

Environmental Science and Technology

Time: 90 minutes

Total Marks: 45

ECC

Answer the following (Write answers as **POINTS** only)

1. In which context *Ninnis Glacier* tongue of Antarctica discussed?(1 mark) [COs-1,6]

Climate Change Positive Feedback loop

2. Define: (3 marks) [COs -1,2]

a. Ecological Debt Day

It is the date when humanity annual demand on nature exceeds what earth can regenerate over the entire year

$EOD = (\text{World Biocapacity} / \text{World Ecological Foot print}) \times 365$

X

b. Electrofishing

Electrofishing: is a common scientific survey method of using electroshock to sample fish populations to determine abundance, density, and species composition. When performed correctly, electrofishing results in no permanent harm to fish, which return to their natural state in as little as two minutes after being caught

c. Grasshopper effect

Global distillation or the grasshopper effect is the geochemical process by which certain chemicals, most notably persistent organic pollutants (POPs), are transported from warmer to colder regions of the Earth, particularly the poles and mountain tops..

This happens when chemicals and other pollutants that are released into the environment evaporate and in the form of vapour are then transported in colder areas where the vapour condenses and the pollutants are deposited as toxic rain or snow. pollutants may condense and then become vapour again in different places depending on climate conditions. This is why the phenomenon is also called the "grasshopper effect".

3. What is the concept of "Kubuqi model" (2 points – 2 marks) [CO-3]

The Kubuqimodel is an example of desert greening project. The use of degradable material by sand barrier technology is helping transform hundreds of acres of Inner Mongolia's Kubuqi Desert into green landscape in an environment-friendly way

The locals grow a drought-tolerant herb, Chinese licorice, which is the most used herb in traditional Chinese medicine. The plant helps enrich the desert soil, with the bacteria around the roots of the plants generating nitrogen, which forms a biological crust above the sand that begins the fertilization process of the desert soil.

21st September, 2022

Mid Exam

The desert and oasis tourism, along with the sales of the herbs they grow have become a reliable source of income for the local residents, laying a solid foundation for the economic sustainability of the program.

4. Explain the impact of one of the dirty dozen chemicals defined by Stockholm convention treaty on bird's health and population – (2 points – 2 marks) [CO-1]

DDT:

Eggshell thinning

DDT interferes with metabolism of calcium, Result - thin shells in predator birds such as osprey, bald eagles, brown pelicans Birds unable to brood (aka sit on) their eggs without breaking them

Feminization: Acts as a hormone disrupter, mimics oestrogen: Has impacted sex ratio in some birds

5. "Environmental science is not environmentalism" – Explain (2 points – 2 marks) [COs-1,2]

EVS: how nature works, how the environment affects us, how we effect the environment, how we can live more sustainably without degrading our life-support system: The pursuit of knowledge about the natural world

Environmentalism: A social movement dedicated to protecting the natural world

6. Differentiate between (5marks) [COs-1,2,6]

a. Ecological foot print and biocapacity

• EF: The total area of land & water needed to produce the resource a person uses, plus the total amount of land and water area needed to dispose of its waste (ha).

~ measure of resource and waste a person needed for his/her life style

Biocapacity is the capacity of a given biologically productive area to generate a supply of renewable resources and to absorb its wastes

b. Cornucopian and Cassandra thoughts

A cornucopian believes that innovation will allow humankind to develop ways to replenish a supposedly endless supply of resources. Cornucopians reject the notion that Earth has finite resources. This directly relates to their stance that technology can regenerate or replace any resources under pressure. Cornucopia, as the name suggests, is the belief that the earth will always have enough resources to provide for humanity and the rest of nature.

Cassandra conversely is the theory that our population will get so large that at some point the earth's resources will be depleted.

c. Utilitarian Conservation and Biocentric preservation

UC: argued that the forests should be saved "not because they are beautiful or because they shelter wild creatures of the wilderness, but only to provide homes and jobs for people." Resources should be used "for the greatest good, for the greatest number, for the longest time."

BP argue that nature deserves to exist for its own sake, regardless of its usefulness to us. Biocentric Preservation, emphasizes the fundamental right of all organisms to pursue their own interests

d. Oligotrophic and eutrophic lakes

Oligotrophic Lake: Nutrient poor, water is clear, oxygen rich; little productivity by algae, relatively deep with little surface area.

Eutrophic lake: nutrient rich, lots of algal productivity so it's oxygen poor at times, water is murkier → often a result of input of agricultural fertilizers

e. Bioaccumulation and biomagnification

Bioaccumulation: An increase in the concentration of a pollutant in a biological organism compared to its concentration in the environment. It is how pollutants enter a food chain

Biomagnification: Increase in the concentration of a pollutant as it passes from one trophic level to the next

7. Explain the **impact** of (3 most relevant points for each-3 marks— **12 marks**) [Cos - 1,2,6]

a. Aral Sea Degradation on local environment and population

Salt and sand are carried by the wind from the Aral Sea region every day, and dumped within a 300 km radius.

The salt pollution is decreasing the available agriculture area, destroying pastures, and creating a shortage of forage for domestic animals. The number of domestic animals in the region has become so low that the government has issued a decree to reduce the slaughter of animals for food. –

Fishing in the Aral Sea has ceased completely, while shipping and other water-related activities have declined; the associated economic changes have taken a heavy toll on agricultural production.

The quality of drinking water has continued to decline due to increasing salinity, bacteriological contamination, and the presence of pesticides and heavy metals.

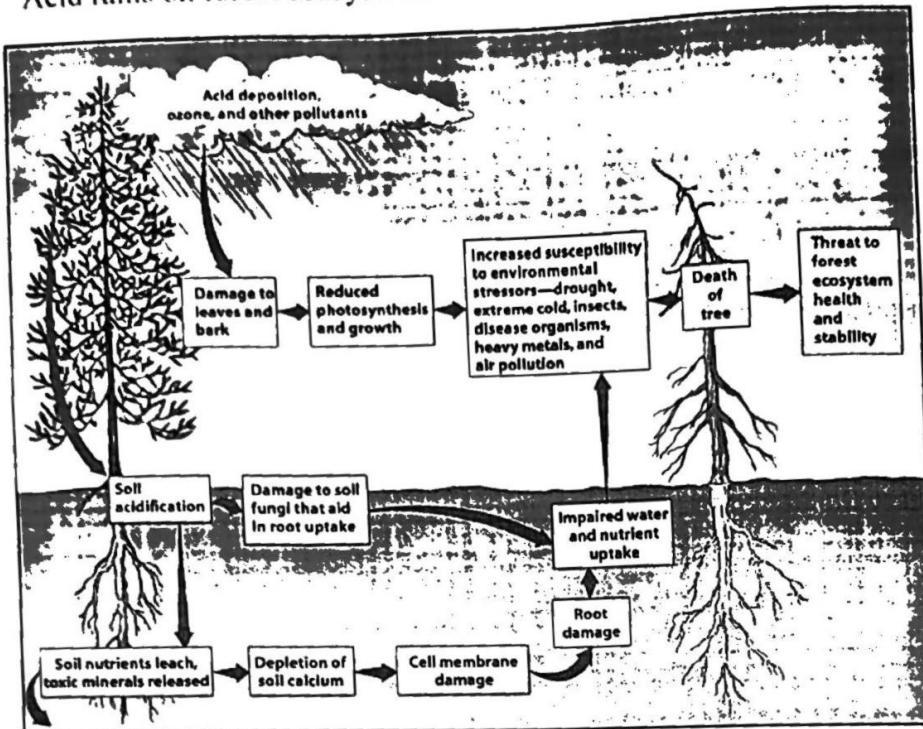
Diseases like anemia, cancer and tuberculosis, and the presence of allergies, are on the rise. The incidence of typhoid fever, viral hepatitis, tuberculosis and throat cancer is three times the national average in some areas

b. Thermal pollution

This increase in temperature—or 'thermal shock'—kills fish and other animals, Increases plant growth thereby reducing the oxygen supply in the water. The result is often choking algal blooms and dead lakes and rivers.

Coral Bleaching

c. Acid rains on forest ecosystems



Soil acidification – nutrients loss – root damage – impaired water and nutrient uptake

Leaves damage- Effect Photosynthesis

Increases susceptibility to environmental stress-drought, disease, etc – lead to death

d. Sea level rise on Sundarbans's vegetation

Increased salinity will change the habitat pattern of the forest. Sundari, the most typical kind of tree in the Sundarbans is thought to suffer from top dyeing disease because of increased salinity (Kausher et al., 1993).

The resultant increase in salinization and accretion of sediments may alter vegetation composition.

Eventually the species offering dense canopy cover would be replaced by non-woody shrubs and bushes, while the overall forest productivity would decline significantly.

The degradation of forest quality might cause a gradual depletion of rich diversity of the forest flora and fauna of the Sundarbans ecosystem

8. Explain (5 most relevant points – 5 marks – 15 marks) [COs-1,2,6]

a. The scientific phenomenon behind Ethiopian famine and its impact

The 1984 Ethiopian famine shocked the world. It was partly caused by a decade's long drought right across sub-Saharan Africa - a region known as the Sahel. For year after year the summer rains failed. At the time some scientists blamed overgrazing and poor land management. But now there's evidence that the real culprit was Global Dimming.

The Sahel's for most of the year it is completely dry. But every summer, the heat of the sun warms the oceans north of the equator. This draws the rain belt that forms over the equator northwards, bringing rain to the Sahel.

But for twenty years in the 1970s and 80s the tropical rain belt consistently failed to shift northwards - and the African monsoon failed

Scientists found that the pollution from Europe and North America affected the properties of the clouds in the northern hemisphere and the clouds reflected more sunlight back to space and this cooled the oceans of the northern hemisphere. And the result of this was that the tropical rain bands moved southwards tracking away from the more polluted northern hemisphere towards the southern hemisphere.

Polluted clouds stopped the heat of the sun getting through. That heat was needed to draw the tropical rains northwards. So the life giving rain belt never made it to the Sahel.

So the droughts in the Sahel in the 1970s and the 1980s may have been caused by pollution from Europe and North America affecting the properties of the clouds and cooling the oceans of the northern hemisphere.

b. Gaia Hypothesis

Hypothesis: that the entire mass of living matter on Earth (the biosphere) functions as a single and vast superorganism that actively modifies its planet to produce the environment that suits its needs.

Life, or the biosphere, regulates or maintains the climate and the atmospheric composition at an optimum for itself. "

Lovelock states that our atmosphere can be considered to be "like the fur of a cat and shell of a snail, not living but made by living cells so as to protect them against the environment.

Inherent in this explanation is the idea that biosphere, the atmosphere, the lithosphere and the hydrosphere are in some kind of balance -- that they maintain a homeostatic condition.

This homeostasis is much like the internal maintenance of our own bodies; processes within our body insure a constant temperature, blood pH, electrochemical balance, etc.

The inner workings of Gaia, therefore, can be viewed as a study of the physiology of the Earth, where the oceans and rivers are the Earth's blood, the atmosphere is the Earth's lungs, the land is the Earth's bones, and the living organisms are the Earth's senses. Lovelock calls this the science of geophysiology - the physiology of the Earth (or any other planet)

c. Climate change impact on species diversity

Species 'left behind' as they are unable to change distribution fast enough.

Species with long life cycles and/or slow dispersal are particularly vulnerable.

Some isolated or disjunct species are particularly vulnerable, as they may have 'nowhere to go'. These include Arctic and alpine species, and Island endemics

Coastal species which will be 'squeezed' between human settlements and rising sea levels.

Plant genetic composition may change in response to the selection pressure of climate change.

Some plant communities or species associations may be lost as species move and adapt at different rates.

Increased invasions by alien species may occur, as conditions become more suitable for exotic species whilst native species become less well suited to their environment.

9. Explain Plan B (of the following figure) and its impact. (3 most relevant points- 3 marks) [COs-1,3]



Plan B is Nuclear winter

Nuclear winter is the term for a theory describing the climatic effects of nuclear war. Smoke from the fires started by nuclear weapons, especially the black, sooty smoke from cities and industrial facilities, would be heated by the Sun, lofted into the upper stratosphere, and spread globally, lasting for years.

The smoke will block the sun's light for weeks or months. The land temperatures would fall below freezing. This combination of reduced temperatures and reduced light levels would have catastrophic ecological consequences

The resulting cool, dark, dry conditions at Earth's surface would prevent crop growth for at least one growing season, resulting in mass starvation over most of the world.

* Smoke
* Sun block
* Cool, dark, dry
* Ozone depletion
* Photosynthesis

Average light levels would be below the minimum required for photosynthesis during the first 30-40 days after the explosion and most fresh water would be frozen

In addition, there would be massive ozone depletion, allowing enhanced ultraviolet radiation. More people could die in the noncombatant countries than in those where the bombs were dropped, because of these indirect effects. Nuclear proliferation is now expanding the threat.

A nuclear war between India and Pakistan could produce so much smoke that it would produce global environmental change unprecedented in recorded human history.