VASUDHA

An Annual Publication of the
Department of Geography
Shri Shikshayatan College, Kolkata
December, 2024
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KOLKATA

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EDITORIAL

It is with great pride and enthusiasm that we present the 16th edition of "Vasudha", the Annual Journal of the Department of Geography, showcasing the research of students, and alumnae. The journal reflects our commitment to fostering undergraduate geographical inquiry and interdisciplinary exploration along with displaying the departmental activities carried out throughout the year, including Field Trips.

The subject of Geography bridges natural and social sciences and our goal is to provide a platform for young scholars to contribute meaningful insights. This journal celebrates our alumnae's achievements and inspires current students to develop essential research skills. Through this platform, we aim to create a space for intellectual growth, discussion, and collaboration that benefits the academic community and beyond.

We thank the management, faculty members, editorial team, and contributors who made this publication possible. Their dedication and support ensures the continued success of 'Vasudha', and we look forward to seeing it thrive in future editions.

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A VISIT TO LURAY CAVERNS : SHENANDOAH VALLEY, VIRGINIA, USA

Dr. Nivedita Roy Barman

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Nestled in the heart of Virginia's Shenandoah Valley, the Luray Caverns are a natural wonder that feels like stepping into another world. As one of the most famous cave systems in the eastern United States, Luray Caverns has been captivating visitors since its discovery in 1878. My journey to this subterranean marvel was nothing short of magical, filled with awe-inspiring formations and fascinating history. Discovered in 1878, the caverns attract hundreds of thousands of visitors each year, offering a unique glimpse into the breathtaking world of geology, history, and natural beauty. The distance from Washington DC to Luray, Virginia is close to 100 miles and the drive was scenic, with rolling hills and the Blue Ridge Mountains providing a picturesque backdrop. On reaching Luray, we purchased tickets to join the guided tour and descended slowly into the cool, dimly lit depths, not knowing what to expect.

The modest entrance to the caverns belied the grandeur hidden beyond, as the vista changed instantly to something very different as we started our journey down the slopes. One of the most striking features of Luray Caverns is its extraordinary size and scale, stretching over 259,000 square meters, with some chambers reaching heights of up to 40-50 m and providing a mesmerizing panorama of natural formations.

The Discovery :

The world-renowned Luray Caverns were discovered on August 13, 1878, by Andrew Campbell, William Campbell and Benton Stebbins, who were residents of Luray. These men were prospecting for a cave and suspected that the hillside might have caverns judging from indications such as exposed limestone and many surface sink holes. The discovery was made after William Campbell felt a current of cool air coming from a small opening among rocks at the bottom of a large sink hole. His uncle Andrew Campbell was the first to enter the caverns and he could scarcely believe that he had stepped into the largest caverns of East America, an eerie world of stalactites and stalagmites sparkling in the light of his candle.

Formation of the Caverns :

Luray Caverns is estimated to be 400 million years old according to scientists. The temperature inside the caverns is approximately 120^{0}C with 87% Relative Humidity. The caverns were formed through a process known as limestone dissolution, where slightly acidic rainwater seeps into the ground, reacting with limestone to create intricate underground formations. As large volumes of water subside and only slow seepage continues, nature's decorating process begins. Upon entering the unique cave atmosphere, the solution of calcium carbonate gives up some of its carbon dioxide and allows a precipitation of lime to form. This precipitation begins as a thin deposit of crystallised calcite and as the process continues, stalactites are formed hanging from the ceiling. With the drops falling to the floor, the deposits form a thicker formation called stalagmites. When a stalactite growing down from the ceiling meets a stalagmite growing up from the floor, a column or pillar is formed. Over extensive periods, this natural process has resulted in the development of stunning stalactites, stalagmites, and other formations that adorn the cavern's vast chambers. All such cave formations are together called 'Speleothems'.

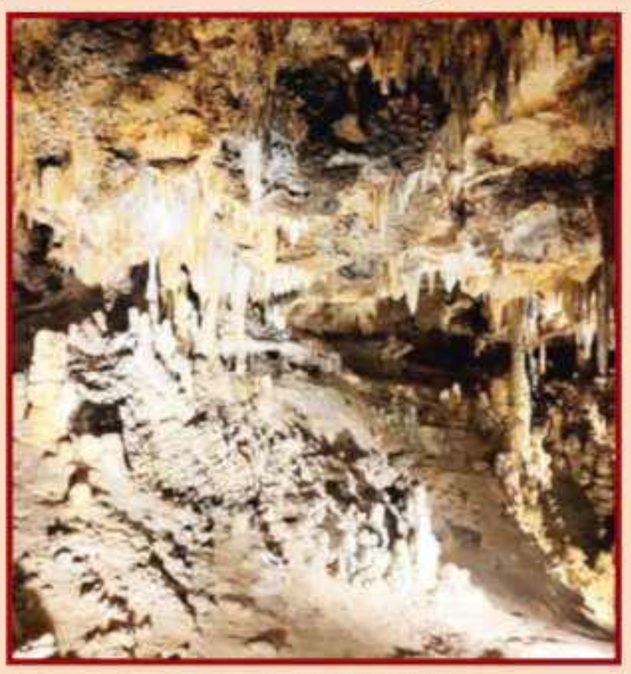
Inner Beauty :

As I stepped into the caverns, the temperature dropped, and the air grew damp. The first sight that greeted me was the towering columns and intricate stalactites illuminated by soft, strategically placed lights. The effect was breathtaking, as if I had entered a cathedral carved by nature. The tour wound through a series of chambers, each more impressive than the last. Here are some of the highlights that left me in awe :

1. **The Great Hall :** A massive chamber featuring towering stalactites and stalagmites, the Great Hall showcases the impressive scale and beauty of the caverns. It is one of the largest rooms and is often the first stop on the tour.
2. **The Giant's Hall :** This massive chamber was filled with towering columns that seemed to defy gravity. The sheer scale of the formations was humbling, which reminds us of the immense power of nature and the passage of time. This hall features some of the largest stalagmites in the caverns, including formations that resemble a giant's hand and other fantastical shapes.
3. **The Dream Lake :** A picturesque underground lake that perfectly reflects the formations above it, creating a stunning visual effect. The still waters enhance the natural beauty of the cave. This lake is the largest body of water in the caverns. It is 230 sq.m. in area and ranges from 50 cms., at its deepest point. The pool gives a perfect reflection of the ceiling.

Dream Lake

4. **The Crystal Grotto :** An area adorned with delicate crystal formations that sparkle in the light. The crystals look almost magical and contribute to the cavern's enchanting atmosphere.



Crystal Grotto

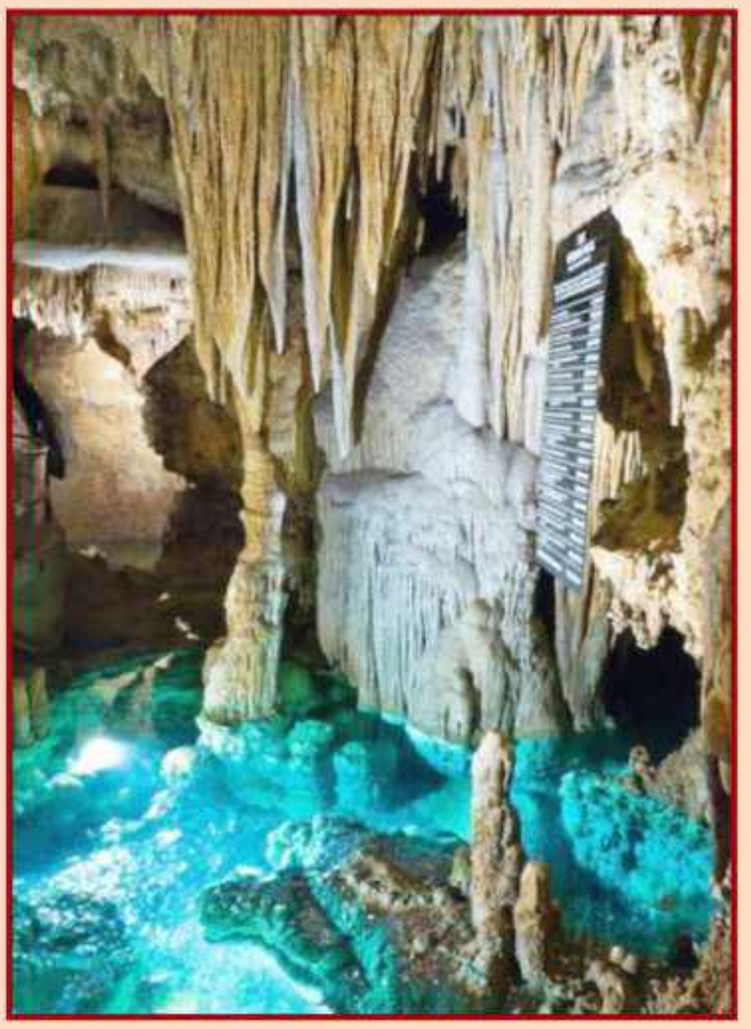
Saracen's Tent

5. **The Saracen's Tent :** It is a stone drapery of flow stone formation continuing from the floor of the cave to its ceiling. This unique formation resembles a draped tent that adds a dramatic touch to the caverns. It is named for its resemblance to an exotic tent from Middle-Eastern culture.

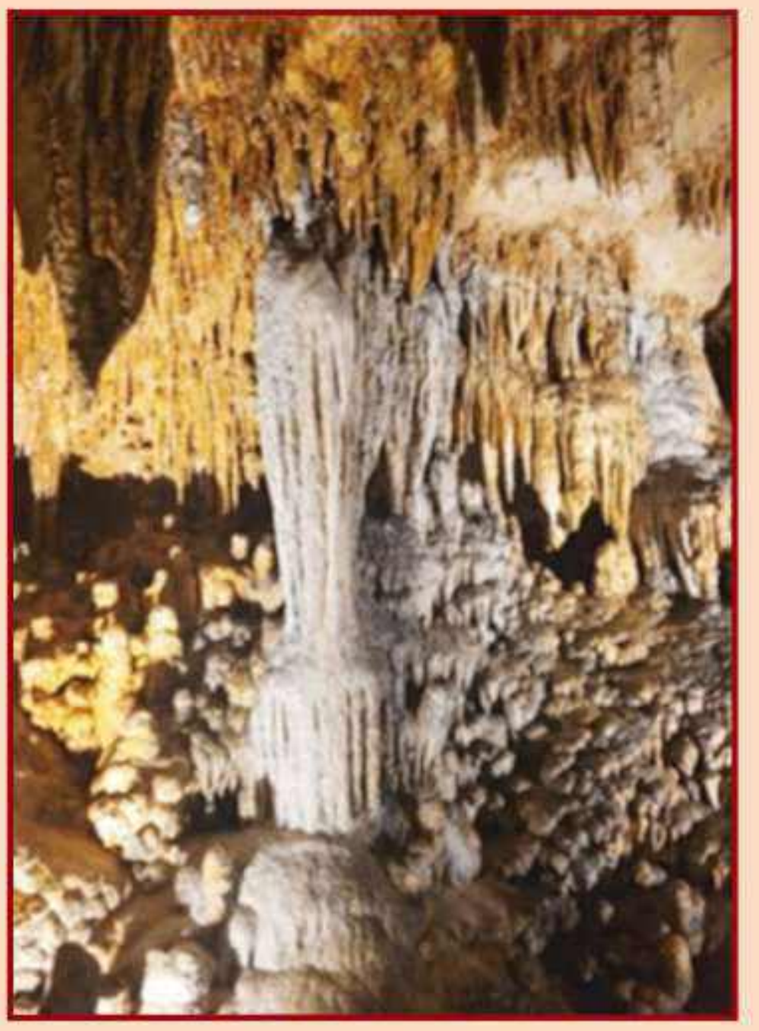
6. **The Stalacpipe Organ :** This fascinating feature is the world's largest musical instrument. It produces musical notes by striking stalactites of various sizes, creating a melodic experience for visitors. It was invented in 1954 by Mr. Leland W Sprinkle of Springfield, Virginia, a mathematician and electronic scientist at the Pentagon. He precisely selected stalactites to match a musical scale in what would eventually become the largest musical instrument. Electronic mallets were wired throughout the caverns and connected to a large console. When a key is pressed, a tone occurs as the rubber-tipped plunger strikes the stalactite, which has been tuned to concert pitch. Visitors can hear a melody played on this organ, creating a harmonious blend of geology and music.

Stalacpipe Organ

7. **Wishing Well :** A small natural opening that welcomes water and reflects the light beautifully. Visitors often toss coins over their shoulders while making a wish.



Wishing Well



Frozen Waterfall

8. **Frozen Waterfall :** A striking formation that resembles a waterfall made of ice, showcasing the unique geological processes in the cave. It is an excellent example of the diverse formations found within.

9. **Fried Eggs :** Fried Eggs are the bases of two stalagmites which were accidentally broken as workmen constructed the pathways of the tunnel in the early 1920s. New formation has begun with deposits at the centre looking like the yolks of eggs.

Fried Eggs

Titania's veil

10. **Titania's veil** is the formation named after the fairy queen in Shakespeare's play "A Midsummer Night's Dream". This delicate, translucent formation resembled a cascading curtain of stone. The intricate folds and ripples were formed by the slow drip of lime-rich water over countless years. It is notable for its towering presence, reaching a height of 15m in Giant's Hall. This formation exemplifies the beauty and intricacy of calcite stalactites and stalagmites found within the caverns.

Importance :

Apart from its geological significance, Luray Caverns also holds historical importance. The caverns served as a refuge during the Civil War, providing shelter for soldiers and locals alike. In the late 19th century, they became a popular tourist destination, with the cave's management, developing pathways and lighting systems to enhance the visitors' experience. The introduction of electric lighting in the early 20th century allowed visitors to appreciate the beauty of the formations in a whole new light, further solidifying its place as a must-see attraction.

Luray Caverns also boasts of a rich variety of ecosystems within its formations. While the caverns primarily contain geological wonders, they also provide a habitat for unique species of bats, insects, and other wildlife, some of which are adapted to the dark, nutrient-poor environment. The delicate balance of this ecosystem is an important aspect of the caverns' conservation efforts.

Visiting Luray Caverns is not only an educational experience but also a recreation of beauty and wonder. The tour through the caverns typically lasts about an hour, guiding visitors through the most impressive chambers while providing insightful information about the cave's formations, history, and geology. The temperature within the caverns remains a constant 12^0 Celsius, providing a cool retreat from the heat of summer.

Conclusion :

Exploring the Luray Caverns provides a deep appreciation for the beauty of the natural caverns and highlights the impressive geological processes that have shaped this unique underground world. It stands as a testament to the power of natural forces and the beauty of the earth's hidden wonders. The stunning formations of the caverns, its rich history and ecological significance make it a remarkable destination for visitors of all ages. As visitors explore its depths, they are reminded of the intricate relationships between nature and history, making Luray Caverns a truly unforgettable experience to witness the power of nature and the incredible artistry of time. For anyone visiting

Virginia, Luray Caverns is an absolute must-see. Whether you're a nature enthusiast, a history buff, or simply someone looking for a unique and unforgettable experience, the caverns offer something for everyone. As we drove away, the memory of those shimmering formations and the echoing notes of the Great Stalacpipe Organ stayed with us, a reminder of the hidden wonders that lie beneath our feet.

Acknowledgement :

I owe this memorable experience in Luray to one of the greatest couples I know, my school friend Anirban Bhattacharya and his lovely wife Hermine Karapetyan. It was they who kept encouraging us periodically to visit their beautiful home in Ashburn in Virginia from our hotel in Washington DC, and then driving us to Luray once we reached them. Thank you both, for giving us the opportunity to experience something so grand, which not only added to my clarity of stalactites and stalagmites as a geographer, but also enhanced my craving as a traveller to see more of such wonders of the world in the near future.

ANALYSIS OF RELATIONSHIP BETWEEN AQI AND TEMPERATURE DURING WINTERS IN DELHI

Soumili Dutta

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Introduction

Air pollution refers to the contamination of air due to the release of pollutants into the atmosphere which are detrimental to not only the humans but also the planet as a whole. According to the World Health Organisation (WHO), 4.2 million deaths occur every year because of exposure to outdoor air pollution. With increasing urbanisation and industrialisation, India has managed to come under the world radar, occupying a distinctive position as a country contributing largely to the pollution of the atmosphere. According to World Air Quality Report, prepared by Swiss Organisation IQAir, India ranked 5th as the most polluted countries (2021), with New Delhi being the World's 3rd most polluted city. Air Quality Index (AQI) is an index used to quantify the level of air pollution of a region. India uses the National Air Quality Index, launched in 2014, that measures the quality of air. It is seen that the already polluted city of Delhi, shows record high levels of AQI placing it in severe category specially during winters. The air quality is linked to dropping temperature conditions in several media reports. This study was conducted to analyse the correlation between temperature and air quality index, and whether indeed the AQI falls with a fall in temperature as per claims. This was performed using datasets of the air quality index and the temperature of 6 years for the winter months, December and January. The research question has been addressed is :

Can lowering temperature be indeed correlated with worsening Air Quality Index ?

Study area and Datasets

The National Capital Territory of Delhi has been selected to conduct this study. Delhi, sprawling over 1483 sq. km. has a population of 1,67,53,235 (as per 2011 census data), time and again has been listed among one of the most polluted areas of India. It is geographically located in North India within the latitude 28^{0}24′17″N and 28^{0}53′00″N, and longitude 76^{0}45′30″E and 77^{0}21′30″E. It is not only northern India's main commercial centre, but also its major centre for small businesses. Being one of the most important economic hubs of the country, Delhi's growing population and rising economic affluence were the primary drivers of increasing air pollution and degrading air quality of the NCR.

Delhi has a total of 39 active air pollution monitoring stations, spread across the entire territory (Figure 1). These stations are managed by different organisations like the Central Pollution Control Board (CPCB), Delhi Pollution Control Committee (DPCC), and System of Air Quality and Weather Forecasting And Research (SAFAR) of Indian Institute of Tropical Meteorology (IITM), Pune

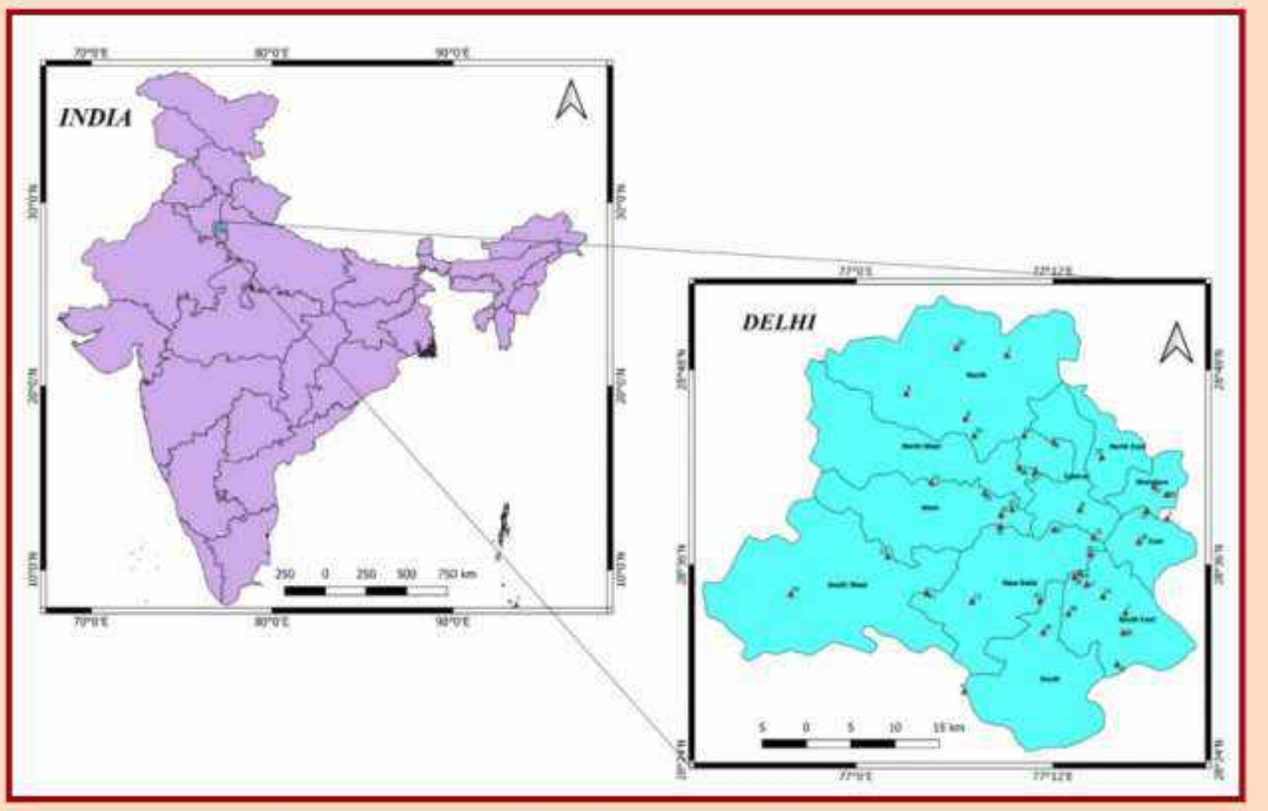

Figure 1 : Location and Study Area Map

and the India Meteorological Department (IMD). Continuous Ambient Air Quality Monitoring (CAAQM) stations of CPCB are distributed at various locations across Delhi including East Arjun Nagar, IBHAS Dilshad Garden, NSIT Dwarka, Shadipur and Sirifort. Data from all these 39 stations have been used to get a picture of the air pollution scenario in the National Capital Territory of Delhi. This was obtained from the CPCB website.

For the winter months of December and January, which have has been considered for 6 years : 2017-18, 2018-19, 2019-20, 2020-21, 2021-22, 2022-23, the daily temperature data has been used as recorded by the Safdarjung Airport weather Station. The daily obtained air quality index as recorded by the air pollution monitoring stations spread across the NCR has been averaged to get the Mean AQI of each day for the entire Delhi region and an average temperature of the respective day in the specified period has been considered to check the correlation between the two datasets.

Methodology

Data has been collected from the above-mentioned sources, cleaned and extracted for Delhi during the analysis period. Daily averages of AQI and temperatures have been computed from the obtained data for the studied years to conduct the analyses. Daily trend of AQI and temperature have been plotted to visualize the trend in air quality index and average temperatures over the two winter months of December and January for the years 2023-22, 2022-21, 2021-20, 2020-19, 2019-18, 2018-17. Next, scatter plots were generated, taking average temperature as the independent variable in the x axis and mean air quality index as the dependent variable in the y axis. Also, the correlation coefficient between the two datasets of temperature and air quality index was calculated using the "Pearson's correlation coefficient method" using *.corr ()* function from pandas library in python.

Results and Discussions

From the daily trend plots (figure 2 and 3), it is evident that the average temperature trend show higher temperature in the early December and the temperature falls from around the 15th of December and remains low in January. Sudden dips in temperatures could be due to the presence of North westerly winds blowing from the hills and rainfall events. Daily mean Air Quality Index show a varying trend throughout the two months. Sharp dips in AQI seen especially during January can be attributed to rainfall, which cleans the air by washing down the suspended particulate matter to the ground. It is

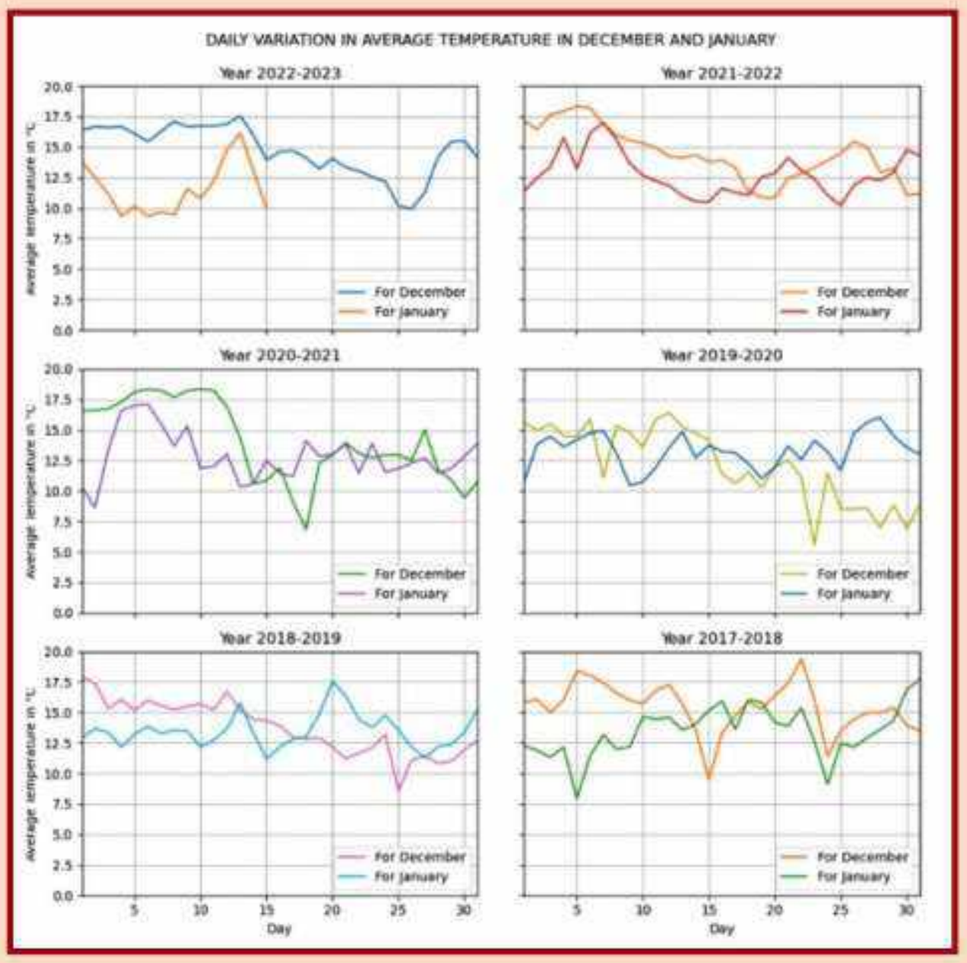

Figure 2 : Daily variation in average temperature in December and January for selected period

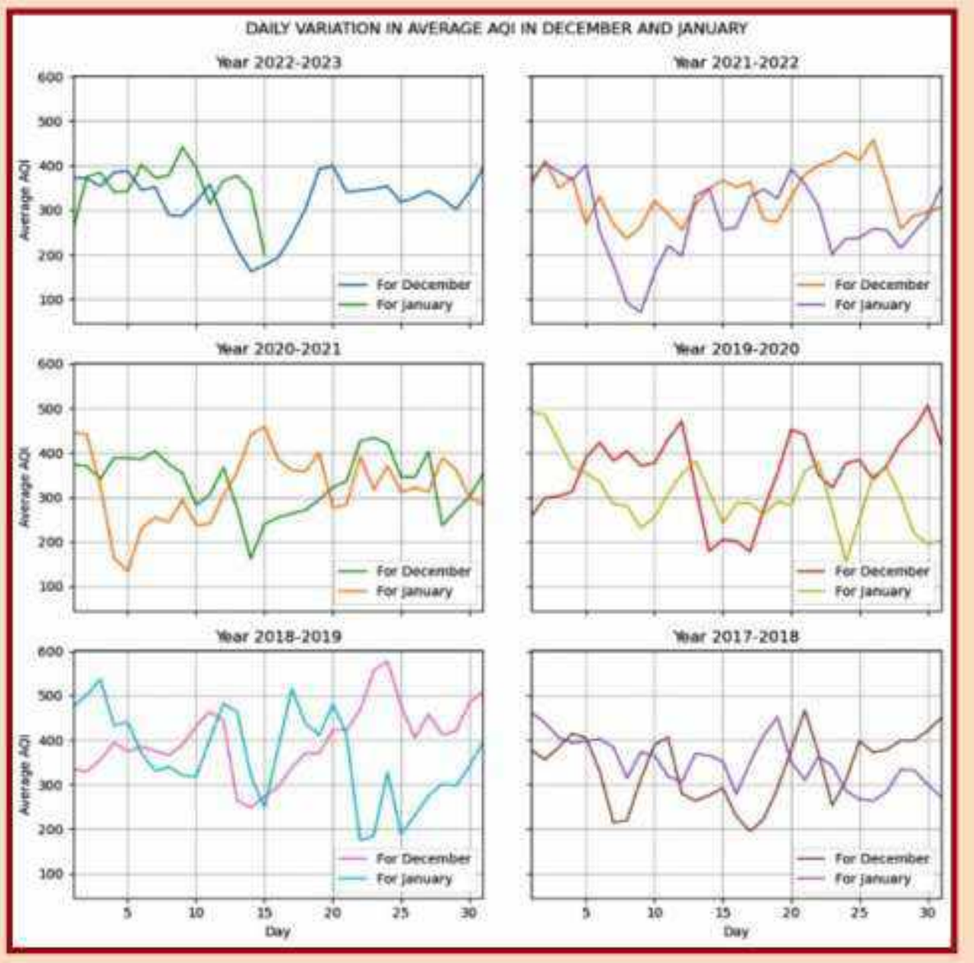

Figure 3 : Daily variation in average Air Quality Index(AQI) in December and January in the selected period

seen that the air quality index of Delhi mostly stays above 200, in poor category and deteriorates to very poor to severe category. The deterioration of air quality index in relation to lowering of temperature has been visualised by preparing a scatter plot of temperature vs AQI for the selected period.

The scatter plots (figure 4) obtained show that none of the plots indicate a strong negative correlation between temperature and AQI. Plots of 2021, January and 2018, December show a moderate negative relation. To ascertain that air quality deteriorates due to low temperature, there should have been a moderate to strong negative correlation between the two datasets of average temperature and average AQI in both the months over all the years. That is, with a decrease in temperature, AQI should have increased indicating deteriorating air quality. However, no such strong negative correlation is visible in the scatter plots. To know about the degree of relation between the two datasets, Pearson's correlation coefficient was calculated. A negative value indicates a negative correlation, while a positive value indicates a positive correlation. Values ranging from 0 to ± 0.25 indicate “Weak correlation”; from ±0.25 to ±0.75 indicate “Intermediate correlation”; while values ranging from ±0.75 to ±1 indicate “Strong correlation”. ±1 indicate “Perfect correlation” whereas 0 indicate no correlation between the two variables, or datasets. Pearson's Correlation Coefficient, also called product moment correlation coefficient, is represented using 'r'. The 'r' values thus obtained have been mentioned in the corresponding scatter plots.

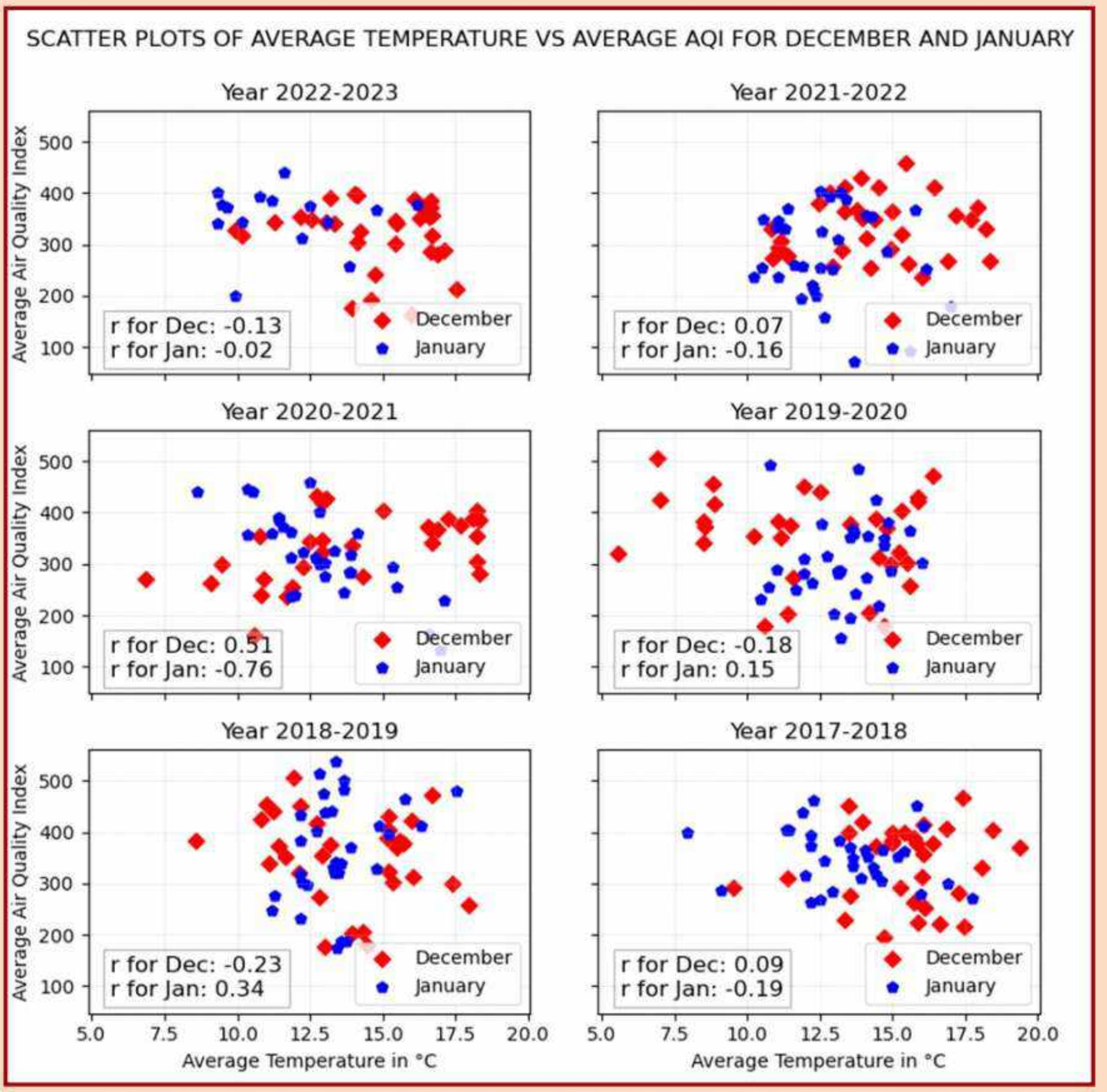

Figure 4 : Scatter plot of average temperature vs. average AQI for the selected period

It can be observed that there is a weak negative correlation between the two, as seen in some of the years. High positive correlation values in 2020 could be related to the effect of COVID, resultant lockdown and subsequent improved air quality. January 2019 positive value could be because of rainfall episodes, and implementation of GRAP, that improved the AQI while the temperature stayed low. Thus, this varying picture makes it clear that we cannot correlate temperature and AQI with full certainty.

Conclusion

The analysis of temperature and Air Quality Index (AQI) over six years of winter data shows that no conclusive correlation can be established between temperature and AQI. The varying correlation coefficients suggest other factors significantly influence AQI. Measures like the Graded Response Action Plan (GRAP) are enforced when air quality worsens, controlling pollution through traffic, industrial, and construction restrictions, improving AQI independently of temperature trends.

In winter, temperature inversion, that traps pollutants near the ground, wherein heated air above confines the cooler denser air near the ground, resulting in vertical mixing of air within this layer, thus not allowing pollutants to escape, thus degrading air quality. However, this is also influenced by wind speed, rainfall, and humidity. Stubble burning from upwind states, increased heating energy consumption, and vehicular emissions worsen AQI. Firecracker activities during Diwali and New Year celebrations further contribute to air pollution.

Overall, while temperature and AQI show a weak negative correlation, temperature is not the main factor affecting winter air quality. Other meteorological and anthropogenic factors play a larger role, making it difficult to draw a definitive conclusion on temperature's effect on AQI. A major limitation of this study was that there were several data gaps in the recorded observations of several stations. Further, research is needed on this, that includes other meteorological parameters to find the effects on AQI. However, efforts should be made to continue to address seasonal pollution issues.

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VULNERABILITIES OF MOUSUNI ISLAND, INDIAN SUNDARBANS : PERSPECTIVES OF SUSTAINABILITY

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1. Introduction –

The Indian Sundarbans is a part of the world's largest delta having a vast and dynamic ecosystem located at the mouth of the Ganges, Brahmaputra, and Meghna rivers, traversing India and Bangladesh. The unique mangrove forests (140000 ha), the most extensive in the world; inhabit here, which protect the island from many vulnerabilities. The region is declared UNESCO (1987) World Heritage site for its rich biodiversity covering approximately 10,000 sq. km. Despite its ecological importance, the islands of the Indian Sundarbans are highly vulnerable to various natural and anthropogenic threats, one of which being **climate change,** and the region is also a victim to tropical cyclones since it was exposed to the Bay of Bengal.

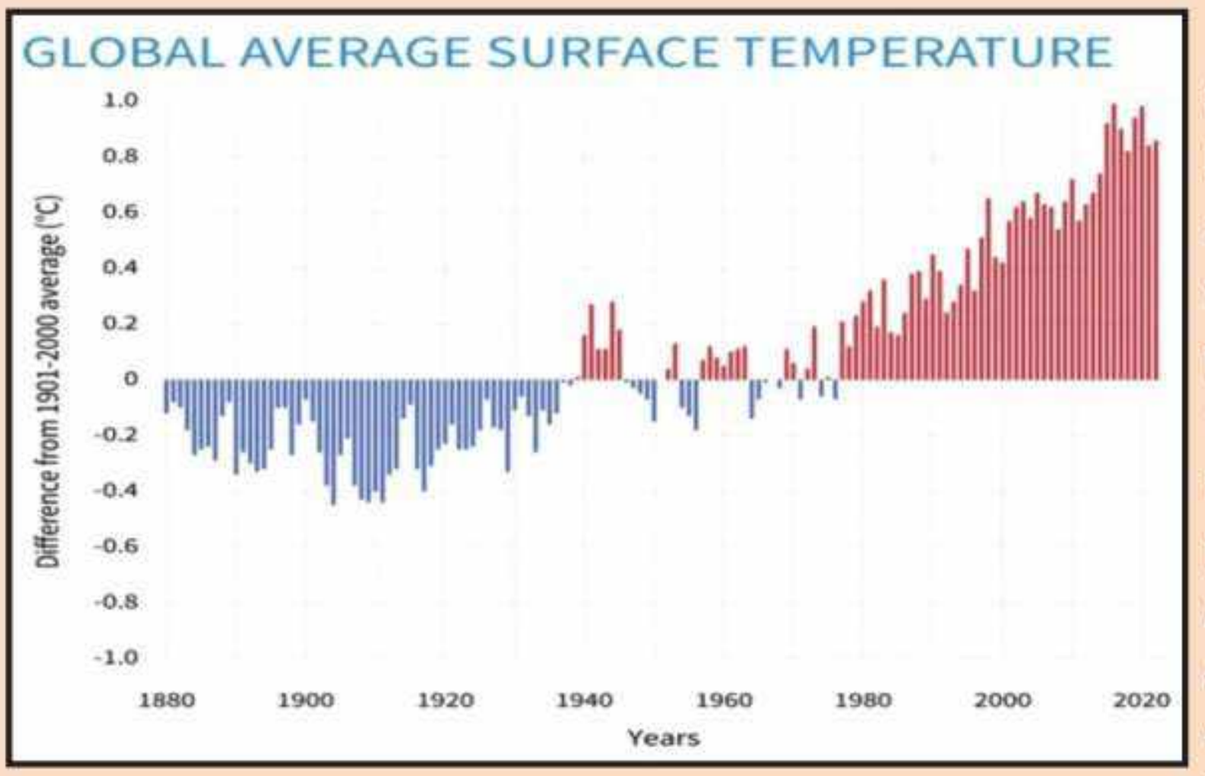


Fig.1 : Yearly surface temperature compared to the 20th-century average from 1880-2022.Source : National Centres for Environmental Information

Climate change refers to the long-term shifts in temperature patterns. Earth's temperature has risen by an average of 0.08°C per decade since 1880 and the rate of warming is even more than twice as fast (0.18°C) per decade since 1981(climate.gov). The sea surface temperature in the Sundarbans' islands has been rising at a rate of 0.5°C per decade, affecting marine and coastal ecosystems, altering the habitats of various species, and impacting fisheries, being their primary livelihoods. Over the past six decades, the Sundarbans have lost approximately 210 km² of land primarily due to erosion, rising sea levels (5.2mm/year), intruding into the low-lying areas of freshwater systems with salinity levels reaching a maximum of 27.5ppt, and human activities such as deforestation and unsustainable agricultural practices.

Coastal disruptions as a response to climate change have also affected marine ecosystems; inundation of coastal ecosystems and elimination of wetlands by the effect of sea level rise as a global change. Development along the coastal areas with growing population increases the vulnerability of coastal ecosystems with sea level rise across the world. The impact of climate

Fig. 2 : Saltwater intrusion into agricultural fields

change inhibiting vulnerability is immense at the regional level. Due to the intensification of tropical cyclones, the Sundarbans and its adjacent islands are facing several challenges.

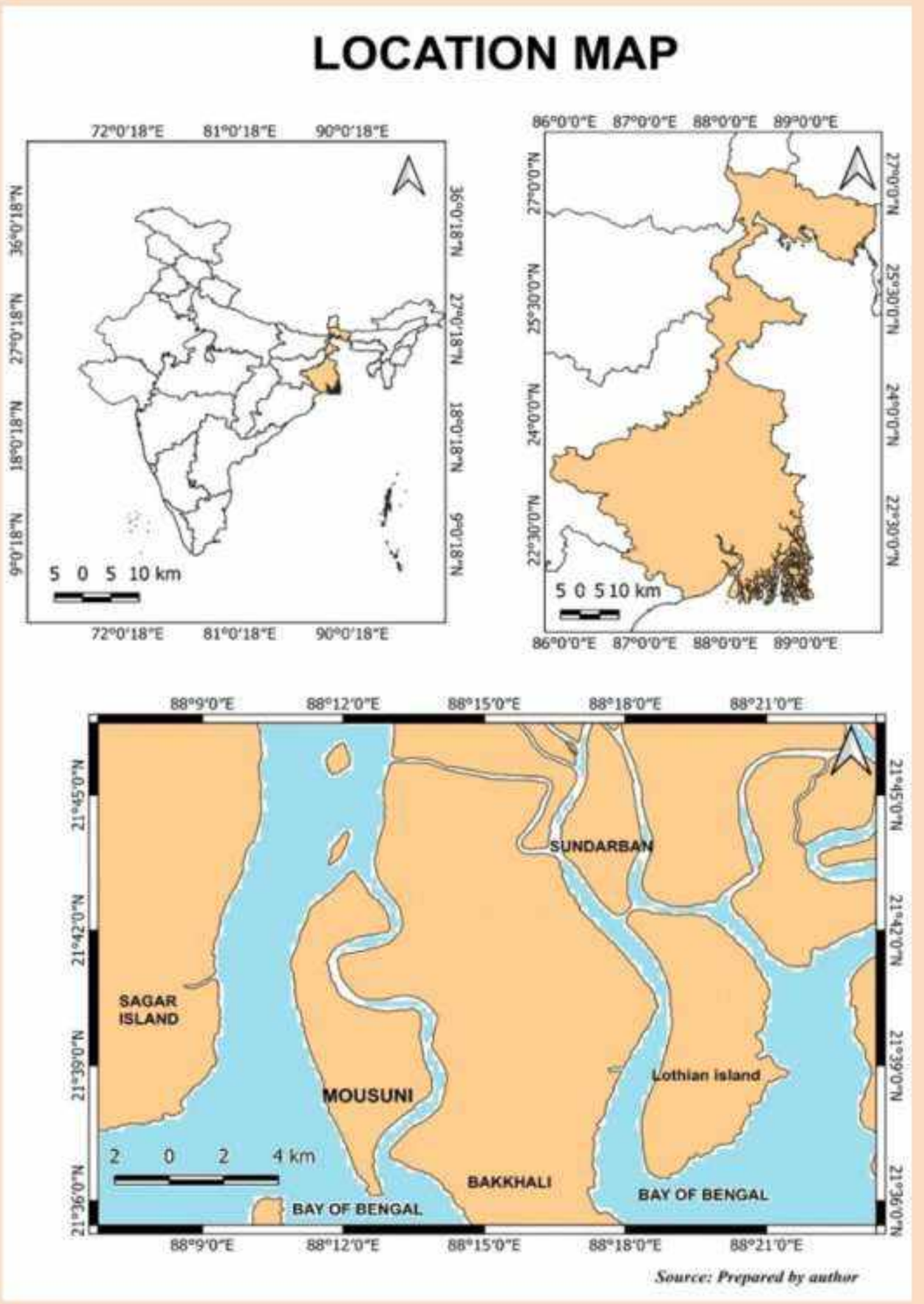


Fig.3 : Study area of Mousuni island

Mousuni island of the Indian Sundarbans is the most threatened by severe cyclonic occurrences and is one of the 10th most vulnerable ocean-confronting islands in South 24 Parganas district of West Bengal (WWF India, 2010). The extreme vulnerabilities have increased the risk to the inhabitants as well as to the island. The rise of sea level has resulted in beach erosion, destruction of agricultural lands by saltwater intrusion, increasing tidal surges leading to the demolition of embankments, and destruction of their homelands and the resorts, which are one of the important sources of income. Some of them have been homeless by the severe cyclones. The only way to combat this changing climate is to take precautionary sustainable measures.

Mousuni island of Namkhana block is a part of Indian Sundarbans located in the southern part of the Ganges delta, facing the Bay of Bengal with 27.1 km² of land. Around 22073 people (Census 2011) reside here. It is bounded by the Muri Ganga River in the western part, Pitt's Creek in the eastern part, and the southern part is fringed by the Bay of Bengal.

Increasing global warming has resulted in the erosion of most of the parts of Mousuni island. In future, it is predicted that this island might disappear along with the other islands. Thus, it is to be protected by taking sustainable measures mainly by the locals living there and other government bodies by adapting strategies and policies of ICZM which will be more beneficial for such coastal areas.

The primary objective of the case study is to assess the vulnerability of Mousuni Island and to combat it with sustainable measures.

2. RESULTS & DISCUSSION –

2.1. Tropical Cyclone & its impacts :

According to the National Disaster Management Authority of India, Cyclones are caused by atmospheric disturbances around a low-pressure area distinguished by swift and often destructive air circulation. Cyclones are usually accompanied by violent storms and bad weather. Pre-monsoon and post-monsoon storms are even stronger than monsoon season. The cyclonic

Figure 1 : Location and Study Area Map

impact is mainly felt in coastal areas of the Indian Sundarbans due to the warming of the Bay of Bengal. According to the study, severe cyclonic storms that are registered over the Bay of Bengal have increased by 26% Fig. 4. After the effect of Remalover, the last 120 years, specifically during post-monsoon (Singh, 2007). Mousuni island, located in the southern part of the Ganges delta also faces the devastating effect of cyclones along with the Sundarbans. In recent years, the effects of cyclones like Aila, Bulbul, Amphan, and Yaas have been felt by the people of Mousuni Island and the adjoining areas.

Heavy downpouring of rain with the severe storm has also resulted in the breaching of a 300m embankment near Baliara and its adjoining areas causing waterlogging in the areas. (Source : *Ei Samay newspape*r,14th August, 20)

Due to a lack of monetary support, the residents cannot rebuild the resources with proper infrastructure. Cyclone Jawad, despite losing steam, was still strong enough to trigger a collapse in an embankment at Mousuni island, sandwiched between Gangasagar and Bakkhali, on the western fringes of the Sundarbans, marooning thousands. (Source : The Telegraph, 6th December, 2021)

An elderly woman from Mousuni Island, near Namkhana and adjacent to the Sundarbans delta, succumbed to her injuries on Monday morning, of Remal, following a tragic accident. The incident occurred when a tree fell on her hut, leading to the collapse of the roof and she died. (Source : The Economic Times, 27th May, 2024)

CYCLONE	DATE	SPEED	LANDFALL
Bulbul	5 NOV, 2019	130km/hr.	Indian Sundarbans
Amphan	20th MAY, 2020	175km/hr.	Bakkhali
Yaas	25th MAY, 2021	140km/hr.	Balasore
Remal	26th MAY, 2024	135km/hr.	Between SagarIsland and Khepupara

Table 1 : Showing data of respective cyclones in Mousuni Island

Not only their houses were disrupted but also agriculture was disrupted due to salt water inundation. The lives of the people are at stake every time during the cyclone. A concrete cyclonic shelter was seen at Baliara, but it could not provide access to the whole of the island during the cyclone. Bulbul as well as Amphan consecutively blew off the island leaving people homeless.

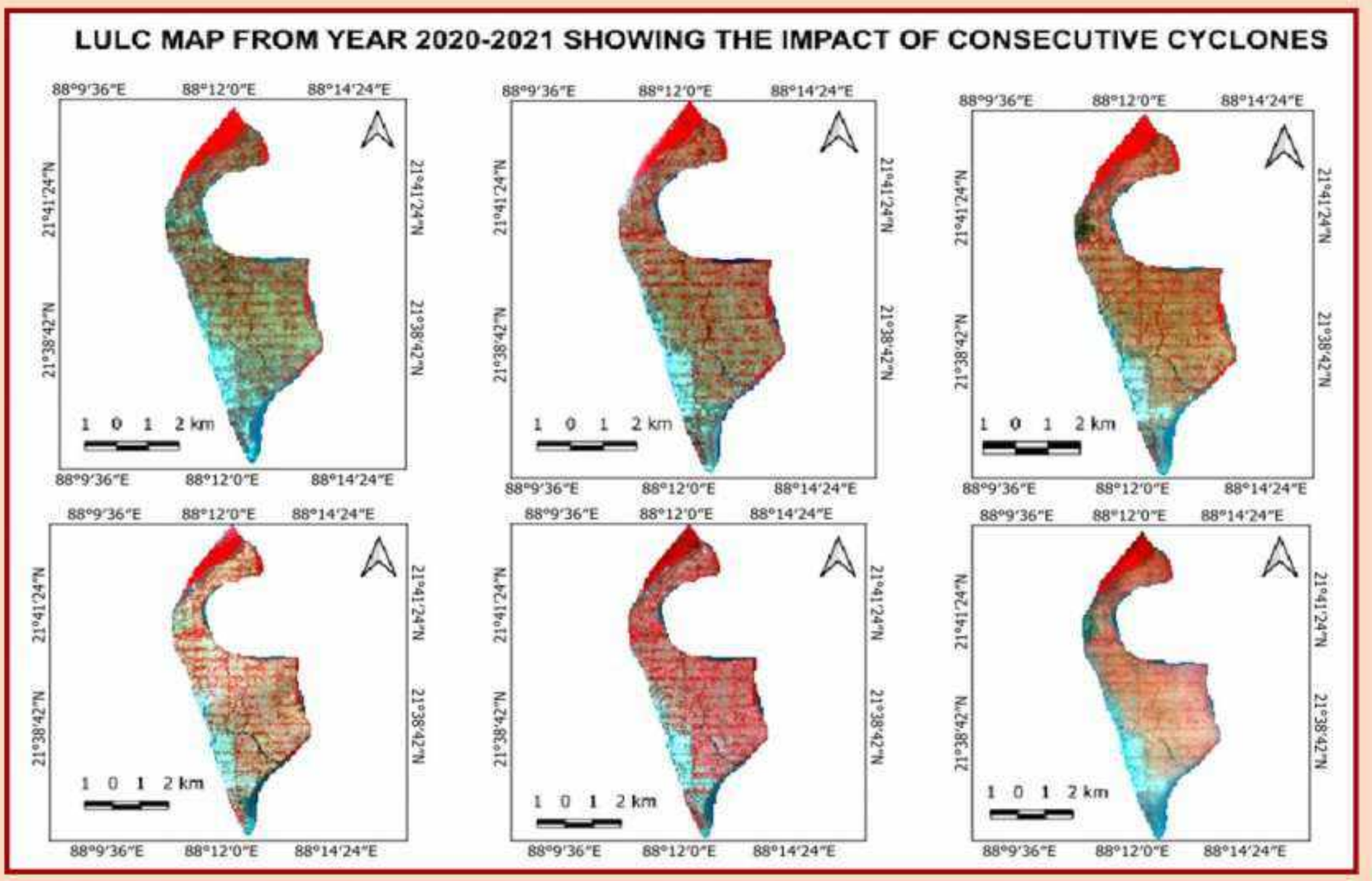


Fig.5 : Map showing the change in vegetative cover with red and intrusion of water bodies in blue

The satellite image shows the effect of pre & post cyclone. The vegetative covers depicted by red and blue depict the intrusion of saline water after consecutive cyclones from 2020-2021. The vegetative cover has continuously reduced mainly after Amphan and Yaas. Based on the primary survey, cyclone shelters on this island were also surveyed. A total of four cyclone shelters are there (according to locals), but only 3 could be surveyed. The multipurpose cyclone shelter is the largest among the three and well-structured with three floors and around 18 rooms in all near Kusumtala. Every cyclone shelter is provided with tube wells, whereas the electrical system is fully destroyed despite having well electrical connections. Cyclone shelters cannot alone combat the vulnerability without people's contribution to adapt strategic policies and mitigation measures.

Figure 1 : Location and Study Area Map

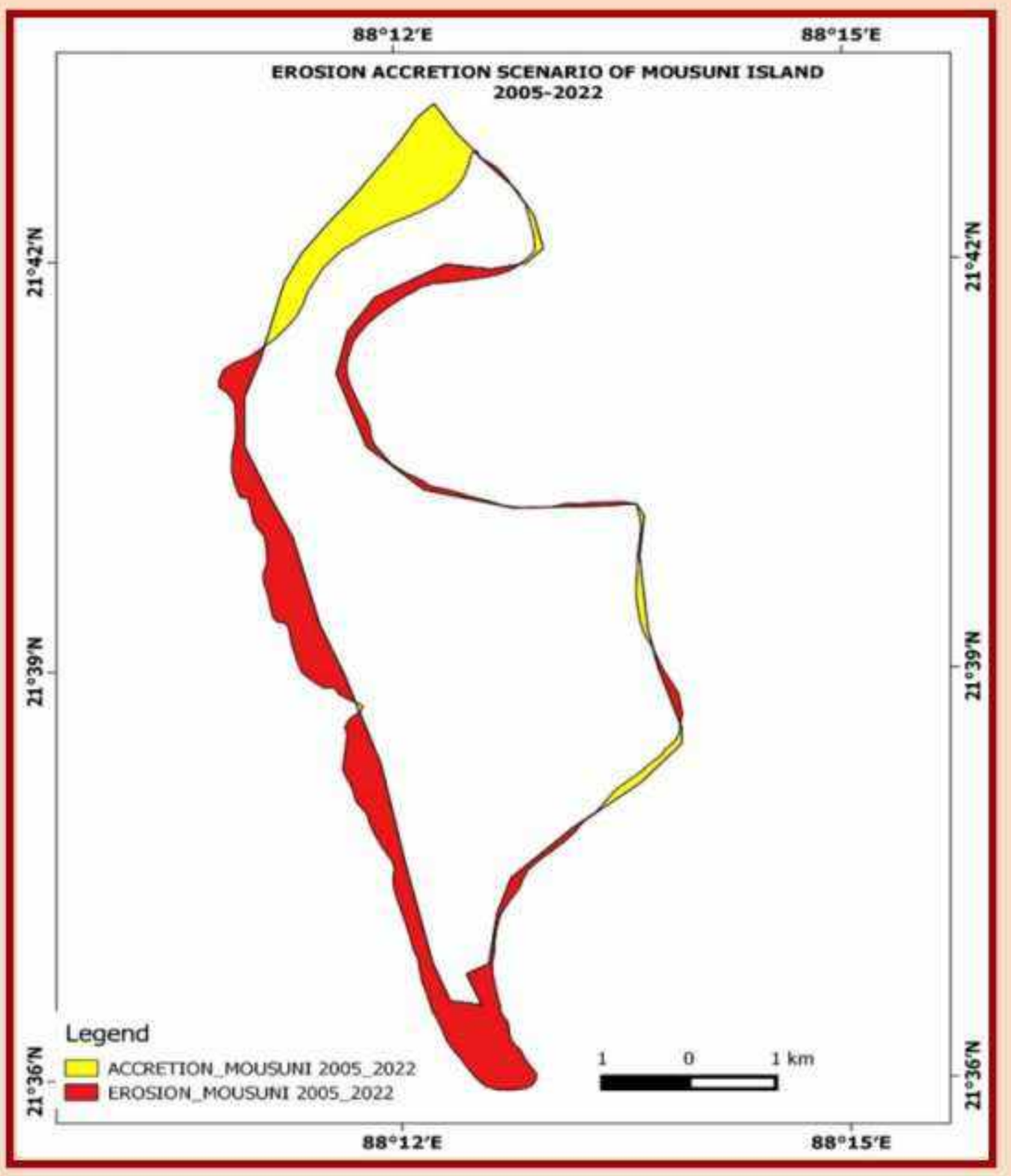


Fig.7 : Erosion-accretion area of Mousuni island from 2005-2022

The erosion accretion pattern of the study area shows a very Transient character. Rising sea level along with tidal and ocean current changes is responsible for the delta's retrograding nature. Mousuni Island is experiencing significant changes in the context of erosion and accretion. These processes are dynamic and ongoing, affecting the island's landscape, ecosystem, and the livelihoods of its inhabitants. The erosion accretion scenario was studied from the year 2005-2022, and it was observed that the island has gone through changes specifically on the South and Southwestern coast.

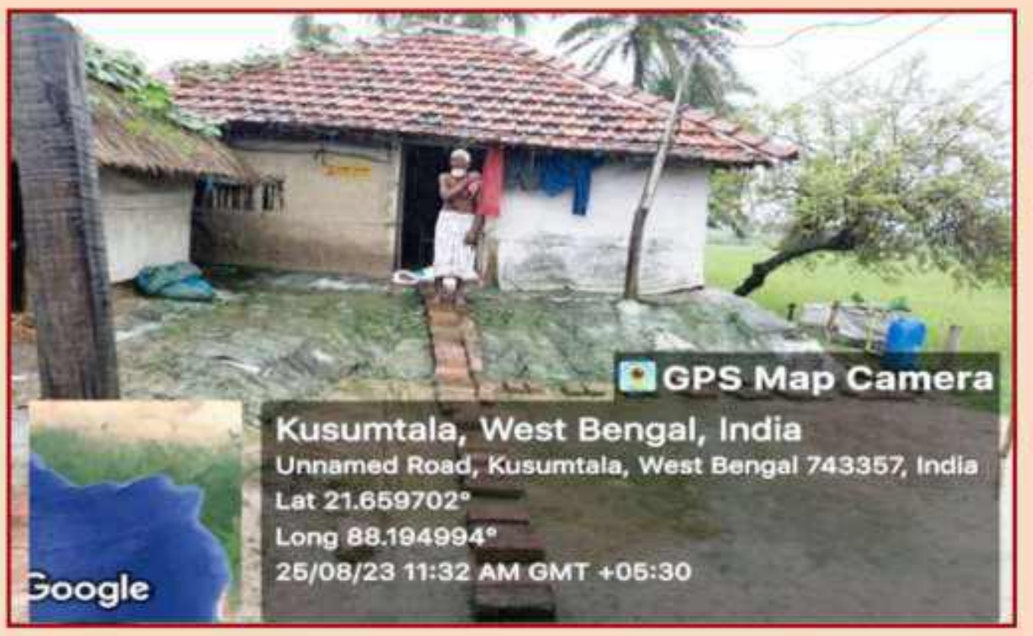
About 4.248 km² of land was eroded due to extreme cyclonic intervention and due to fluvial erosion and wave action. Accretion of about 2.081 km² was observed on the Northern side of the island, Kakramarichar due to deposition from the adjacent creek of the Indian Sundarbans, which is deltaic having intricate networks of rivers and creeks. Most of the land remains under saline water during high tide. To prevent degradation of soil fertility due to intrusion of salt water, the construction of embankments was done in the tidal creeks, thereby protecting the islands and inside water bodies. Agriculture is widely affected by the saline water intrusion. Thus, embankments are constructed to combat saline water intrusion caused due to tides or cyclones. Thus, embankments are the lifeline of these regions.

Fig. 8 : Change of earthen embankment

Within three months, there was a drastic change in the embankments in the area. The first photo, taken on May 8th before the monsoon season, shows the site still accessible. However, three months later, the area became almost inaccessible due to the seasonal rainfall. The geo-jute embankments along the coast were mostly repaired by residents or hotel owners, as these structures are essential for preventing further damage.

bank of the Chinai River of Mousuni Island. 12 km. embankment breached due to high tidal wave during the full moon. Thousands of families have been rendered homeless. They took shelter in the tent along the roadside. Some places of Muri Ganga and Ghoramara panchayet of Sagar Island embankment breached. Almost 40 km. of embankment was destroyed during this time in the whole Sundarban region (Anandabazar Patrika, 17 July 2014).

2.3. PEOPLE'S PERCEPTION

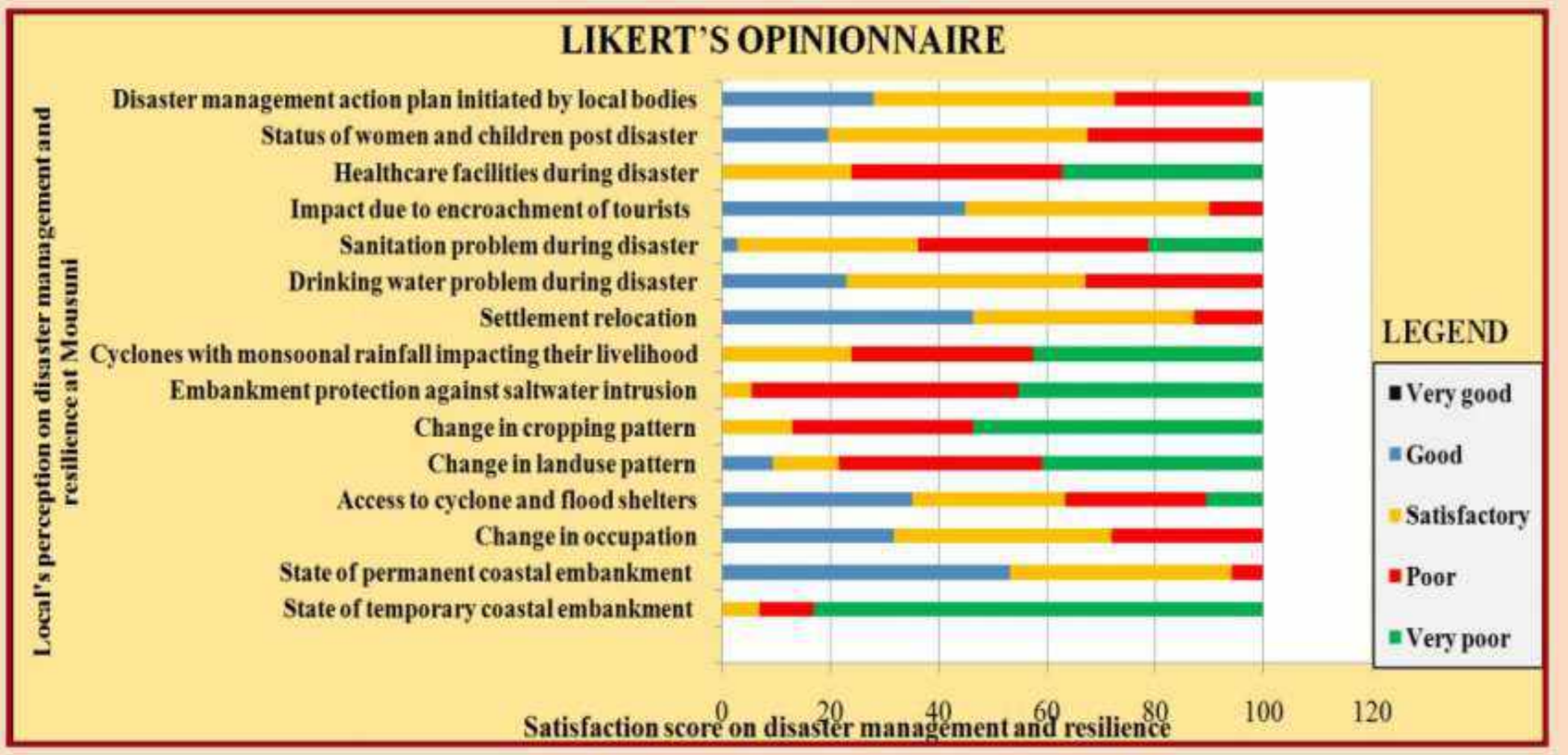


The permanent structured concrete embankments, reinforced with tetrapod and boulders in some places, have been somewhat effective in preventing further slab collapse. However, during high tide, the tetrapod nearly gets submerged, highlighting the vulnerable situation. During a cyclone, the risk is even greater, as overtopping of water is a prominent concern.

Embankment breaching took place along the

Fig. 9 : Agricultural field turning into saltpan

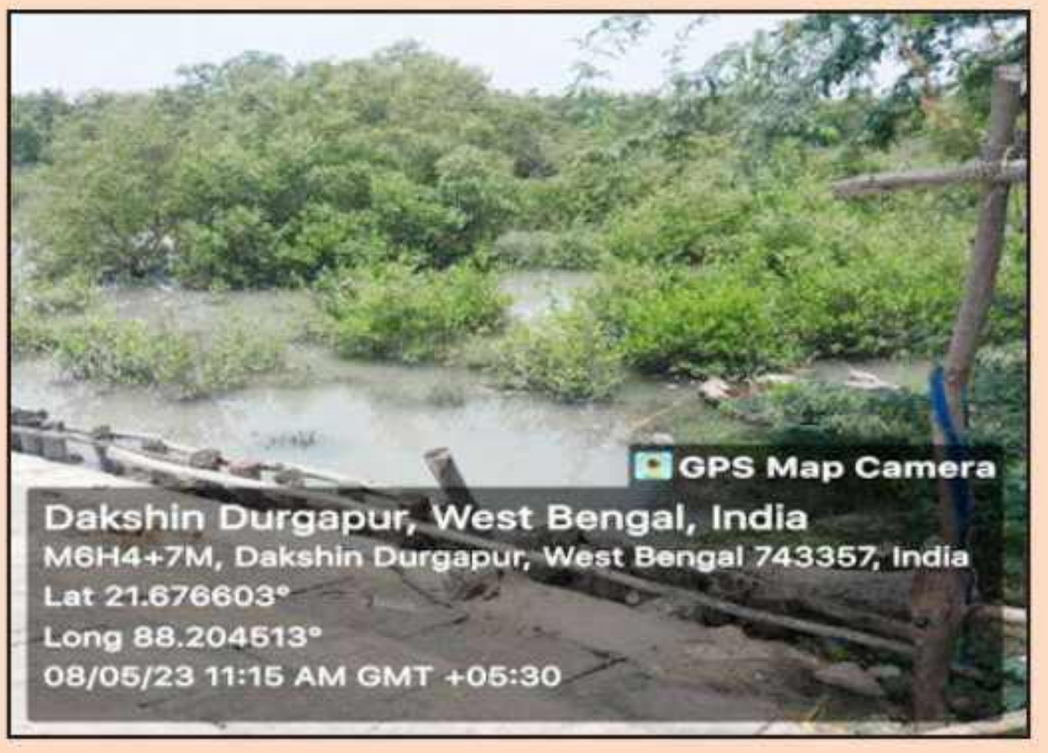
The people living on the island are the ones to face the vulnerability in their daily lives. Most of them have become accustomed to this change like their daily lifestyle and have started taking measures accordingly. Some of the locals have made arrangements by themselves to combat cyclonic effects mainly those who cannot access the cyclone shelters. The Likert opinionnaire scale, based on the perceptions of locals, has yielded predominantly negative results. It reveals that the



residents face vulnerability almost year-round. Their primary occupation, agriculture, has been disrupted, leading many of the youth to migrate to the southern part of India in search of job opportunities. However, some of them have chosen fishing as their livelihood.

3. Conclusion

The increasing trend of disastrous events in climate change like frequent cyclones, heavy rainfall, and flooding aggravates rapid coastal erosion. Any estuary is extremely responsive to increased sea levels (Dyer, 1995). Mousuni being a part of the Hugli estuary and being a sea-facing island, makes it more vulnerable to such events. The coastal sustainability action plan emphasizes that relying solely on technology is insufficient to address the challenges of advancing rivers or tidal waves. Instead, it advocates for Tidal River Management (TRM), which focuses on the natural restoration of land. This approach necessitates relocating residents to safer areas, allowing nature to recover. Bioengineering techniques, such as planting mangroves or other local plant species, are also recommended. These plants act as natural buffers, helping to prevent further erosion. Under such a scenario, embankment management becomes crucial to protect the coastline. Regular monitoring of embankments is required along with constant research work. The protection of banks with groins needs to be monitored. The Geo-jute method of earthen embankment seemed to be a complete failure, thus, alternative site-specific techniques need to be studied and implemented. In the extreme south of the islands (Baliara), a mudflat is observed taking advantage of such, a mangrove buffer can be created from additional protection of the embankments. Mangroves like Avicennian marina, Avicennian alba, and Avicennian officinalis may be planted on the mudflats. The construction of resorts that restrict beach formations and violate CRZ-1 norms needs to be checked. The settlement needs to retreat towards the central part of the island to construct a proper embankment. Apart from these, capacity building and vulnerability assessments are required. An alternative source of livelihood apart from agriculture is required to be promoted. Since Mousuni is hazard-prone, more cyclone shelters should be built for easy accessibility of the entire population of the Island.



ZEALANDIA – THE EIGHT CONTINENT

Aditi Majhi
Semester V

Since childhood, we know that there are 7 continents and 5 oceans in the Earth. ***But is this information true ?***

As we grew up, we found out that all these continents were actually part of a huge landmass called Pangaea and the huge body of water around Pangaea was Panthalassa.

Pangaea (Pangia) : Pangaea is derived from the Greek word "pan" (meaning all) and "gaea" (meaning Earth). It was a supercontinent that existed during the late Paleozoic and early Mesozoic eras, approximately 335 to 175 million years ago. It was formed through the collision and aggregation of earlier continental blocks.

Panthalassa : Panthalassa was the vast global ocean surrounding Pangaea. It was the single, continuous ocean that existed during the time of Pangaea.

Jurassic period was around 180 million years ago. The Gondwanaland and Laurasia got separated.

Laurasia consisted of North America, Europe and Asia and Gondwanaland, consisted of South America, Africa, India, Australia and Antarctica. South America and Africa separated, resulting in the formation of South Atlantic Ocean. India got separated and moved northward, eventually colliding with Asia to form the Himalayan Mountain range.

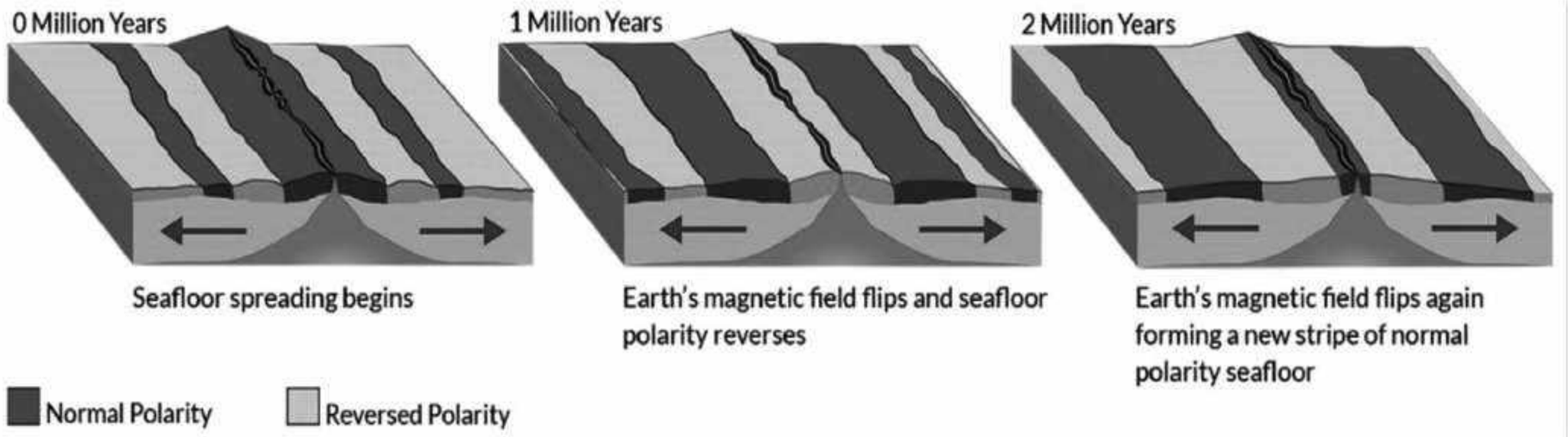
As the question arises, whether all those lands exist or some of them have sunk under the water ?

On 26 September 2023, In the field of geology, one of the most reputed journals "Tectonics" proved that Zealandia continent is submerged under the water. It's area is so huge that even if you combine the Indian subcontinent (4.4 million km^2) i.e. India, Pakistan, Nepal, Bhutan, Bangladesh, Sri Lanka and Maldives, its area is almost bigger, which has about 4.9 million km^2.

But how did it separate ?

When the plates were moving over each other due to tectonic activities, in the beginnings Zealandia was present at the boundary of the Indo-Australian and Pacific plates but at that time, the

tectonic activities were so intense that both these plates were rapidly moving away from each other and these formed Zealandia continent, which was present above these plates, to sink into the sea about 50 - 35 million year ago, that is in the historic time scale, even after the extinction of dinosaurs, at last 15 million years later, this continent was completely above the sea .



Scientists theory on 'Why did Zealandia Sink ?'

Basically, below Zealandia they saw that there were some such structures, which are made of volcanic basalt rocks. Now this can only happen when two tectonic plates move away from each other and molten magma comes out from the crack between the two. In this case, since that magma, as soon as it aligns and comes up, in contact with the cold water of the sea so naturally, it solidifies and forms a stripe. Since this molten magma has been coming out for thousands of years, every new stripe is coming out in this way and is scratching the sides, the Zealandia land mass above this pattern is sinking.

If we want to learn about its history, the first question that comes to mind is : Why are all the continents in the Northern Hemisphere ?

This question isn't a new one, it dates back to the 17th century. In 1492, *Christopher Columbus*, an Italian explorer, set out to find India but instead arrived at a land that is now known as the United States of America. After discovering North America and subsequently Asia and Europe, he pondered why most of the continents were in the Northern Hemisphere ? To maintain the Earth's balance, he thought there should be some continents in the Southern Hemisphere as well. He named this hypothetical southern land "Terra Australis", meaning "The Land of the South."

Therefore, in 1606, the "Dutch East India Company" initiated a mission with explorers and navigators Abel Tasman and Willem Janszoon. But where should this search begin ? They believed that since most of the three major oceans — Indian, Atlantic and Pacific were in the Southern Hemisphere, the search for Terra Australis should start from the southernmost points of the landmasses discovered up to that time.

Why does New Zealand want to prove Zealandia as a continent after so many years ?

Actually, the search started around in 418 years ago, in the 17th century. But, behind this there was a big reason of great economical advantage.

In 1982, the United Nations passed a law *"United Nation Convection on the Law of Sea"* came into force and finally provided some serious motivations. It states that countries can extend their legal territories beyond their Exclusive Economic Zone, which reaches 200 nautical miles(370km) out from their coastlines to claim their "extended continental shelf" – with all the rich mineral and oil. So, from the

perspective of New Zealand, if the land submerges beneath, it proves to be a continent, then its territory will be 6 times larger. This means that 6 times more natural resources and minerals will come under their control. Now, obviously, if a country has 6 times more resources than it would have had an impact on economic growth which would increase by 6 times.

To prove a land to a continent, we have to go through 4 major laws which are –

1. High elevation relative to regions floored by oceanic crust.
2. A broad range of siliceous igneous, metamorphic and sedimentary rocks.
3. Thicker crust and lower seismic velocity structure than oceanic crustal regions.
4. Well defined limits around a large enough area to be considered a continent rather than a microcontinent or continental fragment.

Because of this, the chapter of the lost continent, hidden beneath New Zealand was reopened and to study this, the New Zealand government called many international geologists to do detailed research. This time the goal was to prove this large submerged land mass to be a continent. It was relevant that the composition of the rocks beneath New Zealand was more matching to the composition of a continent than to oceanic bed. We all know that the bottom of the ocean is mostly made of volcanic basalt rocks and the continents are mainly made up of granite rocks, yet the submerged land mass beneath New Zealand in the ocean was made of granite rocks like in continents. It means possibly the landmass beneath New Zealand could have been an 8th Continent.

Zealandia is everywhere substantially elevated above the surrounding oceanic crust. The main difference with other continents is that it has much wider and deeper continental shelves than usual. Zealandia has a model elevation of ~- 1100 m (Cogley 1984) and is ~94% submerged below current sea level. The highest point of Zealandia is AORAKI-MOUNT COOK at 3724 meters. We already have discussed, being >1 million km^2 in area, and bounded by well defined geologic and geographic limits, Zealandia is, by our definition, large enough to be termed a continent. At 4.9 million km^2, Zealandia is substantially bigger than any features termed microcontinents and continental fragments, ~12x the area of Mauritia and ~6x the area of Madagascar.

If this 8th continent had been confirmed in 1982 then why wasn't it included in our geography books till now? And why is it unknown in the news for 375 years ?

Well, the inclusion of maps in our books, specially, when the precise mapping of its boundaries has been done through the currently accepted methods i.e. satellites and this was exactly what was missing in the case of Zealandia. So that's why, after many years of delay in the year 2017, finally it's official satellite mapping was started and the final result came on 12th September 2023 and last but not the least, it also has its own separate tectonic plate called Zealandia Plate, also known as "Te Riu-a-Maui-plate", which is completely different from its surrounding Pacific Plate and Australian Plate. New Zealand is just a small peak of that continent and the existence of Zealandia continent was finally confirmed.

It seems a little weird to accept it from somewhere, right ?

But, in science, as we already know, many times definitions are very blurred. We cannot define anything exactly and there is something similar happening here in Zealandia, which is also called a continent. This is because we cannot pin point the continents exactly and define them. When we talked about elevation, it is not properly defined how much height from the ocean bed a landmass is that can be called as a continent. If Zealandia was only 1 cm above the ocean bed, could it still be declared a

continent? Well, instead of putting multiple definitions under one term, maybe a different term should be derived for such anomalies. Zealandia is a long, narrow microcontinent that is mostly submerged in the South Pacific Ocean.

A microcontinent is a landmass that has broken off from a main continent. So, in the same way, a new word was coined for Zealandia and in the same way, the new continents that are being mapped, like Mauritius, Beringia, Dogger land etc. It can also categorize them under this word. Even though, for now, they are just some submerged invisible continents.

Now my question to you is that, is Zealandia is the eighth continent ?

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TIME DILATION : WHEN SPEED CHANGES TIME

Amrin Khatun
Semester V

Imagine a world where time doesn't tick at the same pace for everyone. No, this isn't a sci-fi movie plot, though it does have that "Doctor Who" vibe. We're talking about time dilation, a mind-bending concept from Einstein's theory of relativity. It's like the universe's way of telling us, "Hey, relax or hurry up, it's all relative!" Let's dive into the fascinating world of time dilation, peppered with a few jokes to make the journey more enjoyable.

What is Time Dilation ?

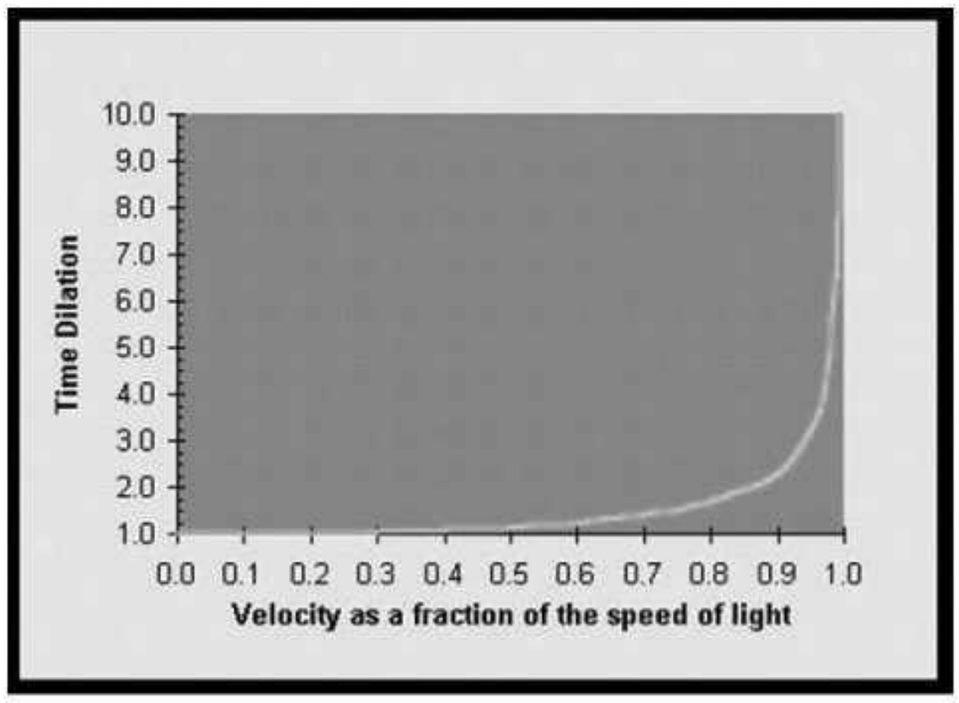
Time dilation refers to the difference in the elapsed time as measured by two observers, due to relative velocity or difference in gravitational potential. In simpler terms, it's when time runs at different speeds for different observers, depending on how fast they're moving or how strong the gravitational field they're in.

Picture two friends, Alex and Jamie. Alex is on Earth watching Netflix, and Jamie is speeding through space at near to light speed. When Jamie returns, Alex has aged more than Jamie. It's like Jamie found the ultimate anti-aging routine!

The Speed Factor : Moving Clocks Tick Slower

Einstein's Special Theory of Relativity tells us that as you move faster, time slows down relative to someone who is stationary. This phenomenon is called "time dilation due to relative velocity."

Let's put it in a scenario. Imagine you're on a spaceship traveling at 90% of the speed of light, and your twin is back on Earth. If you take a trip that lasts 10 years according to your spaceship clock, when you return, you might find that 20 years have passed on Earth. Your twin would be two decades older, while you've aged only a decade. No wonder space travellers in sci-fi always look so young!



This isn't just a theoretical idea. It has practical implications. For instance, particles called muons, which decay in microseconds, last longer when moving close to the speed of light because their internal "clocks" slow down. It's like nature's way of giving them extra playtime.

The Gravity Factor : Clock Near Massive Objects Tick Slower

Einstein's General Theory of Relativity introduced the idea that time slows down near massive objects. This is called "gravitational time dilation." The stronger the gravitational field, the slower time passes.

Imagine you're in a spaceship near a black hole while your friend stays on Earth. If you spend a few hours near the black hole and then return, you might find that years have passed on Earth. It's like the ultimate "time flies when you're having fun" experience, except you might be too busy escaping the black hole to notice the fun part.

One real-world application of this concept is GPS satellites. These satellites orbit Earth and experience less gravity than we do on the surface, causing their clocks to run faster. Scientists must account for this time difference; otherwise, your GPS would be as unreliable as using a sundial in a cave.

The Twin Paradox : A Thought Experiment

One of the most famous illustration of time dilation is the Twin Paradox. Suppose one twin travels into space at high speed and the other stays on Earth. When the traveling twin returns, he/she will be younger than the twin who stayed behind. This isn't just an argument for why space travel might be the ultimate anti-aging treatment; it's a fundamental prediction of relativity.

Let's spice it up with a joke : Why did the twin who travelled to space refuse to share their anti-aging secret ? Because they knew the other twin would never understand the concept of time dilation!

Time Dilation and Everyday Life

While time dilation might seem like a far-off concept that only matters to astronauts and physicists, it actually affects us every day. Besides GPS systems, which we already mentioned, another example is in high-energy physics experiments. Particles accelerated to near-light speeds in particle, colliders live longer than they would if stationary, allowing scientists to study their properties more thoroughly. Even airlines have to account for time dilation. Pilots and crew flying long-haul, high-speed routes around the globe experience minuscule but measurable time differences compared to those on the ground. While it won't make them significantly younger, it's a cool nod to the reality of time dilation.

Could We Use Time Dilation for Time Travel ?

This brings us to a tantalizing question : Can we use time dilation for time travel?

While the idea of hopping into a spaceship and returning to a different era is thrilling, we're not quite there yet. Time dilation lets us move into the future at different rates, but jumping back into the past remains the stuff of science fiction.

However, experiments like those with the Large Hadron Collider bring us closer to understanding the fabric of time and space. Who knows? Maybe one day, time dilation will be the key to unlocking the secrets of time travel. Until then, we'll have to stick with re-watching "Back to the Future."

Wrapping Up : Time Dilation is Mind-Bendingly Fun

So, there you have it. Time dilation is the universe's way of keeping things interesting. Whether you're zipping through space or hanging out near a black hole, time doesn't play by the same rules everywhere. It bends and stretches, making the cosmos a wonderfully wibbly-wobbly place.

Next time you're running late, you might be tempted to blame time dilation. Just remember, unless you've been traveling at near-light speed or hanging out with black holes, your excuse might not hold up. But understanding this incredible phenomenon gives us a deeper appreciation for the complexities of our universe and a fun conversation starter at your next party! And remember, time is relative. So, if you need an excuse for being late, you can always say, “Sorry, I experienced a bit of time dilation on the way!” Just be prepared to explain it – maybe with a few jokes to keep things light.

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DEVASTATION IN SIKKIM : CLOUDBURST, FLASH FLOODS AND ITS ENVIRONMENTAL OUTCOME

Muskan Sharma
Semester V

Sikkim,a beautiful State of India located in the Northeastern part of the country, in the Eastern Himalayas. It shares its border with Tibet Autonomous Region of China to the North and North-east, with Bhutan to the South-east, with West Bengal, a state of India to the south and Nepal to the West. Sikkim is one of the smallest states in India usually known for its biodiversity which includes its pleasant climate, the spellbinding scenery and Kanchenjunga, the highest peak in India. Gangtok, the capital of Sikkim is full of energy, activity and life.

On 4th October 2023, Sikkim witnessed a glacial lake outburst flood caused due to the heavy rain which resulted in breaching the bank of South Lhonak Lake, a glacial moraine. Sikkim witnessed more than its normal rainfall due to a cloudburst in early October. The state received five times the usual precipitation between 3rd and 4th October alone. The flood eventually reached the Teesta Dam at Chungthang before its gate could open, causing the dam to collapse in minutes.

Severe damages were reported, the National Highway 10 that passes through the Indian states of West Bengal and Sikkim collapsed causing Sikkim to cut off from rest of India. Water levels downstream in the River Teesta rose by 15 to 20 feet flooding many areas in Mangan, Gangtok, Pakyong, and Namchi districts in Sikkim, and Kalimpong, Cooch Behar, Jalpaiguri and Darjeeling districts in West Bengal. Almost 40 people were declared dead, 22 injured and 75 missing report was filed as of 6th October. By 18th October, 92 people were confirmed dead, with more bodies being retrieved. There was heavy loss of life and public properties.

Both the citizens and the government did their best to help the ones in need. Government aided them with funds and relief operations while the citizens of Sikkim helped the needy with food and shelter. The government of Sikkim declared this destruction as a Disaster and the Indian Central Government released ₹48 Crores in disaster relief funds. The Indian Army did a great job alongside the Government.

The government of Sikkim has proposed many Flood Management Programmes [FMP] which would include river management, flood control, anti-erosion, drainage development, anti-sea erosion, flood proofing works besides Flood Prone Area Development Programme in critical regions. It also included restoration of damaged flood control and management works.

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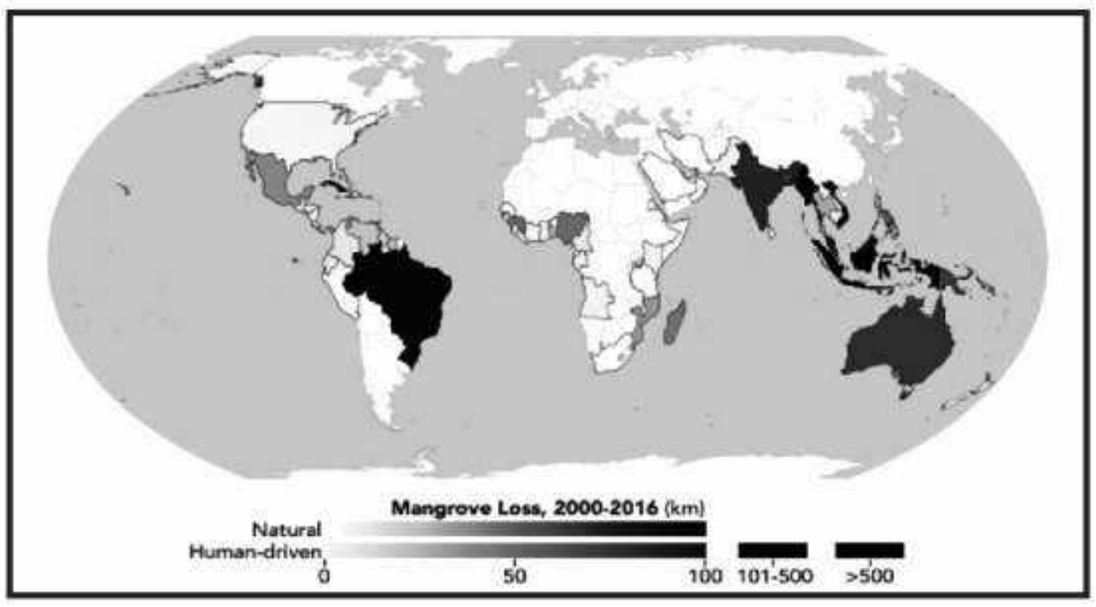
BREATHING ROOTS IN DANGER !

Riyanka Banerjee
Semester V

Mangrove forests are unique ecosystems that thrive in the interface between land and sea. They protect the coastlines from erosion and storm damage, store carbon within their roots, trunks and in the soil and provide habitats for commercially important marine species. Specially adapted to living in salt and brackish water, mangrove trees are found along coasts and estuaries throughout 123 countries in the tropics and subtropics. They look much like the coastal cousins of inland forests. Their tangled prop roots help them thrive well in harsh coastal environment where the tide flows in and out and there is little oxygen in the soil. Although mangroves account for less than 1 per cent of the cover of global tropical forests, they provide critical ecosystem goods and services to the mankind. Mangroves provide protection against storms, erosion and flooding, sources of food and timber, improved water quality and carbon sequestration. Mangrove forests also provide natural habitat for over 1,533 different species, including nursery habitats for many commercially important fish, and are beneficial to the health of adjacent ecosystems such as coral reefs and sea grass meadows. Mangroves are crucial for humans too. They are an important carbon sink and can hold up-to four times more carbon per hectare than tropical rainforests. Unlike rainforests, which mostly store carbon in trunks and branches and therefore release it when the trees die, mangroves store most of the carbon in their soil and sediment. Mangrove forests play a vital role in supporting coastal and marine ecosystems, shielding nearby areas from tsunamis and extreme weather, combating climate change by storing carbon. If left undisturbed, that carbon can stay for millennia. Mangroves also provide livelihoods for societies living near coastlines, while protecting them from violent tidal surges and floods during cyclones and hurricanes. They can also provide an economic boost through ecotourism. Sunderbans are the best example of ecotourism in India.

Yet despite their critical importance, mangrove forests are in decline across the world. The decline is driven by a multitude of factors ranging from shrimp farming and palm plantations to tropical cyclones and global warming. Cyclones damage mangrove forests abruptly but temporarily, so the forest can often be recovered. But mangroves have been struggling to deal with the more gradual and permanent damages caused by farming, fish farming and anthro-pogenic climate change. Mangrove forests are threatened by many human pressures, including conversion to aquaculture and agriculture, coastal development, overharvesting, agricultural and industrial pollution and climate change impacts. Forest clearing and pollution originating from aquaculture and agriculture are the single biggest factor, accounting for around 47% of global mangrove forest loss according to the

published scientific studies we consolidated. Aquaculture and agriculture had particularly big impact in South East Asia, West Africa and Latin America – the two critically endangered mangrove species are particular victims here. According to latest satellite imagery, the global loss of mangroves has stabilised and gains have occurred in and around many of the world's large rivers, estuaries and deltas. Mangrove forests have been degraded, polluted and have lost biodiversity, The impacts which cannot be seen by satellite imagery. Biodiversity in mangrove forests is increasingly at risk. Climate change and associated sea-level rise, droughts and coastal acidity constitute the second biggest factor behind the mangrove decline. Urbanisation and coastal development were the third major social-ecological driver we identified. Mangroves can thrive in harsh environments and are used to natural perturbations like tropical cyclones. But several confounding pressures exacerbating each other known as the synergistic effect, impose much greater stress than the individual pressures alone and that is what mangroves failed to withstand. NASA studied the maps of global mangrove loss. Using high-resolution data from the joint NASA-U.S.GeologicalSurvey Landsat program, researchers have created the first map of the causes of change in global mangrove habitats between 2000 and 2016 – a valuable tool to aid conservation efforts for these vital coastline defenders. The global map will benefit researchers investigating the carbon cycle impacts of mangrove gain and loss, as well as help conservation organizations identify where to protect or restore these vital coastal habitats.



Mangrove forests and other blue ecosystems deliver effective nature-based solutions, and it is critical that we act now to protect, restore, and sustainably manage them, so they can continue to deliver critical ecosystem services for nature, people and the
planet. UNEP is delivering global leadership on mangrove ecosystems, promoting international cooperation and science-based and ecosystem- based management approaches, supporting regional and global assessments, developing best practice manuals, and working with partners to implement conservation and restoration projects on the ground. Conservation efforts and sustainable management are crucial to safeguard these valuable ecosystems and the services they provide to coastal communities and the environment. By implementing conservation strategies, India can contribute significantly to the conservation and sustainable management of its mangrove forests, ensuring their survival and the valuable services they provide to both nature and society.

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THE CITY'S OASIS OF NATURAL BIODIVERSITY

Riyanka Saha
Semester V

Kolkata is a city full of wonders. A city that takes pride in the beauty of its water bodies. If a lake is the 'Eye of the Earth', then our city has got the most beautiful eyes! And someone who has visited the Rabindra Sarovar Lake can never deny this. Located at the southern part of the cityscape, this artificial lake in Kolkata is truly an oasis, amidst the pollution-ridden city. Around 38% of the total 192 acres area, 73 acres constitute the water body, whereas the remaining 119 acres constitute a variety of floral species which are centuries old!

The Artificial Lake – Rabindra Sarovar

A DEEP DIVE INTO THE HISTORY

With Southern Avenue in the north and Kolkata Sub-Urban Railway Track in the south, this lake is an important accessory of the city, as it provides a natural carbon dioxide sink of the metropolitan city, apart from its aesthetic values and pristine beauty. The present lake region was once a malarious marshy jungle, until in the early 1920s, initiatives were taken to develop the area for habitation. During the lake excavation, three cannons were unearthed which are presently displayed on the southern part of the lake. These cannons are thought to have been left behind by Siraj-ud-Daulah's army after the seizure of Calcutta.

The Pedestrian lanes around the Lake

Previously known as the Dhakuria Lake, it was renamed in 1958 as Rabindra Sarovar as a tribute to the Nobel Laureate, Rabindranath Tagore. Apart from societal benefit, the lake ecosystem provides a suitable habitat for the co-existence of amphibians, fishes, animals and migratory birds. It was declared as a "National Lake" in 1997, under the National Lake Conservation Programme of the Ministry of Environment, Forest & Climate Change.

BEAUTY IN DIVERSITY

The Calcutta Horticulture Society played a great role in transforming the lake into an area of sustainable hotspot. Several studies have found out that nearly 366 species of terrestrial vascular plants and 7000 species of plants are found in the lake premises. Some parts of the lake have floating vegetation like Lotus. The Bur-flower tree to The Queen's Crape-myrtle, Arjuna tree, Devil's tree and several other species have found their home in this tranquil environment. Not to forget is the old Banyan tree, that have proudly spread its branches. The floral wealth here is very much essential to the ecological security in the city.



THE DIVERSE VEGETATION AT RABINDRA SAROVAR

Winter, here attracts numerous migratory birds in the islands of the lake. Be it the migrated Taiga flycatchers, cotton pygmy goose, black-headed cuckoo shrike, or the commoners, Blue-throated Barbet, Coppersmith Barbet, Oriental Magpie Robin, they have been examples of healthy terrestrial habitat quality.

Apart from them, the amazing diversity of bugs, beetles, butterflies, fishes, five stripped palm squirrel add on to its rich biodiversity. This man-made wetland plays a vital role in nutrient cycling, breaking down organic matter and recycling nutrients, which supports plant growth and maintains the overall health of the ecosystem.

MENACE IN THE AREA

Recently, several signs of water pollution and deterioration of water quality in the lake has been an issue of concern. The lake has shrunk considerably with unrestricted growth of aquatic vegetation, leading to thick floating vegetative in the corners of the lake, is a growing menace. Growth of water hyacinth has led to bleaching of oxygen thereby harming the fishes.

The Five stripped palm Squirrel, avian specie . and swans in the Lake ecosystem

Furthermore, non-biodegradable items near the shore like plastic bottles, cups, packets and the practice of idol immersions by indiscriminate dumping of different idols as part of the Hindu celebration has been another important causal factor contributing to serious water pollution. The alarming level of water pollution was confirmed when morning walkers were shocked by hundreds of dead fish floating on the surface of the water. Strong light and noise by several rowing events have been a concern for the avian visitors to the lake. The migratory birds gave the island a miss last winter as there was no resting place. Rapid concretization and construction bridges often lead to weakening of roots and withering of trees.

CONCLUSION

Kolkata Municipal Corporation (KMC) is working to protect the environment of the lake and its surrounding areas under the strict supervision of the State Pollution Control Commission. Restoring the lake ecosystem will be quite costly, according to KMC officials, due to problems with ongoing algae blooms, waterweed infections and dumping of waste along the lakeshore. The drainage system will require substantial renovation and care should be taken to ensure better aesthetics as well as rapid erosion of the lake.

Awareness of the ecology and delicate biodiversity of this unique ecosystem in a bustling city like Kolkata is slowly gaining momentum. Civic groups and clubs are campaigning to restore and maintain the lake's ecosystem. The level of awareness of keeping the lake water and nearby facilities free from contamination and disturbances has certainly increased. The lake has over the last five or six decades been a point of positive social interaction and appreciation of the aesthetics and beauty of nature, and we must realize that all good things have a price!

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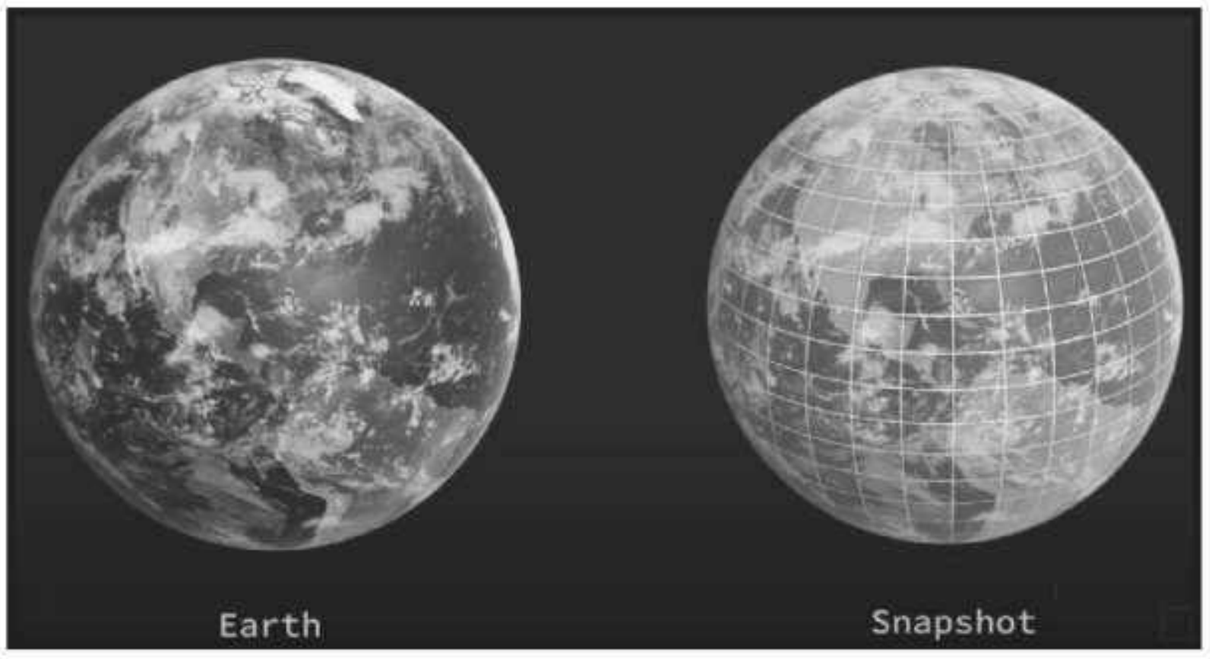
FROM SUPERCOMPUTERS TO SMART PREDICTIONS: HOW AI IS REVOLUTIONIZING WEATHER FORECASTING

Shreja Saha
Semester V

On September 11th, 2023, as the Northeast U.S. braced itself for potential impacts, all eyes were on Hurricane Lee. This formidable storm, having regained strength as a Category 3 hurricane, was predicted to veer northward in the following days. By September 16th, Lee made its landfall in Nova Scotia, Canada, leaving behind a trail of destruction with flooded roads, fallen trees, and widespread power outages along the East Coast.

Despite the impressive accuracy of weather forecasts, prediction of Lee's trajectory five days before its landfall, there was an unexpected frontrunner in this meteorological race : an AI model was developed by Google. Remarkably, this AI forecasted Lee's path three days ahead of traditional weather stations. This marked a significant moment in the evolution of weather prediction, as Artificial Intelligence (AI) began to demonstrate its potential to revolutionize meteorology, offering a glimpse into a future where we might better anticipate and prepare for extreme weather events.



The Traditional Approach to Weather Forecasting

Weather forecasting, more than just predicting whether you'll need an umbrella, involves a complex interplay of data collection, physics and computational power. Traditionally, meteorologists started with a snapshot of the Earth's atmosphere, gathered from a myriad of sources including satellites, weather stations and ocean buoys. These observations are processed into a detailed 3D grid that represents the atmosphere's conditions, such as temperature, pressure, wind speed and humidity, both vertically and horizontally.

These grids form the basis for intricate physics-based simulations, often performed on some of the world's most powerful supercomputers. For instance, the European Centre for Medium-Range Weather Forecasts (ECMWF) and the U.S. National Weather Service utilize these simulations to create forecasts that are refined by local meteorologists, who adjust them, based on regional factors like topography and nearby water bodies.

Given the immense complexity, these models typically run multiple forecasts with slight variations in the initial data, a method known as ensemble forecasting. This approach generates a range of possible outcomes, helping to measure the uncertainty of predictions. If the ensemble forecasts converge on a similar outcome, the confidence in that prediction increases. However, the further the forecast, the more uncertain it becomes due to the inherent variability and the limitations in computing power.

What is ensemble weather forecasting?

An ensemble weather forecast is a set of forecasts that present the range of future weather possibilities. Multiple simulations are run, each with a slight variation of its initial conditions and with slightly perturbed weather models.

Enter AI : A New Paradigm in Weather Prediction

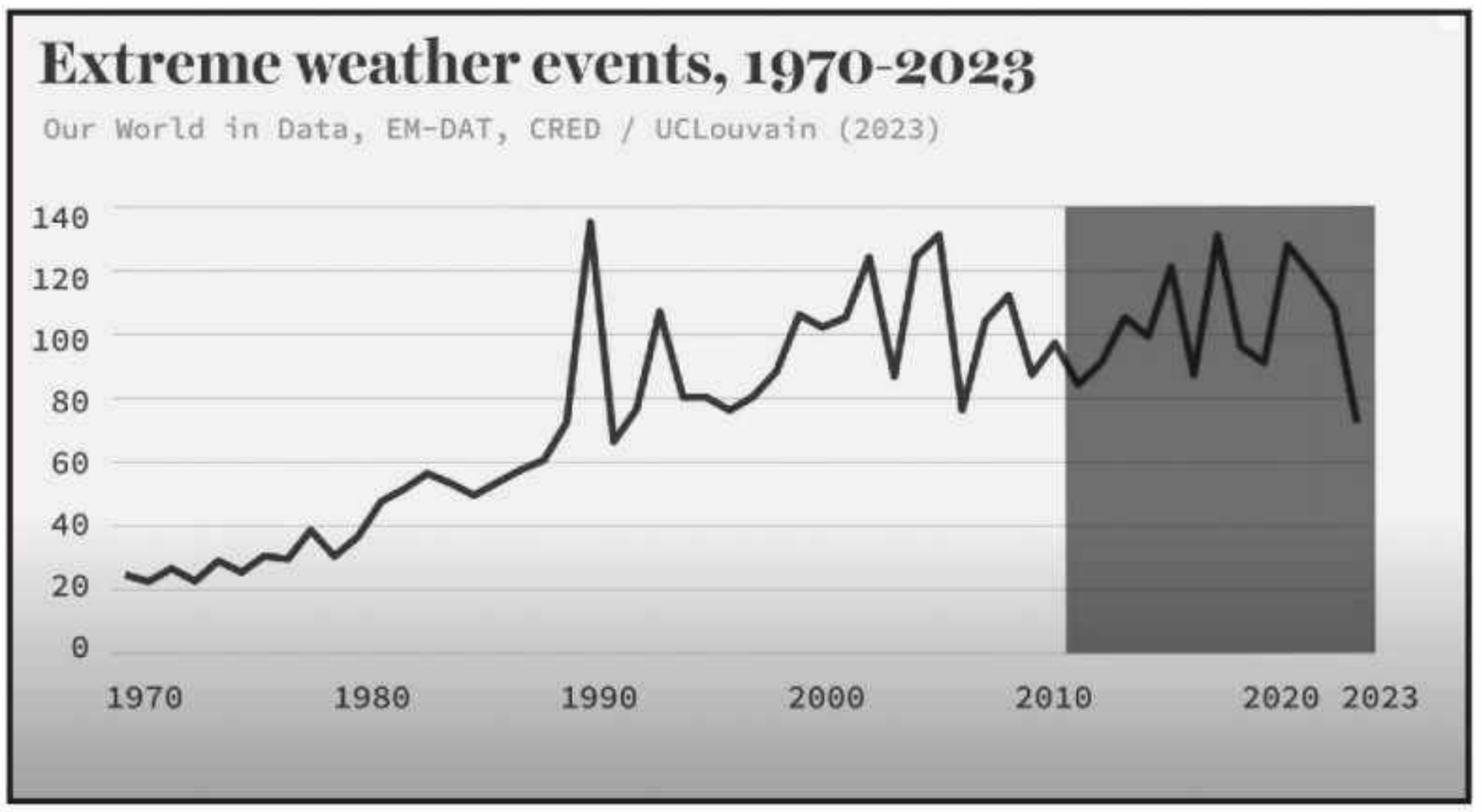
In 2020, the publication of the ERA5 dataset by the Copernicus Climate Change Service (C3S) presented a treasure trove of historical weather data, spanning over four decades. With its high-resolution, hourly snapshots of the global atmosphere, ERA5 was an ideal candidate for training AI models.

Tech giants like Google, Huawei, and Nvidia seized this opportunity in developing AI models, capable of predicting weather patterns without relying on the extensive physics-based calculations traditionally required. These AI models were trained to recognize patterns by comparing historical data snapshots to subsequent weather outcomes. Over time, they learned to make predictions with remarkable accuracy.

For example, Huawei's Pangu weather model can produce a week-long forecast in just 1.4 seconds, a feat unimaginable with conventional methods. These models still utilize the same observational data that feed into traditional models but bypass the need for lengthy computations, enabling them to deliver rapid predictions.

The Role and Limitations of AI in Weather Prediction

- **Comprehensive Uncertainty Measure :** AI can generate thousands of ensemble forecasts quickly, providing a more comprehensive measure of uncertainty.
  - Crucial for decision-makers like emergency managers planning evacuations.
- **Limitations of AI Models :**
  - Often prioritize safer, more statistical likely outcomes to improve accuracy scores.
  - This may lead to underestimating rare and extreme events.
  - Trained on historical data, making it difficult to predict weather patterns that are becoming more frequent due to climate change.
- **Human Element in Forecasting :**
  - AI lacks the nuanced understanding of human meteorologists.
  - Human meteorologists effectively interpret and communicate forecast uncertainties.
  - This human touch is essential for conveying implications and aiding informed decision.



Conclusion

The advent of AI in weather forecasting brings a blend of promise and caution. AI models have shown that they can match the predictive skill of traditional models, even outperforming them in certain scenarios like forecasting the paths of tropical cyclones and extreme weather events.

As AI continues to evolve, its role in weather forecasting is likely to expand, potentially offering faster and more detailed predictions. The European Centre for Medium-Range Weather Forecasts has already started to integrate AI forecasts alongside traditional ones, providing the public with a chance to compare their performance.

In the near future, checking the weather might involve a combination of physics-based and AI-powered models, offering a clearer view of the atmospheric events that shape our lives. While AI may not provide a perfect crystal ball into the future, it holds the promise of enhancing our ability to anticipate and prepare for the increasingly complex weather patterns of our changing world. The fusion of human expertise and cutting-edge technology may well define the next frontier in meteorology.

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THERE IS NO PLANET B!

Sneha Pandey
Semester V

Climate change is one of the major challenges of our time. Our planet is heating up. Climate change refers to the long-term shifts in temperature and weather patterns. Greenhouse gases emitted by human activities alter Earth's energy balance, the balance between its incoming and outgoing energy and consequently its climate. Scientists have determined that, when all human and natural factors are considered, Earth's climate has been altered towards warming with the biggest contributor being Carbon Dioxide (CO_2).

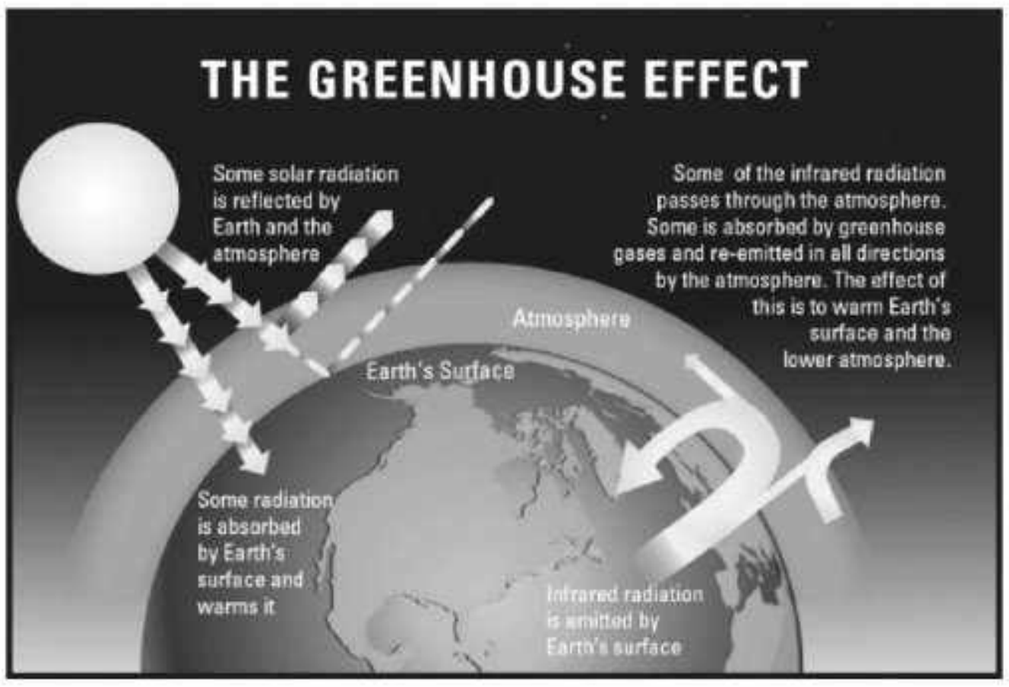

Fig : Greenhouse Gases (ghg's) Disturbing The Earth

Most of the impacts associated with the warming trend have become evident in recent years. The heat content of the ocean has increased. The ice cover in the Arctic summer sea has dramatically shrunk.

Frequent and intense droughts, storms, heat waves, rising sea level, melting glaciers and warming of oceans are harming the animals and destroying their habitat.

Climate change can have a range of impacts on our physical, mental and community health. Exposure to extreme heat can lead to cardiovascular, cerebravacular and respiratory diseases including heat stroke and dehydration. Warmer temperatures can worsen air quality and lead to asthma attacks.

The decade from 2010 to 2019 was the warmest ever recorded, bringing with it massive wildfires, hurricanes, droughts, floods and other climatic disasters across continents. Every person in every country, on every continent will be affected in some way or the other due to climate change. If left unchecked, climate change will cause average global temperatures to increase beyond 3^0C. Already, we are seeing how climate change is exacerbating storms and disaster threats such as food and water scarcity which can lead to conflicts, wars and instabilities. We do not have a backup planet or planet 'b' where we can live. Hence, doing nothing will cost us much more in the future.

IS INDIA'S TECTONIC PLATE SPLITTING INTO TWO BENEATH TIBET ?

Vareeja Ratna
Semester V

INTRODUCTION :

The Earth's crust, or lithosphere, consists of 15 to 20 moving tectonic plates. These plates shift due to heat from Earth's mantle, causing continents to drift over millions of years. Around 250 million years ago, a single landmass, Pangaea, began breaking apart, leading to the current continental arrangement. The collision of the Indian and Eurasian plates created the Himalayas through compression, folding, and uplift. This ongoing tectonic activity now raises the question : Is the Indian plate splitting into two beneath Tibet ?

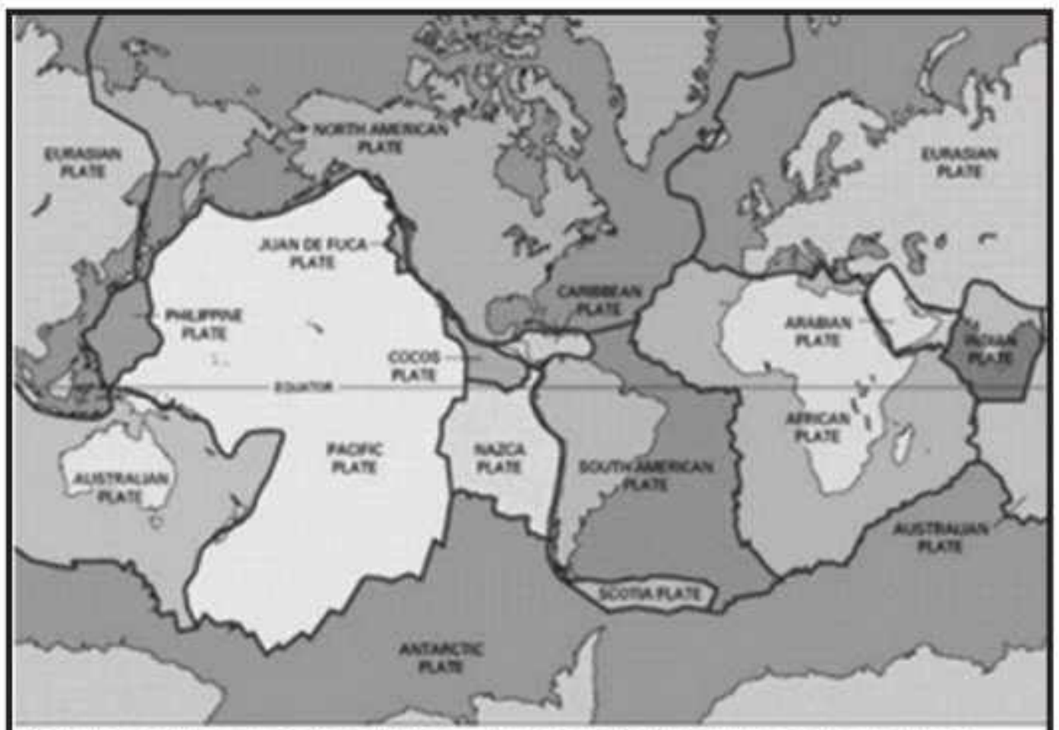

Fig 1. The Earth's crust is divided into distinct "tectonic plates" that are always slowly moving. Earthquakes are concentrated along these plate boundaries, via USGS

A GEOLOGICAL BATTLEGROUND :

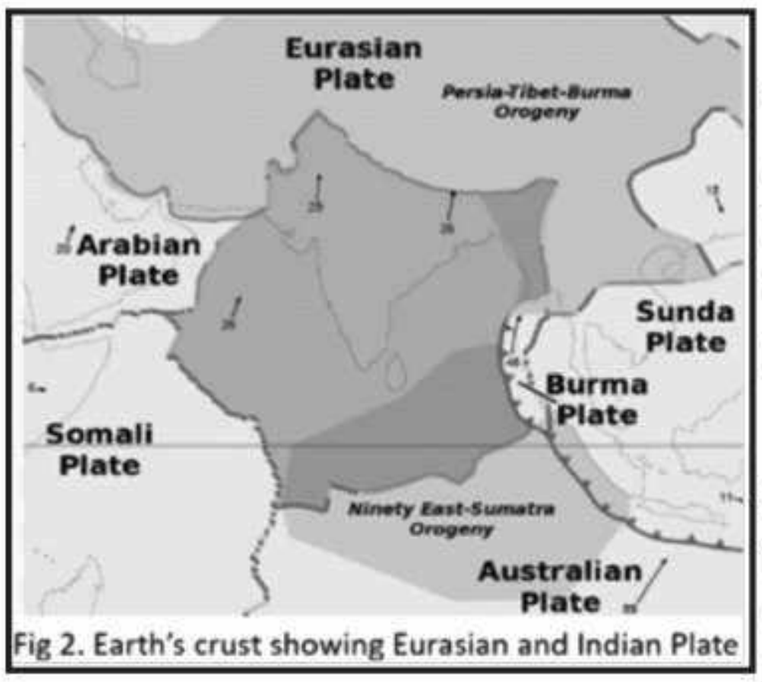

Fig 2. Earth's crust showing Eurasian and Indian Plate

Recent research suggests the Indian plate is undergoing "delamination," a process where the upper part remains high, contributing to Tibet's elevation, while the lower section sinks into the mantle. Studies presented at the American Geophysical Union Conference in 2023 propose this as a key factor in the plateau's formation.

A team of scientists from China and the U.S. examined seismic waves from earthquakes and geochemical signatures from Tibetan hot springs. They found that the Indian plate, colliding with the Eurasian plate for roughly 60 million years, may be behaving unexpectedly. While previous theories suggested horizontal or vertical subduction, new data indicate that part of the plate is tearing apart, with its eastern section detaching from the western portion.

Simon Klemperer of Stanford University, along with Chinese researchers, studied deep earthquake waves and analyzed gas emissions from hot springs. Their findings suggest the Indian plate is breaking into upper and lower layers, with the upper portion sustaining Tibet's high altitude while the lower portion sinks. The team speculates that this tear could divide the Himalayan range, influencing seismic activity.

Barbara Romanowicz, an Earth and planetary science professor at UC Berkeley, finds this explanation plausible. The Indian plate, being relatively buoyant, should not subduct easily. Yet, studies indicate its lower portion is delaminating,

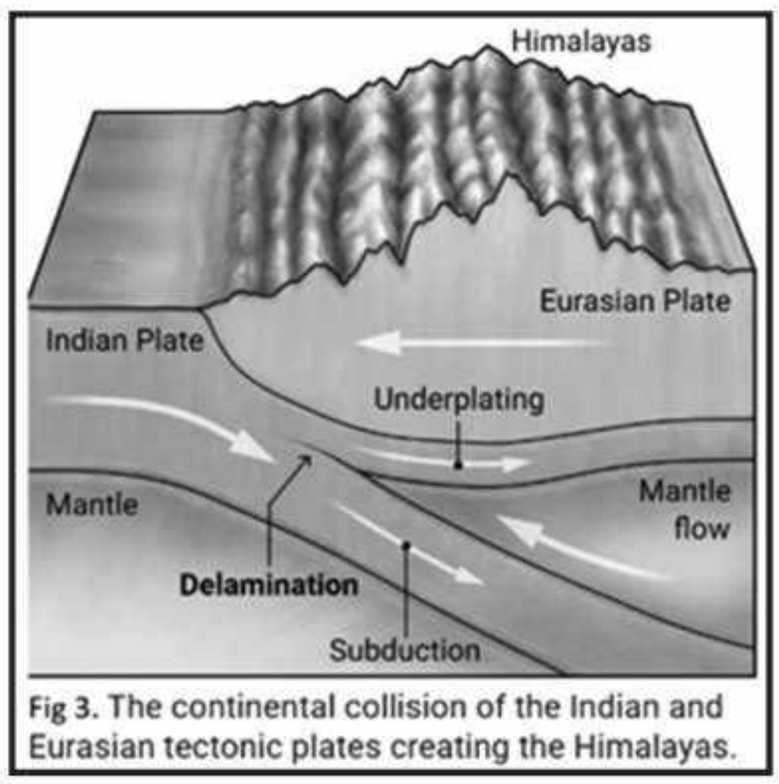

Fig 3. The continental collision of the Indian and Eurasian tectonic plates creating the Himalayas.

separating from the upper layer. This supports the theory that the Indian plate may be undergoing an unprecedented splitting process.

EMPIRICAL EVIDENCE :

Geophysicist Lin Liu from the Ocean University of China led an investigation using data from 94 broadband seismic stations. His team analyzed 'up-and-down' S-wave and 'back-and-forth' P-wave movements to map the plate dynamics. Their findings revealed that the Indian slab is not smoothly subducting beneath the Eurasian plate. Instead, its dense lower section is peeling away and sinking, while the upper layer continues its journey under Tibet.

While computer models have long suggested that thick tectonic plates could split, this study provides the first empirical evidence of such an event in real time. The research aligns with helium-3 isotope patterns in Tibetan hot springs and the region's earthquake activity, indicating an ongoing, large-scale transformation beneath Tibet. The study also identified a potential tear near Bhutan, where subduction curves, which makes it a prime location for further tectonic fragmentation.

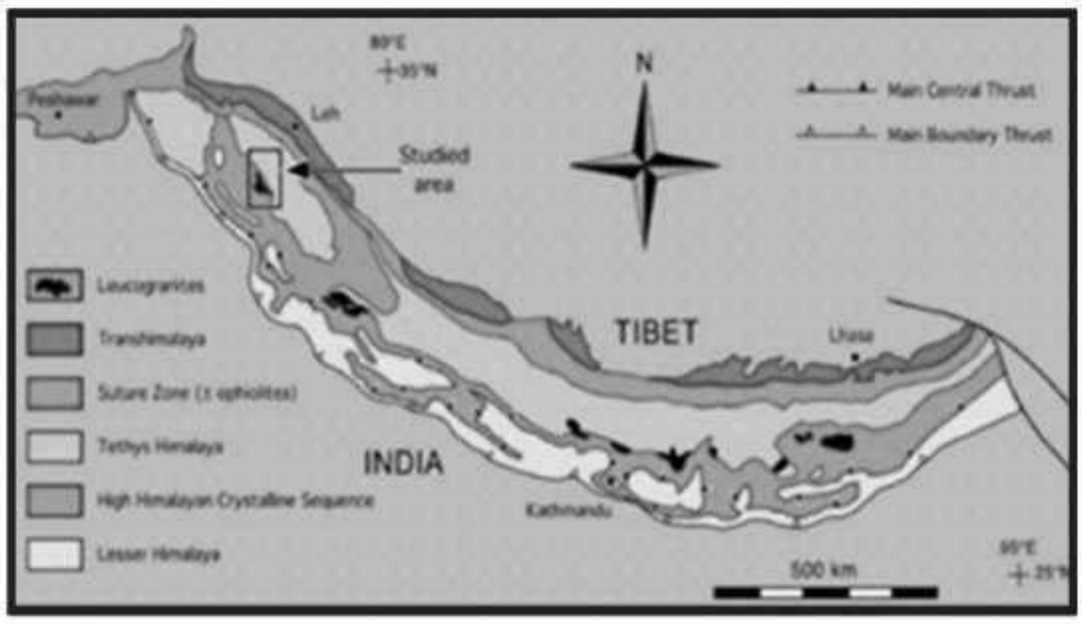

Fig 4. A simplified geological map of Himalayas.

Recent seismic data reinforce this conclusion. The bottom of the Indian plate remains intact at 200 km depth west of the break, whereas east of the split, mantle material is rising at around 100 km depth. This suggest that the process is already underway and may influence future earthquake activity.

CONCLUSION :

Understanding tectonic plate movement is crucial for assessing earthquake risks. The proposed slab tear along the Indian plate may divide the mountain range and affect seismic hazards in the region. Historical earthquakes, such as the 1934 Bihar-Nepal earthquake and the 2015 Nepal earthquake, highlight the devastation caused by tectonic activity in the Himalayan orogenic belt.

Klemperer's research, along with isotope data and seismic studies, suggests the Indian plate is indeed splitting, a process that could have long-term geological and seismic implications. The interaction between the Indian and Eurasian plates continues to shape the region's landscape, presenting both scientific intrigue and significant risks for populations living in these seismic hotspots.

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GEOGRAPHY FIELD SURVEY IN ANMOL BISCUIT INDUSTRY, DANKUNI

Adriza Chakraborty
Semester III

Julien Day School Ganganagar organized an educational tour on 17th August 2022 to Anmol Biscuit Industry in Dankuni for the humanities students of classes 11 and 12. Anmol Industries Limited is a leading "biscuit producing" company in India. It was formed in 1994 and has since been joyfully engaged in producing biscuits and other confectioneries. Its portfolio covers an array of biscuits in sweet, semi-sweet, nutritious, premium cookies and an assortment of cakes produced at world class state-of-the-art manufacturing facilities all over India. Guided by strong principles of Quality, Ethics and Brand Promise, Anmol has evolved into one of the most trusted and responsible brands in the packaged food industry. Anmol biscuits began with a small unit in 1994 under leadership of Shri Baijnath Choudhary. Anmol Biscuits believed theoretical knowledge is important, but it is the practical demonstration and understanding of believed that brings perfection. Hence, they introduce their endeavour towards the vision through Anmol Udaan. Anmol Udaan is a program that encourages students to visit their manufacturing units at Dankuni, West Bengal, Greater Noida and Uttar Pradesh. Here, they can learn about the technological wonders of the most sophisticated machinery assisted by human effort and integrity.

Anmol Industry itself produces all materials including the flavours added to the biscuit ingredients like flour which are manufactured by them. Ingredients like milk, sugar, food colouring are provided by Dairy Farm dealers in West Bengal. GT road is the major route here through which they transport their finished products to the market. The main vehicles attract tempo and also distribute through railways and waterways. Water for processing comes from the Hugli River. Labour supply they get from nearby villages and states of Bihar and Odissa. Latest machineries like roller, cutter, laminator, automatic oven and sliding machine. They got power supply from important thermal centres in Kolkata and Durgapur. Electricity is provided by Tribeni Electric Power Station.

THREE TIERS OF ANMOL BISCUIT INDUSTRY

1) MACHINERY AND TECHNOLOGY

Anmol Industry uses the latest technology for the production of their three basic products. They are :

a) Crunchy Biscuits
b) Scrumptious Cookies
c) Delicious Cookies

Steps followed in biscuit or cookie manufacturing :

- Step 1 : Pre mixing. In this section all the ingredients are mixed and poured into the mixer.
- Step 2 : Mixing. Dough formation known as mixing stage.
- Step 3 : Moulding
- Step 4 : Baking (200^{0}cel)
- Step 5 : Sandwiching or Cooling (5-10 minutes)
- Step 6 : Packing

2) NATURE OF WORKERS

Anmol Industry is a labour oriented Industry. There are 2,860 workers employed there. The total number of regular workers are 1,680 and number of contractual workers are 1,180. 60% of the workers are skilled whereas 40% semi-skilled, workers. Number of female worker is 0 whereas female workers are seen in the management and official group.

3) PRODUCTION

Anmol has been a well-known brand among consumers for many years. They have a strong presence in more than eighteen states. Anmol is the 4th largest biscuit manufacturer. There are five major Anmol Industry located in West Bengal. They are located in Hugli, Raniganj, Kolkata, Siliguri and Dankuni.

MAIN PRODUCTS OF ANMOL INDUSTRY

a) Crunchy biscuits
b) delicious cakes
c) Scrumptious cookies

This Industry produces 4,00,000 cakes, 7,00,000 biscuits and 3,00,000 cookies per day. The various products are as follows :

- Marie Plus Biscuits
- Tip Top Chat Pate Jeera Munchies
- Yummy Cream Light Biscuits
- Coconut Biscuits
- Rusk Biscuits
- Lemon Orange Flavoured Cream Biscuits
- Sugar Free Cream Crackers
- Chocolate Biscuits

MARKET RESEARCH

Based on Questionnaire, basic data were collected from the labour management team for future plans, including the use of sophisticated technology, computer aided and their current position in the National and International market. During survey we learned that they have both National and International Clients. There are many distributers who collect products and sale them to their

respective markets. Anmol Biscuits are exported to 16 countries. They take orders online and serve their customers. They derive their maximum profit from urban cities, especially schools and college canteens. As we all know, tea is a very important beverage in India, and biscuits are complimentary to it. Anmol is the second largest biscuit manufacturing company in West Bengal. They produced 80 brands and distribute them in 80 districts in India. Overall, there are 6000 outlets in India. Their market research in 2022 shows that maximum sales took place in Jeera Flavoured biscuit and Rusk. They have started the cookies section after the Covid period which is now capturing the markets and hearts of the people because of its unique taste. Production growth rates vary from year to year.

DEPARTMENT OF HEALTH AND SAFETY

They have a fire extinguisher in each and every department. They have several fire exit gates. They have a health unit in the industry. An ambulance service is also available in order to take them to hospital. Mr. Sukhen Roy is the head of the health and safety department.

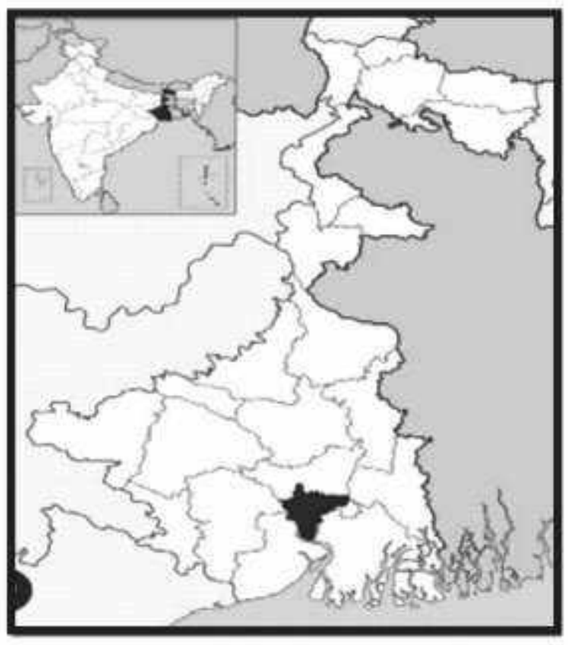
While surveying we noticed that the industry uses sophisticated machinery to run the factory and is responsible for delicious products. There is a lot of human effort and integrity. The industry is well-maintained and has hygienic environment. It is the face of modern Industry in India.

INDUSTRY SURVEY ON TECH MAX LIGHTING COMPANY LLP

Aanandi Chakraborty

Semester III

LOCATION –

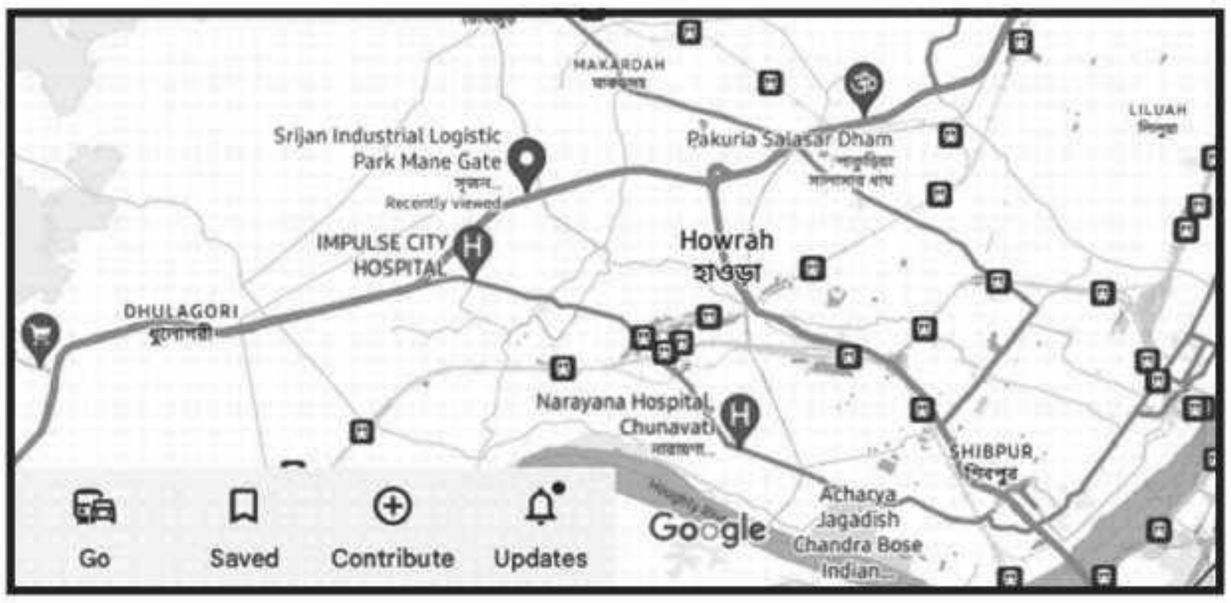


The company is located in Srijan Industrial Logistics Park in Howrah district. It is approached through Mumbai Road (NH6). The address of the company is :

Head Office : 25, Black Burn Lane, 2nd Floor, Room Number 210, Kolkata – 700012 (WB), India.

Factory : Srijan Industrial Logistics Park, NH6, Bombay Road, Howrah – 711302 (WB), India.

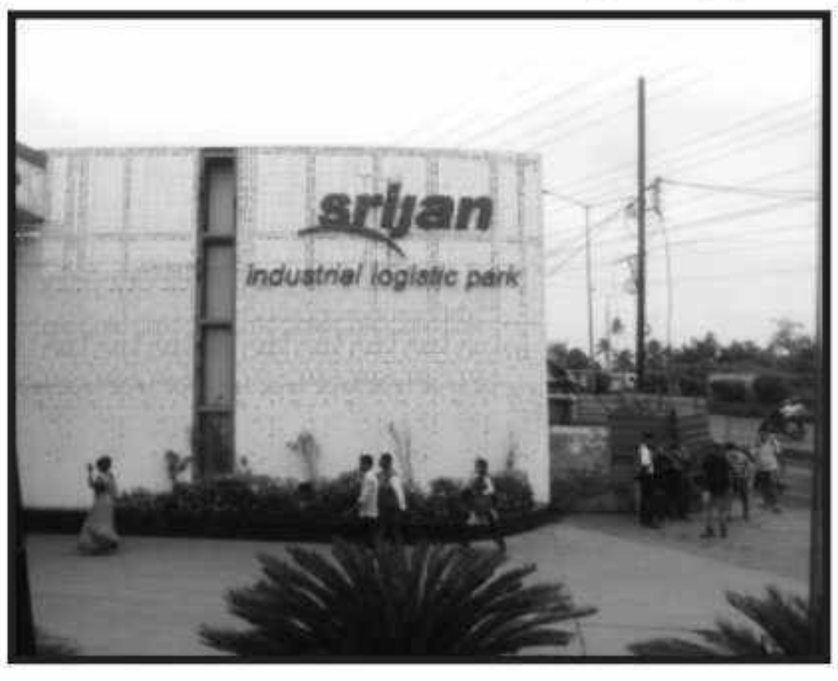
HISTORY OF TECHMAX –



The factory is owned by three brothers, Mr. Md Wasique, he looks after the sales department, Mr. Md Hamza, he looks after the purchase department and Mr Md Sain, who looks after the production department. Mr. Jyoti Prakash is the manager of this company.

Initially, they had a family business of fluorescent bulb trading. Their uncle used to own the company then. Later on, due to modernization, new ideas were welcomed. As a result, the fluorescent light bulbs became obsolete and LED bulbs were introduced. Since then, the three brothers joined their family business. Eventually they trained the unskilled labours under professional guidance, taught them how to manufacture LED bulbs on their own. A manufacturing factory was eventually introduced.

MAX LED, incorporated in the year 2006 and an ISO9001: 2015 Certified organisation, is a pioneer in the field of LED lighting and has been engaged in providing lighting solutions for residential, commercial, outdoor and other industrial lighting products. With a vision of Make in India program, in the year 2015, they tried to push new boundaries by selling up a new world class manufacturing facility in Kolkata along with a team of highly qualified electronics engineers and lighting professionals, with the goal to manufacture world class lighting products.

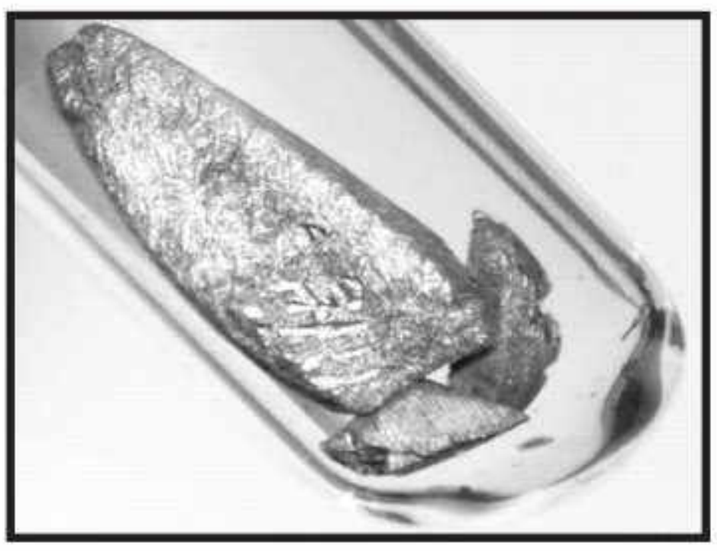


FACTORS LEADING TO THE DEVELOPMENT OF THE INDUSTRY –

1. Easy availability of raw materials
2. Easy availability of affordable local labour
3. Easy availability of regular water facilities
4. Well developed roads and railways for transportation purpose
5. Regular supply of electricity from the local electricity board of Howrah district known as the WBSEDCL.
6. Demand of lighting products in and around India. Bhutan and Nepal are the major buyers outside India.

RAW MATERIALS –

- Europium
- Yttrium
- Germanium
- Brass
- Aluminium
- Terbium
- Cerium
- Indium
- Glass



- Wires purchased from JK wires from Faridabad
- LED is purchased from Indo Japan and also from China, and India itself.
- Machines like ETON from China and JUKI from Japan are imported

PROCESS OF MANUFACTURING LED BULBS –

- Preparation of the Circuit Boards
- Preparation of LED strips
- Pasting of LED strips on the motherboard
- Checking of LED panels
- Specifications printed by laser
- Pasting of LED strips in different models of lighting products by assembling them
- Inspection of the final product
- Packaging of the products

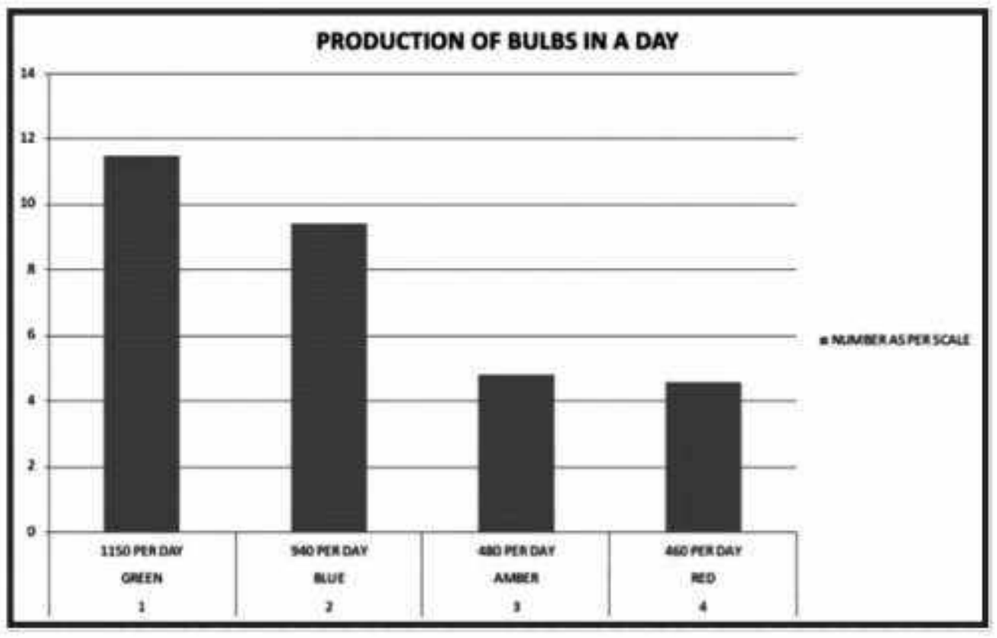
PRODUCTS MANUFACTURED BY THE COMPANY –

1) LED panel lights
2) LED cob down lights
3) LED track lights
4) LED bulbs
5) LED tubes
6) LED strip lights
7) LED street lights
8) LED flood lights
9) LED par lights

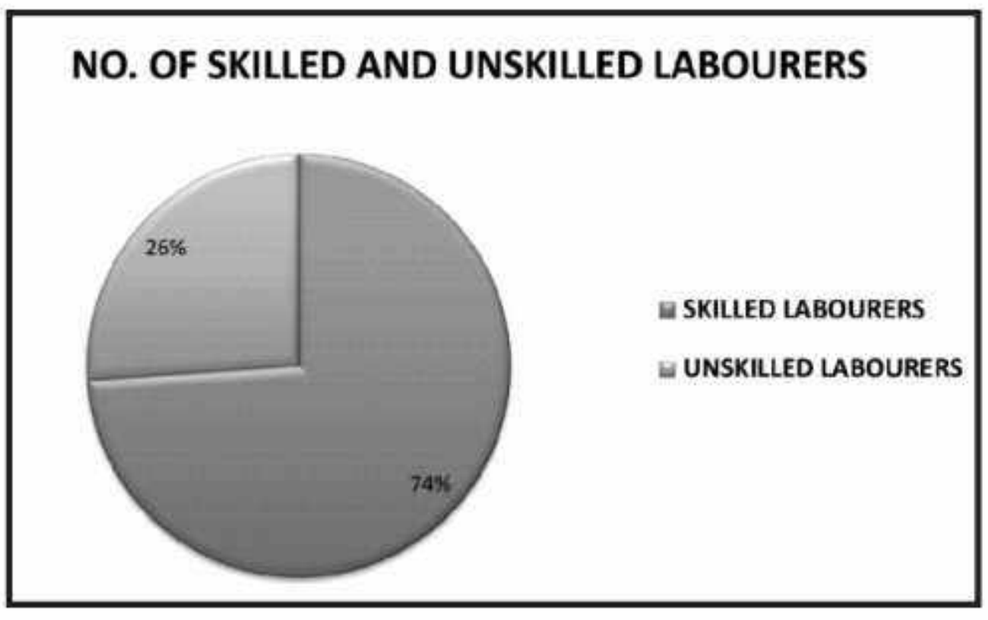
PRODUCTION OF BULBS IN A DAY –

SL NO.	COLOURS	NO. OF BULBS	NO. AS PER SCALE
1	GREEN	1150 PER DAY	11.5
2	BLUE	940 PER DAY	9.4
3	AMBER	480 PER DAY	4.8
4	RED	460 PER DAY	4.6

SCALE: 1 CM = 100 BULBS



LABOURS –

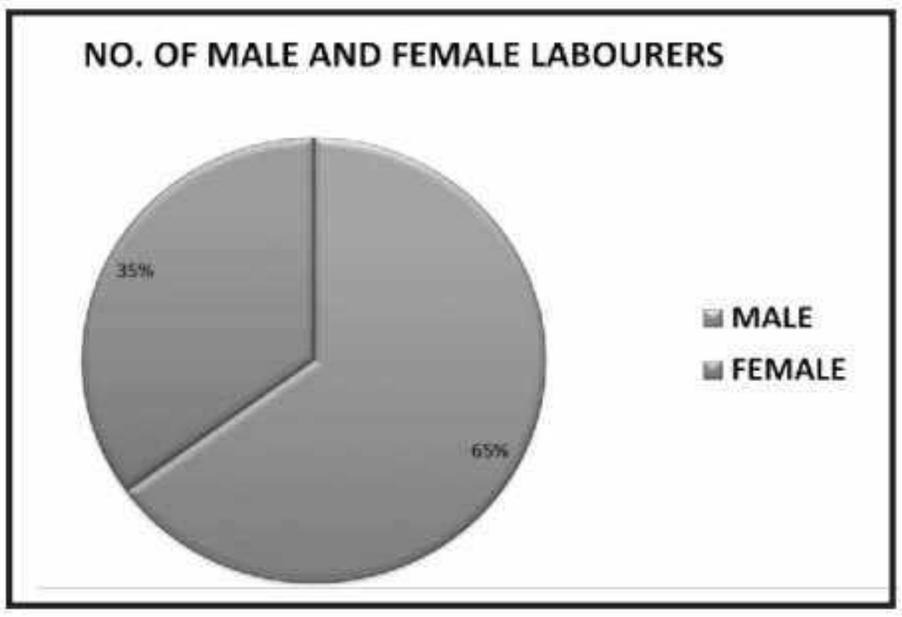


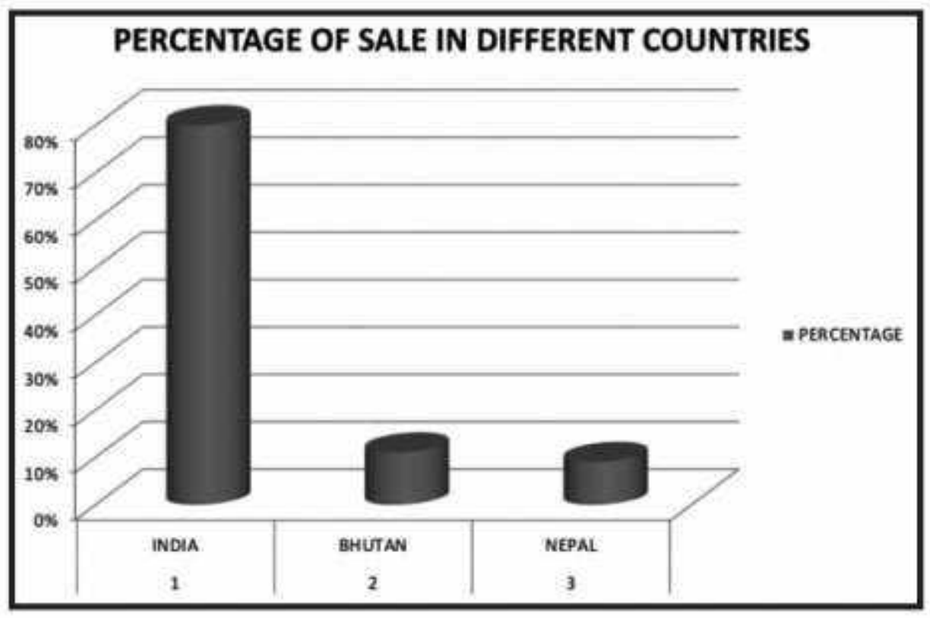
Total labourers = 200

Skilled labourers = 74%

Unskilled labourers = 26%

EXPORT : -





IMPORT -

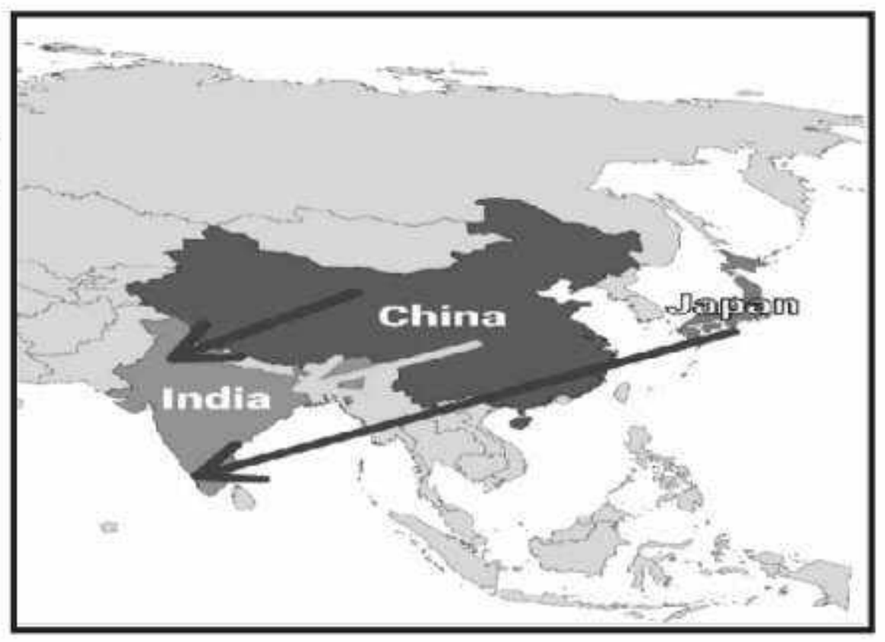
The production house has markets and distributors across India and neighbouring countries. The raw materials and machines are imported from :-

- Raw materials –

1) Lead is purchased from China

- Machines –

1) ETON – China
2) JUKI – Japan



Note : Here the green arrow represents raw materials and the blue arrow represents machines.

SUSTAINABLE EFFORTS MADE BY TECHMAX –

The efforts made by the company to control pollution and protect the environment include :-

- It is cost-effective.
- No lead or mercury content is used thus it is environment friendly.
- The bulbs manufactured have long lifespan, requires low maintenance and saves energy.
- The standard bulbs last 20 times longer.

Through this project we learnt that LEDs are highly compatible with today's modern economic needs and have successfully become an essential part of every household.

SPATIAL INFORMATION TECHNOLOGY

Ananya Sain
Semester III

As society progresses, the need for resources for us to sustain increases. The earth is a complex, dynamic body, which has all the resources for our sustenance. In order to locate these resources which are spread all over the globe, computers, machines and other devices became essential.

We know that computers enhance our capability in data processing and drawing of maps, diagrams and graphs. Disciplines that deal with these principles and methods of data processing and mapping using combination of computer hardware and the application software refers to as the **Database Management System** and **Computer Associated Cartography** respectively. However, the role of such application is restricted to data processing. The questions that still remains are : What, Where and Why it exists and so on. In order to understand these questions, we need to collect data from different sources, integrate them using computer that supports Geo-processing tools. Here lays the idea of Spatial Information Technology, which is more commonly known as **Geographical Information System.**

Spatial Information Technology refers to the features and the phenomena distributed over a geographically definable space. The data we use today include components like locations address, etc. Thus, spatial information technology relates to the use of technological inputs in collecting, storing, retrieving, displaying, managing and analysing of the information. It is a combination of Remote Sensing, GPS, GIS, Digital Cartography and Database Management System.

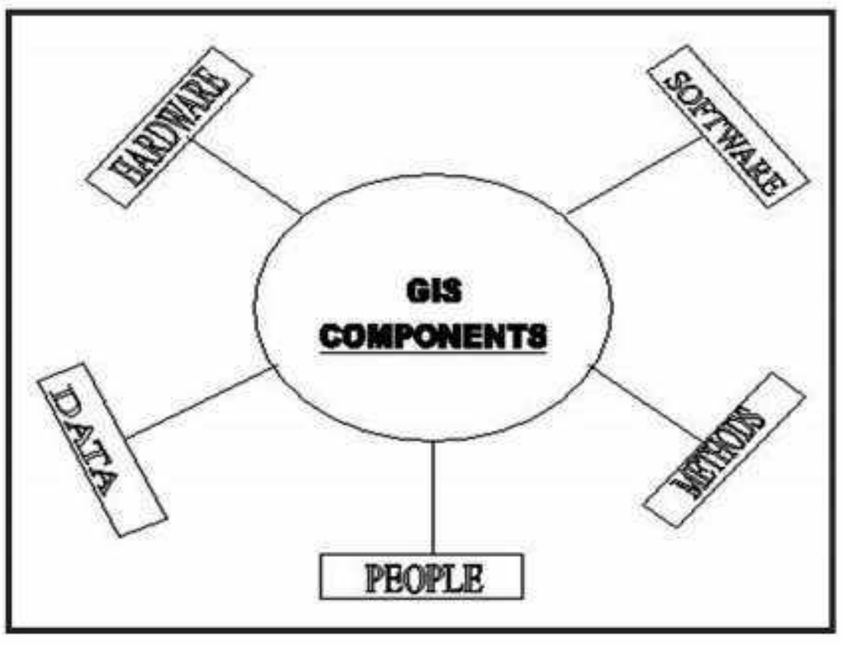
Geographic Information System is a system for capturing, storing, checking, integrating, analysing, and displaying of data. There are 2 types of data representation – **Spatial Data**, which is characterised by their positional, linear forms of apparent, on the other hand the data which describe spatial data is called as the **Non-Spatial data**. Spatial data is the pre-requisite for GIS. The sources of these data can be from data suppliers, carrying out surveys or topological maps.

The advantages of GIS over Manual Method can be noted as below :

- The map information can only be presented in a particular way, whereas GIS allows data to be modified according to user needs.
- Altering in the information requires making of a new map, whereas spatial operation can be applied to integrated data and generate a new dataset.

The components of a GIS are –

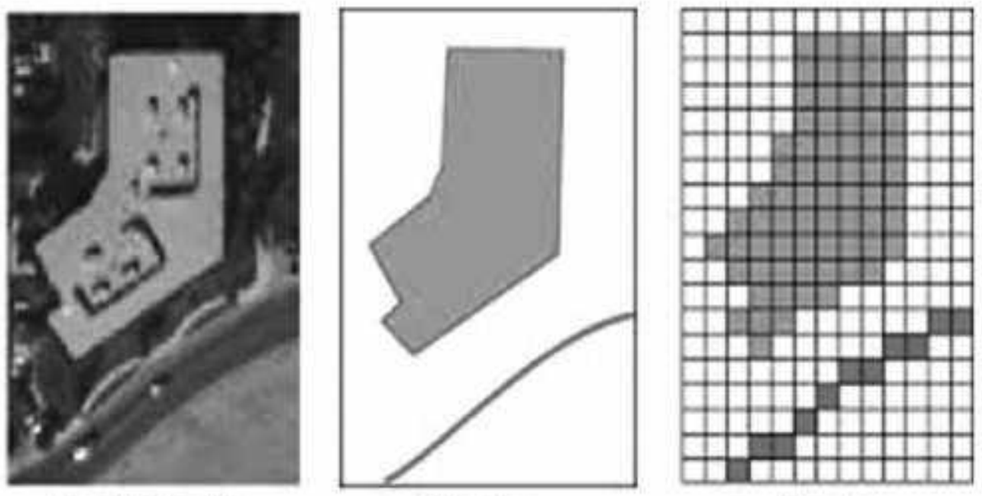
- Hardware
- Software
- Data
- People
- Procedures



Spatial data format are of two types – **Raster format** and **Vector format.**

Raster data represent a graphic feature as a pattern of grids or squares, whereas Vector data represent the objects as a set of lines drawn between specific points.

The following table highlights the difference between raster and vector data.



Raster	Vector
1. Raster graphics are composed of pixels.	1. Vector graphics are composed of paths.
2. These can be used to draw mathematical curves, polygons etc.	2. These can draw continuous and Smooth lines.
3. They cost less and occupy more space depending on the image Quality.	3. They cost more and occupy less Space.
4. Raster graphics can be saved by using file extensions such as JPEG, GIF, BMP, etc.	4. Vector graphics can be saved by using file extensions such as PDF, EPS, SVG, etc.

The Raster data format has some advantages. They are as follows :

- Simple data structure.
- Easy and efficient overlying.
- Compatible with satellite.

However, Raster data also has some disadvantages. They are as follows :

- Inefficient use of computer storage.
- Errors in perimeter and shape.
- Difficult network analysis.

The Vector data format has several advantages. They are as follows :

- Compact data structure.
- Accurate map output.
- Efficient for network analysis.

Even, Vector data has some disadvantages. They are as follows :

- Complex data structure.
- Difficult overlay operation.
- Incompatible with satellite imagery.

SEQUENCE OF GIS ACTIVITY

1. Spatial data input –

A spatial database in a GIS can be created in two ways :

A. **Getting Digital Data from Suppliers –** There are many sources from which we can easily obtain digital data, but when combining data from different sources, the compatibility of data must be checked in the project. This is done by local government and private agencies to cut down the time and money involved in the project. Users must consider the following characteristics to ensure the data compatibility with the application –

i) The scale of the data
ii) The quality of the data
iii) The length of the record

B. **Creating digital data –** The manual input of the data can be done in four stages :

i) Entering the spatial data
ii) Entering the attribute data
iii) Data verification and editing of the spatial and attribute data.
iv) Linking the spatial and the attribute data.

2. **Entering the Attribute Data –** Attribute data are those data that define the properties of a spatial entity that need to be handled in GIS. Example – A road may be represented in the spatial part of the GIS, while the information about its type, the width of the road, and number of traffic can be stored as attribute data. These data can be sourced from primary survey, published data, census data.

3. **Data verification and editing –** Spatial data stored in GIS requires verification. The best way to do this is by printing the input data and comparing maps to locate the errors. The errors that can occur are :

i) Double or incomplete spatial data.
ii) Spatial data at the wrong scale.
iii) Distortion of the spatial data.

4. **Spatial and attribute data linkages –** Linkage of the spatial and attribute data are important in GIS. Errors in linking of the spatial data and attribute data can result to inaccuracies in the final data analysis.

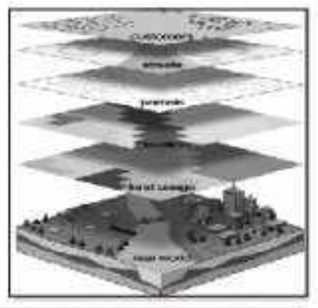
i) **Linkages :** It is the combination of one data file with the other data file.

ii) **Exact matching :** It occurs when information is recorded in one file along with other related data and rest of the information about the same is recorded in another file. Thus, the exact information is extracted and joined in another file.

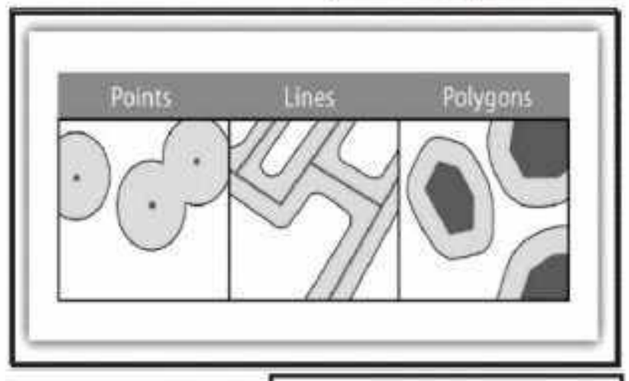
iii) **Hierarchical matching :** Sometimes, data is collected in different levels of detail and at different times. For example, we might have detailed information about land use in big areas but less detailed information about changes in smaller areas. To make these match, we can add up the smaller areas until they match the bigger ones.

iv) **Fuzzy matching :** Where the boundaries of smaller areas do not align perfectly with larger ones, we use fuzzy matching. This happens a lot with environmental data. We overlay the maps and compare them to find relationships, even if the boundaries don't match exactly.

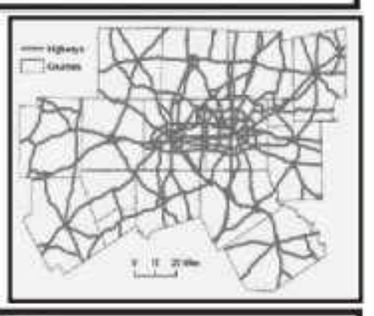
5. **Spatial Analysis –** The strength of GIS lies in its analytical capability over other information systems. The analysis is done with the help of the spatial and the non-spatial attributes in the database. This helps in analysis, facilitates answering real life question by developing and applying models. This can help in urban planning, agriculture, transportation, etc. This can be of four types –



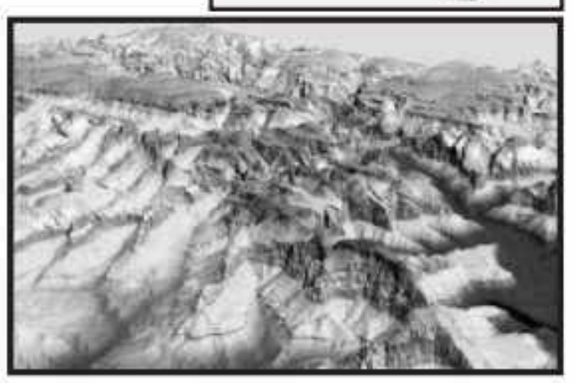
i) **Overlay analysis :** This involves layering two or more maps of the same area on top of each other to make a new map. Overlaying maps helps in tracking land use over time. For example, we can compare maps of urban areas from different years to see how they have changed over time and where new developments have accured.



ii) **Buffer analysis :** It involves creation of a zone around a point, line, or area on a map, extending to a specified distance. This helps determine which areas or people are affected or unaffected by certain facilities or services, like hospitals, roads, or parks. When we create a buffer, it makes a new shape around the original feature, indicating its proximity to other elements.



iii) **Network Analysis :** It is a set of connected lines. These lines represent railways, streams, road, waterlines, pipelines, telecommunication lines etc. that need to be analysed as a network.



iv) **Digital terrain model :** It is sometimes also called Digital Elevation Models (DEM). This topographic model of the bare earth can be manipulated by computer programs. The data files contain the elevation data of the terrain in a digital format corresponding to a rectangular grid.

Mapping is an essential form of inquiry across a wide range of domains. Mapping also represents the interplay of society and technology, which has been going on for thousands of years. It has evolved from the earliest forms of writing to modern satellite imaging and web-based social networks. With the advent of GIS, numerous spatial data, analysis, visualization, and thinking are transforming our society in ways. Billions of people use technologies such as Global Positioning Systems (GPS), Google Maps, etc. It helps the Government to identify crime hot-spots, plan social interventions, and identify routes to evacuate vulnerable populations from harm. Companies use spatial analysis to site stores, evaluate supply chains, and determine how much to charge for goods and services. Researchers combine spatial data from maps, satellites, smart phones, sensor networks, and social media. They assist commuters in minimizing travel time; farmers to best plant and protect crops; epidemiologists to identify emerging disease hot-spots; emergency planners to develop smarter evacuation routes; policy makers to visualize climate-change scenarios. Thus, Spatial Information Technology plays a crucial role in shaping the future.

LIVELIHOOD SCENARIO OF THREE IDOL-MAKERS OF HOOGHLY DISTRICT, WEST BENGAL

Anawya Basu
Semester III

The plan or framework used to conduct a research study is known as the research design. A research problem guides the selection of approaches and methodologies, data collection, and interpretation of results to find answers or solutions.

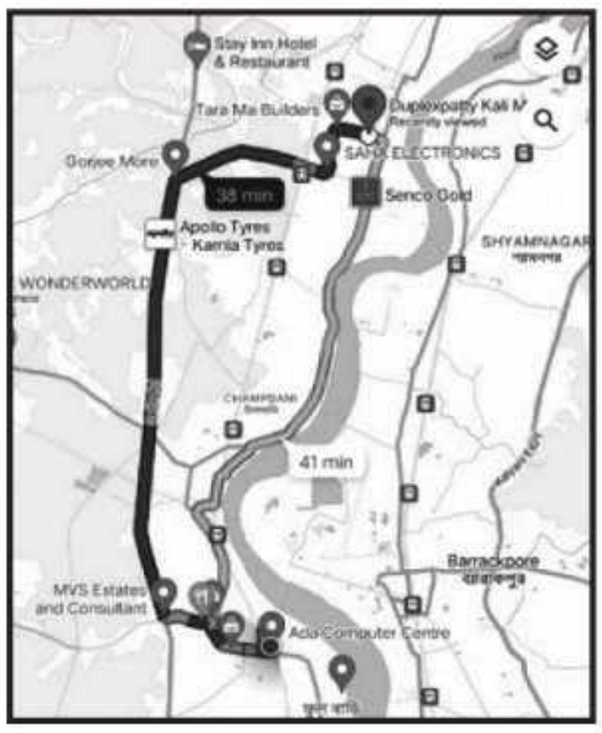
CHARACTERISTICS OF RESEARCH DESIGN :

- ✓ Neutrality
- ✓ Reliability
- ✓ Validity
- ✓ Generalizability
- ✓ Flexibility

CHARACTERISTICS OF RESEARCH PROBLEM :

- ✓ Fresh perspective- Novel
- ✓ Significant
- ✓ Feasible
- ✓ Clear and specific
- ✓ Rooted in evidence

We had initially visited the Kumar Tuli para of Chandan Nagar, famously known as 'duplex patty'. We met two interviewees at this location and asked them questions from my interview guide.



The map which led us to this location is provided. This shows the route from our source to the destination.
Source: google maps

"The interview guide helps us to collect data by using a set of Questions that focus on the study's salient points. We continued our survey using predetermined Questions."

On reaching the destination we interviewed the owner of GOKUL CHANDRA PAL & SONS, named ANATH BONDHU PAL. Their family has been in this business for over 150 years, and they has been involved in this for three generations. Anath Bandhu Pal, 55-year-old man, with a family of 15-16 members among which he and his three brothers are involved in this business, namely – Amar Pal 53-years-old, Japan Pal 51-years-old and Sapan Pal 49-years-old. The son of the shop owner isn't yet in this business, he's into some other profession.

Their working hours starts from morning 8 till afternoon 2 and then a break for 2 hours after which it continues till night 10; and sometimes even midnight, especially during puja season. They have no native place and live in Chandan Nagar only.

The monthly income of the shop owner extends from 25000-50000 during peak seasons and the annual income is approximately 2 lakhs. The total number of workers under him is 8-10 and their wage rate is 600-700 per day (off-season), and 1500-1600 (peak season). Employees stay in their houses

located nearby and some daily migrate from one place to their work destination. During Jagadhatri puja, the wages get extended to 2500 daily. In the lean season, his business runs loss sometimes.

He makes all kinds of idols, ranging from 2000 (small) to 100000(large). The Raw materials used for making these idols are bamboo, rope, sandy soil ("Bele Mati"), clayey soil ("Atel Mati"), cloth, etc. Machines are only used for cutting and painting purposes. Each machine costs around 25000 on an approx. Rate and two laborers are trained to operate them properly. The Electricity bill for the machines is over 4000. Barnish powder is used to grease the machines.

With the respondent, ANATH BONDHU PAL

Trucks, small lorries or Toto-Rickshaws are used for transportation purposes in local districts like Mudiali, Howrah, etc. They have not supplied outside India yet. They had buyers from Bihar and Jharkhand pre-pandemic.

Profit earned ranges from 30000-40000 but the business went in extreme loss post-pandemic. "In this post pandemic situation, everything lies in downfall" as they said with 5000/- loss per day.

The business is at a standstill due to small pujas in the locality and around. Their idols are sometimes presented at Kolkata-Sheoraphuli Hub. They have taken loans from United Bank, court more.

IDOLS MADE BY JAGANNATH PAL

PAINTS AND MACHINES USED FOR IDOL-MAKING

Youth advertise their business through social media platforms like Facebook, etc. They haven't taken any financial assistance from the government.

Next, we interviewed JAGANNATH PAL; who is famously known for his idol-making of "BORO-MA" Jagadhatri goddess idol at Boro Panchanantala Sarbojanin. His age is around 50. He lives in Chandan Nagar and is the first person from his family in this business because of his passion for art. Their working hours is 9a.m to 4p.m and 8p.m. to 11p.m. His annual income ranges around 1 lakh but he is facing extreme loss due to the pandemic which may take time to overcome. The Total number of workers under him is 6-8 and their wage rate is 300-500 per day based on the work.

Raw materials used in his work are rope, cloth, jute, straw, different types of soil such as alluvial soil, clayey soil, sandy soil and paints etc.. The idols are kept under the sun for drying. Machines are also used for cutting, greasing and painting purposes costing about 5000-10000 approximately.

His idols are transported by small lorries, trucks and cars to nearby districts of Howrah, Dakshin 24 Parganas, Medinipur, Bankura, etc. but he has yet to get any orders from any other state of India outside West Bengal. His idols cost over 2000 (small) to 9000 (large) and even more if the size increases. He started his business with the making of pottery and wells which led to this business of idols. 'IDOL MAKING IN PROCESS' The third person we interviewed was in Serampore, Kumar para named SAPAN PAL, son of a famous idol-maker. He is about 60 years old and has been in this business since age 20. He is a graduate. He is married and has 2 children; his daughter is married away and his son works at LARSEN & TOURBO, who is also married and has a child aged 5.

IDOL MAKING IN PROCESS

The total number of workers under him is about (10-12) and some have seasonal unemployment, they only join the work during peak seasons like Durga puja, Kali puja, Saraswati puja, etc. Wage rate depends on their working hours and the type of task they perform, also both skilled and unskilled laborers have different wage rates.

Raw materials are paints, lubricants, rope, jute, straws, alluvial-sandy-clayey soils, pins, wood, etc. workers as well as machines are used in idol making.

MATERIALS AND MACHINES (MOTOR) USED FOR IDOL MAKING

WITH THE INFORMANT, SAPAN PAL

He has got orders from Rome twice pre-pandemic in the years 2018 & 2019. He gets orders from states like Orissa, Jharkhand, Bihar, etc. The cost of his idols ranges from 5000 to 20000 (including transportation cost if sent outside West Bengal in cases). His annual income is around 500000.

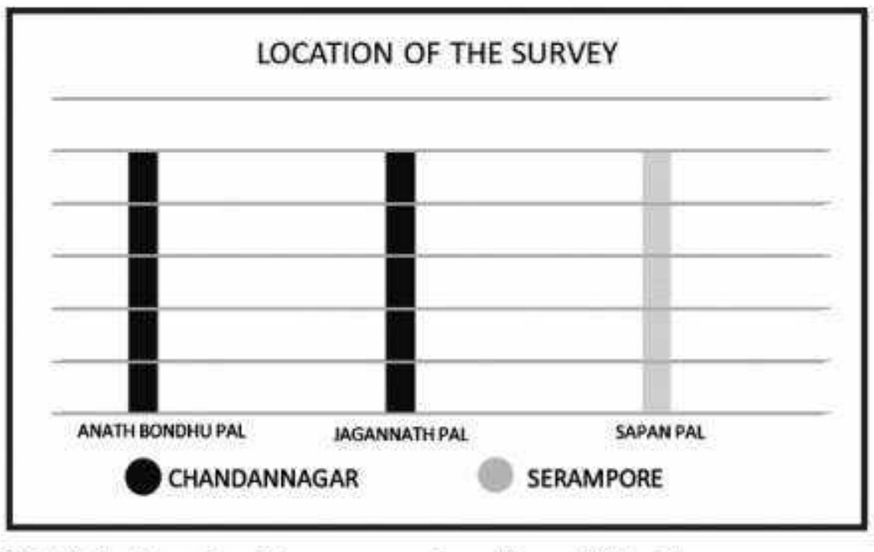


FIG 1.1 showing the survey location of the three persons

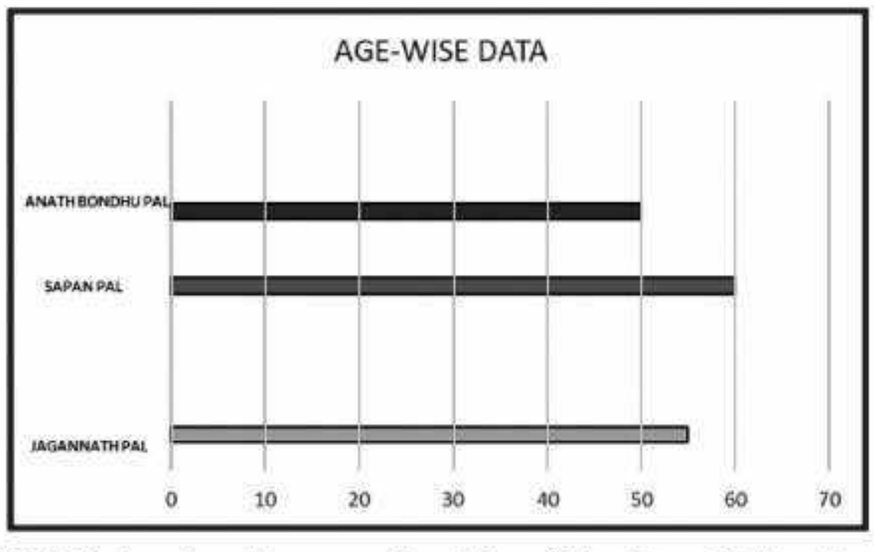


FIG 1.2 showing the age-wise data of the three idol-makers

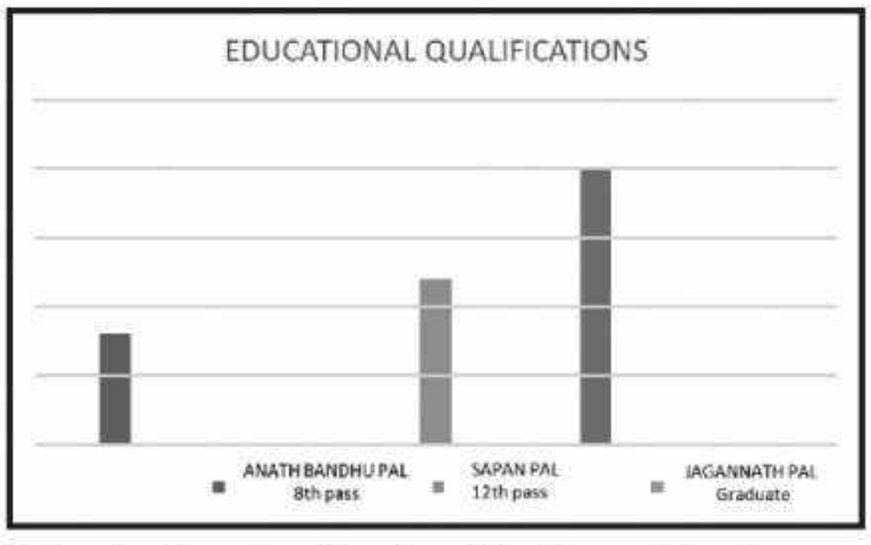


FIG 1.3 showing the educational qualifications of the three sculptors

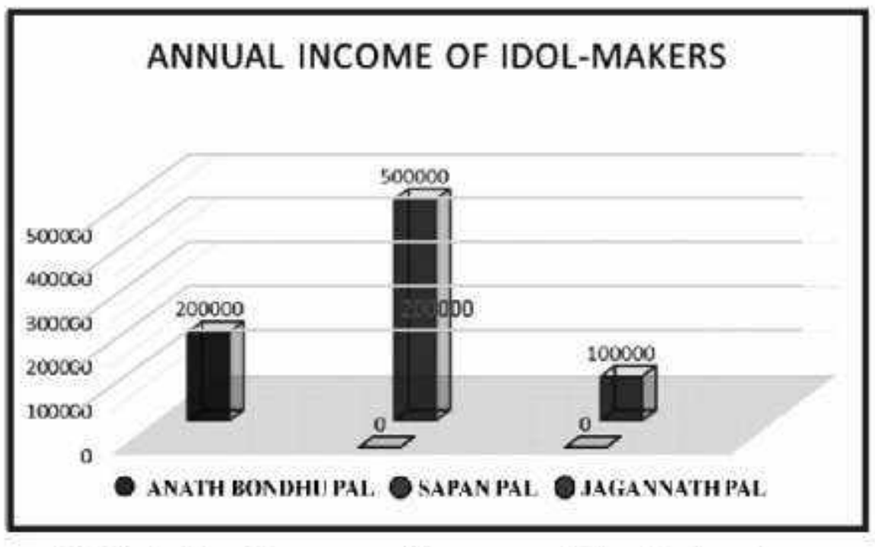


FIG 1.4 showing annual income of the idol-makers

SOCIO-ECONOMIC & DEMOGRAPHIC STATUS OF KIRITESHWARI VILLAGE

Anishka Sharma
Semester III

Socioeconomic characteristics and status are the foremost issues all over the world, especially in developing countries. The study of socioeconomic status, helps us to understand the actual situation of the population in a particular region. However, the study of socioeconomic status is found very rare it at micro level such as the village and ward level. Economic growth and Socioeconomic status are growing very rapidly with the help of various models given by planners. Despite of these, there are several villages which have unbelievable socioeconomic status and cannot avail to the minimum basic needs for their living. The study area of Kiriteshwari village located nearly 12 km away from the district of Murshidabad has been discussed in this article.

The small village of Kiriteshwari, with an average population of about 1600 persons, is nestled in the heart of the Kiritkona village near the bank of Bhagirathi River, in Murshidabad district. It is a charming village and a treasure trove of cultural heritage and natural beauty. The village has been recognized as the 'Best Tourism Village 2023' in the bronze category. The village also emerges as a radiant gem where it commits to the sustainable rural tourists shrines through its preservation of tradition. The cultural theme of Kiriteswari village revolves around its rich cultural heritage, including the Kriteswari temple and the preservation of its natural resources.

As a part of a team of students of Welland Gouldsmith School of Class XII, I went for an excursion to the village of Kiriteshwari, situated 20 kilometres away from the district headquarters in Berhampur to conduct a socioeconomic survey.

Objective :

i. To find out the socio- economic profile of the village
ii. To find out the food security situation
iii. To find out possible measures to overcome the problem.

Data base and Methodology

The present study is based on primary data and secondary data. The Stratified Random sampling technique has been used for the study. The entire village is divided into equally four units and 22 households have been randomly selected from each unit of the village. Out of 432 households, 88 households were considered for the study. The secondary data is used for the study of the general profile of the village and primary data is used for knowing unknown fact about the village. All the data were converted into relative numbers such as percentages in order to observe the overall situation of the village.

Poverty And Human Development

The term 'poverty' means scarcity of sufficient money or lack of a certain number of multifaceted things including food, cloth and habitation. Poverty is basically of two types, absolute poverty and relative poverty. Relative poverty occurs when people cannot obtain resources to support a minimum level of physical health. Absolute poverty shows inequality everywhere and can be eradicated as Demonstrated by some equality. As per the Indian Rural Development Report, 1999, the state of West Bengal was one of the poverty prone state in India. If the spatial variation of poverty in West Bengal is considered, there is again found disparity as per NSS reports where it has been noticed that the

poverty ratio is 31% in West Bengal Central Plain, 43% in West Bengal Western Plains, 58.7% in West Bengal Himalayan Parts and 41.7% in West Bengal Eastern Part. In order to measure and interpret the poverty situation in this district the following indicators have been used.

i. Population growth
ii. Low literacy rate
iii. Regional imbalance

Population growth

Murshidabad district is ninth most populated district in India and has a population 7.103807 million (according to the 2011 census). This vast population day-by-day increases due to natural increase and early marriage policy of people. Positive growth of population as indicated in the table has increased unemployment, per capita consumption of resource available, which hasled to poverty to a most extend. It was observed in 1901, the rural population and urban population of the district respectively were 1246578 and 75908 and are 5703115 and 1400692 in 2011 respectively.

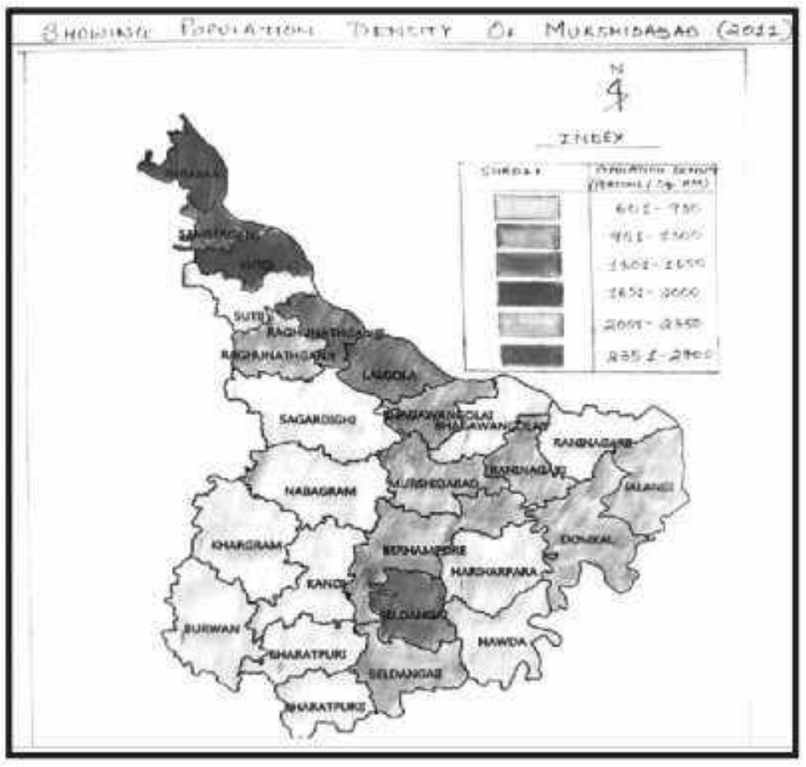


Table: Population growth of Murshidabad district

YEAR	TOTAL POPULATION	URBAN POPULATION	RURAL POPULATION
1901	1322486	75908	1246578
1911	1345073	83483	1261590
1921	1224181	87885	1136296
1931	1370677	91808	1278869
1941	1640530	120449	1520081
1951	1715759	134927	1580832
1961	2290010	195464	2094546
1971	2940204	248425	2691779
1981	3697552	346018	3351534
1991	4740149	494347	4245802

Census of India, 2011.

Low Literacy Rate

Education is the most important factor of wellbeing of people but the literacy rate is low in Murshidabad district. Here, the general literacy rate is 66.59% among which the male literacy rate is 69.95% and the female literacy rate is 63.09%. The women education is very low as compared to that of the male population that directly involved socio-economic status and unemployment of them. The quality of education is also one of the most important factor that people focuses on and can improve their income opportunities and individual life style. The study shows that the district has been suffering both from qualitative and quantitative infrastructural development.

CATEGORY	NO. OF PERSONS	PERCENTAGE
Total Persons	4055834	66.59
Male	2177187	69.95
Female	1878647	63.09

Regional imbalance

Regional planning was done for the equal distribution of resource, development, purpose of government facilities etc. So, regional imbalance is the most crucial factor for growth and development of Indian society. It regional imbalance can be restricted the development can easily peer in equally. In this study area, this imbalance is peculiar, it is found that development has taken place within the city area but basic services and benefits to rural people are neglected. The agencies and magnitude of poverty is increasing steadily day-by-day in rural areas.

Conclusion

The survey highlightes the socio-economic and demographic landscape of 'Kiriteshwari Village', shedding the light on both it's progress and perisistent challenges. While the village stands out as a cultural and tourism hub, recognized for women, hinders employment opportunities and economic upliftment. Additionally, regional imbalancement and population growth have exacerbated poverty and resource constraints. Despite these challenges, government initatives and tourism-driven development have began to improve infrastructure and create opportunities for sustainable growth. However, a more holistic approach is required one that prioritize education, skill development and equitable resource distribution. Addressing these gaps can significantly enhance the livelihood of the villagers and pave the way for a long term socio-economic stability.

AN OVERVIEW ANALYSIS OF SOCIO-ECONOMIC FRAMEWORK, COLOOTOLA AREA KOLKATA

Mantashah Shahnawaz

Semester III

Household surveys are one of the most important sources of social and demographic statistics. Since housing censuses are also a key source of such statistics, they are conducted every 10 to 15 years. Household sample surveys, which can investigate almost any population-based subject, are therefore a powerful alternative, becoming one of the most flexible sources of data on social phenomena in the last few decades.

Method of Survey :

- Select different families of a village or locality. Around 5 to 10 families should be selected.
- Prepare a questionnaire for selecting information.
- Prepare a sketch and map of the concerned locality.

Importance of Household Survey :

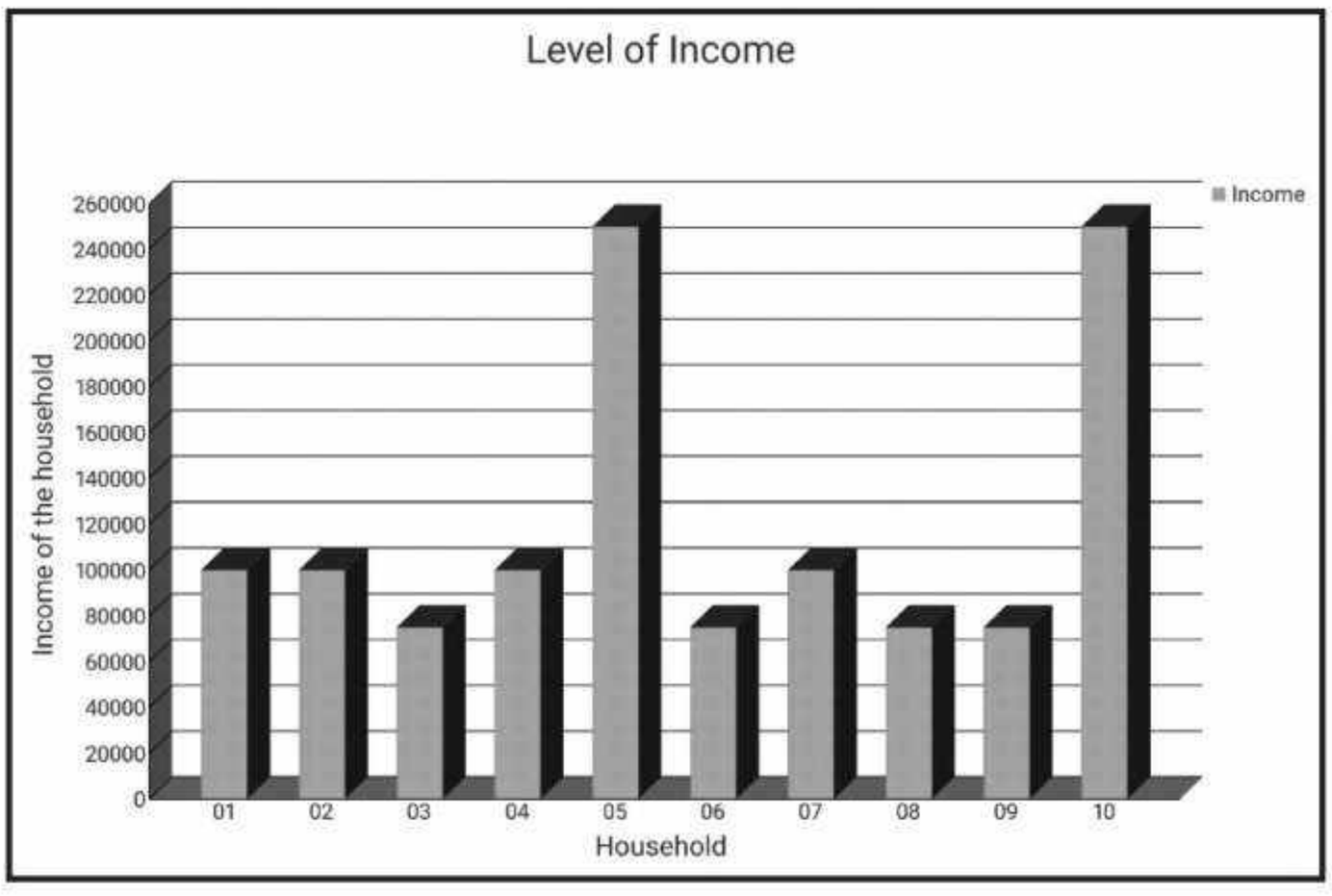
- Household surveys provide data on income, expenditure and consumption patterns. By studying these, policymakers can assess the well-being of households and understand their basic needs and challenges
- Household surveys contribute to monitoring progress toward global goals such as the Sustainable Development Goals (SDGs). These goals comprise more than 200 indicators and household surveys help track progress (or lack thereof) in each indicator.
- Household survey data provide evidence for designing and evaluating development policies, targeting services, and assessing poverty reduction efforts.
- Household surveys go beyond economic statistics. They offer attitudinal and behavioural insights that are difficult to obtain elsewhere.

Given below is an example :

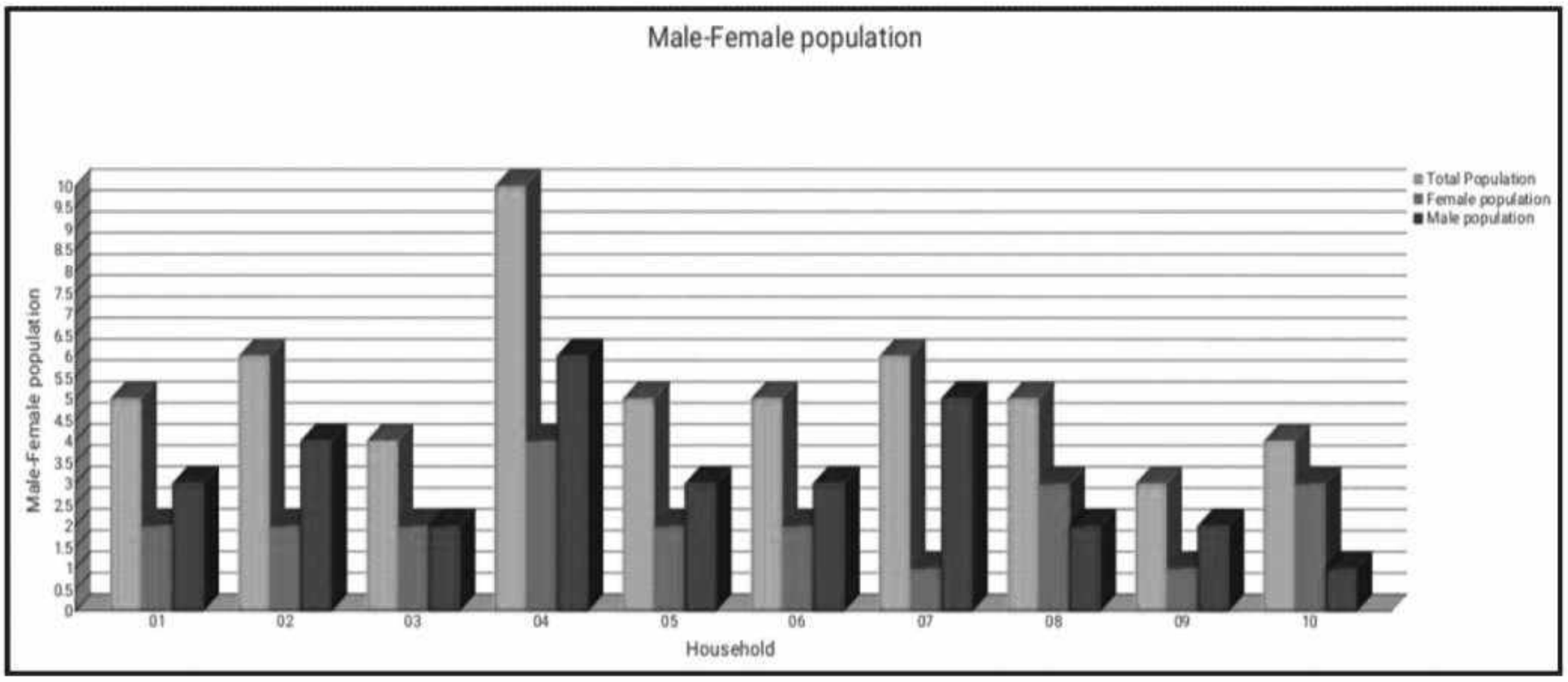
Families	Total Members	Female (F)	Male (M)	Level of Education	Total Income per annum	Employed and Unemployed member
01	05	02	03	HS-2 1F,1M	=1,00,000	03
02	06	02	04	H.S-1; UG-2 1F, 2M	=1,00,000	03
03	04	02	02	H.S- 1 1F	<75,000 or =75,000	01

Families	Total Members	Female (F)	Male (M)	Level of Education	Total Income per annum	Employed and Unemployed member
04	10	04	06	H.S-2; UG-2 2F, 2M	=1,00,000	04
05	05	02	03	H.S-2; UG-1 2F,1M	>2,50,000	04
06	05	02	03	UG- 2 1F,1M	<75,000 or =75,000	02
07	06	01	05	Madhyamik4 4M	=1,00,000	03
08	05	03	02	HS-1;UG-2 2F,1M	<75,000 or =75,000	03
09	03	01	02	HS-2 1F,1M	<75,000 or =75,000	01
10	04	03	01	HS-2;UG-2 3F,1M	>2,50,000	03

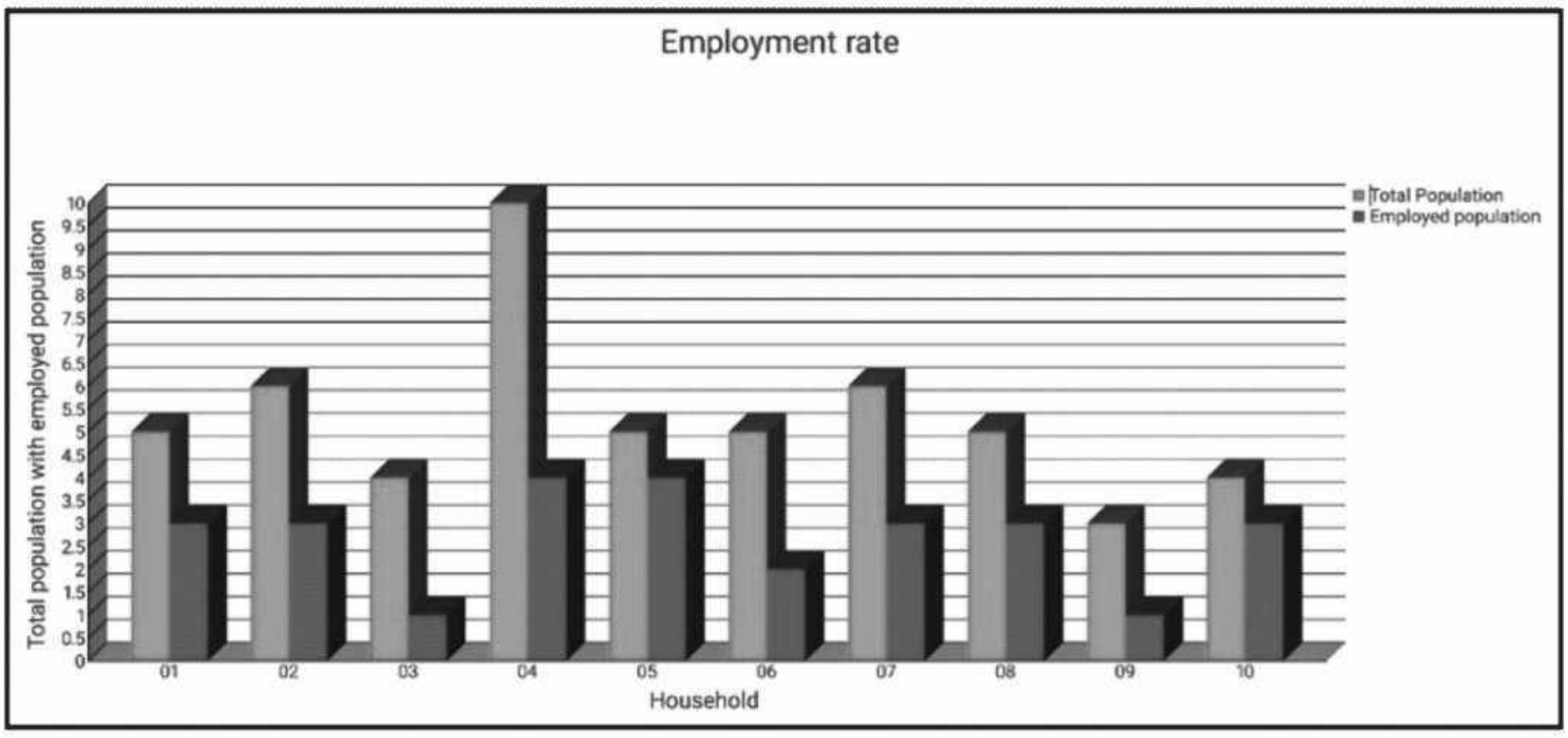
Survey of 10 families in Colootola area



GRAPH 1: Representing the level of income of the family



GRAPH 2 : Representing the Male-Female population of the area along with total population



GRAPH 3: Representing the employment rate of the area

CONCLUSION

The household survey of 'Colootala' provides valuable insights into the socio-economic conditions of the areas, highlighting key challenges such as male dominance in the work force, high employment rates and limited access to quality education, indicating economic strain on households. Furthermore, the survey reveals that a lack of education maybe a primary factor contributing to unemployment, restricting access to stable and well-playing jobs.

Addressing these issues requires targeted intervention, including improved education opportunities, vocational training and employment initiatives. By bridging gaps, the overall socio-economic famework of Colootala can be strengthened, paying the way for a more equitable and sustained future for its residents.

FIELD SURVEY TO PEPSI FACTORY

Snigdha Saha
Semester III

A Field Survey is defined as the process of collecting and gathering information at the local level in specific fields such as households or industries by conducting primary surveys based on observation, interviews, questionnaires and so on, provided the researchers is present in the field.

For every Geography student in Class 12, Field Survey is a mandatory and the most interesting part of the syllabus. Being a student of Geography in Class 12, I also attended the Field Survey conducted by my school. It was an Industrial Survey of Pepsi Factory. On May 2022, teachers of the Geography Department of my school, Salt Lake School, decided to take all geography students of the ISC batch to Varun Beverages in Kolkata which is a Pepsi Factory near Garia.

The whole survey was divided into three stages, namely Pre-Field, Field and Post- Field stages. In the Pre-Field Stage, our two Geography teachers divided the whole group of eighteen geography students into two groups with nine each. We sat down together to discuss how to do the survey, make a proper questionnaire, interview schedules and so on. In the Field Stage, we went to the factory, observed the surroundings very carefully the surrounding, took information and data from the field, clicked pictures, gave the questionnaires to the workers, and asked questions to the laborers about the factory. Lastly, in the Post-Field Stage, one group was engaged in assembling the information to structure the writing part and the other group was engaged in selecting proper pictures and drawing bar graphs, pie charts, and histograms based on the information collected from the field.

While surveying in Pepsi Factory, we enjoyed it a lot as it was the first time we all had such an amazing experience which seemed very interesting to me. The workers, laborers and managerial department were very well behaved and co- operative.

We saw heavy machineries where the production work was ongoing. Workers explained to us about the process of making different products in their factory such as Pepsi, 7up, Mirinda, Mountain Dew, Tropicana, Aquafina (Water), Cream-Bell(Ice Cream) and many more. We witnessed the Slice making process as it was ongoing in the machine.

As we are the COVID batch, we were strictly instructed to sanitize our hands before entering the

factory and wear masks inside the factory. They gave us aprons, head caps, shoe caps and masks before entering the processing unit. These are the basic precautions that the factory has adopted to safeguard their workers from severe accidents within the factory. During the COVID period, they took safety measures while making the products and also provided sufficient loans to their workers to carry on their daily costs.

The Managerial Department explained to us about their company's expansion rate not only in India but also outside India. They told us that their hygienic way of processing the disposable bottles, tetra packs, recycling materials, unique packaging system, collecting water from underground makes their factory more reliable than any other factory. Further, they explained that the term "PEPSI" was named after the digesting enzyme "PEPSIN" which in Greek means "digesting". It was a wonderful experience for us to interact with them.

In the factory, we saw that each and every department is interrelated and there is full unity among every individual. It was truly a brilliant experience to see this type of bonding among them, we really liked this feature among them..

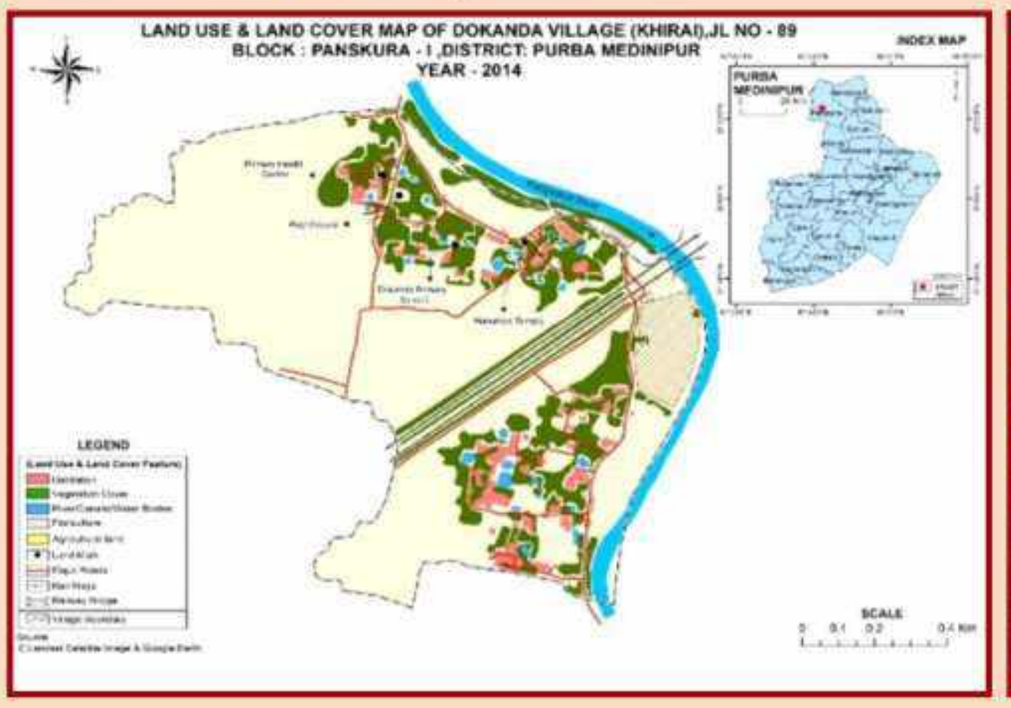
The People of the Pepsi factory were so humble that they gave all of us a small gift hamper of different products, manufactured and packed in the factory. After returning back to school, all of us along with the guidance of two teachers prepared the project with the data collected from the survey.

CORRELATION BETWEEN PHYSICAL AND SOCIO-ECONOMIC LIFE OF MAN IN DOKANDA MAUZA OF PURBA MEDINIPUR DISTRICT, WEST BENGAL.

Students of 2022-25 batch

Introduction :

The Geography Department of Shri Shikshayatan College had arranged for an excursion to Dokanda village from 18th to 20th January, 2024 as a part fulfillment of the Calcutta University Geography Honours Syllabus. Dokanda mauza-popularly known as Khirai – a valley of flowers, is located in the upper course of Kasai river near Khirai railway station in Panskura I Block of Purba Medinipur district. The village, lying at approximately 22°21' N latitude and 87°42' E longitude has a unique characteristic in geology, climate, soil and vegetation, as it is situated in the valley of the Kasai or Kangshabati river. Dokanda (Code No. 344182) having a total area of 132.88 hectares (1.32 sq km) with 301 households and a total population of 1267 (642 male and 625 females as per 2011 Census) is located in Ghoshpur Gram Panchayat of Panskura I Block in Purba Medinipur District of West Bengal. The main objective of preparing this report is to present a comprehensive geographical account of Dokanda Mauza and interpreting the correlation between the physical and socio-economic parameters of the study area.

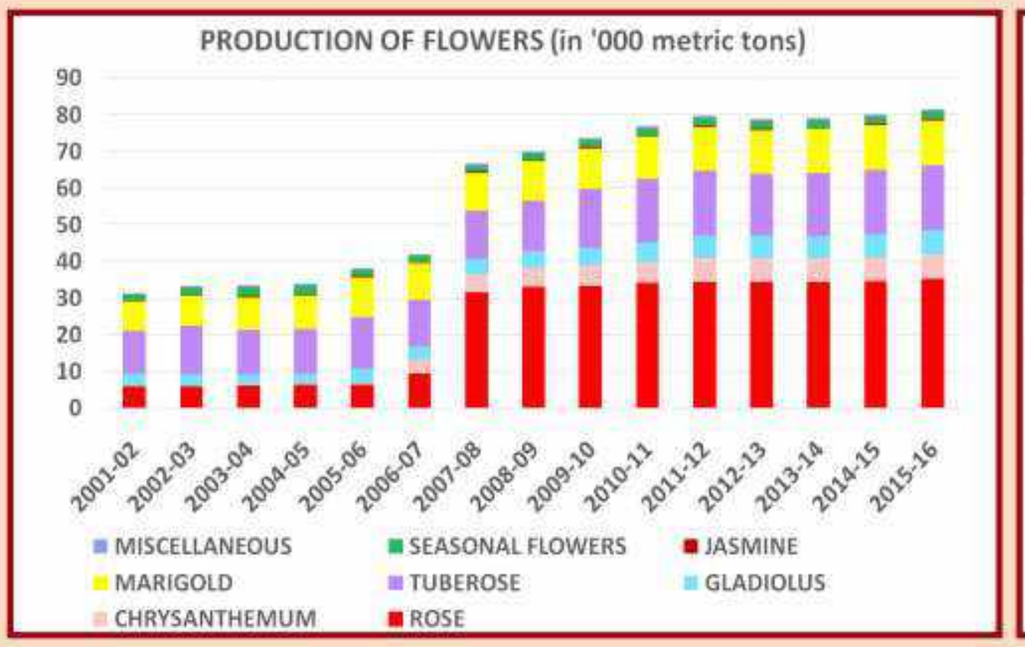


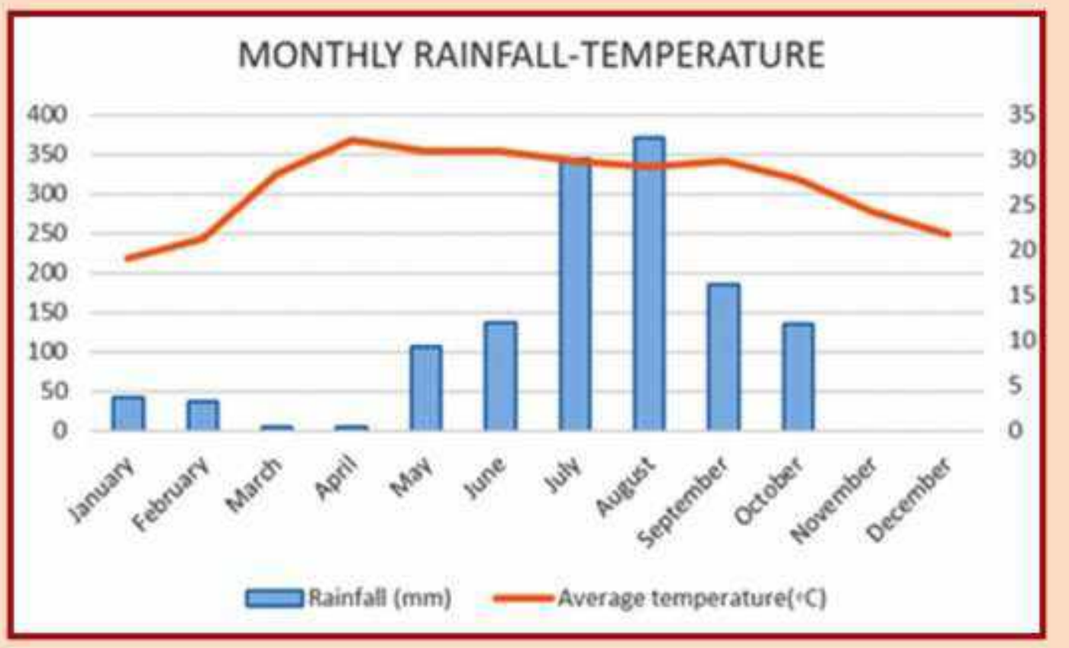
1. Physical Environment

1.1 **Geology and Relief :** The region consists of alluvial deposits, including sand, silt, clay, and conglomerates, indicating its fluvial origin. The village lies within an older alluvial plain at an elevation below 16m, with a gently sloping terrain.

1.2 **Drainage & Climate :** The Kasai River, along with streams and canals, supports floriculture and agriculture. The climate is monsoon-dependent, with the highest rainfall in August and moderate annual temperatures ranging from 20°C to 35°C. Humidity and temperature exhibit a strong positive correlation, influencing the local floriculture industry.

1.3 **Soil & Floriculture :** Predominantly alluvial soil, rich in silt and clay, ideal for flower cultivation. High nitrogen and phosphorus levels support the growth of marigold, rose, gladiolus, and other flowers. Floriculture is the dominant occupation, facilitated by fertile soil, irrigation access, and proximity to transport networks.





2. **Socio-Economic Environment :**

2.1 **Demographics : Population (2011 Census) :** 1267 residents (642 males, 625 females). Literacy Rate: 81.53% (Male : 86.14%, Female : 76.8%). The age pyramid indicates a higher middle-aged population and a low life expectancy.

2.2 **Livelihood & Economic Base :** 60% of households are engaged in floriculture, with small landholdings of 0.5–2.5 bighas. Floriculture is a family-based occupation; hired laborers are employed during peak seasons. Monthly income varies; most households earn between ₹ 5000–₹ 10,000, while a few exceed ₹ 20,000. Market Linkages; Flowers are sold locally and transported to Kolaghat, Mullick Ghat, and Kolkata markets.

2.3 **Standard of Living & Quality of Life :** Housing: 67.27% of houses are pucca, most have electricity and water access. Sanitation: Community toilets are used by many households, though private sanitation is improving. Transport : Well-connected by roads and railways, with a bus stop and railway station nearby. Education & Healthcare : Primary schools and a health sub-center exist, but higher education and specialized medical facilities require travel to Panskura.

Challenges & Recommendations

3.1 **Major Challenges :** 1. Lack of Cold Storage Facilities – Flowers perish quickly due to the absence of proper storage solutions. 2. Seasonal Unemployment – Dependence on monsoon-based farming leads to economic instability. 3. Limited Healthcare & Education – Basic health and higher education facilities are unavailable locally. 4. Low Wages for Laborers – Agricultural workers struggle with low income and inconsistent work opportunities.

3.2 **Recommendations :** 1. Development of Irrigation Infrastructure – To improve agricultural productivity. 2. Government Support for Floriculture – Subsidies, market assistance and cold storage units should be introduced. 3. Higher Wages & Employment Opportunities – Expanding alternative livelihood options. 4. Better Access to Health & Education – Upgrading local healthcare and establishing secondary schools.

4. Conclusion :

Dokanda, popularly known as the "Valley of Flowers," is a thriving floriculture hub with significant economic potential. However, infrastructure gaps, seasonal employment issues, and lack of advanced facilities pose challenges to its sustainable development. With proper government intervention and improved market facilities, Dokanda can emerge as a major floriculture centre in West Bengal.

DEPARTMENTAL TOUR AND ACTIVITIES : 2024

EXCURSION TO KHIRAI

AI & MACHINE LEARNING COURSE

HERITAGE DAY CRUISE ON GANGA

ACADEMIC COUNSELLING BY ALUMNI

WORLD ENVIRONMENT DAY FILM SHOW

DRONE SURVEY WORKSHOP

INSTITUTIONAL VISIT

STUDENTS' SEMINAR