

SCI CATALYST

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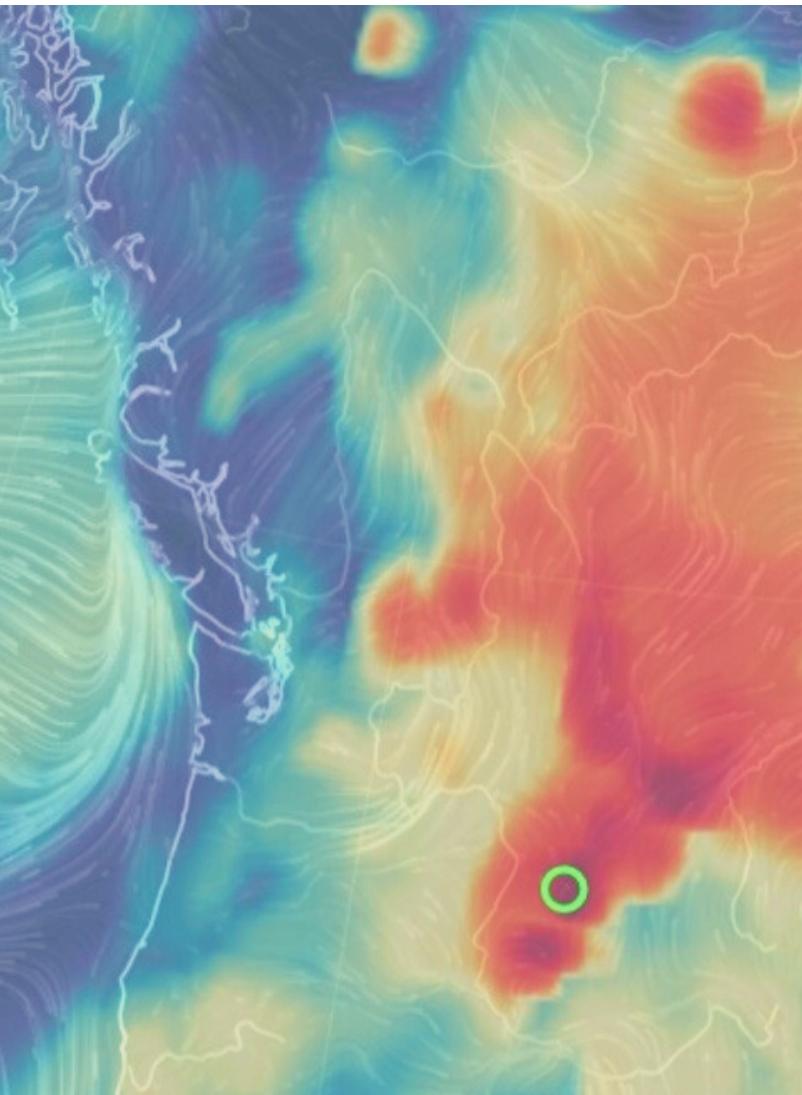
EARTH DAY 2020: ARE WE ACCOUNTABLE?

increased level of deforestation,
overconsumption of resources, industrial
development, urbanization.

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IMPACT OF CLIMATE CHANGE ON INFECTIOUS DISEASES

some of the many ways in which climate
change can have an impact on infectious
diseases.



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INVINCIBLE POLYMER

we are creating a plastic planet which can no
more be plastic.

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HOW DO WE MONITOR EARTH?

a silver lining technology helping us to
monitor earth.



EARTH DAY 2020: ARE WE ACCOUNTABLE?

- Sucharitha

Bhavans Vivekananda College.

It's 22nd April, we "celebrate" 50th anniversary of The Earth Day all around the globe. This means, Is there supposed to be less pollution around us? Less consumption of resources (non-renewable) for a better environment? Or how about no plastic for a day? None of these can be under control within a few days, weeks, or years. Is hoping for better is the only solution??

Tremendous changes in nature that include an increased level of deforestation, overconsumption of resources, industrial development, urbanization have been occurring over these years that paved to the current "ideal" modernization. As we head towards a better future, most of us fail or overlook the fact that if this continues, the future would serve us no good in the long run. The thick toxic clouds due to stubble burning and winds drifting across the neighboring states succeeded with emissions from industries that would eventually hound us. Rising air pollution increases the risk of diseases and mortality rates in the world. Better technology at the cost of deteriorating health???

According to FAO (Food and Agriculture Organization of the UN), among the biodiversity hotspots in the world, Africa already lost most of its tropical forests by the year 2000 due to deforestation. The drastic loss hasn't really been easy for nature to recover given deeds of the humans including overconsumption and exploitation. The most recent case from 2019 Brazil reported the greatest loss of Amazon forest because of vigorous human exploitation.

This deforestation surge led to the loss of the world's biggest terrestrial carbon sink (1,114.8 sq km) in a matter of days. Expanding human activities also contribute to climatic changes resulting in the hottest year in Australia. These are just a few of the many disasters around which many of us are still ignorant.

A look at few initiatives by Government of India for environmental protection:

1. National Thermal Power Corporation Ltd. (NTPC), India's largest power utility, has formulated several policies to ensure the generation of green power. It has planted over 1.45 crore trees, being one of the biggest afforestation efforts in the country.
2. The Fly Ash Mission by TIFAC (Technology Information Forecasting and Assessment Council) recommended the utilization of fly-ash in the manufacture of cement, bricks, agriculture, road construction, land-filling and back-filling of mines.
3. The Tata Energy Research Institute (TERI) is providing consultancy services to the Ministry of Power on CDM (Clean Development Mechanism) which include identifying the costs, monitoring, and verification of CO₂ emission reduction and supervision of project implementation from the respective CDM parties from the developed countries.
4. Introduction of cleaner/alternate fuel like CNG, LPG, and promotion of public transport network including Metro and many more.

Each of us has the ability to make Earth a better place by changing little perspectives in our lives, like reducing the usage of CFCs, minimizing plastic usage and adapting to public transport, and so on. Let's not just hope but act. It is the need of the hour.

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CURRENTLY, ABOUT 2.01 BILLION METRIC TONS OF MUNICIPAL SOLID WASTE (MSW) ARE PRODUCED ANNUALLY WORLDWIDE.

WORLDWIDE, APPROXIMATELY 1 MILLION WATER BOTTLES ARE SOLD EVERY MINUTE; THAT'S 468 MILLION WATER BOTTLES A YEAR.

BY THE YEAR 2050, IT WOULD TAKE THE EQUIVALENT OF THREE PLANETS TO PRODUCE ENOUGH NATURAL RESOURCES TO SUSTAIN OUR CURRENT LIFESTYLE.

AIR POLLUTION KILLS ABOUT 7 MILLION PEOPLE AROUND THE GLOBE EVERY YEAR.

"In nature, nothing is perfect and everything is perfect. Trees can be contorted, bent in weird ways, and they're still beautiful."
– Alice Walker

IMPACT OF CLIMATE CHANGE ON INFECTIOUS DISEASES

- Rachita Dash

University of Hyderabad.

Diseases caused by pathogenic microorganisms (such as bacteria, viruses, fungi, or parasites) that have the ability to spread from person to person are termed as *infectious diseases*. While we may have no power over the random nature of the evolution of these pathogens that may result in a virulent strain, we must nonetheless attempt to minimize any determinant that may aggravate the spread of such diseases. Curiously enough, one such determinant is a largely overlooked problem that is already wreaking havoc across the globe - **climate change**. To this end, this article explores some of the many ways in which climate change can have an impact on infectious diseases.

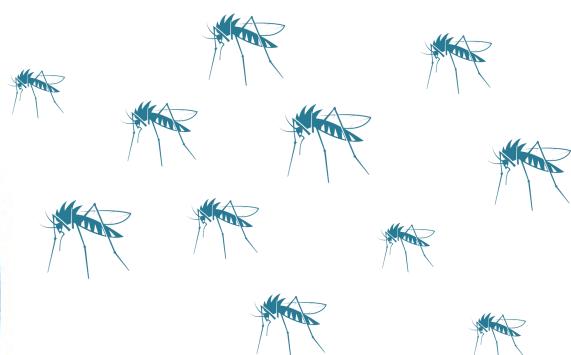


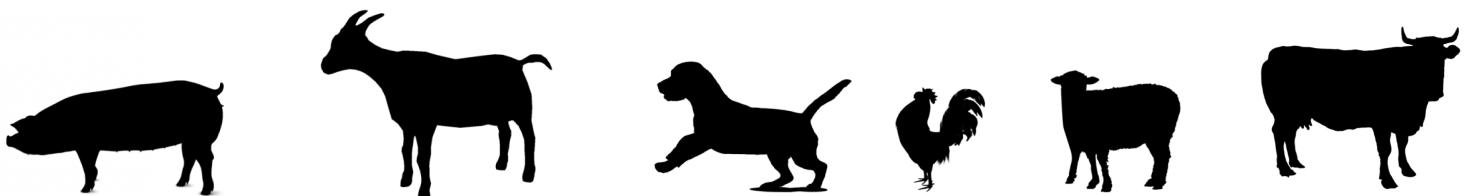
1. Expansion of Habitat of Mosquitoes:

Most infectious diseases require a host, a pathogen, and often, a vector. A prime example of a deadly vector is the disease-carrying mosquito that is accountable for a global annual count of one million deaths. Its ability to transfer viruses and other small parasites to humans allows it to cause dangerous diseases to the likes of **malaria, dengue fever, yellow fever, and chikungunya**, which are widespread in regions characterized by a warmer climate.

At the current rates of global warming, the **Intergovernmental Panel on Climate Change**

- **IPCC's 2007 assessment**¹ has projected worst-case temperature rise of **4.3°F to 11.5°F by the year 2100**. As temperatures warm, the malarial parasite *Plasmodium* reproduces faster and the mosquitoes that carry them and other parasites take blood meals more often. Erratic rainfall patterns causing floods and water accumulation could worsen the effect as they provide favorable conditions for young mosquitoes to develop and adult mosquitoes to survive. A recent study (Kraemer et. al, 2019) has found that by 2050, the geographical range of two particularly pernicious mosquito species – *Aedes aegypti* and *Aedes albopictus*, will considerably increase, endangering **49% of the world's population**, ascribable significantly to climate change.





2. Increased Zoonosis:

Over the past two decades, there has been a sharp increase in the incidence of zoonotic diseases, making up “nearly 75% of all new, emerging, or re-emerging diseases affecting humans at the beginning of the 21st century” according to the USAID³. Comprising of **AIDS**, **SARS**, **H5N1 avian flu**, and **H1N1 influenza** among others, these are diseases that are naturally transmissible from non-human animals (usually vertebrate) to humans. Climate change affects their Spatio-temporal distribution and epidemiology, as it impacts disease reservoir and vector dynamics through alteration of their ecological niches. Furthermore, wild animals that may have carried diseases for years without repercussions will be forced to come in contact with humans all the more, due to habitat loss aggravated by deforestation and climate change.

3. Revival of Dormant Pathogens:

Another worrisome phenomenon on the rise is intergenerational contagion. Deadly microbes that have been dormant for years in permafrost will re-emerge as it thaws with the rise in temperature. In 2014, Claverie et al. authored a paper that described the extraction of a **30,000-year-old “giant virus”** with Pandoravirus like morphology from Siberian permafrost and its revival in the lab after nearly a millennium. Although the probability of these pathogens reviving themselves remains debatable, recent events provide a strong impetus for us to take the possible threat seriously.

In a study conducted in 2011, Boris Revich and Marina Podolnaya found that there were statistically significant positive trends in annual average temperatures and prevalence of anthrax in Northern Russian settlements which are located near burial grounds of cattle that had died from anthrax in the 19th century.

Undoubtedly, climate change alone does not affect infectious diseases. However, it is imperative that we acknowledge the relationship between the two, in the hope that it acts as yet another incentive for us to raise awareness, increase preparedness and strive towards tackling climate change effectively.

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 - o Archives of Clinical Microbiology: The impact of climate change and other factors on zoonotic diseases - Preneshni R. Naicker.
 - o Yale Environment 360 digest: March 5, 2019.
 - o Stanford Eath: how-does-climate-change-affect-disease: March 15, 2019. [Figure 1]
 - o US GAO report GAO-12-55: www.gao.gov/products/GAO-12-55 Biosurveillance: Nonfederal Capabilities Should Be Considered in Creating a National Biosurveillance Strategy. [Figure 2]

EIGHT MILLION METRIC TONS OF PLASTIC MAKE THEIR WAY INTO OUR OCEANS EVERY YEAR, ENDANGERING WILDLIFE AND THE ENVIRONMENT.

THE NATIONAL PARKS SERVICE ESTIMATES THAT 180 BILLION PLASTIC STRAWS ARE USED EVERY DAY IN THE UNITED STATES ALONE.

APPROXIMATELY 1,800 GALLONS OF WATER TO PRODUCE A SINGLE PAIR OF JEANS

THE MEAT IN PET FOOD IS RESPONSIBLE FOR ABOUT IT TAKES 1,611 GALLONS OF WATER TO PRODUCE JUST A SINGLE LITER OF ALMOND MILK.

"The Earth will not continue to offer its harvest, except with faithful stewardship. We cannot say we love the land and then take steps to destroy it for use by future generations."
—John Paul II

INVINCIBLE POLYMER

- Ananya

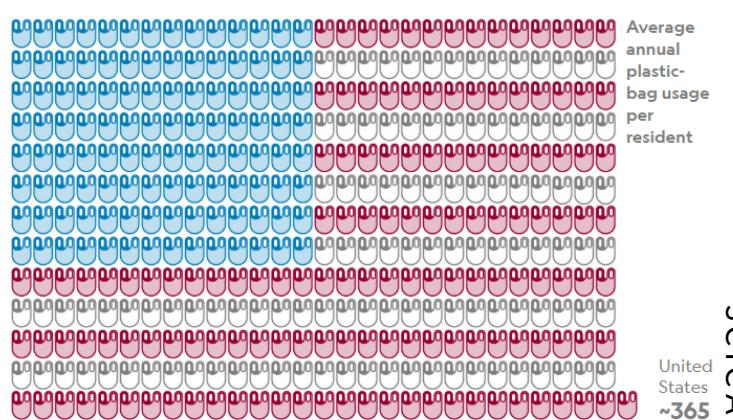
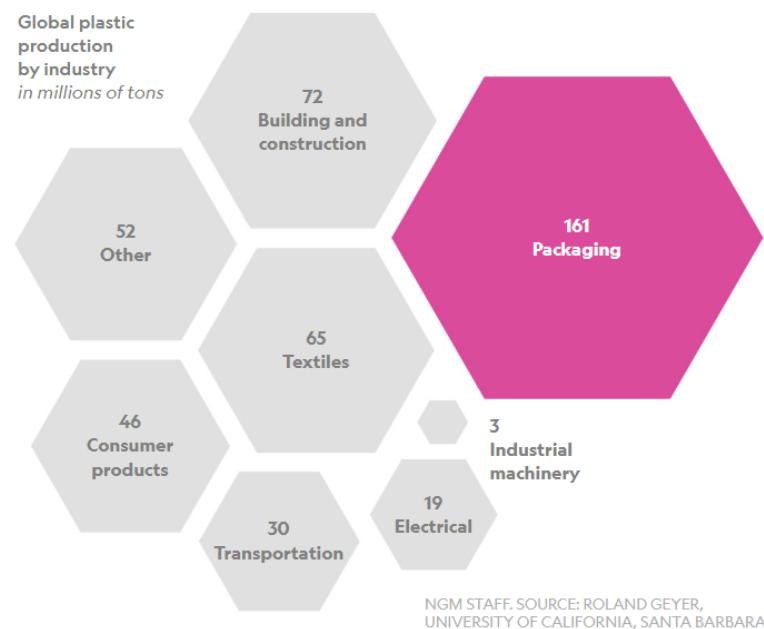
University of Hyderabad.

We all know the invincible. Imagine the one thing that we come across every single day of our lives. If you have ever tried to live off it for one day completely, it becomes a herculean task of the decade. So, what am I talking about? **Plastic**. Can there be something so indestructible in this world? Is there really an alternative to its thousand forms and widespread use? "To use once and dispose of" seemed the likely options for many years until we realized that it never really went away. The word 'plastic' means more than the chain of atoms arranged in a repeated fashion, it also implies being easily moulded. Today, plastic finds its way in our clothes, shopping bags, electronics, switchboards, vehicles, water bottles, straws, mugs and whatnot. Have a look around you to add to this infinitely long list! But to add to the grim reality, scientists suggested that **humans consume about 5 grams of plastic every week**. To conclude, we are creating a plastic planet which can no more be plastic.

Possible ideas and solutions had been pouring in from the world. One such idea is- an engineering solution for a synthetic menace. A recent study shows the production of an improved **PET hydrolase for degrading plastic**. PET stands for **polyethylene terephthalate**, the most widely used form of plastic for packagings like plastic bottles and food containers; and the clothing industry. It originates from joining two molecules by an ester bond.



Some **18 billion pounds** of plastic waste flows into the oceans every year from coastal regions. That's the equivalent of **five grocery bags** of plastic trash sitting on every foot of coastline around the world.

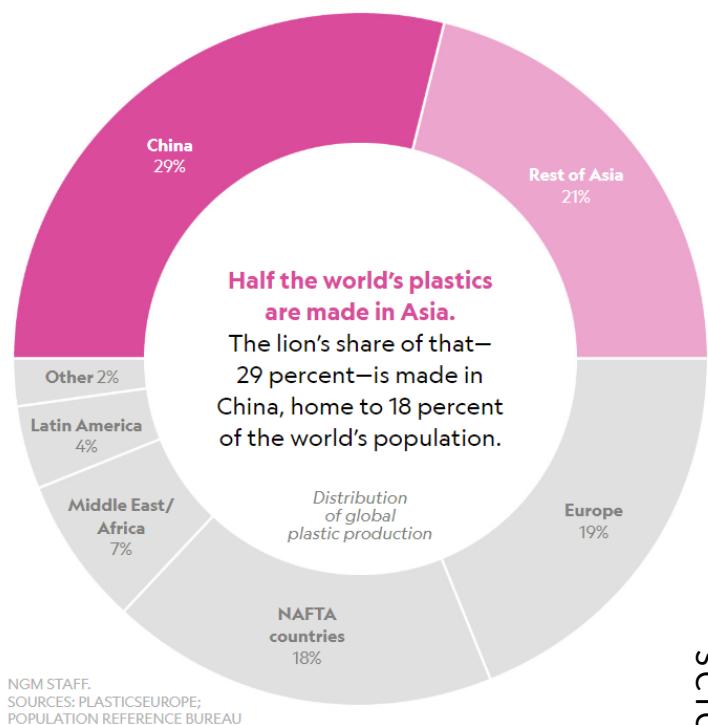
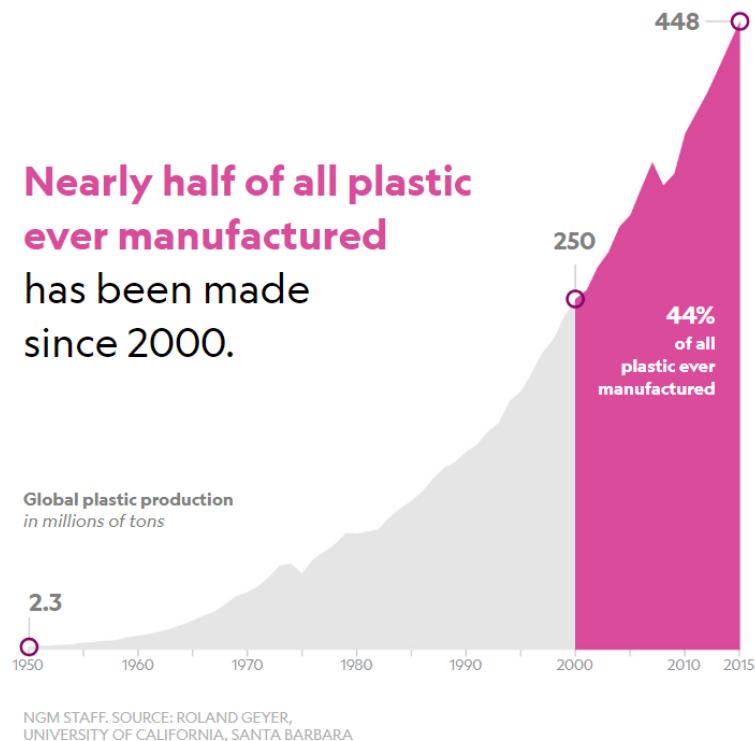


Shoppers in the United States use **almost one per resident per day**. Shoppers in Denmark use an average of four plastic bags a year.

What if there's an enzyme that can liberate its constituents back? This group compared all known hydrolases in their efficiency to act like molecular scissors to PET. They found that LCC(Leaf compost cutinase) outperformed other known hydrolases in depolymerization of the terephthalic acid. They moved on to test this performance on bottle grade PET that led to a decrease in its degrading power from 93.2 to 81.9 mg of the material per hour per mg of the enzyme. Sometimes, the products of a reaction can act as potential inhibitors of the reaction itself. But here they found the enzyme itself was unable to function after a certain point of time.

To make the enzyme work better, they produced 209 variants of the enzyme's active site pocket. Imagine shaking hands with someone, if you were to get this action right, what needs to fit in? Your palms and fingers need to sync with the other person, not the entire hand. That is exactly what the scientists did. They created different versions of the enzymes to accelerate the breaking of the PET. The introduction of specific amino acid residues was used to generate a thermostable version. These variants had a melting temperature higher i.e. in the range of +9.3 to +13.4 degrees Celsius as compared to the wild type version. So the enzyme will survive longer in the furnace to drive the reaction! As they narrowed down to two particular versions, molecular simulation studies helped them to see the aided catalytic reaction. A circular process of production and recycling by balancing the cost of enzyme and its productivity is further shown. They reinforced the standards of the virgin PET produced from the recycling to the commercial PET bottles. Hence, they show a 90% depolymerization rate for their engineered hydrolase.

Nearly half of all plastic ever manufactured has been made since 2000.



This study can revolutionize the recycling norm of a whopping 91% of the plastic that isn't recycled today. I read somewhere that if you want to stop the tub from filling; you will have to close the faucet. Taking a bucket full of water out of the tub cannot be the solution. Plastic stands at the same place for me. However invincible it might, there are alternatives to it. As scientific revolutions continue to find innovative solutions, changing personal habits matters. From swapping your plastic bottle to a steel one to carrying an old bag from your home to the grocery shop, these habits can challenge the industries to produce what the consumer demands.

If you want to be a part of the solution, take your pledge "Planet or Plastic" to reduce the use of single-use plastics. You can celebrate the plastic-free July movement or watch "A Plastic Ocean" to be informed of the problem and do your part.

"It's true that individual acts alone can't cure what ails the planet. But each one of us can find ways to contribute to the solutions—in our homes, our neighborhoods, and the wider world"

-Patricia Edmonds

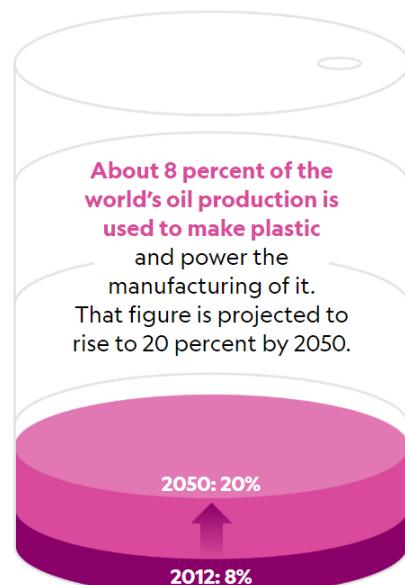
Happy Earth Day!

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NGM STAFF. SOURCE: EUROMONITOR INTERNATIONAL; CONTAINER RECYCLING INSTITUTE



NGM STAFF. SOURCE: WORLD ECONOMIC FORUM

Image Source: Natgeo-
<https://www.nationalgeographic.com/news/2018/05/plastics-facts-infographics-ocean-pollution/>

**BETWEEN THE YEARS 1993 AND 2016,
GREENLAND LOST APPROXIMATELY
286 BILLION TONS OF ICE PER YEAR
AND ANTARCTICA LOST 127 TONS OF
ICE DURING THE SAME TIME FRAME.**

**OVER THE LAST 15 DECADES,
INDUSTRIAL ACTIVITY HAS RAISED
CARBON DIOXIDE RATES FROM 280
PARTS PER MILLION TO 412 PARTS
PER MILLION.**

**WHEN RAINFORESTS THRIVE, THEY
EXTRACT 8 BILLIONS OF TONS OF
HARMFUL CARBON DIOXIDE FROM
THE AIR.**

**SINCE WE USE 65 BILLION ALUMINUM
CANS A YEAR IN THIS COUNTRY, IT'S
IMPORTANT WE RECYCLE AS MANY
CANS AS WE CAN.**

"The three great elemental sounds in nature are the sound of rain, the sound of wind in a primeval wood, and the sound of outer ocean on a beach."

– Henry Beston

HOW DO WE MONITOR EARTH?

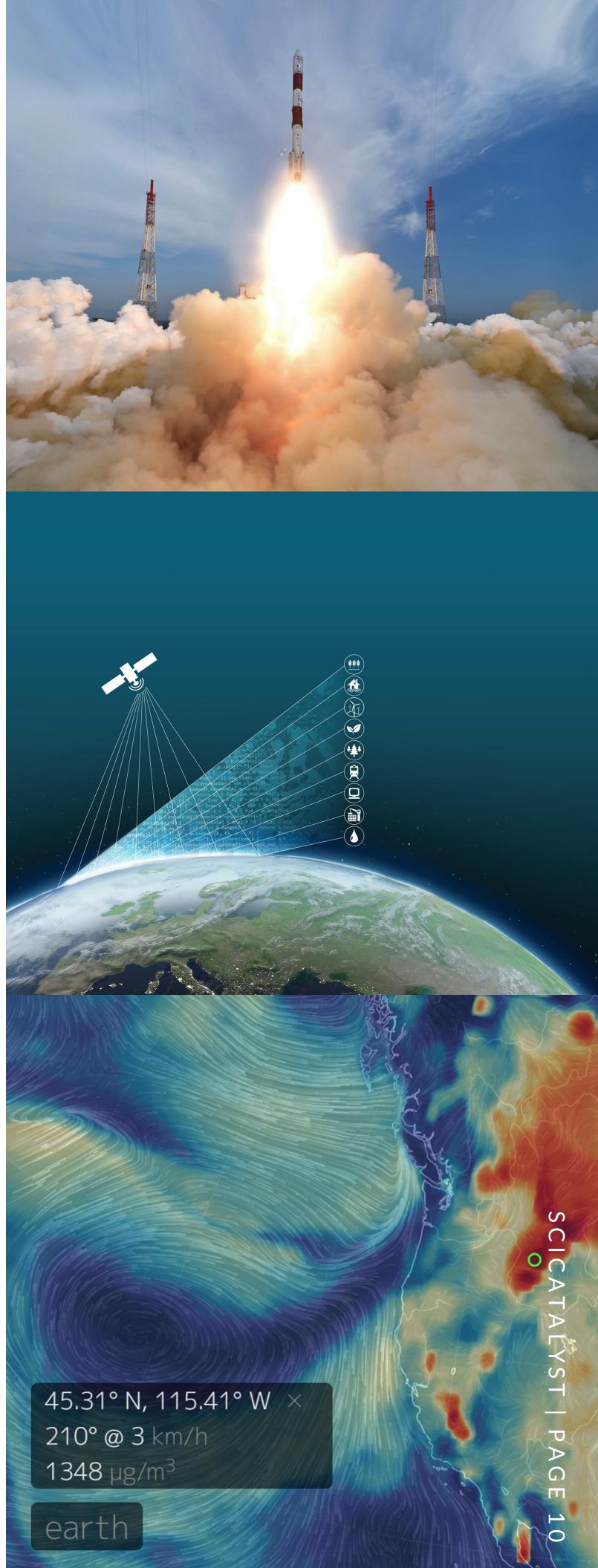
- Kavya

University of Hyderabad.

As we are evolving with our technology and many comforts with it, but we have failed to create sustainable systems. Overexploitation of the "natural resources" such as deforestation making trees into furniture, pollution from our vehicles and industries, accumulating long-lasting materials we use i.e., plastic, electronic wastes using coal for electricity, dump radioactive waste from nuclear power plants. Oil spills and plastics killing sea life. All the byproducts of our comforts are accumulated on earth affecting it. As every cloud has a silver lining our technology is helping us to monitor earth.

But how the technology is helping to monitor the damage?

To observe Earth, we use our technology "satellites" along with organizations such as National geographic society, Smithsonian, Wildlife conservation society, etc. We can also be involved in this observation by collecting data from our surroundings. NASA provides many apps that can be downloaded for free on the phone. Globe observer⁵ is one such platform where we find playful apps to collect data that will be used by NASA. They also provide a platform⁶ to collaborate with scientists in their projects. Any interested person can volunteer in these projects without any qualification and can be called as a "Citizen Scientist". There are many satellites and their services provided by ISRO¹NASA's Earth Observing System (EOS)³ has a series of polar-orbiting and low inclination satellites collecting data from earth. Few other important satellites are mentioned below.



45.31° N, 115.41° W ×
210° @ 3 km/h
1348 µg/m³

earth

RISAT-2BR1

It was launched on **December 11, 2019**. It carries a **synthetic aperture radar (SAR)** payload, which transmits radio signals and records how they are reflected back towards the satellite. It provides services in the fields of **agriculture, forestry, and disaster management**.

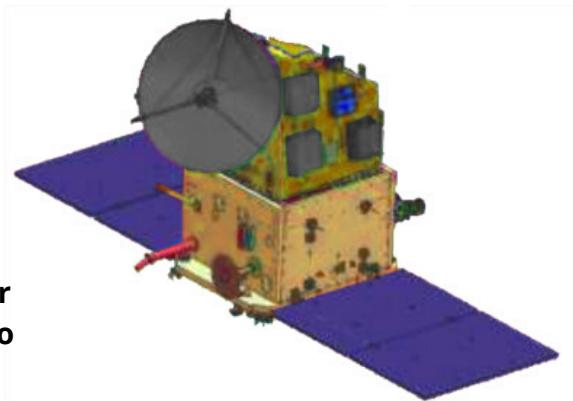


Cartosat-2

It was launched on **January 12, 2018**. It is a remote sensing satellite, its images are used in cartographic applications, **road network management, water distribution, land changes, geographic changes, and manmade features**.

Cartosat-2

It was launched on **September 26, 2016**. It provides information about wind vector data products for **weather forecasting, cyclone detection and tracking services to the users**.



Satellites and Functions:

Aqua, Aquarius, Jason- Ocean Monitoring.

Aura, NOAA-N Prime- Ozone Monitoring.

CHAMP, Geotail- Sun and its influence on Earth.

ATTREX, GOES, NPP- Weather Monitoring.

Fire and smoke, GOES, Landsat- Wildfires.

Aqua , LDCM- Land and vegetation.

ICESat- Icecaps Monitoring.

CYGNSS, GOES- Cyclones and Hurricanes.

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**AIR POLLUTION IS RESPONSIBLE FOR
5 MILLION DEATHS EACH YEAR.**

**300 MILLION TONS OF PLASTIC GETS
CREATED YEARLY, AND THIS WEIGHS
THE SAME AS THE ENTIRE HUMAN
POPULATION, AND 40% IS SINGLE-USE
ONLY.**

**OF ALL HAZARDOUS MATERIAL
SHIPPED EACH YEAR IN THE USA,
RADIOACTIVE WASTE ACCOUNTS FOR
5% OF THE TOTAL.**

**MORE THAN ONE-THIRD OF PEOPLE
ON EARTH CANNOT VIEW THE MILKY
WAY FROM THEIR LOCATION BECAUSE
IT IS OBSCURED BY LIGHT**

"The environment is where we all meet; where we all have a mutual interest; it is the one thing all of us share."
—Lady Bird Johnson