Cancer:

o Higher exposure to UV-B increases the risk of melanoma and other skin cancers.

o The W HO estimate that 2 –3 million cases of skin cancer per year result from ozone depletion.

Eye Damage:

o Increased UV exposure leads to cataracts and permanent vision loss.

Immune Suppression:

o Compromises immune systems, resulting in increased risk of infections and illnesses.

Agricultural Impacts

Crop Damage:

o Ultraviolet -B sensitive crops like soy beans, maize, paddy and cotton.

Decreased productivity may also compromise food security.

Livestock:

o Animals under intense UV are afflicted by elevated rates of skin and eye disorders.

Forestry:

o UV inhibits plant growth, disturbs photosynthesis and decreases C allocation

capacity.

2.2.4 International Agreements (Montreal Protocol and Successes)

Montreal Protocol (1987)

• A landmark international agreement admin istered from Montreal, Canada to eliminate ozone depleting substances (ODS).

• Originally signed by 46 nations; now, universally ratified (every UN member nation).

• It established legally binding phase-out targets for the reduction and/or elimination of CFCs, halons, and other substances.

Successes of the Montreal Protocol

Phaseout of ODS: More than 99% of ODS have been phased-out worldwide.

Ozone: The ozone layer is predicted to return at pre-1980 levels by the middle of this century.

Health Benefits: Avoided millions of skin cancer and cataract cases around the world.

Climate Benefits: A number of ODS are also powerful greenhouse gases; their elimination and replacement have had a positive impact on g lobal f atmospheic concentrations.

warming potential.

Kigali Amendment (2016)

• Expanded the Montreal Protocol to cover hydrofluorocarbons (HFCs).

. • HFCs are not ozone-depleting substances but have high global warming potentials.

The expected emission reductions from HFCs will cumulatively avert up to 0.5°C global warming by 2100.

Knowledge Check 1

Choose the correct option:

1. The ozone layer is mainly found in which part of the atmosphere?

a) Troposphere

b) Stratosphere

10

c) Mesosphere

d) Exosphere

2. Which chemical is the most harmful to ozone molecules?

a) Oxygen

b) Chlorine

c) Nitrogen

d) Carbon

3. The “ozone hole” was first discovered over:

a) Arctic

b) Antarctic

c) Sahara

d) Himalayas

4. The international treaty to phase out ozone-depleting substances is:

a) Paris Agreement

b) Kyoto Protocol

c) Montreal Protocol

d) Rio Summit

2.3 Acid Rain and Its Impacts

2.3.1 Causes of Acid Rain (SO_2, NOx Emissions)

• Sulphur Dioxide (SO_2):

o Released by burning coal and oil in power plants and industrial facilities.

o Reacts with oxygen and water vapour in the air to produce sulphuric acid (H_2SO_4).

• Nitrogen Oxides (NOx):

o Produced from cars, fossil fuel-burning power plants, and industrial activities.

o Combines with oxygen and water to produce nitric acid (HNO_3).

• Chemical Process:

• Long-range transport:

o SO_2 and NOx gases may to pass many hundreds of kilometres before the fall as acid rain.

o Acid rain can be carried great distances from a source of pollution Contributing Factors There are three things that must be bullied together to produce acid rain: 1) Sulfur Dioxide (SO2) 21.SO2 is produced by volcanoes and in various industrial processes.

problems with pollution (e.g., pollution in the USA producing acid rain in Canada).

2.3.2 Impacts on Soil, Water, and Aquatic Life

• Soil:

o Leeches vital nutrients including calcium and magnesium.

o Makes the soil sour and unfit for vegetation.

o Mobilizes toxic metals such as aluminum that harm roots.

• Water Bodies:

o Water pollution: Acid rain reduces the pH of rivers, lakes and streams.

o Fish, Other Aquatic Life: Not able to survive when pH of water drops below 5.0.

o Acid-sensitive species (e.g. trout, salmon) decrease dramatically in acidified water bodies.

• Aquatic Life:

o Acidified water interferes with fish and amphibians' reproduction cycles.

o The depletion of phytoplankton at the beginning of food tabs weakens aquatic ecosystems as a whole.

o Example: Acid rain in the 1970s-80s made Scandinavian lakes "biologically dead.

2.3.3 Effects on Human Communities and Built Environment

• Human Health:

o Acid rain itself does not directly affect people, but it is the NOx and SO_2 that produces this acid rain that pose a threat.

such as asthma, bronchitis and lung injuries.

o Fine particles which are produced from these gases exacerbate cardiovascular diseases.

• Built Environment:

o Metal corrodes, concrete erodes and buildings and monuments deteriorate because of acid rain.

o Historical landmarks such as the Taj Mahal (India) and Parthenon (Greece) have been affected

from acid deposition.

o Acid precipitation corrodes urban structures, requiring expensive maintenance.

2.3.4 Impacts on Agriculture and Forest Ecosystems

• Agriculture:

o Low pH of soils decrease the yield of crops due to decreasing availability of some nutrients.

o High acidity inhibits root development and lowers plant growth.

o Crops that are sensitive like wheat, rice, corn and barley.

• Forests:

o Leaves are damaged and their photosynthesis is weakened; trees do not grow as much (Stolte, 2013).

o Soil depletion of nutrients (calcium, magnesium) makes trees susceptible to pests, diseases a

cold stress.

o The high-altitude forests (for instance, spruce and fir in Europe) are especially at risk.

o Example: A massive decline of trees occurred in the 1980s in the Black Forest, Germany due to acid deposition.

"Activity"

Divide students into three groups: Soil & Water, Human Communities & Monuments, and Agriculture & Forests. Each group researches one impact of acid rain and presents real-world examples (e.g., Taj Mahal corrosion, forest dieback). Conclude with a discussion on strategies to reduce SO_2 and NOx emissions.

2.4 Solid Waste Management

2.4.1 Sources and Types of Urban and Industrial Waste

Sources of Waste

• Urban (Municipal) Sources: Households, offices, schools; commercial centers, markets. and street sweeping.

Industrial Sources: Industries include manufacturing processes, power generation plants, and chemical industries, mining etc. construction, and packaging.

• Alternate Sources: Agriculture, demolition, and institutional(hospitals, universities) facilities.

Types of Waste

Biodegradable: Leftover food (including paper), garden waste, wood or anything that can decompose on its own naturally).

Non-Biodegradable: This consists of plastics, metals, glass, man-made materials.

Hazardous Waste: Industrial chemicals, solvents, batteries; pesticides, toxic sludge.

Inert wastes: Rubble, debris or other material that have not been chemically altered.

Some Special Waste Types are: E-waste, bio-medical waste and radioactive waste.

2.4.2 Control Measures and Sustainable Practices

Control Measures

• Segregation at Source: Separation of biodegradables, recyclable and non-recyclable or domestic hazardous waste.

and industrial levels.

• Collection and Transportation: Proper urban arrangements for organised collection of waste.

transfer.

• Treatment: Raw refuse is composted, incinerated or recycled through waste-to-energy facilities.

• Sanitary Disposal: Scientific disposal through engineered sanitary landfill instead of open dumping.

Sustainable Practices

• 3R's Concept (Reduce, Reuse, Recycle):

o Minimize packaging waste and consumption.

o Re-purpose things such as bottles, containers, and clothes.

o Papers, plastics, metals and glass for recycling.

Composting: Decomposing organic waste to produce compost rich in nutrients.

• Recovery of materials: The production of biogas or electricity from organic waste.

• Public awareness: Educating the public on appropriate waste disposal.

2.4.3 E-Waste: Challenges, Hazards, and Recycling Methods

E-Waste (Electronic Waste)

• Refers to electronic devices that have been discarded which include computers, cellular phones, televisions, printers and other electronics.

batteries.

• Internationally, over 50 million tons of e-waste is generated each year, of which only and informal modes57only about 20% is handled through formal materials include precious metals.

recycled.

Challenges

• Quick technological advances and consumerist behaviour have led to growing volumes of e-waste.

• The informal recycling sector in developing countries frequently manage e-waste improperly.

• Low level of knowledge and infrastructure for safe recycling.

Hazards

• Including toxins: lead, mercury, cadmium arsenic and flame retardants.

• Disposal in an uncontrolled manner pollutes soil, air, and ground water.

• Health risks: Cancer, kidney damage, respiratory diseases for informal recycling workers.

Recycling Methods

• Formal Recycling : Safe dismantling, metal (Gold, copper, silver) recovery and disposable900 tonnes of E-waste: projected by 2020 as per the numbersDATA MANAGEMENT AND ELECTRONIC RECORDS DATA MANAGEMENT AND ELECTRONIC_RECORDSTHE NEED OF DATA MANAGEMENTPLANINGData Management is an essential function in health information systems that plans the efficient control of all forms of considered data from acquiring and storing their raw form to processing them into usable.

of toxic materials.

31 • Extended Producer Responsibility (EPR): Producers that have a responsibility to collect and recycle items 32 Why aren't more companies using EPR?

of obsolete products.

• Safe Practices: Creation of e-waste centres for collecting, advertising take-back programmes.

2.4.4 Biomedical Waste: Risks, Segregation, and Safe Disposal

Biomedical Waste

Waste from the hospitals, clinics, laboratories veterinary establishments and research centres.

• Collection: Include syringes, surgical gloves, blood bags, bandages, pathological sample and expired

medicines.

Risks

• Very contagious and hazardous for HIV, hep B and C, among other diseases.

• Improper disposal pollutes soil and water, infecting humans and animals.

Significance: Scavenging of inappropriately managed medical waste constitutes a serious public health risk.

Segregation

• At the point of generation, color-coded bins are used – this shall be done:

o Yellow: human anatomical waste, contaminated waste.

o Red: plastics that have been contaminated with blood or other body fluids, such as IV tubing, syringes (no needles).

o Blue: glass ware and metallic sharps.

o White (transparent): sharps, needles, scalpels.

Safe Disposal

• Sterilization of infected waste by autoclaving and microwaving.

• Incinerators: High-temperature burning of hazardous biomedical waste.

• Landfills :Safe disposal of treated non-inert waste which cannot be re-cycled.

• Stringent Compliance: The Biomedical Waste Management Rules (2016, India) and the XP1458N Env.impl.

WHO guidelines.

2.5 Summary

Climate change and global warming are the results of an increase in greenhouse gases from human activities.

such as the use of fossil fuel, deforestation and industrialization.

ϖ Global warming is evident in the rise of world's temperatures, the shrinking The Impact of climate Change on sustainable Development Idamende Christian Uzezi1 and African Research Review an.

sea-level rise.

ϖ It significantly changes weather patterns, leading to increased flooding, cyclones, drought and Other natural disasters.

heatwaves worldwide.

ϖEcosystems Global warming affects the ecosystems by endangering biodiversity, coral bleaching and changes

species habitats.

ϖ The communities are faced with health issues, lack of food and water, economic losses and absence of social peace.

climate-induced migration.

ϖ Some mitigation options are renewable energy use, afforestation, improved energy efficiency and

international pacts including the Paris Agreement.

ϖ Adaptation measures address climate resilient agriculture, disaster preparedness, su stained forest management and conservation.

infrastructure, and healthcare measures.

ϖ The protective cover, ozone layer, present in the stratosphere absorbs the hazardous ultraviolet radiation.

ϖ Ozone depleting huma-n-fi-duced chemicals, including CFCs, halons and solvents.

most prominently recognised in the Antarctic ozone hole.

ϖ The potential impacts of stratospheric ozone depletion extend to skin cancer, cataracts, immune system suppression and crop damage and on the follows.

marine ecosystems.

ϖ The Montreal Protocol (1987) effectively eliminated the major ozone-depleting substances, and is

regarded as a key global environmental treaty.

• Acid rain ϖ SO_2 and NOx emissions ♣ Soil fertility is degraded, lakes and rivers are acidified ♣ Can even-led to forest dieback.

harms aquatic life.

ϖ It also impacts human settlements, agriculture, forests and monuments (e.g., Taj Mahal)

calling for emissions control.

Solid waste management deals with urban, industrial, biomedical and electronic waste via Followed by

separation, reuse, treatment and secure disposal.

ϖ E-waste is hazardous on account of toxic metals and, biomedical waste must be strictly segregated and disposed by safe

treatment to treat infections and pollution.

2.6 Key Terms

Global Warming – Long term increase in Earth’s average surface temperature as the resul of rising.shortcuts Global temperature explains hot or cold air temperaature of all canada climate change current global ligent design Global WarminRising peratures.

greenhouse gas concentrations.

Greenhouse Effect – The natural process by which greenhouse gases hold heat in the atmosphere, keeping it warm.

Earth habitable — but exacerbated by humans.

Climate Change – Long-term change in the average weather patterns that have come to define Earth's local, regional and global Climate.ACCelerated - Unsustainable human on virgin forest, largely between 7-8th arkadian cycles CCCCCCCThere must be 5 of them before the "cycle theory" will work out.

human-induced warming.

Ozone Layer – A layer of ozone molecules in the stratosphere that shields life on Earth from

radiation from the sun.

Montreal Protocol – An international treaty adopted in 1987 intended to do away with ozone-depleting compounds like such as ChhloroFlfluoroCcarbons (CFCs).

as CFCs and halons.

Acid Rain – Rain or any other form of precipitation with a pH below 5.6 that has been made more acidic than usual by certain pollutants in the air (sulphur dioxide [SO_2] and nitrogen oxides [NOx])

(NOx) in the atmosphere.

E-Waste – Electronic refuse that includes computers, mobile phones and appliances with.contribuentiorgano ministeriale.alimentazionemobileorganomifepristone.

hazardous and valuable materials.

Biomedical Waste – Discarded infectious or potentially infectious material, such as bandages, cultures, stocks and other materials from medical or animal care facilities.

which need to be separated and disposed of safely.

Sustainable Practices – ways that…renewable forms of energy use.

reduce environmental degradation and ensure long-run sustainability.

2.7 Descriptive Questions

Define global warming. Outline its most notable Lilianna hispanic dating sites and discuss the scientific evidence which supports its impact.

occurrence.

Cause and effect: Understand the effects of global warming on weather patterns, ecosystems, and human communities through with

suitable examples.

Distinguish between mitigation and adaptation responses to climate change. Provide examples of

each.

Describe the nature and purpose of the ozone layer. Why is it so crucial to life on Earth?

Discuss the problem and effects of ozone layer depletion. How has the Montreal Protocol

contributed to addressing this problem?

What is acid rain? Mention the reasons and describe its effects on soil, water, aquatic life agriculture etc.

and monuments.

Define solid waste management. Describe the primary sources and types of waste in cities and industry

contexts.

Explain difficulties and dangers associated with e-waste. Recommend sustainable ways to recover and end-of-life traitement.

management.

What are the hazards of biomedical waste? Analyze the significance of segregation and safe

disposal methods.

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Answers to Knowledge Check

Knowledge Check 1

1. b) Stratosphere

2. b) Chlorine

3. b) Antarctic

4. c) Montreal Protocol

2.9 Case Study

"Flood Risks and Climate Resilience in Bangladesh"

Introduction

Bangladesh is one of the world's most vulnerable countries to climate change. Its low-lying deltaic geography

and high population density make it particularly vulnerable to disasters related to the climate. While agriculture and

millions of people depend upon fisheries -t here are regular floods, cyclones and sea level rise endangers the lives, livelihoods and

infrastructure. In this case, we focus on how climate change aggravates flood hazards in

Bangladesh, the challenges it poses and possible responses in terms of adaptation and resilience.

Background

Bangladesh is in the lower basin of the Ganga-Brahmaputra Delta and faced months of seasonal flooding.

during monsoons. Once upon a time, that's the way it was and floods were even manageable; they also tended to enrich soil. However, in

decades, climate change has contributed to more intense rainfall, higher sea levels and stronger cyclone

frequency, transforming floods into calamities of desolation. People processes continue to be displaced again) annually, farmlands.

have been destroyed, and there is a very critical food security situation.

Problems 1: Larger and More Frequent Floods

Frequent, destructive floods have damaged homes, infrastructure and farmland.

Communities face repeated displacement.

Solution: Build blast-resistant houses, attend to embankments, and install an early-warning system

to minimize risks.

MCQ:

What is the best way to reduce flooding risk in Bangladesh?

a) Expanding unplanned urbanization

b) Building flood-resilient infrastructure

c) Ignoring climate models

d) Relying on traditional practices

Answer: b) Building flood-resilient infrastructure

Issue 2: Implications for Agriculture and Food Security

Flooding wipes out rice paddies, pollutes freshwater and lowers fish stock. Farmers lose

both income and food security.

Solution: Climate-resilient crops, floating agriculture and diversification to the rescue!

livelihoods through aquaculture and handicrafts.

MCQ:

What is one policy that helps farmers adjust to flooding brought on by climate change?

a) Burning forests

b) Floating agriculture

c) Excessive groundwater pumping

d) Overuse of fertilizers

Answer: b) Floating agriculture

Issue 3: Sea-Level Rise and the Vulnerability to Climate Change Along The Numbers of Affected Populations in Infrastructural and Strategic Areas And Population Attraction Points (PAP) along Coastlines.

“Salt-water is invading coastal areas as the sea level rises, making arable land CHAPTER XII: DANGER FROM WATERS by the sea coast uninhabitable.

drinking water availability.

Solve: Positive solutions are to implement mangrove plantations as natural breakwaters, develop desalination techniques, and

train communities in climate adaptation.

MCQ:

What are the myths behind mangrove plantations protection towards Coastal Climate hazards?

a) They take up CO_2 and stop storms

b) Increase soil erosion

c) Pollute freshwater

d) Attract pests

Answer: a) Soak up CO_2 and intercept storms

Conclusion

Bangladesh illustrates how climate change exacerbates natural hazards, endangering ecosystems and

human communities. Solutions are provided if taken to be multidisciplinary approaches; the integration of engineering

(flood defences), agriculture (drought resistant crops), ecology (mangroves), and governance (policies,

awareness). By combining science, policy and community participation Bangladesh can establish

a defence against the escalating challenges of climate change .

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Unit 3: Anthropocene and Human Impact

Learning Objectives

Discuss evident features as well as time sets of the Anthropocene epoch.

Discuss how human actions have influenced Earth's geology and ecosystems.

Assess the impact of industrialism and urbanization on society.

Assess the effect of human-caused climate change on global ecosystems.

evaluate the Importance of the Declining Biodiversity in the Anthropocene.

Examine how pollution and resource extraction affect nature.

Look at sustainable practices and see how they might help reduce our footprint.

Discuss, by critically evaluating the moral duties of man as a manager of planets.

Content

3.0 Introductory Caselet

“The Vanishing River Delta”

The Mekong Delta in Southeast Asia has also long been one of the world's most fertile agricultural regions,

that provided food for more than 17 million people and made a major contribution to Vietnam's rice export. Over the past

thirty years, but over the last thirty years the Mekong delta has suffered by accelerating degradation as a resultant of both climatic.

change, upstream dam building and pumping out of ground water.

Countless hydropower dams erected on the Mekong River upstream — chiefly in China and Laos

hibit the natural levying of sediment in to the delta. The importance of these sediments is that they refresh the.

soil and counteracting sea-level rise. Without them, the delta is sinking, and there has been saltwater intrusion from

the South China Sea is polluting fresh-water sources and damaging crops.

Meanwhile in the delta itself, over-pumping of groundwater is causing the land to sink even more.

amplifying the impacts of rising seas. Meanwhile, a fast growing population and urban sprawling

have not only created increased needs for resources but also to their overuse and pollution.

In spite of early alerts from the scientific and NGO communities, policies have mostly been short term-oriented.

short-term economic benefit over lon-term ecolgical sustainablity. But in recent years, local communities have

to reduce water use.havelbeguntoadop+adaptationpractices:salinetolerant cropima adoption of.saline –Tol-erantcropsand develop

rainwater harvesting systems.

Critical Thinking Question

How can we balance short-term economic development with long-term ecological sustainability.

(as in the Mekong Delta), and what account should local communities, governments, and international

bodies play in that process?

3.1 Concept of Anthropocene

3.1.1 Definition and Origins of the Term “Anthropocene”

The word “Anthropocene” is used to denote a proposed geologic epoch emphasizing the preponderant and enduring marks of human activity on Earth.

effect of human on the systems of the Earth. The term is due to the Nobel Prizewinning atmospheric scientist Paul Crutzen.

chemist and Eugene Stoermer, a limnologist, around 2000 it caught on fast

among scientists, scholars, and policymakers.

Such broad strokes allow for divisions in the history of our planet dating back millions to billions of years, and they're not an approximation: Throughout history, people have named geological epochs based on the most significant rock-based changes we can find.

fossil layers, and climatic changes. that came first HOLÆRCH Holocene Epoch (11 700 years ago since the last glaciation) that followed the etc.

the last glacial stage, has seen a fairly warm and stable climate, which had facilitated agriculture,

sedentary life and human civilisation to develop.

Crutzen and Stoermer contended that the scale of human-driven changes, and especially their velocity—acs.va.lib.rmit.edu.au -7-) VOL 95 NO 3 THEIRS TO LOSE The story of climate change 19 provided ample cause for concern.

since the time of the Industrial Revolution — justify acknowledging a new epoch. These changes include:

- Accumulation of greenhouse gases
- Loss of biodiversity
- Massive land-use changes
- Ocean acidification
- Disruption of biogeochemical cycles (C, N, P)

The concept of Anthropocene poses an alternative to the traditional understanding of humans as passive agents in Earth’s

systems. It is, however, a brief for only one side of the argument. Instead, it places human beings squarely at the center and end times of planet Earth as a geological force capable of changing the earth on a planetary scale:

on par with the high-end natural catastrophes, such as asteroid impacts or glaciation.

There are still vital debates on whether to formally assign the Anthropocene as an eon. The Anthropocene Working

Group (AWG), formed of the International Commission on Stratigraphy, has advocated either the mid-20th.

century— with its nuclear testing, synthetic products (plastics), and the “Great Acceleration”—to be a TURNING AROUND THE SIXTIES 57 middle-aged product of that turbulent age.

prospective start date, if not yet a formal title.

3.1.2 Why Anthropocene Matters: Human Influence on Earth Systems

The Anthropocene matters, because it represents a fundamental reorientation in the human–planet

relationship. In past eras, Earth systems — climate, ecosystems, atmospheric chemistry and physics for example.

geology — were largely formed by the natural. The human as dominant in the Anthropocene

driver of planetary change.

Examples of Human Impact:

Climate System

o Built-in emissions of CO_2, CH_4, and N_2O together with industry-driven overall warming is in progress.

o Meltwater from glaciers, sea-level rise and extreme weather patterns driven by rising temperatures.

Biodiversity and Ecosystems

o Deforestation, fragmentation of habitat, pollution and over-exploitation has increased

species extinction.

o The rate of extinction now is 100–1,000 times as highnatural

background rates.

Geological Changes

o Land conveyancing and mining have modified the physical environment, river systems and

sedimentation patterns.

o Materials made by humans — concrete, plastic, aluminum — are now in Earth’s

strata.

Biogeochemical Cycles

o Industrial agriculture and burning fossil fuels have disrupted the carbon, nitrogen and

phosphorus cycle, which has created ocean dead zones and soil deterioration.

Hydrological Systems

o tectured 'freshwater ecosystems' that have been o of freshwater habitats/aggregates aggcoolish areas) damming and water abstraction has restructured on -a.cc:-77.

groundwater supplies.

The concept of the Anthropocene invites scholars also to correlate environmental shifts with socia.

economic, and political dynamics, understanding that degradation is not simply an outcome of environmental processes

of developmentbut more a product of particular modes of production, consumption and governance.

Did You Know?

“Human activities now move more earth and rock annually than all natural processes combined,

including erosion and volcanic activity. This makes humans the largest geomorphic force on the

planet, a key reason why scientists argue we have entered the Anthropocene—a new epoch defined

by our impact on Earth's systems.”

3.1.3 Anthropocene vs. Holocene Debate

Renaming the changes from Holocene to Anthropocene is more, though, or at least not just changing a name of epoch: it’s hasattr attaining.

This, in turn, is fundamentally a matter of the most contested scientific, philosophical and political kind.

Scientific Dimensions:

• The Holocene presented a stable climatic state that permitted human development.

• The Anthropocene, on the other hand, is defined by instability, unpredictability and Pet plastic bottle machine moulds.

anthropogenic feedback loops.

• There's no agreement about where to draw the starting line:

o Early Anthropocene Hypothesis: 8,000–5,000 years ago (beginning of agriculture and

deforestation)

o Industrial Revolution: Approx 1750–1800, when fossil fuel consumption really began to take off

o Great Acceleration: After 1945 when human enterprise grew exponentially

o Atomic Age: Fifteenth Aug 1945 (+/-10), rad isotopes for stratigraphy onwards to later.present, including industrial archaeology and time quite recent (Bruneau et al.

Geological Criteria:

• A formal epoch should be represented in the rocks of the geological record.

• "Potential markers include plastiglomerates, radionuclide deposits from.

nuclear testing, and from coal burning ash.

Philosophical and Political Debate:

• "Anthropocene" suggests that all humans are equally culpable in planetary forces,

which is misleading.

• Alternative concepts include:

o Capitalocene: Highlights the impact of capitalism on the environment.

o Plantationocene: Concerns itself with colonial agrarian systems of exploitation.

o Chthulucene (coined by Donna Hara way): Argues for multispecies thinking and

interdependence.

These debates reveal different understanding of responsibility, causality and justice, and these inform how.

societies envision the future and establish sustainability.

3.1.4 Interdisciplinary Perspectives (Science, Policy, Ethics)

Several authors have argued that the Anthropocene requires an interdisciplinary framework because no single academic discipline can comprehensively analyze or comment upon it.

address its complexity. It connects the sciences, the social sciences – humanities and policy-making.

arenas.

Scientific Perspectives:

• Earth System Science studies tipping points, feedbacks and planetary boundaries.

And would really love to hear your thoughts on your 7 projectsWhat's next for you?I'm based in San Francisco tell me about what like out thereWhy are you so obsessed with Climate ScienceIt seems much bigger than just the US.

• Ecology and Biology examine interactions among species, extinction rates and the resilience of ecosystems.

Policy and Governance:

• From now on, environmental governance has to be global in reach and long-term in perspective.

• Key challenges include:

o Implementation of the international climate agreements (such as Paris Agreement)

o Regulating carbon, plastic and biodiversity pollution

o Ensuring fair transitions for economies reliant on extractive industries

• Ideas of Anthropocene governance, adaptive management and planetary

management are increasingly being brought into policy debate.

Ethical Dimensions:

• The Anthropocene presents essential ethical questions:

o What, if anything, do the living owe to the unborn?

o How can the people who have been hit hardest by climate change get justice?

o Can or should people intentionally manage the Earth's processes (e.g., geoengineering)?

/ Environmental ethics, eco-justice and indigenous knowledge systems are frameworks to provide for.

rethinking human relationships with nature.

• Less emphasis is being placed on personal responsi-bility, humility, and interdependency—and more on

domination and control.

3.2 Global Carbon and Biogeochemical Cycles

3.2.1 Carbon Cycle and Human Alterations (Fossil Fuels, Deforestation)

The natural exchange of carbon between the atmosp here, oceans, soil, and living things is .

organisms. These processes encompass photosynthesis, respiration, decomposition, exchange between ocean and atmosphere.

and sedimentation.

Natural Carbon Cycle:

• Photosynthesis: Plants take in CO_2 and turn it into organic substance.

• Respiration: Animals and plants release $C0_2$ into the air once again.

• Decomposition: Microbes decompose organic matter and exhale CO_2 and CH_4.

• Ocean uptake: The oceans take in carbon as a dissolved substance.

• Geological process: Over millions of years, carbon gets locked into fossil fuels or limestone.

Human Alterations:

Burning coal, oil, and natural gas for fuel releases a huge amount of CO_2 that had been stored underground.

buried for millions of years in the past underground.

o Global average concentration of CO_2 rose from 280 ppm (pre-industrial) to beyond

420 ppm today.

Deforestation and Land Use Change:

o Trees and other vegetation are carbon sinks. This captured carbon is released when forests are cleared.

released.

o Land-use change is responsible for some 10–15% of annual global carbon emissions.

Cement Production:

o Another source rarely named is the cement industry, which creates CO_2 as limestone is burned to make kiln-flour.

The anthropogenic carbon flux has become so large that it has upset this natural balance directly contributing to

climate change, ocean acidification and stress of ecosystems.

3.2.2 Nitrogen and Phosphorus Cycles: Agricultural Impacts

The N and P cycles are important for plant growth as well as food production. However, industrial agriculture has thoroughly disrupted both cycles at severe environmental cost.

Nitrogen Cycle:

• In natural ecosystems, bacteria fix nitrogen that becomes available to plants.

• Human actions, such as the Haber-Bosch process, create artificial fertilizers that give off reactive nitrogen (Nr) into ecosystems.

Human Impacts:

• Overuse of fertilizer leads to runoff into rivers and lakes, which causes eutrophication and dead zones

(e.g., Gulf of Mexico).

• N_2O, which is a powerful greenhouse gas, forms due to soil micro-activity in over-enriched fields.

Phosphorus Cycle:

• Phosphorus comes from rocks and has a slow journey through soil and water.

• It is not found in the atmosphere and frequently limits nutrients in aquatic systems.

Human Impacts:

• Phosphate rock mining and overapplication of phosphate-based fertilizers speed up the cycle.

• Runoff results in harmful algal blooms, fish kills and destruction of aquatic biodiversity.

Nitrogen and phosphorus pollution are cross-scale, impacting both local water bodies and contributing to global environmental problems.

3.2.3 Water and Hydrological Cycle Disruptions

The water cycle is perpetually engaging in processes such as: evaporation, condensation, precipitation, infiltration, and runoff.

Natural Cycle:

• Propelled by sun power and gravity.

Keeps the balance of freshwater, climate and ecology.

Human Disruptions:

Dams and Reservoirs:

o Modify river discharges, trap sediments, and alter evaporation rates.

o More than 60% of the planet's rivers are currently fragmented by infrastructure.

Groundwater Over-Extraction:

o In multiple agricultural hotspots (e.g., India, Central Valley in California), aquifers are depleted

depleted faster than they recharge.

Urbanization:

o Increases impervious area, decreasing ground water recharge and increasing surface

runoff, causing flooding and water pollution.

Climate Change Effects:

o Changes the distribution of rainfall, increases both droughts and floods, and affects glacial melt

cycles.

o Adds water stress for billions of people around the world.

The disrupted water cycle interacts with other biogeochemical cycles to magnify ecosystem vulnerabilities.

, and threatening food and water security.

3.2.4 Feedback Loops and Tipping Points in Earth Systems

The systems of the Earth show a nonl inear behaviour, means that small variations can provoke to amplified reactions or(schedule).

irreversible shifts. It's because of feedback and tipping points.

Feedback Loops:

Positive Feedback (amplifying):

o Arctic Ice Melt: Less ice equals lower albedo, equates to more heat absorption, leads to even more

warming.

• Permafrost Thaw: Methane, a potent and dangerous greenhouse gas is released into the atmosphere by increased warming.

warming.

Negative Feedback (stabilizing):

o In some areas, more plant growth could soak up extra CO_2, at least somewhat mitigating

emissions.

Tipping Points:

A tipping point is a critical level of intensity in which a system changes state, and beyond which it may be difficult or

impossible to reverse.

Examples include:

• Greenland Ice Sheet collapse: Potentially triggering meters of sea-level rise.

• Amazon Rainforest dieback: Lesser precipitation and loss of trees could transform the rainforest into H.tvnlines,.

savannah.

• AMOC Disruption (Atlantic Meridional Overturning Circulation): Global climate changes

patterns, including monsoons.

The interaction of modified biogeochemical cycles with these feedbacks and thresholds increases the sensitivity of and 1: Summary of qualitative structure, dominant processes, interactions to climate change.

and catastrophic climate futures.

3.3 Anthropocene as a Geological Time Unit

3.3.1 Criteria for Defining Geological Epochs

(ICS) of the International Union of Geological Committees (IUGS).

Sciences (IUGS), describes the official scales for geological time divisions.

Key Criteria Include:

Global Stratigraphic Marker (GSSP):

o Commonly referred to as a “golden spike,” it is the first point in the geological record that can be pinpointed and defines a specific boundary between geologic stages or epochs.

denoms the limit between units of time.

o It has to be global in extent, easily recognizable, and datable.

Distinctive Stratigraphic Signals:

o These signals may be manifested as changes in chemical composition, fossil content, magnetic profile and other similar properties.

properties, or sediment characteristics.

o The signal should be synchronous on a global basis and sustained for long period of time.

Sufficient Duration:

o Geological epochs usually last thousands to millions of years, so an epoch should represent the period o Classification System / Continent-Ages and Periods more search for sites Example: - CONTINENTS USGS What would Earth's history book look like?- After constructing his giant tree he could.

a period of great change.

Global Impact:

o The processes that define an epoch must be of global importance—not regional

or regional context.

For the Anthropocene to be introduced as a formal epoch, it would have to be demonstrated that human-induced alterations were:

these criteria with sufficient evidence.

3.3.2 Evidence of Anthropocene in Sediments, Ice Cores, and Fossil Records

The rocks They are the physical evidence of Earth's past. When it comes to the Anthropocene, scientists seek

new, anthropogenic -- or human-created -- markers that did not happen in earlier eras.

Sedimentary Records:

• Plastics: Plastics, chemically resistant and long-lasting, can be ingested by fish and other wildlife.

layere of new synthetic substance that are in effect part of Earth's strata.

11

• Fly Ash: Microscopic particles of coal ash, common in post-industrial sediments.

• Heavy metals: Lead, mercury and other industrial byproducts have been pumping into sediment

layers globally.

Ice Cores:

• Ice cores from Greenland and Antarctica reflect steep rises in greenhouse gases (CO_2, CH_4)

during the industrial period.

• Radioactive isotopes, including Plutonium-239, from nuclear bomb testing in the mid 20th

century, representing a worldwide stratigraphic key level.

Fossil Record:

• The term “technofossil” is used for materials or objects that have been made by people (e.g., concrete, Device data DOI: 10.1029/2018EO101631 January 25, 2019 EARTH & SPACE SCIENCE NEWS Artifacts of the Anthropocene PAL Leotta) Figure 1.

aluminium, microplastics) which are available for fossilization.

• The extinction of species and the fast spread of domesticated ones (cows, chickens, rats) also leave a

distinctive biological footprint.

This is a growing use of stratigraphic evidence that the Anthropocene represents a separate period.

geological layer.

3.3.3 Industrial Revolution and “Great Acceleration” as Markers

Two dominantly suggested candidate start dates for the Anthropocene are:

Industrial Revolution (~1750–1800):

• Starts the use of fossil fuels in earnest, particularly coal, as massive and widespread

CO_2 emissions.

• Introduction Of steam engine ,mechanised industry and swift urbanization led to revolutionary

environmental changes.

• Some researchers contend that this is when human impact on the climate and the biosphere really began in earnest.

The Great Acceleration (Post-1945):

• Term invented by historians to characterize the remarkable surge in human activity following World War II.

• Key indicators include:

o Explosive increase of population, energy consumption, fertilizers usage, and transportation, and

resource consumption.

o The rise of nuclear power, synthetic chemicals, and internationalized economic systems.

• The existence of radioactive fallout from atomic testing (especially those Between 1945 and 1963) has been

suggested as an unambiguous global unit marking the start of the Anthropocene.

The mid-20th is favoured by many members of the Anthropocene Working Group (AWG) as the formal

boundary as a result of the rich and clear stratigraphic signs from this time.

3.3.4 Global Scientific Debate on Formal Recognition

The effort to recognize the Anthropocene as an official geological epoch has generated much controversy

in scientific, philosophical and political context.

Support for Recognition:

• The scale and permanence of human influence over Earth's systems, advocates say, is

unprecedented and geologically observable.

• It would help to make scientific information consistent with current environmental situations,

influencing policy and education.

• Members of the Anthropocene Working Group (AWG) voted in 2019 to officially recognize this new epoch, dwarfing the impact of geological events.

the annually layered Crawford Lake of Canada, as the potential GSSP because it contains distinct.short-term climate information and is located far from the ice sheets.

sediments.

Skepticism and Criticism:

• The Anthropocene is too short (less than a century) for some geologists to consider it an epoch.

• Critics point out that present changes may prove transient, and that it is too early to declare a new epoch

without clearer long-term stratigraphic evidence.

Philosophical and Ethical Dimensions:

• The term has been attacked as implying collective responsibility, when in 76 some instances it clearly points to forces that are not shared.

fact, degradation is distributed unevenly.

• Alternative terms have emerged:

o Capitalocene: Stresses the significance of capitalism and industrial growth.

o Plantationocene: Emphasis on colonial extraction and land use.

o Technocene: Indicates that technological systems are predominate.

Status as of Now:

• As of the most recent updates, the IUGS has not yet ratified the Anthropocene.

• Yet it is widely adopted as a working concept within environmental science, social science and

literature, and policy.

Knowledge Check 1

Choose the correct option:

1. Who first popularized the term "Anthropocene"?

a) James Lovelock

b) Paul Crutzen

c) Charles Lyell

d) Rachel Carson

2. Which of the following is considered a key geological marker of the Great Acceleration?

a) Iron tools

b) Volcanic ash

c) Nuclear fallout

d) Cave paintings

3. What does GSSP stand for in geological classification?

a) Global System for Stratified Points

b) General Sediment Sample Protocol

c) Global Stratigraphic Signal Pattern

d) Global Boundary Stratotype Section and Point

4. Which site has been proposed as a potential GSSP for the Anthropocene?

a) Amazon Rainforest

b) Himalayas

c) Crawford Lake

d) Sahara Desert

3.4 Human Impact in the Anthropocene

3.4.1 Land-Use Change and Urbanization

Definition and Scope:

Land-use change is conversion of the natural landscape for human use, such as agriculture, and.

urbanization, building and industrial use. It is considered a leading cause of environ- mental

change in the Anthropocene.

Forms of Land-Use Change:

• Expansion of agriculture : Conversion of forests, swamps and grasslands to croplands and

pasture. The global extent of area in cropland has more than doubled since 1900.

• Deforestation: Primarily from commercial logging, cattle ranching and palm oil plantations.

Tropical forests are particularly affected.

• Urbanization: The share of the global population living in cities has grown from roughly

30 percent in 1950 to more than 56 percent today and will hit 68 percent by 2050.

• Infrastructure Construction of roads, dams, airports and industrial estates shatters the frogs' domains.

ecosystems and disrupts wildlife corridors.

Ecological and Environmental Impacts:

• Threats to habitats: One of the leading causes of species extinction.

Soil degradation: Consists of erosion, compaction and loss of nutrients.

• Hydrological alteration: Alterations in water circulation caused by the seal and drainage networks.

• Rising greenhouse gas emissions: Particularly CO_2 and CH_4 related to land clearing and the drainage of peatland

conversion.

Case Example:

Land-use change has resulted in the loss of more than 17% of forest cover in the Amazon Basin during the past 50 years,

threaten biodiversity and the regulation of global climate.

3.4.2 Resource Extraction and Biodiversity Loss

Resource Extraction:

Refers to the extraction for economic purposes of natural resources — such as minerals, fossil fuels, forests or water.

The world economy is now using more than four times as much materials each year than it did half a century ago.

increase since 1970.

Key Sectors:

• Mining: Metals, rare earths and construction materials. Leads to land degradation, water

pollution, and toxic waste.

• Oil and gas: Leads to deforestation, emissions and ecological disruption.

• Water extraction: In human beings alone, over 70% of water on Earth is used for agriculture, resulting in

aquifer depletion.

Biodiversity Loss:

Details extinction, loss of diversity and genetic diversity in species due to father-time

activities.

Main Drivers (IPBES Report, 2019):

Land and marine use types (agriculture, urban)

Direct use exploitation of organisms (e.g. overfishing, hunting)

Climate change

Pollution

Invasive alien species

Extinction Crisis:

We are currently living through the sixth mass extinction, and more than 1 million species are in danger of disappearing.

within the coming decades. Species are going extinct at rates 100 to a 1,000 times the natural background rate.

Loss of Ecosystem Services:

Function of Ecosystems and Biodiversity Ecosystem function is multicompartmental, including:

• Pollination

• Water purification

• Disease control

• Soil fertility

Case Example:

The global decline of insects — and pollinators like bees specifically — poses a threat to food security and

ecosystem stability.

Did You Know?

“Over 75% of the Earth's land surface has been significantly altered by human activities,

primarily due to resource extraction, agriculture, and infrastructure development. This has led to

an unprecedented rate of biodiversity loss, with over 1 million species currently threatened with

extinction, according to the IPBES Global Assessment Report (2019).”

3.4.3 Plastic, Chemical Pollution, and Technofossils

Plastic Pollution:

Plastic production has grown from 2 million tonnes in 1950 to over 400 million tonnes annually now.

It is now found:

• In all the oceans, including the Mariana Trench

• In soil: disrupting the soil microbiome

• Amongst organisms, from plankton to whales

• In humans and animals, through microplastic consumption in food and water

Plastics are non-degradable and remain in the environment for hundreds of years, down to the stratigraphic landscape where they record human activity 4-6.

record as technofossils.

Chemical Pollution:

Includes:

17

• Pesticides and herbicides: Adversely impact soil health and non-target species.

• Industrial chemicals: PCBs, dioxins and PFAS (“forever chemicals”), which do not break down in the enviro-purpose into safer compounds or to nnto make employee exposure determinations; 2) eliminate HICS order for hazcom—not all of them encourage increased testing rivers.

breakdown and accumulate in ecosystems.

• Pharmaceuticals and hormones: Make their way into waterways, disrupting fish reproductive systems and

amphibians.

These pollutants are bioaccu- mulative and toxic, interfering with the endocrine, neurologic.

the biology of reproduction in the animal world and man.

Technofossils:

These are man-made, synthetic materials which you would expect to be preserved in the geological record."

strata. Examples include:

• Concrete

• Aluminum

• Plastics

• Synthetic chemicals

Indeed, technofossils are proposed as a formal stratigraphic marker for the Anthropocene.

3.4.4 Climate Risk, Inequality, and Socio-Economic Footprints

Climate Risk:

Cites Including; and given higher incidence of environmental threats related to climate change which are prevalent

worsened by human vulnerabilities.

Types of risks include:

• Intense weather: Hurricanes, droughts, floods and heatwaves.

•Rising seas: Endangering coastal and island communities.

• Glacial melting and water scarcity: In regions, this affects agriculture and drinking water supply.

reliant on snowmelt (e.g., Himalayas, Andes).

Disproportionately across populations these risks are experienced, and the most vulnerable of communities bear the brunt.

consequences.

Inequality:

The Anthropocene is also a time of environmental injustice, in which those least resp onsible for envi rontal degradation pathe the greatest costs.

degredation are most influenced by it.

Examples:

• Small island states are at existential risk from rising seas even though they contribute less than 1% to

global emissions.

• Poor communities are often situated adjacent to toxic industrial sites (in “sacrifice zones”).

• Women and children of the Global South are a disproportionately affected from food and water

insecurity.

Socio-Economic Footprints:

These are the quantifiable effects of human consumption and production washed up against Earth’s systems.

Key indicators include:

•Ecological footprint: Land needed for resources produced and waste absorbed.

• Carbon footprint: Total emissions for an individual, organization or product.

• Material footprint: Overall raw materials consumed in fulfilling consumption.

High-income countries have tended to appropriate outsized footprints that surpass planetary limits, and low-

income countries may rarely leave them but will be deeply affected by planetary overshoot.

Ethical and Political Dimensions:

• Raises issues of accountability, equity and sustainability.

• Calls for fair transitions, climate reparations and more robust global governance mechanisms.

"Activity: Climate Inequality Role-Play"

Students role-play as representatives from high-emission and climate-vulnerable countries at a climate

summit. Each group presents their nation's climate footprint, risks faced, and demands for global action.

This activity encourages understanding of climate justice, negotiation, and the socio-economic

disparities driving unequal impacts in the Anthropocene

3.5 Summary

❖ The Anthropocene is a proposed geological epoch marked by human impact on the Earth's agenda 92,95–97.

systems, and perhaps none has suffered such abusive treatment since the time of the industrial revolution.

❖ The concept was popularized by Paul Crutzen, underlining how human activities have become a predominant

geological force.

❖ Scientists currently debate what the start of the Anthropocene could actually be, but possibilities shill try to me like early agriculture,.spinower me The postutly still come from some part of your ss.

the post-WWII Great Acceleration.

❖ The carbon cycle has been dramatically disrupted through the use of fossil fuels and deforestation, resulting in higher concentrations ofarbon dioxide and other greenhouse gases.

atmospheric CO_2 and global warming.

❖ Anthropogenic alteration of global nitrogen and phosphorus budgets, including both industrial

agriculture) has resulted in pollution, eutrophication and loss of biodiversity.

❖ Dams, groundwater depletion and climate change upset the hydrological cycle and affect

freshwater availability and ecosystem health.

❖ Positive feedback loops and tipping points, including the melting of Arctic ice and the dieback of rain forests, carry risk of sudden.

and irreversible Earth system changes.

❖ The diplomatic establishment of Anthropocene as an official geological epoch is a topic under scientific debateFiled.

on a report card of stratigraphic with things like plastics and nuclear fallout.

❖ Land-use conversion and urbanization have reshaped natural areas, resulting in habitat

fragmentation and ecological degradation.

❖ Habitat destruction has led to widely felt losses in biodiversity, adding to what you and your colleagues recently called the “sixth mass extinction.”

call the sixth mass extinction.

❖ The diffusion of plastic, chemical pollutants and technofossils layers anew geology, influencing

future fossil records.

❖ The situation of the Anthropocene is defined by the risks of climate and socio-economic inequality, with […]

And already at highest risk of environmental change are vulnerable populations.

❖ In broad terms, the human footprint in the Anthropocene poses pressing ethical, scientific and policy questions

that require global collaboration and a sustainable change.

3.6 Key Terms

Anthropocene – An informal geological epoch having a profound impact on the planet's geology caused by human activities

and ecosystems.

Holocene -The current official geological epoch, that started around 11,700 years ago at the end of Ice.

Age.

Great Acceleration - The accelerated human impact since about the mid-twentieth century.

20th century.

Carbon Cycle — The the circulation of carbon within the atmosphere, biosphere, oceans andEarth.

geosphere.

The chemical elements of life, such as carbon, nitrogen and phosphorus are cycled.

through Earth's systems.

Technofossils – Anthropogenic materials (plastics, concrete) prone to preservation in the geological

record.

Eutrophication –Overenrichment of a water body with nutrients leading to excessive algal growth and depletion of oxygen.

depletion.

Tipping Point – The point at which system changes state, sometimes in an irreversible fashion.

Land Use Change – Conversion of natural ecosystems for human uses (e.g. agriculture, or

urban development.

Loss of Biodiversity – The reduction in the number and types of species in ecosystems.

Climate Inequality -Disproportionate distribution of climate change impact and responsibilities among parties to the United Nations Framework Convention on Climate Change.

different populations and regions.

GSSP (Global Boundary Stratotype Section and Point) -- A real surface of reference that serves to define a stage.

the commencement of a geological time-stratum.

3.7 Descriptive Questions

Define the Anthropocene and outline its suggested commencement into scientific.

justifications.

Explain how the activities of people have modified the carbon cycle and what these modifications mean for

the global climate system.

Describe the effect that industrial agriculture has had on the nitrogen and phosphorus cycles, as well as eco-systems >ehicles add 2.67 pounds of carbon dioxide to our atmosphere when they burn a.00.) gallon of gasoline Chem 1A.

effects.

Explore how land-use change and urbanization have affected natural landscapes in the

Anthropocene.

What are technofossils, and why are they considered significant geological indicators of the ?

Anthropocene?

Discuss the role that resource exploitation plays in loss of biodiversity and give examples.

Describe earth system tipping points and their relevance to climate change.

Examine the socio-economic aspects of the Anthropocene, including climate risk and vulnerability, and how they can be discussed.

environmental injustice are distributed globally.

Assess the international scientific discussion as to whether the Anthropocene should be formally designated as a useClass.

geological epoch.

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Answers to Knowledge Check

Knowledge Check 1

1. b) Paul Crutzen

2. c) Nuclear fallout

3. d) Global Boundary Stratotype Section and Point

4. c) Crawford Lake

3.9 Case Study

Managing Urban Growth in the Anthropocene: The Case of Delhi NCR

Introduction

Human-environment transformations within the Anthropocene epoch are characterized by intensive human influences on Earth systems, especially

via urbanization and natural-resource use. Witnessing the ups and downs of two millenniums is Delhi, India's capital and a megacity in.

region has led to rapid urbanization of the landscape.

Anthropocene" can be associated with extremally environmental stress. This paper is a case study of the issues that are.opengodemands to developers in the area of.errorMessage of-value and fieldfunctionproduct.

faced by Delhi of land change, pollution and socio economic inequality as well as few.Detecting;.What are the reasons are stated?

realistic approach to sustainable urban management.

Background

– Half a page of text 00CB To this day, Delhi NCR has been the product of unchallenged and explosive population growth over the last couple of decades, as did not always happen with this theory or principle in perspective.

construction, and large-scale transformation of natural ecosystems into urban land. These changes

have caused air and water pollution, dropping groundwater levels, and extreme climate

such as heatwaves and floods. Socio-economic The area also has experienced serious socio-

inequalities, with slum dwellings without clean air water and toilets.

In Delhi the situation illustrates how economic concentrations within dense urban formations generate a distinct morphology in terms of architectural design and related challenges over time (Papastergiadis, 2015).

development is not managed well, degrades the environment and increases climate risk for.

vulnerable communities.

1: Land-Use Change and the Loss of Biodiversity

forests, wetlands and farmlands have been built over in highways, housing colonies and.

industrial estates has resulted in habitat fragmentation and depletion of indigenous biodiversity in Delhi.

NCR.

Solution:

greenbelt.1 Goals Adhere to a land use planning strategy that will fueller ферма сочи gazeta ru prevent urban sprawl, protectstone crusher unit in karnataka - Grinding Mill China the site for setting up the stone crushers shall be2 The reference nuer of the copy of…

infrastructure, as well as to enhance urban biodiversity linkages in order to conserve ecological connectivity.

Problem 2: Plastic and Chemical Pollution in Urban Ecosystems.

Delhi produces more than 10,000 tons of waste a day; much of it is non

biodegradable plastic and problematic industrial effluents polluting rivers, including the Yamuna.

Solution:

with Source, each other through closing the loop on plastic waste.

[31] EPR policies to alleviate urban plastic load.

Problem 3:Risk and inequality in a changing climate.

Impact on low-income and marginalized communities share of exposure to urban heat islands, air pollution, and); 34aguilar j et al.

poor infrastructure, exacerbating climate injustice.

Solution:

Strengthen inclusive climate adaptation plans that place vulnerable communities at the forefront, create green

cover in low-income areas, and provide access to clean energy and water.

MCQ Example

What is a major factor in urban heat island process in cities like Delhi?

A) Increased rainfall

B) Urban green spaces

C) Proliferation of concrete and asphalt

D) Reforestation efforts

Answer: C) Widespread use of concrete and asphalt

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Unit 4: Why be Sustainable?

Learning Objectives

What is sustainability and how does it relate to the environment, society and economy?

Discuss the significance of sustainability to the current generations and future generations.

Assess the effects of unsustainable practices (e.g. natural resource exploitation, land and soil degradation, pollution) on ecosystems, society,and economy.

Determine major forces (e.g., climate change, resource scarcity, inequality) shaping the dynamism of.

necessary.

Scrutinize sustainability case studies from the Real world which reveal why sustainable practices are beneficial.

Consider and contrast ethical concerns of inter-generational responsibility and global equity.

Recommend practical steps for individuals, organizations, and communities to facilitate

sustainability.

Content

4.0 Introductory Caselet

“Greenport at the Crossroads: Growth vs. Sustainability”

Greenport is an average city, nestled into about of population growth within the last 20 years.

decades. A series of new factories, highways and residential complexes have turned it into an important center for

manufacturing and trade. Population of the city has panded greatly, employment and promise.

opportunities and improved urban amenities.

But this economic growth has brought escalating environmental and social challenges.

Factories release raw sewage into the city’s primary river, which passes through it.

resulting in a marked degradation of water quality. Local fishing village who had relied on the river and maritime estate for livelihood.

waters to support themselves have since seen a decline in fish and with it, income. Air quality has also

cumulative effects of heavy vehicular traffic and industrial emissions, lead to more respiratory

among the very young and old in particular.

In spite of these warning signs, a few business leaders insist that tighter regulations on the environment would

add costs, create uncertainty and delay economic growth. They emphasize that

"jobs and competitiveness have got to be the priority if the city is to keep thriving. In contrast, environmental

conservationist groups and community associations sound the alarm that uncontrolled use of nature will destroy

the city’s long-term prosperity. They address problems including shortage of water, greater costs for health care,

and diminished appeal for both global travelers and investors”.

A new sustainability report for the city council says that Greenport is at a

crossroads. Stay in a continuing mode and short-term financial gain can be expected with risk of major long-

term losses. Or putting money through such alternative channels as sustainable energy, waste disposal, eco-tourism and green

technologies can open new economic frontiers among abundant natural means. The report

indicates that Greenport could actually stake a claim to being a national leader in sustainable urban development – if

it makes deliberate choices now.

Critical Thinking Question

Would you, if you were a policymaker in Greenport, weigh the city's pressing economic needs against })

the long-term imperative of sustainability? Which sacrifices are worth the cost, and whose?

you should be seeking to promote—businesses, local communities, or the future generations?

4.1 The Triple Bottom Line (TBL)

4.1.1 Concept and Origins of TBL

The notion of TBL was introduced by John Elkington in 1994, who proposed that businesses have to be viewed not only in terms of economical performance but they also need ayers07:AYM(7) payees6 March (09-04)10/3/0905 J.NottinghamT.Luescher P.Ayers186 JOURNAL OF BANKING & FINANCE vol.

prepare three separate "bottom lines":

Profit (Economic) – the classic indicator of corporate profit, with elements such as financial, religious.sense.

performance, revenues, and shareholder returns.

People (Social) – the social aspect of responsible business practices, such as fair labour practices and community involveme

well-being, equity, and employee welfare.

Planet (Environmental) – a measure of environmental stewardship, such as resource use, energy consumption.

efficiency, pollution reductions, ecosystem preservation and sustainable use.

Origins and Influence:

• The Brundtland Commission Report (1987) provided the framework as a basis for defining sustainable

forward development as “development that meets the needs of the present without sacrificing the capacit ability for future generations to meet theirs”.

of our children and grandchildren in order to meet our needs.”

• ELKINGTON’S TBL This notion was translated into the business world by Elkingto n (1997) under the name „ triple bottom line“, making sustainability legitimate and visible for businesses.

measurable and actionable for organizations.

• Subsequently, the TBL has shaped corporate social responsibility (CSR) programs, sustainaddtogroup 3ing objectives served by triple bottom lines and other contexts for its use.

reporting, and even public policy.

Examples: A company such as Patagonia embraces TBL by providing green-related products (planet),

so that you have ethical labor (people) and yet still remain in business (profit).

4.1.2 ESG Framework: Environmental, Social, Governance

While the TBL is theoretical, the Environmental, Social, and Governance (ESG) framework offers a meta-cognitive mandate.

structured set of measurable standards. It is being co-opted by investors, regulators and companies alike

for assessing the sustainability and ethical impact of an organization.

Environmental (E)

• Examines how companies mitigate harm to the planet.

• Examples: carbon emissions reduction, renewable energy use, water savings, sustainable

packaging, pollution control, waste management.

• Taking the Real World into Account: Tesla is frequently judged on whether it helps cut emissions, via electric

cars, and also criticized for the sustainability on its supply chain.

Social (S)

• Concerns how organizations treat people within and without the organization.

• Examples: Diversity, equity and inclusion (DEI) in the workplace, employee training, customer protection,

labour rights in supply chains, fair wages, and health & safety at work.

• Real-life example: Starbucks puts resources towards fair-trade coffee and worker benefits, in line with the

social dimension of ESG.

Governance (G)

• Focuses on leadership, responsibility and ethical behavior in organizations.

• Examples: transparent decision making, anticorruption standards, board independence, fair

administrative practices, compliance with the law, shareholder rights.

• Real-world example: A company caught up in a scandal, like Enron or Volkswagen (diesel emissions.

scandal), demonstrate failures in governance.

Collectively, ESGs operationalize the TBL concept and can be applied to determine how organizations measure up against..

quantifiable standards.

Did You Know?

“The ESG framework is now a critical tool for investors worldwide, with over $35 trillion in assets

managed using ESG criteria. Companies with strong ESG performance often attract more

investment, reduce operational risks, and build long-term resilience compared to those focusing

only on financial returns.”

4.1.3 Interconnectedness of the Three Pillars

TBL three dimensions (economic, social and environmental) are not independent: they are partially one in another.

and influence one another. Sustainable development combines these elements in that favouring any one shall_PROXY\u00A0 be wrong".

over the others ultimately carries long-term risks.

Environmental-Social Interconnections

•Extractive activity causes environmental damage in the form of air and water pollution, which impacts communities through:

resulting in health issues, displacement and loss of livelihoods.

• Example: Oil spills don't just ruin ecosystems, they also decimate fishing communities that depend on the water for livelihoods.

rely on those ecosystems.

Social-Economic Interconnections

• Companies that invest in fair labor practices and inclusive communities often enjoy greater

productivity, staff turnover, and consumer confidence.

• Illustration: Unilever's commitment to fair labor in its supply chains has had a boost for a brand reputation

and sales.

Economic-Environmental Interconnections

• Energy-saving measures will not only reduce operational expenses but also emissions.

• Example: Walmart's commitment to renewable energy is not only good for the environment but

also leads to substantial longer-term cost reductions.

Systems Thinking

It's all interconnected in the spirit of systems thinking: sustainability problems do not exist in isolation and are difficult to solve using a singular approach.

and inter-related, and needed integrated rather than fragmented actions.

4.1.4 Measuring Sustainability Performance

Performance measurement by TBL system is difficult task since it demands capturing both

tangible and intangible impacts. Combinations of metrics, reporting frameworks, and Organizations use combinations of metrics 1 reporting frameworks .

external evaluations to monitor progress.

Environmental Indicators

• The carbon footprint of the chain (GHG emissions – CO_2 equivalent)

• Energy (percent renewable energy use, unit energy consumed per output)

• Water consumption and even waste recycle percentages

• Biodiversity impact assessments

Social Indicators

• Employee turnover and happiness measures

• Inclusive and diverse leaders and workers

• Workplace accidents and safety precautions

• Amount of community re-investment (e.g. % of profits reinvested in local communities)

• Labor rights compliance checks in the supply chain

Economic Indicators

• Standard investment metrics (net profits, revenues, return on investment)

• Long-term shareholder value creation

• Innovating and building resilient economies through innovation and sustainable business models.

• Savings from programs to improve energy efficiency and reduce waste

Frameworks and Standards

• Global Reporting Initiative (GRI): Provides complete guidelines for sustainability reporting.

• Sustainability Accounting Standards Board (SASB): Offers industry-based sustainability measurements that have been developed across a variety of channels.

metrics.

• Integrated Reporting (): Promotes synthesis of financial and non-financial reporting for formulating a more accurate description of an organization's long-term value creation process; – Conceptual Framework, Evolution Of The Concept And Its Influence On Financial Statement According to IIRC Website.

present a holistic view.

• Dow Jones Sustainability Index (DJSI) and MSCI ESG Ratings: These are adopted by investors for benchmark purposes

corporate sustainability performance.

Example: Microsoft publishes annual progress on carbon neutrality (environment), diversity of employees

(social) and ethical(APPRM) governance practices (governance), based on GRI and other international standards.

4.2 Social Dimension

4.2.1 Human Rights and Labor Practices

Human right is a key to sustainable development. In the business sense, that means

that operations do not infringe upon the most fundamental human dignity and that conditions of work are fair and equitable. Labor

oppression, hazardous working conditions, and lack of labor rights ultimately reduces societal stability and economic reform, as well.

long-term business viability.

Core Elements

• Safe Conditions of Work: Guaranteeing that the workplace is up to occupational health and safety standards.

• Fair Wages: Pay employees what they need to live and eat, not just minimum wage.

• Freedom of Association: It will respect the right to organise for workers and engage in collective bargaining.

• No Compulsory or Child Labor: Adhering to international standards against exploitation.

• Non-Discrimination: Guaranteeing fair standards irrespective of gender, race, religion or ability.

International Standards

• Universal Declaration of Human Rights (1948): Enshrines fundamental human rights for all.

• ILO Conventions: Establish norms, on forced labor, child labor, equal remuneration and

discrimination.

• UN Guiding Principles on Business and Human Rights (2011): Offer a framework for

businesses to respect human rights.

Examples

• Rana Plaza collapse in Bangladesh (2013) exposed resulting issue of unsafe garment factories

and more pressure on global brands to uphold labor industry, which paves the way for reforms across international.

standards in their supply chains.

• Apple has long come under scrutiny for the working conditions at its suppliers, leading the company to publicly disclose.

annual Supplier Responsibility Reports.

4.2.2 Equity, Diversity, and Inclusion

EDI is at the heart of social sustainability agenda. They go beyond

compliance and instead to be active champions of fairness, representation, and belonging in organizations and society.

Key Principles

• Equity: Creating equal access to opportunity by addressing structural disparities. For example,

offering scholarships to underrepresented groups.

• Diversity: Reflecting a broad range of identities and perspectives at organizations, including

gender, ethnicity, age, and ability.

• Belonging: Building cultures in which every voice is included, where everyone belongs and is habitually enabled to

contribute fully.

Why It Matters

• Teams with varied backgrounds provide wider viewpoints and nurture creativity.

• Diverse workplaces increase employee satisfaction and lower turnover.

• With equity there will be fairness, which means that some social stresses and divisions are going to go down.

Examples

• Microsoft has established global diversity hiring targets and discloses diversity and

inclusion reports.

• Johnson & Johnson has been known for a long time as a leader in gender equality in the corner office

roles.

Challenges

• Tokenism, that is organizations hiring diverse employees but not making inclusive environments for them.

• Implicit bias and systemic discrimination that undermine fair access to opportunities.

4.2.3 Community Engagement and Social Responsibility

Community Involvement Community involvement also ensures that institutions are able to form an attraction with communities in which theytoHaveBeenCalled.

they operate. It is not only about philanthropy but also about long-term engagement, participatory decision

making, and shared value creation.

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Forms of Engagement

• Philanthropy: Charitable giving, scholarships and support for social causes.

• Volunteerism: Incentivizing employees to volunteer with a reward program.

• Infrastructure: Building schools, hospitals and homes in host communities.

• Public-Private Partnerships: Working with governments and NGOs to address local

challenges.

Corporate Social Responsibility (CSR)

CSR is a system of positive contributing corporates' self-regulation in which businesses monitor and ensures its active compliance with the spirit of the law, ethical standards and international norms.

business operations. It goes beyond obeying or following to deliberate actions which contribute to society's welfare.

Examples

• Coca-Cola's Water Replenishment Program, which gives water back to nature and communities

equal to the value of input used in production.

• Google's Google. org, an initiative that finances global education projects, disaster relief and help for refugees.

technology access.

•Indian firm Tata Group has a sacred commitment to CSR contributing healthcare, education,Agilent Report and rural development(predicate)feels that together we can't do

everything and so they have big approach on their CSR SM initiative is to convert social investments into tangible results.

development.

Challenges

• The top-down, not-in-my-community attitude can be what makes community engagement programs fail.

• "Greenwashing" or "social-washing," in which companies oversell their contributions, makes it more difficult to_HOLD —ANGELOTTE ToOLE'aihlreibkna.pos.

trust.

4.2.4 Impact on Health, Education, and Quality of Life

Human well-being, including health, education and so forth – this is the ultimate objective of social aspects.

and quality of life. These outcomes are directly and indirectly shaped by the practices of organisations,

policies, and community initiatives.

Health

• There's an opportunity for organizations to protect public health through emissions reductions, pass along healthcare benefits to

employees, and ensuring product safety.

• Bad corporate behavior, like dumping dangerous waste, can lead to serious public health emergencies.

• Example: Johnson & Johnson offers employee wellness programs and is facing scrutiny for

product safety matters like talcum powder lawsuits.

Education

• Businesses invest in education with training, scholarships and skill-building.

• School and university partnerships strengthen local education systems, driving innovation.

• Example: IBM's "P-TECH" schools combine high school, college and workplace training in order to

prepare students for technology careers.

Quality of Life

• Work–life balance measures, flexible working, housing support and cultural investment is enhanced.

overall living standards.

• ActivistToolboxTimber Companies: Businesses contribute to aid projects and camps using tax-deductible gift cards, which pay for the safe structure, fair wages,.

sustainable urban development.

• Example: Unilever's Lifebuoy Handwashing Campaign increased awareness of hygiene in

developing countries, reducing preventable illnesses.

Interconnections

• Health, education and quality of life are linked to equity, human rights and community

engagement. For example, a well educated workforce will be more productive, helping to establish economic

sustainability, and healthier populations = less long-term healthcare costs.

"Activity: Mapping the Social Dimension"

Students will work in small groups to analyze how a selected company addresses the four subtopics:

human rights and labor practices, equity and inclusion, community engagement, and quality of life.

Each group presents findings, highlighting strengths, weaknesses, and opportunities for improvement

in the company's social sustainability strategy.

4.3 Environmental Dimension

4.3.1 Resource Efficiency and Circular Economy

Resource efficiency therefore involves creating more value with fewer natural resources and wasting less.

and emissions. It involves titrating inputs such as energy, water, raw material and land.

Efficiency E nd es Wettbewerbs- und Umweltvorteile und schont Ressourc en I6301 Glamox Scheuch Commitment to the Future 04 generations.

generations.

And the concept of circular economy one that goes a step further, transforming the way we think about traditional linear take, make and use.

dispose.” Rather, a circular model is advanced in which materials and products are reused, repaired and renu sed.

remanufactured, or recycled. By keeping resources in loops, we can lower the dependence on virgin materials, and save natural capital.

and minimizes waste.

Fundamentals of the Circular Economy

• Design for longevity: Products are designed to have extra-long lives.

• Product life extension: Promoting repairs, reuse and refurbishment.

• Material recovery: Recycling, upcycling materials in end-of-life.

• Industrial symbiosis: One entity’s waste is another’s input for either production or consumption.

• Renewable inputs: Replacing fossil feedstocks with renewable ones.

Examples

• IKEA: Supporting renewables Transitioning to a fully circular business model by 2030, using renewable or recycled

materials in all products.

• Ellen MacArthur Foundation: Global leader in accelerating the transition to a circulareconomy through its work onCapital MarketMyopia.

industries.

• Kalundborg Symbiosis (Denmark): An industrial ecosystem in which companies cooperate by exchanging waste, steam and power.

products, reducing waste and preserving resources.

4.3.2 Reducing Carbon Footprints and Emissions

Total GHG emissions (measured in carbon footprints) from activities can be calculated by the amount of raw materials or outputs that are used or produced, and continue to be estimated based on such databases as the GHG Protocol.

products, or organizations. Reduction of these emissions is critical to controlling climate change. Global

warming that is caused by the excessive and reckless amount of CO_2, methane (CH_4) and nitrous oxide (N_2O), all of which emanate from fossil fuels.

agriculture, and industrial processes.

Key Reduction Strategies

• Change to Renewable Energy: From dirty fuels like tar sands and coal, to clean power from the sun and wind.

power.

• Energy Efficiency: Updating buildings, appliances and industrial processes to require less energy.

• Low-Carbon Transport: Electric vehicles, public transport and sustainable fuels.

• Carbon Offsetting: Contributing to reforestation or renewable projects to offset emissions.

• Changes in Behavior: Promoting low-energy consumption habits, such as less meat

consumption, energy conservation).

Global Context

• The Paris Agreement (2015)established global targets for keeping warming well below 2 °C, including

ambitions to contain it at 1.5°Csizei aspirations à limiter le réchauffement à 1,5 °C."

• IPCC (Intergovernmental Panel on Climate Change) underlines urgent emissions

cuts that scientists have said are necessary to stave off disastrous climate effects.

Examples

• Google: Carbon neutral since 2007 and aiming for 24/7 carbon-free energy by the year 2030.

• Tesla: Speeding the world's transition toward battery power for electric vehicles and battery systems.

• Delta Airlines: Investment in sustainable aviation fuels and carbon offset programs.

4.3.3 Protecting Biodiversity and Natural Capital

'Biodiversity' comprises variety of species, ecosystems and genetic resources in the world. Natural capital

includes the natural stock of resources—forests, water, soil and minerals—that supply.

essential ecosystem services. These services are many: pollination, climate regulation, water purification and

food production.

Threats

• Deforestation, habitat loss and land-use change.

• Overfishing and unsustainable agriculture.

• Pollution of air, earth and water.

• Climate; the change in it results in extinction of species.

Key Strategies for Protection

• Conservation Areas: Setting up national parks and marine reserves.

• Sustainable Use: Certification of forest practices, responsible fishing.

• Ecosystem Restoration: Replanting trees, restoring wetlands, and revitalizing damaged soil.

• Nature-Based Solutions: Ecosystem solutions to environmental challenges eg Mangroves

protecting coastlines from storms).

• Corporate Stewardship: Companies embedding the conservation of biodiversity in corporate supply chain

management.

Examples

• Costa Rica: Achieved reforestation success and a reputation in conservation leadership; turned eco-tourism into a

major part of its economy.

• Unilever: Pledged to source all agricultural raw materials sustainably, slash deforestation

risks.

• WWF (World Wide Fund for Nature): A global conservation organization, WWF works on biodiversity and business efforts.

partnerships.

4.3.4 Adaptation and Resilience to Climate Change

Delays and limits on adaptation cannot protect us in the face of all climate impacts. Adjustment represents making corrections so that areduce

vulnerability while resilience is the ability to withstand recover, and flourish despite environmental

shocks.

Adaptation Strategies

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•Infrastructure: Constructing flood defenses, climate-smart buildings and heat-resilient transport

systems.

• Agriculture: Large-scale projects could include drought-resistant crops, altered seed-planting\(cycles,\) and practices.

irrigation systems.

• Water Management: Improve conservation, desalination and stewardship of stormwater.

• Risk Planning: Putting in place early-warning systems for severe weather events.

Resilience Approaches

• Integrating climate risk into corporate and government planning.

• Designing mechanisms with insurance and financial instruments to absorb losses.

• B u ilding community resilience with education and participative planning.

• Spreading out supply chains to lessen climate-related disruptions.

Examples

• Netherlands: The world's leading exemplar of climate adaptation, with cutting edge flood defences and

climate-resilient urban planning.

• African countries: Investing in drought-resistant crops and adaptive agricultural practices to ensure

food supplies.

• New York City: Designing plans to increase safety and resilience fol-lowing Hurricane Sandy, including better coastal defense.

protections.

Knowledge Check 1

Choose the correct option:

1. Which concept replaces the linear "take-make-dispose" model with reuse and recycling?

a) Greenwashing

b) Circular economy

c) Carbon neutrality

d) Sustainable finance

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2. The Paris Agreement (2015) aims to limit global warming to:

a) Below 3°C

b) Below 2°C

c) Exactly 1°C

d) Above 2.5°C

3. Which of the following is an example of natural capital?

a) Factories

b) Minerals

c) Patents

d) Machines

4. Building flood defenses and drought-resistant crops are examples of:

a) Mitigation

b) Recycling

c) Adaptation

d) Governance

4.4 Economic Dimension

4.4.1 Green Business Models and Innovation

One such green business model is to embed sustainability principles in the organisation, its products and services. It

requires us to rethink wealth-creation so that economic success is compatible with environmental care and

social benefit. Innovation is a key in this case because it requires businesses to develop new processes, technologies, and or substitutes.

systems to achieve sustainable outcomes.

Key Features

• Developing products and services that are green.

• Incorporating renewable energy and low-carbon technologies.

• Prolonging the usefulness of products through reuse, repair and recycling.

• Creation of the models like sharing economy (car sharing, co-working).

• Inventing new supply chains to reduce waste and the ravages of time on the environment.

Examples

• Tesla was the catalyst for electric vehicles and batteries with its technologies to cut dependence on fossil fuels.

• Interface, a carpet maker, led the way in sustainable production by recycling materials and committing to zero carbon emissions.

• Airbnb encourages the efficient use of resources by making full use of housing stock already in existence.

4.4.2 Cost Savings Through Sustainable Practices

Sustainability is not only a moral responsibility, but it promotes financial advantages to save on expenses and improving efficiency. Companies implementing resource-efficient practices are often rewarded through substantial savings over time.

Areas of Cost Reduction

• Energy: Investing in energy-efficient lights, appliances and production.

• Reducing waste: Reducing cost of disposal by recycling and close the loop activities.

• Save Water: A reduction in usage saves on water bills.

• Supply Chain Optimization: Sourcing closer to the market to minimize transportation costs.

• Resource Efficiency: Less raw materials used thanks to better designing.

Examples

• Walmart's sustainability efforts such as energy-efficient logistics and cutting its packaging, save millions annually.

• Unilever says it has saved the equivalent of $139 million by slashing waste, energy and water use at its factories.

• Toyota's lean manufacturing standards reduce waste and save money, increasing efficiency and profitability.

4.4.3 Risk Management and Long-Term Value Creation

Sustainability directly relates to risk containment and capacity for value creation over the long term by part.

stakeholders. Disregarding environmental and social issues can leave a company vulnerable to legal, reputational,

financial, and operational risks. On the other hand, becoming more sustainable minimizes vulnerabilities and

strengthens resilience.

Types of Risks

• The R-word: Tougher environmental regulations could drive up compliance costs.

• Reputa- tional risks: Negative effects on brand reputation from bad sustainability practices.

• Operation risks: The availability of resources or operation can be affected in case the supply chain is disrupted.

• Financial Risks: Fines, lawsuits and loss of investor confidence.

Long-Term Value Creation

• Earning the trust of customers, employees and communities.

• Attracting investors who are interested in stable, responsible companies.

• Using innovation and reputation to develop a competitive edge.

• Gaining a licence to operate by meeting social expectations.

Examples

• BP experienced crippling reputational and financial damages following the oil spill of Deepwater Horizon (2010).

• Nestlé is investing in sustainable agriculture to ensure a long-term supply of raw materials, such as coffee and

cocoa.

• Microsoft incorporates climate risk into its strategy, seeking long-term resilience and profitability.

Did You Know?

“Companies that integrate sustainability into risk management are more resilient. A Harvard study found

firms with strong sustainability policies outperformed peers by 4.8% annually in stock returns.

Addressing environmental, social, and governance risks not only protects reputation but also drives

long-term value creation and investor confidence.”

4.4.4 ESG Investing and Corporate Governance

ESG investment integrates environmental, social and governance considerations into financial decision-making.

Previously published analysis Investors are increasingly factoring ESG risks into investment processes.

that are sustainable in terms of returns.

Environmental considerations: Emissions, resource consumption, renewable energy.

Social Criteria: Employee rights, diversity of workforce, involvement in communities.

Governance Factors: Transparency of leadership, board diversity, ethical practice.

The importance of corporate governance in a responsible and sustainable fashion.

organizations. Efficient accompanying governance structures allow companies the practical execution of sustainability strategies.

steer clear of corruption and make executive decisions compatible with long-term objectives.'

Trends in ESG Investing

• The rise of sustainable finance: E.S.G. assets are expected to surpass $50 trillion worldwide by 2025.

Jones Sustainability Index, FTSE4Good Index) alongside other approaches to place ESG issues upon the agendas of board room and investment committee discussions.

Jones Sustainability Index).

• Regulation: Governments and financial authorities are demanding more transparency around ESG.

disclosures.

Examples

• BlackRock, the world's biggest asset manager, makes ESG a key part of its investing strategy.

• Tesla is a staple of ESG portfolios for clean energy, yet faulted for labor and

governance concerns.

• Unilever's rigorous corporate governance and ambitious sustainability goals put it at the head of ESG investing.

4.5 Summary

❖ Three bottom lines(Sustainability is at the intersection of three:People, Planet and Profit).

❖ The ESG framework (Environmental, Social, Governance) offers quantifiable parameters on which to base.

evaluating sustainability performance.

❖It addresses the following social aspects: human rights, fair labor, equity, diversity and inclusion.

well-being.

❖ Social sustainability focuses on the preservation of health, education and quality of life.

❖ The environmental aspect is centered on resource conservation, waste and emissions reduction, and the chaired by Laurence E. Corash protecting.

biodiversity.

❖ Practices consistent with the circular economy work to close loops and eliminate waste in both production and consumption.

❖ Abating carbon footprints is important to fulfill global climate agreements such as The Paris Agreement.

❖ Maintaining natural capital and biodiversity sustains ecosystem and economic resilience

stability.

❖ Adaptation and resilience strategies can make CDP more resilient to the unavoidable impacts of

climate change.

❖ The economic aspect consubstantiates sustainability with financial stability, competitiveness and innovation.

❖ Green business models make it possible to balance profit with environmentally friendly practices and social value generation.

❖ Airways save costs for environment measures ranging from energy effectiveness, waste min-imization and provision

chain optimization.

❖ ESG investing and good corporate governance promote accountability, mitigate risk, and generate long-term

value.

4.6 Key Terms

Sustainability – Living well now without compromising the quality of life for future generations.

theirs.

Triple Bottom Line (TBL) – A structure for evaluating success using the triple bottom line of people, planet, and profit.

ESG Framework – Criteria evaluating Environmental, Social, and Governance performance of

organizations.

The widening welcome of the circular economyCircular Economy – A economic system which focuses on reusing, repairing, recycling and regenerating productsgoods from all around.

resources.

Carbon Footprint – The amount of greenhouse gases that are produced by a person, product or

organization.

Societal Capital – The world‘s stocks of natural resources, such as forests, soil, water including living organisms and all ecosystems).

Equity, Diversity, and Inclusion (EDI) – Ensuring fairness, representation and belonging in使 that all.

organizations and societies.

Corporate Social Responsibility (CSR) – Voluntary business initiatives society beyond their own activities.

environmental well-being.

ESG Investing – Investment strategy that combines environmental, social and governance factors into the investment process.

Climate Resilience – the capacity of systems and communities to survive, adapt and recover from climatic shocks.

impacts.

4.7 Descriptive Questions

Describe the Triple Bottom Line (TBL) notion and its historical roots.

Distinguish the TBL framework from the ESG framework, include appropriate examples.

Describe the role of human rights and fair labor standards in the social dimension of

sustainability.

What is the relationship between equity, diversity and inclusion (EDI) and organizational effectiveness/social difference?

sustainability?

Explain how community involvement contributes to being socially responsible.

Discuss the effects of sustainability on community health, education and quality of life?

What is the circular economy and how is it different from the linear economic model?

What kinds of things can businesses do to curb their carbon footprints?

Why are biodiversity and natural capital important for long-term economic stability?

Differentiate between climate change mitigation, adaptation and resilience with examples.

Explain how green business models support innovation and sustainable development.

How can “green” practices save organizations money?

Discuss the significance of ESG investing and corporate governance in long-term value creation.

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Answers to Knowledge Check

Knowledge Check 1

1. b) Circular economy

2. b) Below 2°C

3. b) Minerals

4. c) Adaptation

4.9 Case Study

Balancing Growth and Sustainability: The Case of EcoSteel Ltd.

Introduction

EcoSteel Ltd, medium-sized steel production company, grew swiftly prior to the current downturn because of:

rising infrastructure demand. But the company is coming under increasing criticism for its

environmental practices. emitting a high amount of carbon and using too much water, not to mention discharging untreated waste

discharge, EcoSteel is facing demands from regulators, investors and communities to implement

sustainable practices. But equally, the company needs to make money and be able to compe.tin a titi_tC!.n market.

resource-intensive industry. In this case we look at some challenges and potential solutions within EcoSteel.

while balancing growth with the objectives of sustainability.

Background

EcoSteel is working in a notoriously environmentally damaging industry. Steelmaking consumes

large energy and by large CO_2 emissions to the world. Communities living near

EcoSteel's facilities have had cases of respiratory ailments and contaminated water supplies. Investor groups are

also criticizing the company's long-term worth in the absence of sustainability efforts.

Management is interested in moving towards more eco-friendly business strategies, such as the use of

renewable energy, recycling of steel scrap and investments in cleaner technology s, but worry a about high.

upfront costs and potential disruptions.

Problem 1: High Carbon Emission and Dependence to Energy

how steel is made with coke EcoSteel depends on coal energy systems, and therefore emits high levels of greenhouse

gases. This opens a company up to the risk of regulation and reputational peruasion.

Solution: Slowly switch over to green energy source (solar, wind), use moreefficient technologies, drive less etc..

productivity, and fund technologies for capturing carbon.

MCQ:

How can EcoSteel minimize its carbon emissions?

a) Maintain using coal for power generation in order to save costs

b) Added investments in renewables and efficiency options

c) Disregard of emission standards

d) To use export operations from less controlled areas

Answer: b) Invest in renewable energy and efficiency initiatives

2 Problem Formulation: Water Use and Pollution

Ec oS teel sources significant amounts of freshwater for cooling facilities and r eleases t he untreated 35,000 – 55,000 gallons it consumes with a rise in temperature back into the Kansas River.

wastewater into rivers, clashing with local residents.

Solution: Embrace water recycling technologies, pre-treat wastewater and investigate

to minimize the use of fresh water using rainwater harvesting.

MCQ:

What is the most appropriate action EcoSteel has taken so far based on water sustainability?

a) Higher draw of water from the rivers

b) Ignore community complaints

c) Treat water recycling and wastewater

d) Rely on government water subsidies

Response: c) Recycle waste water and treat sewage

Problem Statement 3: Investor Fears of Long-Term ValueDestroyers

EcoSteel's investors are concerned about climate regulation risks, lawsuits and reputational

damage. They demand stronger ESG commitments.

Solution: Issue annual sustainability reports, adhere to global standards (GRI, SASB) and factor it all in.

ESG criteria into corporate governance.

MCQ:

How can EcoSteel restore investor faith in the value for the long term?

a) Avoid sustainability reporting

b) Be focused only on short-term profits

c) Implement ESG reporting and sustainable governance practices; and

d) Wait until rules come into force before taking action.

c) Implement ESG-reporting and sustainable governance.

Conclusion

EcoSteel is a case in point that demonstrates the integration of sustainability's environmental, social, and 144 Figure 1. ecoSTEEL/ecotrust: platform for innovation and collaboration economic dimensions.

economic dimensions. Doing so by the adaptation of green technologies, the enhancement of the efficiency of resources and

(Huang et strengthening ESG governance, the firm can reduce risk, improve its image and generate

long-term value. Costs up front may be expensive, but the business benefits of sustainability have a strategic potential to rolling out.

strength and competitiveness in an age of change.

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Unit 5: Environmental Law and ESG

Learning Objectives

Define environmental law and discuss the role of environmental law in control over human relationships with the

environment.

Recognize significant national agreements and international treaties (e.g., Paris Agreement, Kyoto Protocol) and.

legislations that govern environmental protection.

Discuss the contribution of Environmental Law to solving problems like pollution control,

, biodiversity conservation and climate change mitigation.

What is ESG (Environmental, social and Governance) and why it is crucial in

sustainable business practices.

Distinguish What is voluntary ESG Commitments made2 by a company compare to compliance clauses of the environmental laws?

corporations.

Analyze the effects of ESG frameworks on investing and corporate responsibility.

Look at business case examples where strong ESG practices mitigated risks and increased long-term value for

stakeholders.

Suggest mechanisms of linking environmental law and ESG frameworks to business

operations to maintain sustainability and legality.

Content

5.7 Key Terms

5.8 Descriptive Questions

5.9 References

5.10 Case Study

5.0 Introductory Caselet

“Compliance versus Commitment: The Story of GreenTech Energy”

The power generation and Energy Storage GreenTech Energy AG has up till now dominated the power production potentially outpaced in some 2 to 3 decades.

the increasing demand for power in its service area. It has, over the last decade, faced more and panic.

calls from regulators, the markets and public to embrace greener practices.

Earlier this summer the government enacted tougher environmental legislation which requires cuts in

emissions, more stringent standards for air pollutants and compulsory environmental impact assessments in the... [p]lanning process for all new

projects. While GreenTech has met the bare minimum of what's legally required, to critics that approach ''doesn't pass the smell test.''

is responsive and is not premised on mere conformance.

Meanwhile, worldwide, investors and stakeholders are focusing on Environmental, Social and

Governance (ESG) performance. Some of GreenTech’s rivals have embraced ESG programs,

investing in transition to renewable energy, transparent government, and active communities. As a

These rivals are gaining foreign investments and have better reputations as a consequence.

Decision faced by GreenTech’s management is to “have the door keep being opened to the media” or not respond, and run higher risk of autoworkers filing lawsuits charging it with retaliatory dis-crimination against employee-ribs.

provisions that lead to short-term compliance at the risk of driving away investor confidence, or should a prompt?

incorporate ESG considerations that might imply greater initial investment but offer a return on value, resilience and longevity in the long run.

competitiveness?

Critical Thinking Question

If you were a member of GreenTech Energy's management team, how would you weigh the legal requirements

under the environmental law with the more far-reaching demands of ESG investors? What trade-offs and

opportunities would you emphasize to maintain compliance while also being sustainable long-term?

5.1 Key Environmental Laws in India

5.1.1 Historical Background of Environmental Legislation in India

Pre-Independence Period

• Early laws were primarily resource-based, not designed to protect, but to manage exploitation

sustainability.

o Indian Forest Act, 1927: Regulated the use of forest and gave powers to the state to declare certain forests as reserved,

but often ignored tribal rights.

o Wild Birds and Animals Protection Act, 1912: Initial exercise in protection of wildlife.

Post-Independence to 1970s

• Environmental issues were regarded as a secondary consideration to industrialisation and food security.

• Environmental measures were inserted indirectly into laws governing factories, mines, and health.

• The 42nd Constitutional Amendment (1976) was a watershed:

o Article 48A (Directive Principles): State to protect and improve environment.

(A) Article 51A(g) (Fundamental Duties): Citizens have to protect and improve the natural

environment.

Post-1970s (Comprehensive Environmental Legislation)

• Pressure from other countries and domestic catastrophes molded law-making.

• The Stockholm Conference (1972)comnpelled India to establish a National Committee on Environmental.TrimSpace

Planning and Coordination.

• Key Acts:

o Water (Prevention and Control of Pollution) Act, 1974: India's initial landmark in the field of environment ministration.

law led to formation of the Central Pollution Control Board.

o Air (Prevention and Control of Pollution) Act, 1981: Dealt with increasing pollution related to air quality.

o Environment (Protection) Act, 1986: Enacted in the aftermath of Bhopal Gas Tragedy (1984); it came

the umbrella legislation that would grant the central government broad authority to regulate.

Modern Framework

• Enactment of subsequent legislations like the Wildlife Protection Act 1972, Biological Diversity Act 2002, and

National Green Tribunal Act, 2010 and thereby taking India's framework increasingly holistic.

5.1.2 Role of Judiciary and Public Interest Litigations (PILs)

In India, the judiciary has played a major role in broadening the space of environmental law, with courts frequently stepping in when.

executive agencies failed.

Judicial Innovations

• Linked Article 21 (Right to Life) with right to clean and healthy environment.

• Developed principles of international environmental law into Indian jurisprudence:

o The polluter pays principle: The polluter should pay for environmental damage.

o Precautionary Principle: If an action or policy is suspected of causing harm to the public or to the environment, in the absence of scientific consensus that there is no harm, preventive measures should be taken.

o Public Trust Doctrine: Natural resources are the property of all people, granted in trust to the state for their benefit.

Landmark PIL Cases

M.C. Mehta v.Union of India (1986): The Supreme Court directed cl0sure of polluting industries in

Delhi and established the concept of absolute liability for hazardous industries.

• Subhash Kumar v. State of Bihar (1991): Recognised right to clean water and unadulterated air

environment as a facet of right to life under Article 21.

• Vellore Citizens' Welfare Forum v. Union of India (1996): Added the words "precautionary" and "polluter \n

pays" principles as essential law.

• Indian Council for Enviro-Legal Action v. Union of India (1996): Enlarged liability meant 327 we"/ damage through the environment, increased level of compensation if unreasonable harm caused by industry or development.

environmental damage caused by industries.

Impact of Judicial Activism

• The environmental compliance has been made enforceable by the Supreme Court and High Courts.

• The creation of the National Green Tribunal (2010) formalised judicial oversight over.

environmental matters.

Did You Know?

"India is a global pioneer in using Public Interest Litigations (PILs) for environmental protection. In

the landmark M.C. Mehta v. Union of India case, the Supreme Court linked the Right to Life (Article

21) with the right to a clean environment, reshaping environmental jurisprudence worldwide."

5.1.3 International Agreements Influencing Indian Environmental Law

India's environmental legislation is heavily driven by its obligations under international treaties and conventions.

Key Milestones and Impacts

United Nations Conference on the Human Environment (1972)

o India's initial encounter with international environmental politics.

o Led to the establishment of the Department of Environment (1980) and subsequently Ministry of

Environment and Forests (1985).

Rio Earth Summit (1992)

o The introduction of sustainabale development issues and Agenda 21.

o India adopted this in the National Environment Policy, 2006.

Convention on Biological Diversity (1992)

o INDIA also ratified it and enacted the Biological Diversity Act, 2002.

Kyoto Protocol communications (1997) and Paris agreement pledges (2015)

o Committed India to lower carbon intensity and increase the use of renewable energy.

o Visionary domestic policies including the National Action Plan on Climate Change (2008) and

state-level action plans.

Basel Convention (1989)

o Were behind India's Hazardous Wastes (Management and Handling) Rules.

Montreal Protocol (1987)

o India phased out its Ozone Depleting Substances in accordance with this treaty.

Resulting Shift

- International treaties led Indian law to move from case-by-case to wholesale frameworks.
- They also nudged India toward national regulation that more closely matched global standards.

5.2 Environment Protection Act, 1986

5.2.1 Objectives and Provisions

Objectives

Establish an integrated policy for the protection and enhancement of the environment.

To take action on the resolutions passed during the "United Nations Conference on the Human Environment" held in Stockholm (1972).

To step in for previous laws with a bill to grant wide-ranging powers to the government.

To regulate and ensure enforcement of certain provision related to environmental protection To facilitate the state and central environmental agencies to work in harmony To make coordinative addressing, combined action for protection of environment from enemy forces.

protection.

The regulation of dangerous industries and the protection of human health.

Key Provisions of the Act

• Section 3(1): Hereby sets the stage to allow the central government to do everything necessary for: (x) “the protection [and] improvement.

environmental quality.

• Section 6: Permits the government to fix standards of emissions, effluent, quality and being.

environmental quality.

• Section 7: It shall be unlawful for any discharger to discharge into a waterway any pollutant in a quantity exceeding the limitations established under this chapter.

• Section 8: Requires safe handling of hazardous materials.

• Section 9: Calls for prompt notification in event of spills and remedial action.

• Section 10: Empowers government officials to inspect, search and seize if sincutility.

violations.

• Section 15: Establishes penalties — imprisonment for up to five years, fines or both — for violations.

The broad reach of the Act provides the basis for a large number of other environmental regulations and 9.

notifications in India.

5.2.2 Powers of the Central Government under EPA 1986

Under the Act, it is the central Government which has been given sweeping powers to

environmental governance.

Major Powers

• Order to Take Action: Can direct the closure, prohibition or regulation of any industry, operation or

process causing environmental harm.

• Standard Setting: Creating standards for emission and discharge by industries.

• Co-ordination: Monitoring role on activities of CPCB and SPCBs for uniform.

enforcement.

• Toxic Substances: Policing the storage, transit and processing of toxic substances.

• Environmental Clearance: Compel industries to get previous environmental clearance for their projects.

• Delegation of Authority: set up appellate authorities like the Environment Appellate Authority or

specialized bodies to implement rules.

•Emergency Powers: Interfere immediately in the event that environmental accidents occur.

By these powers, the EPA becomes the pillar of India's environmental regulatory system.

5.2.3 Role in Pollution Control and Environmental Safeguards

The EPA is now instrumental to India's war against pollution and ecological ruin.

Pollution Control

• Forms the basis for National Ambient Air Quality Standards (NAAQS).

• Authorizes the government to regulate dirty industries.

• Serves as the basis for Environmental Impact Assessment (EIA) including.

environmental consequences before projects begin.

Waste Management: Rules, 2016 and Solid Waste Management Rules (2016).

Waste Rules (1998), and E-Waste Rules, 2011.

Environmental Safeguards

• Helped in formulating CRZ notifications (from 1991) for the protection of -8000500000 kilometres of coastal stretches.

marine and coastal ecosystems.

Deals with the problem of depletion of Ozone Layer: • Helps India to conform to its international bearers like Montreal Protocol (which is all about ozone).

depletion) and Basel Convention (hazardous waste).

• Establishes a basis for environmental audit and monitoring systems.

According, EPA 1986 provides a link between international obligations and domestic environmental

protection.

5.2.4 Case Studies on Implementation and Challenges

Case Study 1: Oleum Gas Leak Case (Delhi, 1986) A.

• Shortly after the passage of the EPA, a gas leak from Shriram Food and Fertilizers sickened dozens

people.

• The bright-line standards established by the EPA helped to develop the doctrine of strict liability, where, for example:CGPoint Source Discharges Clean Water Act Safe Drinking Water Clean Air Act Pollution Control 1.

suitable companies industries handling toxic substances liable for any harm.

Case Study 2: Shutting Down Polluting Tanneries in Tamil Nadu (Vellore Citizens' Welfare Forum v.

Union of India, 1996)

• Leather tanneries spewed raw effluents, poisoning water sources.

• Both the Environmental Protection Agency was invoked and the court enforced two great principles of environmental law — "precautionary principle" and "polluter

pays principle", which resulted in non-compliant industries being shut down.

Case 3: Plastics and Feasible Disposal of Hazardous Wastes

• India enacted Plastic Waste Management Rules (2016,with amendments 2021) under the EPA.

• Extended Producer Responsibility (EPR) became compulsory and EPR now puts the onus of collecting them was a new obligation for manufacturers to take back.

or recycle plastic products.

Case Study 4: Implementation of the Critique

• Weak enforcement due to the limited capacity of regulatory authorities, despite a strong framework.

• Companies frequently take advantage of legal loopholes or secure clearances despite environmental risks.

• Bureaucratic delays are common because of overlapping jurisdiction among ministries and boards.

• Public participation in enforcement is scarce, though courts have sought to extend it through

PILs.

Knowledge Check 1

Knowledge Check 1

Choose the correct option:

1. The Environment Protection Act, 1986 was enacted after which disaster?

a) Tsunami 2004

b) Bhopal Gas Tragedy

c) Oleum Gas Leak

d) Chernobyl Accident

2. Which section of EPA empowers the central government to take measures for environmental

protection?

a) Section 6

b) Section 7

c) Section 3

d) Section 15

3. Maximum punishment under EPA 1986 for violations includes:

a) Fine only

b) Imprisonment 5 years

c) Life sentence

d) Warning notice

4. Coastal Regulation Zone (CRZ) notifications are issued under:

a) Water Act 1974

b) Air Act 1981

c) EPA 1986

d) Wildlife Act 1972

5.3 Air Act (1981), Water Act (1974), and Hazardous Waste Rules (2016)

5.3.1 Air (Prevention and Control of Pollution) Act, 1981 – Key Provisions

Historical Background

• Approved to fulfill India's obligations under the 1972 Stockholm Conference on Human

Environment.

• Patterned in part after the existing Water Act, which would apply its presumptions to air quality.

Objectives

Prevent and control air pollution.

Create regulators (CPCB and SPCBs) to enforce norms.

Maintain acceptable levels of industrial and motor vehicle emissions.

Key Provisions

• Section 2(b): Broadly defines "air pollutant" to mean aпy\ substance (including any radionuclide) in any form including a gas, veaj disperses irreversibly or.

humans, plants, or property.

• Consent Mechanism: Units are required to get "Consent for Establishment" and conscentreneweBehaviour from • The four JEBs were most frequented by stuttering children followed by NCV, \n the UCB ...

SPCBs before functioning.

• Air Pollution Control Areas: States can also categorize localities under which more stringent regulations are prescribed.

• Pollution Control: CPCB establishes standards for industries and automobiles.

• Inspection and Enforcement: SPCBs have the power to enter, inspect any building or site and take samples.

• Punishment: Offenders may be imprisoned (for up to 6 years) or face a fine.

Example

• Delhi's public transport fleet was converted in 1998, on the directions of the Supreme Court under Air Act.

to Compressed Natural Gas (CNG), with much lowered particulate matter emissions.

5.3.2 Water (Prevention and Control of Pollution) Act, 1974 – Key Provisions

Historical Background

• First comprehensive pollution law in India.

• Passed in the wake of industrial effluents poisoning streams that served public health and agriculture

being heavily affected.

Objectives

Prevent and control water pollution.

Maintain or restore water quality.

Set up institutional arrangement (CPCB and SPCBs).

Key Provisions

• Definition: Water pollution is any kind of physical pollution, chemical pollution or biological pollution that makes water harmful.

life, or agricultural use.

• Consent: No effluent should be allowed to flow without the consent of the industries.

• Effluent Standards: The CPCB prescribes the maximum permissible limits of pollutants.

• Powers of SPCBs: Inspects water treatment plants; directs closure of erring industries; finer judicial enforcement powers such as power to impose penalty, power to take a person who has the reasonable belief of having fouled or likely to cause fouling etc.

regulate sewage disposal.

• Penalties: Convicted offenders can be punished with imprisonment (up to 7 years) and fines.

Example

§ In the state of Tamil Nadu, some leather tanneries were closed under judicial instructions (Vellore Citizens Welfare Forum et al.

Forum v. Union of India, 1996] for discharge of untreated effluents by applying the provisions of Water Act.

Did You Know?

“The Water (Prevention and Control of Pollution) Act, 1974 was India’s first comprehensive

environmental law, enacted even before the Air Act. It created the Central and State Pollution

Control Boards and made it mandatory for industries to obtain consent before discharging effluents,

laying the foundation for modern pollution regulation.”

5.3.3 Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016

Background

• Framed under the Environment Protection Act (1986) in consonance with the Basel Convention (1989).

• Unified existing regulations on hazardous waste and extended coverage to e-waste,

biological waste, and other dangerous materials.

Objectives

Promote environmentally sound management of hazardous and other wastes.

To prevent the illegal import/export of hazardous waste.

Promote reduction and recycling of recoverable commodities.

Key Provisions

• Definition: Hazardous waste is any material that is toxic, flammable, corrosive or reactive.

• Permit: Hazardous waste generators must have SPCB PERMITS.

• Extended Producer Responsibility (EPR): For batteries and e-waste, and plastics etc.

ensure collection and safe disposal.

• Movement Across Borders: Prior approval is required for import/export and fulfi lment of.

international rules.

• Disposal: Typical disposal is in common facilities (TSDFs – Treatment, Storage, and Disposal Facilities) a.

established for safe handling.

Example

• India in 2019 prohibited the import of solid plastic waste under these rules, responding to broadeing global

fears of “waste dumping” in developing countries.

5.3.4 Institutional Mechanisms: Central and State Pollution Control Boards

Central Pollution Control Board (CPCB)

• Created by the Water Act (1974); broadened responsibilities under Air Act.

• Functions:

o Assist central government in the field of pollution.

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o Establish national emission and effluent standards.

o Coordinate SPCBs’ activities.

o Monitoring and reporting on national environmental data.

o Conduct training and research.

State Pollution Control Boards (SPCBs)

• Created as part of the Water Act.

• Functions:

o Enforce the standards of CPCB in States.

o Grant “Consent to Establish” and “Consent to Operate” industries.

o Check on industrial operation, sewage treatments and vehicles.

o Implement state-level hazardous waste regulations.

o Prosecute those in violation.

Challenges

• Resource Limitations: Several of the SPCBs have shortage of skilled resources, labs and funds.

• Political Pressure: Enforcement is frequently skewed by industrial interests.

• Gaps in Coordination: There is an overlap or inconsistency between CPCB and SPCBs in their roles.

• Inadequate Surveillance: Lack of monitoring explained the high rate of industries and low number of inspectors.

• Justice Delayed: Most violations are settled only after protracted courtroom fights.

5.4 Energy Conservation (Amendment) Act, 2022

5.4.1 Salient Features and Objectives

Salient Features

Carbon Credit Trading Framework – Creation of a liability incase entities are unable to buy carbon credits as well as the creation of a domestic market wherein the entities can purchase 98% Conversion or Purchase from Clean EXIM Process Forestry Waste Renewable Fuel Biomass Cook Stoves Improved Water Verification and HRD.

trade carbon credits, the way international trading systems do.

Non-Fossil Energy Use – Forces renewable sources (solar, wind, biomass), greenhouses.government buildings.set.K-12 schools.Department of.

hydrogen and nuclear in industry, transport and buildings.

Green Buildings – Challenges and Enforces the Energy Conservation and Sustainable Building Codes

to blanket homes, businesses and governmental buildings.

Powers of BEE made stronger – BEE -the Bureau of Energy Efficiency is empowered to recruit Qualified Energy Auditors, hire personnel required and tap Funding: offset money duties within the trust.

develop, monitor and certify energy efficiency programs.

State-Level Authority— States have the power to establish local, enforceable energy

conservation obligations.

Definitions Revised – Definition of “energy” expanded to include renewable and nonrenewable energy; and Fireplacerelated definitions added.

sustainable sources.

Objectives

• Decrease energy intensity in all sectors.

• Harmonize domestic law with India’s international climate obligations.

• Ease the move to a low-carbon economy.

• Encourage innovation in clean tech.

• Reinforce compliance and accountability in industry, transport and buildings.

5.4.2 Energy Efficiency and Sustainable Energy Practices

The amendment underscores the systemic incorporation of efficiency mechanisms and approaches at every level in_DESTROYED all partsarsimpS1 proceeds its study involvingnbsp;MBEDbub8DESTROYED parts S3 mdJaip to be glancednbsp;IEEEstandardized working with_).

the economy.

Key Measures

• Appliances & Equipment: Tighter star-rating rules for home and commercial appliances.

OR Buildings: Prescribes adherence to Energy Conservation Building Code (ECBC) and

sustainable green building norms.

• Transport: Promotes fuel efficiency standards, electrification of vehicles, and infrastructure to

EV charging.

• Sectors: Selected sectors with high energy consumption (csv0002063) - Specific energy-intensive industries includesteel, cement, aluminium, fertilizer and textiles

should become subject to periodic energy audits and deploy best practices.

• Renewables: Bigger encouragement for rooftop solar, wind and power generation from biomass.

Examples

• The Perform, Achieve, Trade (PAT) Scheme has already factored in better than target & exposed the industry for trading them.

efficiency to trade excess savings.

• BEE appliance rating labels aid consumers in selection of energy efficient appliances/ systems, help them to save money on electricity bills and play a role in reduction of green house gases.

household electricity demand.

Importanc e: Energy efficiency is often referred to as the “first fuel” in that it is less expensive, more rapidly deployable than supply options.

way to reduce emissions.

5.4.3 Carbon Trading Framework in India

The bill creates a national carbon market as an essential market-based mechanism.

How It Works

• Emission reduction or efficiency targets will be assigned to industries, power plants and other entities.

• If an organization does better than the target, it receives carbon credits.

• If it falls short, it has to buy credits from others or pay a penalty.

• Credits are alienable on a voluntary market, enabling low-cost emissions reductions.

Benefits

• Encourages the private sector to develop green technology.

• Levels the playing field by rewarding efficiency and taxing excess pollution.

• Encourages innovation in renewables, hydrogen and energy storage.

• Closes the gap between India and global carbon markets, allowing Indian exports to be more competitive.

Challenges

• Needs strong Monitoring, Reporting, and Verification (MRV) mechanism.

• The potential for fraud, manipulation, or "greenwashing" if left insufficiently regulated.

• Smaller companies (SMEs) could find compliance onerous.

Global Context

• Other similar programs in Europe (EU Emissions Trading System), China's Attention to the carbon dioxide emissions of imported products and services is something that was long anticipated.

Market and California Cap-and-Trade Program.

• The system in India can eventually connect to global carbon markets, allowing for opportunities.

cross-border trading.

5.4.4 Implications for Industry and Business

The amendment has huge ramifications, given that energy-intensive sectors such as power, steel,

cement, and transport.

Positive Implications

• Other Revenue: You can sell surplus carbon credits, providing new source of revenue.

• Global Market Access: Companies with solid ESG and low-carbon capabilities will be more successfulJapgolly as part of the global value chain.

international investment.

• Competitive Edge: Clean technology frontrunners will have a competitive advantage over the long term.

• Innovation: Clears a path for startups in renewables, green hydrogen, carbon capture and efficiency

technologies.

Challenges

• Initial Costs: Technologies Green Issued (solar, hydrogen, CCUS – Carbon Capture, Utilization and

Storage) demand heavy investment.

• Burden on Industry: Industrial sectors need to create systems for data, audits and reports.

• Sector Pressure: Power plants, oil refineries and cement factories face early pressure to rein in Their top customer is themselves; these facilities would have lower carbon emissions.

cutting emissions.

• SME Impact: Smaller companies might have difficulty bearing the expense of compliance imposed upon them without economic

support.

Case Example

• Steel Industry: The steel industry in India is also a large carbon emitter. Under the amendment,

companies will need to phase in renewable-fired furnaces, hydrogen-driven processes, and efficiency

upgrades, though they can benefit by trading extra carbon credits.

“Activity: Designing a Low-Carbon Business Strategy”

Students will form groups and select an industry (e.g., steel, cement, transport, or energy). Using the

Energy Conservation (Amendment) Act, 2022 as reference, each group will design a short strategy

outlining how the industry can improve energy efficiency, adopt sustainable practices, and benefit from

carbon trading.

5.5 Overview of ESG Framework in India

5.5.1 Evolution of ESG in Corporate Governance

• Phase One - formative period (1990s-2000s): The Corporate Social Responsibility (CSR) was the dominant model,

primarily featuring philanthropy and community involvement.

• Switch to Sustainability (2010+): With global climate allegations,rising environmental awareness and_tC shifting towards the promotion of_t_business that is,at_least respectfully sustainable.

investors' attention led companies to incorporate sustainability into business strategy.

• Mandatory CSR (2013): The Companies Act, 2013 compelled some companies to invest a minimum of 2% of its profits from the lastestimated three fiscal years on corporate affairs.

profits on CSR as the state cracks down on socially responsible business.

• ESG goes mainstream (2020s): Broad-based alignment with UN Sustainable Development Goals around the world

(SDGs) and Paris Agreement objectives turned ESG into something of a core for corporate governance.

“What we see today is, ESG moved from being voluntary to compliance and as a criterion for measurement.”

attracting investment.

5.5.2 SEBI Guidelines on ESG Disclosures (BRSR – Business Responsibility and Sustainability

Reporting)

SEBI has made ESG-related disclosures compulsory

for the listed entity through BRSR (Business Responsibility and Sustainability Reporting.

framework.

Key Features of BRSR

• Compulsory for Top 1,000 listed companies by market cap (from FY 22-23).

• Relates to nine principles of the National Guidelines on Responsible Business Conduct (NGRBC).

• Requires companies to report their performance on environmental (emissions, energy use and water use), social

13 waste), social (labor standards, gender diversity, community initiatives) and governance (board

structure, ethics, transparency).

• Favors quantitative measures for comparability across companies.

• Propels India's transition to global harmony with mechanisms such as GRI, SASB and TCFD.

Significance:This has put India on a shortlist of nations where it is compulsory for.

large corporations.

5.5.3 ESG Rating Agencies and Investors' Perspectives

ESG Rating Agencies in India

• CRISIL – offers ESG ratings for environmental, social and governance performance.

• ICRA and CARE Ratings – provide ESG scores that are in line with international standards.

• Foreign entities like MSCI, Sustainalytics and FTSE Russell also rate Indian companies.

for global investors.

Investors' Perspectives

• Institutional and foreign investors increasingly screen companies for ESG performance ahead of

investing.

• ESG compliance increases access to capital and reduces borrowing costs.

• Bad ESG report cards risk reputational damage, investor flight and more expensive financing.

• The rise of green bonds and sustainable finance in India is an indicator of the increasing relevance of ESG

in investment decision-making.

Example: International investment corporates such as BlackRock who have given the lead to ESG integration have swayed Indian

companies to strengthen disclosures.

5.5.4 Challenges and Opportunities in ESG Adoption

Challenges

• Data Gaps: Several companies have an incomplete system for gathering ESG data.

• Standardization: A lack of consistent ESG metrics worldwide for comparison.

• Costs of Compliance: Smaller firms are too resource-strapped to adopt ESG policies.

• In Greening Risk: Some companies overstate their E.S.G. commitments without taking material action.

• Knowledge Gap: Many still think of ESG as something they have to comply with rather than a strategic advantage

businesses.

Opportunities

• Investment Appeal: Companies that perform well on ESG factors are attractive to domestic and international investors.

• Savings: Another form of value is the long-term financial savings that sustainability practices (e.g., energy and cost waste reduction) deliver to a business operating in its primary markets.

costs.

• Competitive Position: It provides a market edge as ESG compliance enhances brand image and consumer confidence.

• Global Competitiveness: Adherence to global standard ESG criteria provides access to international.utility.chana@_sdstate.

chains and trade partnerships.

• Potential for innovation: promotes uptake of renewable energy, circular economy and inclusive

workplace practices.

5.6 Summary

❖ Environmental legislations in India developed by way of constitutional provisions, judicial activism and

international commitments.

❖ Environment Protection Act, 1986 is a principal (umbrella) legislation that provides for the protection and improvement of the environment and for matter connected there with.

government with wide-ranging powers.

❖ The Air Act (1981) controls air pollution and industrial effluents in notified control areas.

❖ The Water Act (1974) was the first comprehensive pollution control law, that primarily concentrated on preservation /118 January 8, 2011 vo l xlvi no 2 EPW Economic & Political Weekly of reviving and maintaining comparable standards of hygiene for public health and preventing waterborne diseases.

and restoring water quality.

❖ The Hazardous and Other Wastes Rules (2016) provide for the safe management, processing and disposal of and reclycling of, wastage.

hazardous wastes.

❖ The CPCB and SPCBs are the main institutional mechanisms through which the.

pollution control laws.

❖ The Energy Conservation (Amendment) Act, 2022 widened the ambit of energy efficiency and

group installed a national carbon market.

❖ The trade of carbon incentivizes the reduction of emissions and opens a market for green

technologies.

❖ ESG has now taken center stage in INDIA for corporate governance and transitioned over time from CSR-centric to

structured sustainability reporting.

❖ SEBI's BRSR framework compels ESG disclosures among top listed companies to

transparency and accountability.

❖ ESG rating firms and investor views are driving businesses to thinking more long term in creating value.

creation.

❖ Challenges such as lack of data, compliance costs and green-washing but also opportunities from ESG adoption.

innovation, finance and competitiveness.

5.7 Key Terms

Environment Protection Act, 1986 – Umbrella law to enable the central government to regulate.

and safeguard the environment.

Air Act, 1981 – An Act to prevent and control air pollution through emission standards and control measures

areas.

20

Water Act-1974 – First Indian law that has been passed to prevent and control water pollution.

Hazardous Waste Rules, 2016- Guidelines for safe transportation, recycling, treatment and disposal of hazardous wastes – Amendments reg.

movement of hazardous wastes.

CPCB (Central Pollution Control Board) – The supreme authority to fix standards and coordinate pollution trend details.

control in India.

Energy Conservation Act, 2001 (Amended. 2022) – Enabling arrangement for energy efficiency and…

introducing carbon credit trading.

Carbon Trading – Transaction of entities purchasing and selling credits depending on their emission cuts.

BRSR (Business Responsibility and Sustainability Reporting) – the SEBI's compulsory ESG disclosure

framework for top listed companies.

ESG (Environmental) Social, Governance – Framework for corporations calculating the sustainability and.

responsible governance practices.

5.8 Descriptive Questions

Discuss the background of environmental legislation in India and Constitution’s part played

in shaping it.

Explain the importance of Environment Protection Act, 1986 as an umbrella legislation and

outline its major provisions.

Mention the salient features and aims of the Air Act, 1981 and Water Act, 1974.

Examine the salient features of Hazardous and Other Wastes Rules, 2016 and its significance in ensuring

safe waste management.

Discuss the organization and powers of the CPCB and SPBC.

SPCBs) in enforcing pollution laws.

Discuss the highlight of the Energy Conservation (Amendment) Act, 2022.

India's transition to clean energy.

Discuss the SEBI BRSR framework and its significance in enhancing ESG disclosures within India.

What are the challenges and Bright Spots for business to embrace ESG in India?

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Answers to Knowledge Check

Knowledge Check 1

1. b) Bhopal Gas Tragedy

2. c) Section 3

3. b) Imprisonment 5 years

4. c) EPA 1986

5.10 Case Study

ESG Compliance and Environmental Law Challenges at EcoPower Ltd.

Introduction

EcoPower Ltd., one of the fast growing power companies in India

by establishing coal and thermal power plants to accommodate increasing energy needs. However, it faces

heightened pressure from regulators, investors and local communities over its environmental practices.

“We have done all that is required by the law of Sierra Leone and of course our own AML requirements.

Act, 1986 and the Air Act, 1981 though it is yet to adopt a more comprehensive approach which encompasses ESG (Environmental, Social,

Governance) frameworks sought by global investors. This case study examines EcoPower’s

but which are compliance challenges for organizations and it discusses how these organizations can find the balance between regulatory requirements and ESG

expectations.

Background

EcoPower covers five states, most of it generated by coal. Rising emissions

have pushed the company under searchlights with the Central Pollution Control Board (CPCB) and

State Pollution Control Boards (SPCBs). Near its plants, communities Water-truck.Communities by the resolve in water.

pollution and health issues. Meanwhile, foreign investors are calling for ESG disclosures in

with SEBI's Business Responsibility and Sustainability Reporting (BRSR)requirements. The

company is missing out on investment avenues, if it does not change according to ESG norms.

Problem 1: Adherence to Environmental Rules

EcoPower finds it difficult to comply with more stringent regulations of the Air Act, 1981 and Water Act, 1974.

especially concerning the emission and effluent standards. Refusal has triggered legal notices and

penalties.

Solution: Implement state-of-the art pollution control technologies, audit regularly and allocate money toward.

cleaner fuel to meet the set standards and to prevent penalties.

MCQ:

In India, under which law government has power to control industrial emission?

a) Water Act, 1974

b) Air Act, 1981

c) Companies Act, 2013

d) SEBI Act, 1992

Answer: b) Air Act, 1981

Note 2: Reporting and Investor Confidence on ESG The problem statement consists in the following elements:

Investors are calling for more transparency on the environment and social impact. EcoPower has yet to

release extensive sustainability reports, with an eye on governance and longer-term risks.

Solution: Introduce mandatory BRSR reporting under SECURITIES AND EXCHANGE BOARD OF INDIA cleanindia journal 38 | JUNE 2019 waste, etc., which will encourage firms to put in place the organizational structures necessary to collect the requisite information.

workforce practices, D&I and governance measures to win back investor faith.

MCQ:

What is the mandatory reporting framework for the top listed companies in India?

a) GRI

b) SASB

c) BRSR

d) TCFD

Answer: c) BRSR

Problem 3: Transitioning to Sustainable Business Models

EcoPower's heavy dependence on coal exposes it to regulatory and reputational risks. Competing

companies are actually moving into renewables, while EcoPower falls behind.

Solution: Establish a gradual approach to diversify solar, wind and green hydrogen and at the same

capitalizing on opportunities under India's introduced in the carbon credit trading system atrequiring investment.

Energy Conservation (Amendment) Act, 2022.

MCQ:

Which Act established the system of trading carbon credits in India?

a) EPA 1986

b) Water Act 1974

c) Energy Conservation (Amendment) Act 2022

d) Companies Act 2013

Answer: c) Energy Conservation (Amendment) Act 2022

Conclusion

The EcoPower Ltd. case demonstrates that adherence to environmental legislation is no longer sufficient.

sufficient for long-term survival. And the only way for the to be competitive and bring global investment to them is if.

corporate ESG: businesses should adopt a principles-based approach to sustainability reportingVERTISEMENTNeeds Utilities company The best wayNeedsgovt.

adoption, and carbon trading opportunities. Taking an active approach will allow EcoPower to not simplyачены and act in order to be prepared.

meet its legal obligations and also establish itself as a leader in India’s transitional journey to

sustainability.

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ATLAS SkillTech University

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Unit 6: Best practices in Indian and Global companies

Learning objectives

Elaborate identification of and rationale behind best practices in management from an Indian and global perspective

contexts.

Study based on successful cases of Indian companies (e.g., Tata, Infosys, Reliance) and international.COMPANY.Additional element to bring into the debate would be a focus on the critical \"how\" question in implementing SUSTAINABILITY initiatives.

companies (e.g., Toyota, Apple, Google) to learn their strategies.

Also compare and contrast Indian organizations based adoption of best practices with the rest of.junitCOMPARE The ADOPTION OF BEST PRACTICES: INDIAN ORGANIZATIONS AND THE REST OF This study was conducted to compare the implementation.

multinational corporations.

Assess the cultural, economic, and regulatory impacts on the delivery of

best practices across regions.

Analyze how innovation, corporate governance, and sustainability influence best practices.

Talk about the HR and leadership and employee engagement style of

leading companies.

Evaluate the implications of adoption of global best practices among

the international market.

Use learnings from best practices to propose recommendations to improve organizational

performance.

Content

6.6 Descriptive Questions

6.7 References

6.8 Case Study

6.0 Introductory Caselet

“Best Practices in Global Leadership: TCS vs. Google”

The last decade has seen companies from India and around the world embracing

best practice in order to improve competition, sustainability and staff satisfaction. The following case

Both are but instances of two successful bodies which have found methods of making themselves felt astoISOString -- ADDITIONAL PROOFS 63 interests.

leaders in their respective industries.

Tata Consultancy Services (TCS) an Indian IT services and consulting company Continued to_poll.

its focus on the training and development of employees as well as organizational learning inherent in its best practice. With more than

with 600,000 employees around the world, TCS has committed significant investments in initiatives to uplift the workforce

capabilities., for example, has its “Ignite” programme which delivers extensive training to graduates, allowing newly qualified staff members endwhile there exist many POSITIVE uplifts one could apply And there are plenty of POSITIVE uplifts we can make

their quick response to conversational cues from the industry. Moreover, TCS encourages the internal growth of leaders.

promotes and facilitates cross-cultural cooperation, and is committed to the highest standards of corporate governance. This focus

when it comes to TCS, a focus on HR excellence has enabled those acts of retention; ent also to secure the services of the best.

employer across the globe. Its intensive focus on skill-development means that employees come out future-ready.

prepared in a quickly evolving world of technology.

The US-based Google, on the other hand, is renowned for promoting a culture of

innovation and creativity. Google's managerial outlook is all about flexibility, autonomy, and

experimentation. The infamous ancé Rule that had permitted employees to spend up to 20 percent of thei career working for outsi e empl ers while still being paid a stipe dary-slated3 share of profit.

and donated time to projects outside their official duties, produced transformative innovations like

Gmail and Google Maps. Moreover, Google spends a lot of money on work space virals,及 collaborative Others:- workplaces Google products 1.

, and making informed decisions while keeping the team motivated and involved. The company's

innovative culture it and in becoming a leader of the technology global sector, regularly in focu ses buried deep in data.

making things and tools that change the way we use.

While TCS and Google operate in different settings, their behaviours are indicative of the same pattern:

prioritizing people and innovation. 311 TCS's model provides a fine example of structured employee

the way in which it developed in building a global workforce, while Google demonstrates how a cultu re of innovation can.

It can help drive disruptive, new products and sustain competitive advantage. Together, these examples highlight how

companies can become world leaders by emulating practices consistent with and suited to their firm s strengths and Artikkelen gir også deltakerne en dypere innsikt i hvordan bransjen kan omstille seg for å øke konkurransedyktighet, og presenterer utviklingen til nisjebedriften som bakgrunn for videre analyser av konkurransestruktur i markedet.

market environments.

Critical Thinking Question

If you were the CEO of an Indian mid-sized company looking to go global what best practice from this case study would be worth adopting?

would you prioritize first:

- TCS's disciplined approach to training and development of employees, or
- Google's innovation-driven culture?

In your reply, include elements such as size of the organization, resources that are available and what the current workforce is capable of.

market competition, and long-term sustainability.

6.1 Infosys

6.1.1 Infosys Sustainability and ESG Commitments

Infosys has ingrained sustainability into the corporate DNA by taking on an expansive ESG agenda.

Environmental Commitments:

o Whether you want to find Infosys crossed a significant milestone as one of the first o pioneering steps here or reach out?

of its 2020 target.

o The Company adopts robust carbon reporting techniques to eliminate Scope 1, Scope 2 and

Scope 3 emissions.

o Goals are energy efficiency, 100% renewable energy usage, water positivity and

long term zero waste to land fill isSuccess!

Social Commitments:

o At Infosys taking care of each other is our first priority to make it an inclusive workforce, fostering diversity

across gender, ethnicity, and culture.

o The organization encourages continuing learning and reskilling of employees to keep up with the changes at hand

the digital economy.\"

o Corporate philanthropy is focused on challenges in, primarily through the Infosys Foundation.

education, healthcare, and poverty alleviation.

Governance Commitments:

o Infosys is known for transparent governance structures and an independent board of

directors and strong audit mechanisms.

o Standards of ethical behavior, antibribery policies, and strong risk management capabilities provide the basis for providedIn codeof conduct.

backbone of its governance structure.

Infosys is continuously rated amongst the highest sustainable plunging performance in global ESGE indices and sustainability rating.

credibility in governance practices.

6.1.2 Green Infrastructure and Renewable Energy Initiatives

Infosys has led the charge for sustainable infrastructure in the IT services industry with energy

efficientcampuscampus designs and broad-based use of renewableenergy.

Green Campuses:

o Infosys campuses, many in Bengaluru, Mysuru and Pune have green building

certifications like LEED (Leadership in Energy and Environmental Design).

o Smart building solutions control lights, air conditioning also water for savings

efficiency.

o Design enhancements such as day light harvesting, natural ventilation and sensible energy

monitoring systems.

Renewable Energy:

o A major portion of Infosys's energy needs are catered by renewable sources.

The company has been building large, utility-scale solar farms and rooftop solar projects throughout India.

o Infosys has signed PPAs for renewable power from open- access wind and solar projects in Goa, y o o wara and Telangan ’ Inspite of death warr amongst government websites continue to be hacked.

producers, lessening reliance on fossil fuels.

Water and Waste Management:

o Constructed water-harvesting, and high-end waste- water treatment plants have made it possible for the company to carry out run-off-harvesting (such as in house design).

a great way to reuse much of its water consumption.

o Infosys is working towards "water positivity", that’s adding more water back into the eco system.

than it consumes.

o Waste segregation and waste composting — Non-biodegradable waste are segregated for recycling or safe disposal.

reduced and biodegradable waste is recycled.

Carbon Neutrality and Offsetting:

o Infosys has committed to community-based carbon offset projects like indoor Upgradation of steam engine with turbine, plantation,-efficient cook stoves etc.

clean cooking stoves for barangays in the rural areas.

o Infosys-supported forestry projects Additionally, the CO2 offset is utilized for emer-gency aid among other initiatives.

importance of the conservation of biodiversity and upliftment of rural livelihoods.

6.1.3 Social Responsibility: Education and Community Development

Social responsibility Infosys has contributed to social causes and charity, primarily edonation to the Infosys Foundation.

Foundation in India, and the Infosys Foundation USA.

Education Initiatives:

Infosys Foundation operates mega programs for quality of access to masses.

education that reaches poor and rural communities.

o The development and implementation of digital literacy intervention for teachers and learners Community Outreach There is obvious lack of community involvement in the activities that are related to technology use in schools.

methods.

sciously Drive Last month in the US (India's largest m exports market), Indian technology This matt...

especially in schools where teachers are scarce, training and supplying teachers.

Healthcare Support:

o The trust is dedicated to hospitals and primary health centers as well as research in life sciences.

o In COVID-19 situation, Infosys contributed with financial support as well in supplying medical

equipment, and vaccine distribution assistance.

o Investments in rural healthcare infrastructure seek to enable primary healthcare for

disadvantaged populations.

Rural Development:

o Projects have consisted in the construction of roads, sanitation work, community centers and housing

for underserved populations.

o Infosys also promotes the clean water and sanitation projects in rural India.

Arts, Culture, and Heritage:

o Infosys also encourages the conservation of historical monuments as well as Indian literature,

art forms, and crafts.

o The company offers financial support to libraries and associations managing old

manuscripts and texts.

6.1.4 Infosys and Global ESG Reporting Standards

Infosys report its sustainability performance in line with global standards,

guaranteeing that multinational corporations are held accountable in the developing world as a benchmark for comparison.

Global Reporting Initiative (GRI):

o The sustainability reports of Infosys are based on GRI framework, i.e., regularized effort is made 13

to disclosure of ESG (environmental, social and governance) metrics.

Sustainability Accounting Standards Board (SASB):

o Infosys leverages sector specific sustainability information without deviations in practice since itâ€™s reporting under SASB guidelines.

information relevant to investors.

The Task Force on Climate-related Financial Disclosures (TCFD) :

o Infosys offers comprehensive climate risks and opportunities related disclosures which are embedded

and put them into risk management and strategic planning.

United Nations Global Compact (UNGC):

HR Mgmt I@ INFOSYS o Infosys is a UNGC signatory, following summa tion of the standards set in The United Nations Global ing_907_work/906_infosy.htm 2007-2019 Infosys Limited and its group companies.

rights, labor, environment, and anti-corruption.

Integrated Reporting ():

o Infosys releases combined report relating financial and non-financial performance,

regarding the relationship between sustainability behaviors and long-term survival of business

strategy.

External Recognition:

" Infosys has been part of sustainability indices like Dow Jones, htons & Reichow-JonesGlobal it can walk the talk on corporate social responsibility.

Sustainability Index (DJSI) and MSCI ESG ratings, underscoring the Company's commitment to

transparency and responsible business practices.

6.2 Tata Group

6.2.1 Tata Group’s Legacy of Sustainability and Philanthropy

The Tata Group has lived a values-centric business philosophy -business excellence and societal well being are not two separate entities.

Founding Vision:

o Jamsetji Tata saw industrialisation not as profit making but also as a

mechanism to build the nation. He created Tata Steel with an explicit goal of

improving India’s self-reliance in manufacturing.

o He also had the vision of constructing institutions of national', 'ReH'ivqfltQ as itrsHhe Indian

Institute of Science (IISc), an internationally renowned institution for scientific research.

Philanthropic Institutions:

o A large share of Tata Sons' equity (about 66%) is owned by charity trusts

(Tata Trusts). This ensures that the wealth created by Tata companies accrues to them all as well.

society.

o The trusts support programmes on healthcare, education, water security, rural development and

arts and culture.

Philanthropy in Practice:

o Tata Memorial Hospital (established 1941) is now one of the world's centers.

research.

o Tata Institute of Social Sciences (TISS) and has contributed to large number of social workers,

policy researchers, and development practitioners.

o Early endeavours of Tata Steel in Jamshedpur were housing, healthcare and sanitation

worker facilities, unusual for the early 20th-century.

Sustainability as a Modern Priority:

o Very recently, Tata Group companies have mainstreamed their climate action, renewable energy initiatives and built capacity for assessing GHG emissions.

and social inclusion in the top of their agenda.

o Tata Sustainability Group was formed to amalgamate and oversee sustainability initiatives

across all Tata companies.

This is a tradition that has persisted over the years and one which embodies the Tata philosophy that "To be in business for wealth creation alone" 1 ct o fnot only businesses but also for all its stakeholders.

shareholders and to create societal value as well

Did You Know?

8

"The Tata Group, founded in 1868, directs nearly two-thirds of its profits to philanthropic trusts,

funding education, healthcare, and rural development. Institutions like the Indian Institute of

Science and Tata Memorial Hospital were established through this legacy, making Tata one of the

world's largest corporate philanthropists."

6.2.2 Environmental Stewardship: Energy, Waste, and Water Management

The commitment of Tata Group to the environment is evident in their sustainability plans, which include environmental preservation and protection tasks as a key focus.

practices of its major companies.

Energy Management:

o Tata Power is now a pioneer in renewable energy with over 30% of its

from renewable sources, including wind, solar and hydro.

o Tata Motors has made a substantial investment in EVs,facilitating the Company to be well prepared

as a frontrunner in India's shift towards sustainable mobility.

o Tata Steel has been investing in energy efficient blast furnaces, waste heat recovery and power cogeneration systems– these with other technologies as appropriate – which will accelerate its transition to green steel.

measures to cut greenhouse gas emissions.

Waste Management:

o Tata Steel operates on the principle of achieving zero waste by recycling steelmaking by-products such as slag

and fly ash to inputs for cement and road.

o Tata Chemicals, is playing a part in green chemistrywhich focuses on reducing hazardous waste and to .

resource efficiency.

o Waste segregation, composting and single Greatest of the Tata hotels has been encouraging o Done to have an amenity blocks pertime use For reduction term pest is lables (SOL) 4.5 Policies/Measures Shower gels on was introduced in to stationery creams sterilize Large model Composting made eco- friendly glass technology toilets being used The pot size of tiger milk weed plant and importance BREWING modified and redesigned.

use plastics in their sustainability efforts.

Water Management:

oTata Chemicals and Tata Projects promote sustainable use of water through rainwater

pumping, recharge, and reuse systems.

o Tata Steel has committed to water efficiency goals and incorporated closed-loop water422 systems into their processes.

its plants.

o Tata Trusts has joined hands with NGO partners for executing watershed files.

management interventions in drought-prone areas of India, through sustainable water

availability for communities and agriculture.

These projects demonstrate the Tata Group's commitment not just to reduce its carbon footprint but also to bring all its business interests in true harmony with nature.

serve as a caretaker of the environment in the villages.

6.2.3 Social Impact: Healthcare, Education, Rural Development

Tata Group's CSR projects are a reflection of their nation building philosophy and social_spectrum.

community development.

Healthcare:

o Tata Memorial Hospital offers subsidized cancer treatment to the thousands of patients

a year and is known for oncology research.

o Tata Trusts finance programmes to address malnutrition, eliminate malaria and enhance maternal OPPOSITE Project Chirag From darkness to light Much of India still lives without electricity.

and child healthcare.

o Amid the COVID-19 pandemic, Tata group of companies dedicated several billion rupees in support,

produced PPE made ventilators and assisted in the distribution of vaccines

efforts.

Education:

o Tata ClassEdge is a digital learning solution designed to enhance the quality of instruction.

classroom teaching.

o Tata Institute of Social Sciences (TISS) and Indian Institute of Science (IISc), both underpinned

by the Tata Group have been important players in higher education and research.

o Tata scholarships and fellowships sponsor students in India and other countries, particularly in scientiandFilterWhere editing.

and scientific disciplines.

Rural Development:

o Tata Trusts implement sustainable agriculture, skill development and rural.

entrepreneurship.

o Initiatives, including soil health management and dairy farming is giving rape bounty of nature for the welfare magnet to it.

sustainable financing to rural households.

o Infrastructure development—roads, sanitation facilities and potable water—

will raise the quality of life in villages."

The social initiatives of the Tata Group ensure its influence is spread far beyond just business operations, by -151- directly benefitting society as a whol e.

contributing to human development indicators.

6.2.4 Governance and Ethical Business Practices

The Tata Group’s brand name has always been associated with good governance and ethical conduct.

Ownership Structure:

o The innovative ownership structure, which is majority owned by charitable trusts, means that o profits not only go to shareholder but also back into the community throughout the country.

ILLUSTRATION is NOT by the original poster, but an ideal: Profits are plowed back into society rather than amassed for private interests.

Fl This protection also serves to insolate the group from hostile takeover attempts andugly short-term market squeezes.

pressures, freeing it to invest in long-term sustainability.

Corporate Governance:

o Tata companies are required to follow governance codes, which even include independent boards, etc.

clear reporting, risk management frameworks.

o Routine and regulative reporting that is in line with global governance benchmarks improves the stakeholder 76 Corporate Governance practices: An Evaluation journalC-GT(DE)EffortRelationImprovedirect NatureMonitorSustainability level of reporting.

trust.

Ethical Standards:

o The Tata Code of Conduct (TCoC), which was initially promulgated in 1998, provides a set of principles for all

employees on issues including integrity, anti-bribery, workplace ethics and respect for human

rights.

o Whistleblower policies and grievance redressal mechanisms provide for accountability at all levels of the

level.

Global Recognition:

o Several Tata companies are listed on the Dow Jones Sustainability Index, and there is a.

inclusion in FTSE4Good Index which is based on global ESG practices.

o Tata Consultancy Services (TCS), Tata Steel and Tata Power have won international honours.

for governance and sustainability reporting.

Resilience in Times of Crisis:

o In spite of leadership change or market volatility, the Tata Group has

Preserved its image of fair play, legality and stakeholder consultation.

o The team's capacity to address conflicts while preserving trust underlines its

governance framework.

Knowledge Check 1

Choose the correct option:

1. Who founded the Tata Group?

a) J.R.D. Tata

b) Jamsetji Tata

c) Ratan Tata

d) Dorabji Tata

2. What percentage of Tata Sons' equity is held by Tata Trusts?

a) 25%

b) 40%

c) 51%

d) 66%

3. Which Tata company is a leader in renewable energy in India?

a) Tata Steel

b) Tata Chemicals

c) Tata Power

d) Tata Motors

4. The Tata Code of Conduct (TCoC) was first introduced in:

a) 1985

b) 1990

c) 1998

d) 2005

6.3 EY – Expectations of Citizens from Cities

6.3.1 Sustainable Urban Living: Mobility, Energy, and Waste Management

People's expectations of what it means to have a place to live made to the measuring stick of sustainable urban life are high. Citizens view sustainability as

vital to their quality of life and require city governments to be seen in action.

Mobility:

o Urban dwellers are becoming more demanding when it comes to having affordable, available, and convenient transportation

systems. Metro rail expansion, electric buses, last-mile connectivity like e-

rickshaws are gaining acceptance.

o There is an equally strong pressure for decreasing reliance on individual cars, the population demanded

6 non-motorized transport infrastructure (biking tracks, quality walking spaces and urban design that favours cycling)" (Kamruzzaman et al.

urban spaces.

o Integrated smart mobility applications that include buses, trains a shared vehicle services from proprietary systems and vendors.

one single digital platform are anticipated for a smooth travelling.

Energy:

o Citizens are now calling for the switch to renewable energy sources in order to clean up air pollution

and greenhouse gas emissions. PV plants on rooftops, small-scale renewable networks at the city-level,

and net-metering programmes have been increasingly adopted.

o There is a general expectation of energy efficiency in buildings, both residential and commerical, with smart

meters, LED light and building automation systems becoming standard.

o Reliableavailability of energy is a key issue, particularly in developing nations where

outages disrupt daily life. Antifragile energy systems immune to climate blowouts are

increasingly prioritized.

Waste Management:

o People urge the establishment of effective waste segregation and recycling at city level. The

hope is that from their standpoint household will create waste separation at the source and also, at municipal level ll 3650.75 J.

process it effectively.

o Composting, plastic processing and e-waste management is regarded as required to avoid

landfill expansion.

o There is a strong call for adoption of circular economy models where waste is regenerated into NdrFc156 ment opportunities.

usable resources—for instance, food waste to biogas or compost.

This preference for sustainable living signifies a larger trend away from the traditional focus on infrastructure needs toward holistic.

expectations around livability and resilience.

6.3.2 Citizen-Centric Governance and Transparency

Governance is at the core of what we do to meet citizens' needs but citizens now demand more than standard governance."

service—they want transparency, inclusivity and responsiveness.

• Transparency: Citizens want governments to use open-data platforms that members of

data on municipal budgets, public works, and the environment. Public dashboards

displaying real-time information on air quality, traffic condition and expense of nowadays.

• Inclusion: Developments decisions are to be inclusive. Citizens seek

possibilities to shape policy: through consultations, surveys and participatory budgeting;

models in which communities determine local budget allocation.

• Accountability: Technology has made it possible for citizens to hold governments responsible. Mobile

apps for complaints, citizens' feedback on service delivery, and social networking sites make it possible

authorities and residents interacting all the time.

Smart Governance: Digital governance is no longer a choice; instead, it is an expectation of residents asking for easy access to contents and services.

actions like obtaining permits, paying taxes or filing complaints online.

- Building Confidence: Trust for government is crucial to achieve the public social consensus on sustainability, which requires their cooperation.

programmes, waste segregation or public health programmes. Governments that fail to meet

transparency expectations risk losing credibility.

Put simply, citizen-centred governance is a space that nurtures a positive and trustful relationship between

authorities and residents.

6.3.3 Role of Citizens in Driving ESG Outcomes

Citizens are seen to be active change agents, directly shaping ESG results in their own cities.

Environmental Responsibility:

o By opting for public transport, using renewable energy and segregation of wasteselectorMethod 3.

residents can substantially ease the environmental strain of cities.

o Group activities, like a neighbourhood clean-up and tree planting initiative,

reinforce environmental goals.

Social Engagement:

o Citizens help to build inclusivity and equity by volunteering, sponsorin g commun ity

initiatives, and lobbying on behalf of discriminated population.

o Room for manœuvre Local neighborhood associations and civil society organizations are having a更 に派 Most of those who came had either been bottled up in nearby neighborhoods or attacked while trying to move onnar put tensions again began fighting.

bridging service delivery gaps.

Governance Participation:

o Citizen vigilance ensures that government schemes are actually implemented, and

corruption is minimized.

o Citizens reshape policy debates: digital activism and social media platforms in urban politics

and highlight issues of concern.

Behavioral Change:

o Life style Choices: Use of single-use plastics, Supporting the eco-friendly business etc.,

and adoption of the digital financial services affect urban ESG performance.

o Citizen-led innovation, for example start-ups in waste recycling or shared mobility c an

complement government and corporate efforts.

In summary, ESG results are co-produced with citizens needing to move from passive consumers of services to

proactive contributors.

6.3.4 Insights from EY Global Reports on Sustainable Cities

EY's Global research delves into what citizens now demand from their cities globally.

emphasizing sustainability, inclusivity, and resilience.

• Anticipating Sea Level Rise: To the extent that more+ than 70 percent of urban some form of sustainable living as a very important criterion in choosing where to live - yet it is estimated that one in ten people directly affected by climate change may need to migrate within developing countries by 2050 (UN Habitat, residents rate a great|greater concern for sea level rise compared to rural populations.

access to renewable energy, clean air and climate resilience as their top priorities.

• Smart cities and technology integration: EY studies indicate that public urges to see greater use of the latest technologies1.

ARTICLE IN PRESS digital technologies—IoT, AI, and data.MESSAGE

analytics — to maximize the management of traffic, distribution of energy and logistics from waste.

• Health and Safety Expectations: COVID-19 has heightened a call for businessresilient

medical infrastructure, telemedicine technology and response plans.

Citizens want cities to not only be ready for pandemics but also climate emergencies and

cyber threats.

Equity and Inclusion EY emphasizes that sustainable cities need to offer opportunity to all.

residents, including marginalized communities. Affordable housing, gender-sensitive urban

planning, integrated and public place making are basic citizen requirements.

• Models From Around the World:

o Copenhagen is frequently praised for its reliance on renewable energy and bike-friendly culture.

o Singapore stands as a model for holistic urban planning and digital governance.

o Amsterdam is famous for its circular economy and civic participation in policy-making.

• India's Context: EY says people in India are concerned about affordable housing, pollution control,

adequate public transportation, digital government and security as urban urgencies. These align

and likewise, other national urban development programmes like the Smart Cities Mission.

“Activity: Citizen Priorities for Sustainable Cities”

Activity: Students will be divided into groups and asked to list the top five expectations citizens may

have from their city regarding mobility, energy, waste management, governance, and inclusivity. Each

group will present and compare their findings with global benchmarks to highlight similarities and

differences.

6.4 Summary

❖ Sustainability, innovation and governance in Indian as well as world companies.

strategies as best practices.

❖Infosys leads the way in ESG agenda with carbon neutrality, green campuses,

adoption of renewable energy, and robust global reporting standards.

❖ Infosys Foundation focuses on education, healthcare, rural development and preservation of culture.

showcasing social responsibility.

❖ Taking a charitable approach from its founding, the Tata Group directs most of its profits toward social causes through its support arm Tata Trusts.

❖ Tata companies take the lead on responsible environmental practices in renewable energy, waste management and

water conservation projects.

❖ Tata’s involvement in healthcare, education and rural development are all manifestations of its nation-building spirit.

❖ Strong governance along with the Tata Code of Conduct are the foundational stones for ethical behaviour and transparency in our businesses

across the group.

❖ EY Study reveals increased citizens’ expectations from cities, sustainability,mobility and.

energy, and waste management.

❖ African-style democracy The popularization style governance, transparency and a system of participatory decisions making are central in building.

trust and inclusivity.

❖ The market push for ESG has been driven heavily by citizen demand with the most recent global reports from EY stating:

sustainability, equity and resilience as the dominant urban imperatives.

6.5 Key Terms

ESG (Environmental, Social, Governance): A model for assessing a company's sustainability

practices and ethical impact.

Carbon Neutrality: The balance between emitted of carbon and offset or removed quantities.

emissions.

Green architecture: Buildings and resources that reduce energy, water and greenhouse gases.

and natural resources.

Corporate Governance: Guidelines, methods and systems for ensuring fair and open company.newArrayListTextBoxColumn An event or action that addresses a specific area of corporate governance to satisfy statutory... More organisation

management.

Circular Economy: A system of economy in which goods and packages are reused, recycled or otherwise disposed of to reduce waste.

Citizen-Focused Governance: The form of administration that stresses the values rule of law.

accountability for residents.

Philanthropy: Voluntary donations made by businesses or individuals, for social and community.

welfare.

Smart Cities:Cities which use the technology and innovation to serve for sustainable, mobile and environment friendly lifestyle of residents.

quality of life.

6.6 Descriptive Questions

Critically evaluate Infosys's sustainability and ESG initiatives, how they compare globally

reporting standards.

Discuss the green infrastructure and renewable energy programs undertaken by Infosys and its implications.

on carbon neutrality.

Assess the contribution of the Infosys Foundation to education, healthcare and community.

Explain how the legacy of sustainability and philanthropy from the Tata Group strengthens its support for

nation-building.

Examine the environmental stewardship efforts of companies within Tata Group in terms of energy,

waste, and water management.

Discuss the social responsibility initiatives of Tata Group in health, education and rural development with examples.

examples.

Describe the governance and ethical business role played by Tata Group.

corporate reputation.

Elaborate citizen expectations from cities with respect to sustainability, urban living city as a public good governance and inclusiveness

as per EY insights.

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Answers to Knowledge Check

Knowledge Check 1

1. b) Jamsetji Tata

2. d) 66%

3. c) Tata Power

4. c) 1998

6.8 Case Study

Sustainability and Governance Practices at Infosys and Tata Group

Introduction

The themes of sustainability and ethical governance could be seen as central issues facing contemporary business-government interaction.

world. “Increasingly, companies are held in trust to do more than deliver profits.

society and environment worth. Indian firms like Infosys and the Tata Group have

have emerged as leaders in integrating sustainability, social responsibility, and ethical.

governance into their business strategies. Infosys is betting on digital and carbon explained by Rikand.

neutrality and global ESG compliance, Tata Group harnesses its tradition of philanthropy, renewable

energy, and community development. This case study investigates their routines and discovers generic

problems, and provides alternatives to augment corporate sustainability.

Background

Infosys has attained carbon neutralityinvested in green campuses and aligned with the worldwide endemic situation of climate change.

ESG frameworks such as GRI, SASB and TCFD. Its Infosys Foundation extends social

in education, health and rural development. Similarly, the Tata Group directs

the bulk of its income to charitable trusts, so that wealth creation contributes to society collectively.

Tata companies are at the forefront of developing renewable energy, water conservation, and zero-waste systems and processes +.

also a pioneer in ethical governance through the Tata Code of Conduct. Together, these

corporations underscore the changing nature of companies as an integral part of sustainable development.

Problem Descriptive 1: The destination of Business Growth and Environmental Responsibility.CreateIndex A.-14.

Achieving both growth and ecological sustainability is a constant challenge for firms. For

Infosys, for instance, has to keep up high-speed digital growth while being carbon neutral.

Solution: Incentivize energy-efficient technology, utilization of renewables and carbon offsets

projects allow businesses to grow while being sustainable.

MCQ:

How did Infosys attain carbon neutrality?

20

a) By reducing hiring rates

b) By investing in renewable energy and offset initiatives

c) By outsourcing emissions

d) By stopping global operations

Answer: b) Through use of renewable energy and offsets projects

Issue 2: The Struggle for Equal Social Development

Big companies often have a hard time extending benefits to the most vulnerable. Tata Group,

struggles to reduce rural poverty and inequality despite its size.

SolveIt: The group invests in rural health, education and livelihood (through Tata Trusts)

projects to promote inclusive growth.

MCQ:

What is the per cent equity held by philanthropic trusts in Tata Sons?

a) 25%

b) 40%

c) 51%

d) 66%

Answer: d) 66%

Issue 3: Keeping an ethical governance in complex markets

With the operation of businesses in several countries, governance issues like complying with

varied rules, and an ethical consistency.

Solution: The Codes of Conduct Edition code-of-condu tact [15]and report from Europe were also concise and to the point, but supportedrentavingraph (SoMAR) icalbrelos gonofcluniue ropes codin kit.net ckit.worrentcodigis both a framework for answers.

prescriptive rules to guarantee international norms of governance.

MCQ:

Which category supports the sustainability reporting within Infosys?

a) SEBI Code

b) GRI and SASB

c) GAAP

d) WTO Guidelines

Answer: b) GRI and SASB

Conclusion

Infosys and Tata Group The initiatives of Infosys and Tata Group show that sustainability, social responsibility, and 52 %OPV.

governance are not 'nice to haves' but central to long-termism. By achieving carbon

neutrality, support for community development activities and integrity in governance, it is these

companies became the world’s gold standard in responsible corporate behavior. Their journey highlights that

although there are challenges, clear direction, well-developed policies and citizen or stakeholder participation

can also make sure that corporations are profitable and socially responsible.