Cryosphere Loss

For Prelims: Ambition on Melting Ice (AMI) on Sea-level Rise and Mountain Water Resources, Cryosphere, Climate Change, Global Warming, Green House Gas, Thawing of Permafrost.

For Mains: Impact of Cryosphere Loss on Global Climate.

Why in News?

At **COP27**, a broad coalition of 18 governments joined together to create a new high-level group **'Ambition on Melting Ice (AMI) on Sea-level Rise and Mountain Water Resources'.**

What is AMI Group?

- The "AMI" group aims **to ensure impacts of** cryosphere **loss is understood by political leaders and the public,** and not only within mountain and polar regions, but throughout the planet.
- The founding governments of the group include Chile (co-chair), Iceland (co-chair), Peru, Czech Republic, Nepal, Finland, Senegal, Kyrgyz Republic, Samoa, Georgia, Switzerland, New Zealand, Monaco, Vanuatu, Sweden, Tanzania, Liberia, Norway and Mexico.

What is the Declaration of the Group?

- **Impact of Climate Change:**
  - **Climate change** has already caused dramatic changes in the global cryosphere, Earth's snow and ice regions.
  - Lives and livelihoods are **threatened by, and some already lost from**, these changes. Indigenous peoples in both the Arctic and mountain regions have been among the earliest affected.
    - The **IPCC Sixth Assessment Cycle reports**, including the Special Report on Ocean and Cryosphere in a Changing Climate, conclude that such changes in the cryosphere will **worsen with each additional increment of global warming and greenhouse gas emissions in the atmosphere.**
  - The consequences will **occur both within and far beyond those in polar and mountain regions.**
    - In polar fisheries, in addition to warming these include rapid acidification of polar oceans, which scientists say will reach a critical threshold at 450ppm – a level we are on track to reach in just 12 years.
- **Suggestions:**
  - Protecting the cryosphere through vigorous climate action is not a matter for mountain and polar nations alone: it is a matter of **urgent global concern**, because the greatest impacts on human communities lie well outside these regions.
  - Rapid decreases in global greenhouse gas emissions, to keep alive the possibility of limiting global warming to 1.5°C, **are our best option to limit cryosphere losses** and the resulting chain of potential catastrophes.

- The need to make pre-2030 emissions reductions a matter **of urgency is an imperative for the benefit of all our societies.**

What is the Cryosphere?

- **About:**
  - The cryosphere is the part of the **Earth's climate system that includes solid precipitation, snow, sea ice, lake and river ice, icebergs, glaciers and ice caps,** ice sheets, ice shelves, permafrost, and seasonally frozen ground.
  - The term "cryosphere" traces its origins to the **Greek word 'kryos' for frost or ice cold.**
  - The cryosphere extends globally, existing seasonally or perennially at most latitudes, not just in the **Arctic, Antarctic, and mountain regions, and in approximately one hundred countries.**
    - The largest continental ice sheets are found in Antarctica.
  - Approximately **70% of the Earth's freshwater exists as snow or ice.**
- **Impacts of Cryosphere on Global Climate:**
  - **Albedo:**
    - Snow and ice have high **albedo**. They reflect most of the light without being absorbed and helps in cooling of the earth. Thus, presence or absence of snow and ice affects the **heating and cooling of Earth's surface.**
    - This influences the **entire planet's energy balance.**
  - **Feedback Loop:**
    - Melting of ice **reduces the reflective surface,** and, the ocean and land are darker in color, which absorb more solar radiation, and then **release the heat to the atmosphere.**
    - This **causes more warming and so more ice melts.** This is known as a feedback loop.
  - **Permafrost:**
    - Permafrost is potentially a major source of **methane** and carbon dioxide.
    - The **permafrost** of the polar region has trapped **tons of carbon inside its soil.**
    - If 'feedback loop' aggravates, the carbon is released **in form of methane- a powerful** greenhouse gas**-** which causes the global warming.
    - Permafrost contains about 1,400 to 1,600 billion tons of carbon.
      - In terms of **carbon budgets**, in the 1.5°C climate warming scenario, the melting of permafrost is **estimated to result in a range of 150–200 Gt CO2-eq emissions, while at 2+°C** degrees would result in at about 220–300 Gt CO2-eq by 2100, comparable to the total emissions of countries like Canada or the entire EU.
  - **Melting of Cryosphere:**
    - Melting of cryosphere affects the volume of water in oceans. Any changes in the water cycle, **affects global energy / heat budget, and thereby global climate.**
      - The emission of GHGs and changes in albedo from a melting Arctic are projected to more than double the Arctic's contribution to global warming by 2100.

UPSC Civil Services Examination, Previous Year Question (PYQ)

Q. How does the cryosphere affect global climate? **(2017)**

Q. How do the melting of the Arctic ice and glaciers of the Antarctic differently affect the weather patterns and human activities on the Earth? Explain. **(2021)**

Source: DTE